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Detailed Energy Audit of Thermal Power Plant Equipment

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ABSTRACT

Energy audit is a technique developed to reduce unnecessary usage of energy, control and also streamline processes leading to energy efficiency. Energy audit and its impact on a daily basis is high and hence is of good significance. Energy Conservation over the years has been a key in terms of saving excessive bills and building up unnecessary usage both domestically and industrially. The world is not completely energy efficient yet, it should be a made sure that the process to ensure optimum usage and saving wherever possible. In this paper we shall discuss in brief about energy audit in a thermal power plant, techniques and ways data are obtained. India's strive for complete energizing is yet on the verge of completion, need for saving unused energy and also recovering waste energy can be beneficial in developing an energy content environment. The energy audit carried out in thermal power plant gives a presentation of the data and corners of collecting data.

***Keyword*:** Energy Audit, Thermal Power Plant, Pump Audit, Energy Conservation, Transformer Audit, Motor Audit, Lighting Audit

1. INTRODUCTION

An energy audit is a study of a plant or facility to determine how and where energy is used and to identify methods for energy savings. There is now a universal recognition of the fact that new technologies and much greater use of some that already exist provide the most hopeful prospects for the future. The opportunities lie in the use of existing renewable energy technologies, greater efforts at energy efficiency and the dissemination of these technologies and options. This energy audit of 2 X 25MW Power Plant was carried out. This report is just one step, a mere mile marker towards our destination of achieving energy efficiency and I would like to emphasis that an energy audit is a continuous process. We have compiled a list of possible actions to conserve and efficiently utilize our scarce resources and identified their savings potential. The next step would be to prioritize their implementation. I look forward with optimism that the institute authorities, staff shall ensure the maximum execution of the recommendations and the success of this work.

2. ENERGY AUDIT METHODOLOGY

Considering the vast potential of energy savings and issue of energy efficiency in various sectors of industries, the government of India enacted the Energy Conservation Act, 2001. The Act provides for a legal framework, institutional arrangement and a regulatory mechanism at the central and state level to embark upon energy efficiency drive in country. Having been declared designated customers under the EC Act, it is obligatory on the part of power station to get energy audit carried out periodically.

3. METHODOLOGY AND APPROACH

The field measurements were carried out with calibrated instruments. The required parameter for analysis of different utility was measured and the power consumption was measured. For analysis of the collected data the standard formulas as per PTC standards and CEA guidelines for Energy Auditing of power plants were used. The formulas used for the calculation are given below.

4. AUDIT OF EQUIPMENT

4. 1. Condensate Extraction Pump

Steam, after passing through the turbine, condenses in the turbine condenser and collects in the condenser hot well. For TG#1 & TG#2 there are three condensate extraction pumps (2W + 1S) each respectively. The CEP for TG#1 & TG#2 pumps water through L.P feed heater to the deareator each respectively. The following parameters have been measured to assess the performance of condensate extraction pumps.

1. Discharge pressure
2. Power consumption
3. Flow rate

The operating efficiency has been compared with design efficiency at operating conditions.

Performance of CEP Pumps

Description	Units	Design	CEP 1A	CEP 1B	CEP 2A	CEP 2B
			Actual	Actual	Actual	Actual
Flow rate	m^3/hr	65	53	56	54	56
Discharge pressure	Kg/cm^3		11.5	11.4	11.8	11.5
Temperature	°C		123	123	123	123
Density	Kg/m^3		991	991	941	941
Total head developed	m	119	116	115	125	122
Input motor power	kW		30.9	32.5	32.1	31.5
Rated motor power	kW	37				
Motor efficiency	%		90	90	90	90
Hydraulic power	kW		16.61	17.40	17.36	17.55
Combined overall efficiency	%		53.75	53.53	54.09	55.71
Pump efficiency	%		59.72	59.47	60.10	61.90
Input kW to the pump	kW		27.8	29.3	28.9	28.4
Specific power consumption	kW/CMH		0.583	0.580	0.594	0.563
Percentage loading of pump on flow	%		82	86	83	86
Percentage loading of pump on head	%		98	97	105	103
Percentage loading of motor	%		75	79	78	77

Note: Design pump characteristic curve is not available to compare with the actual parameters.

OBSERVATION:

- All the CEP's are operated very close to its design head but the flow is much lower than design value.
- Check the mechanical side of these pumps to improve the performance.
- Reduce the pressure drop in condensate line (TG 1& 2). Opening of hot well level control valve of TG 1 & 2 is varying from 36 to 47% to control the flow. The discharge pressure of CEP is 11 kg/cm^2. But the condensate pressure after hot level control valve is 4.6 kg/cm^2. Hence throttling across control valve can be minimized by installing VFD at CEP to regulate the flow and maintain hot well level.

4. 2. Boiler feed Pump

In PP-2, Phase #3 there are six BFP installed (Four and two stand by) to pump water from the deareator storage tanks to WHRB through feed water control valves. Each WHRB has a feed control valves which is used to control the feed water level in boiler. For TG#1 & TG#2 there are three BFP (2W+ 1S) each respectively. The BFP of TG#1 & TG#2 pump water to common header and there after it goes to 4 numbers of WHRB.

The following parameters have been measured to assess the operating performance of the feed water pumps.

- Suction and discharge pressure
- Discharge flow rate
- Motor power consumption

The efficiency of the BFP is calculated based on the measured parameters and the detailed calculations of all the feed pumps are given below.

Performance analysis of BFP

Description	**Units**	**Design**	**BFP-1A**	**BFP-1C**	**BFP-2A**	**BFP-2C**	**Reference**
Flow rate	m^3/hr	78.32	67	65	64	63	Measured
Suction pressure	Kg/cm^2		3.00	2.80	2.96	2.97	Measured
Discharge pressure	Kg/cm^2		98.9	98.7	99.3	99.7	Measured
Temperature	°C		123	123	128	128	
Density	Kg/m^3		941	941	937	937	
Total head developed	m	1015	1019	1019	1029	1032	
Input motor power	kW		296.4	287.5	301.5	303.7	Measured
Rated motor power	kW	360					
Motor efficiency	%		93	93	93	93	
Hydraulic power	kW		175.09	169.90	168.09	166.04	
Combined overall efficiency	%		59.07	59.10	55.75	54.67	
Pump efficiency	%		63.52	63.54	59.95	58.79	
Input kW to the pump	kW		275.7	267.4	280.4	282.4	
Specific power consumption	kW/CMH		4.424	4.423	4.711	4.821	
Percentage loading of pump on flow	%		86	83	82	80	

Percentage loading of pump on head	%		100	100	101	102	
Percentage loading of motor	%		77	73	78	78	

Note: Pump characteristics curve is not available to compare with the actual parameters.

OBSERVATION:

- The pump efficiency is on lower side.
- Hence check the mechanical side of the pump to improve the performance.

4. 3. Cooling water pumps

The operating parameter of cooling water pumps have been measured to evaluate efficiency of pump.

- Measuring the suction and discharge pressure.
- Measuring the power consumed by the pump.
- Measuring water flow rate delivered by pump.

COOLING WATER PUMPS

In PP.-3, there are three CW pumps installed (two working and one standby) to cater the cooling water requirement. For TG#1, TG#2 there are three cooling water pumps (2W+1S). Cooling water pump parameter have been measured to analyze the performance of pumps. The results are as follows:

Performance analysis of CW Pumps

Description	**Units**		**Cwp-1**	**Cwp-3**
		Design	**Actual**	**Actual**
Flow rate	M^3/hr	6000	6500	6600
Suction pressure	Kg/cm^2		0.10	0.10
Discharge pressure	Kg/cm^2		1.8	1.8
Temperature	°C		35	35
Density	Kg/m^2		993	993
Total head developed	M	30.9	18.8	18.8
Input motor	KW		596.9	592.3
Rated motor power	KW			

Motor efficiency	%		93%	93%
Hydraulic power	kW		331.22	341.72
Combined overall efficiency	%		55.49%	57.69%
Pump efficiency	%		59.67%	62.04%
Input KW to the pump	kW		555.1	550.8
Specific power consumption	Kw/CMH		0.092	0.090
Percentage loading of pump on flow	%		108%	110%
Percentage loading of pump on head	%		61%	62%
Percentage loading of motor	%		84%	83%

Note: Design pump characteristic curves is not available to compare with the actual parameter.

OBSERVATION:

- The efficiency of the CWP#1 & CWP#3 ARE 59.67% & 62.04% respectively. The cooling water pump flow is a vertical turbine pump. The head developed by the pump is less than the design, but the flow delivered is close to design. Due to this the efficiency of the pump is in lower side.

4. 4. Side stream pump

There are two side stream pumps installed to maintain turbidity in cooling water for CT. the cooling water is fed to the side stream filter (SSF) by the pump to remove the suspended particles in the cooling water. Pump operating parameters have been measured to analyze the performance of the pumps. The results are as follows:

Performance analysis of side stream Pump

Description	**Units**		**SSFP 1**	**SSFP 2**
		Design	**Actual**	**Actual**
Flow rate	M^3/hr	150	163	161
Suction pressure	Kg/cm^2		0.00	0.00
Discharge pressure	Kg/cm^2		4.0	4.0

Temperature	°C		35	35
Density	Kg/m^2		993	993
Total head developed	m	40	40.3	40.3
Input motor	KW		24.2	24.9
Rated motor power	KW	30		
Motor efficiency	%		90%	90%
Hydraulic power	kW		17.77	17.55
Combined overall efficiency	%		73.42%	73.48%
Pump efficiency	%		81.57%	78.31%
Input KW to the pump	kW		21.8	22.4
Specific power consumption	Kw/CMH		0.148	0.155
Percentage loading of pump on flow	%		109%	107%
Percentage loading of pump on head	%		101%	101%
Percentage loading of motor	%		73%	75%

Note: Design pump characteristic curves is not available to compare with the actual parameter.

OBSERVATION

- The discharge valve of these pumps is 4 Kg/cm^2 while at the discharge of the filter is 2.5 Kg/cm^2. The water recirculates to the CT sump by gravity after it is filtered in the SSF. The pump power consumption can be reduced by installing VFD. The cost benefits analysis has been given in the energy conservation measures

4. 5. ACW Pumps

There are three ACW pumps installed (IW+1S) to meet auxiliary cooling water requirement for TG#1 & TG#2 cooling system. The ACW pump take care of the cooling water requirement of the various oil coolers, motor cooler etc. of the various auxiliary equipment's and also the generator hydrogen coolers exciter cooler, stator water cooler etc.

Performance analysis of ACW pump

Description	**Units**		**ACW-1**
		Design	**Actual**
Flow rate	M^3/hr	600	490
Suction pressure	Kg/cm^2		0.10
Discharge pressure	Kg/cm^2		5.5
Temperature	°C		35
Density	Kg/m^2		993
Total head developed	m	55.5	56.4
Input motor	KW		128.7
Rated motor power	KW	132	
Motor efficiency	%		90%
Hydraulic power	kW		74.77
Combined overall efficiency	%		58.10%
Pump efficiency	%		64.55%
Input KW to the pump	kW		115.8
Specific power consumption	Kw/CMH		0.263
Percentage loading of pump on flow	%		82%
Percentage loading of pump on head	%		102%
Percentage loading of motor	%		88%

Note: Design pump characteristic curves is not available to compare with the actual parameter.

OBSERVATION:

- Efficiency of ACW pump is satisfactory.

4. 6. CT makeup pumps

There are three CT makeup pumps installed (1W+1S) to supply water to the tower basin to compensate for water losses such as evaporation, drift loss, blown-down. Pump operating parameters have been measured to analyze the performance of pumps. The result is as follows:

Performance analysis of CT makeup pump

Description	**Units**		**CT Makeup pump-1**
		Design	**Actual**
Flow rate	M^3/hr	400	239
Suction pressure	Kg/cm^2		0.10
Discharge pressure	Kg/cm^2		1.2
Temperature	°C		35
Density	Kg/m^2		993
Total head developed	m	15	12.6
Input motor	KW		19.2
Rated motor power	KW	30	
Motor efficiency	%		90%
Hydraulic power	kW		8.14
Combined overall efficiency	%		42.40%
Pump efficiency	%		47.11%
Input KW to the pump	kW		17.3
Specific power consumption	Kw/CMH		0.080
Percentage loading of pump on flow	%		60%
Percentage loading of pump on head	%		84%
Percentage loading of motor	%		58%

Note: Design pump characteristic curves is not available to compare with the actual parameter.

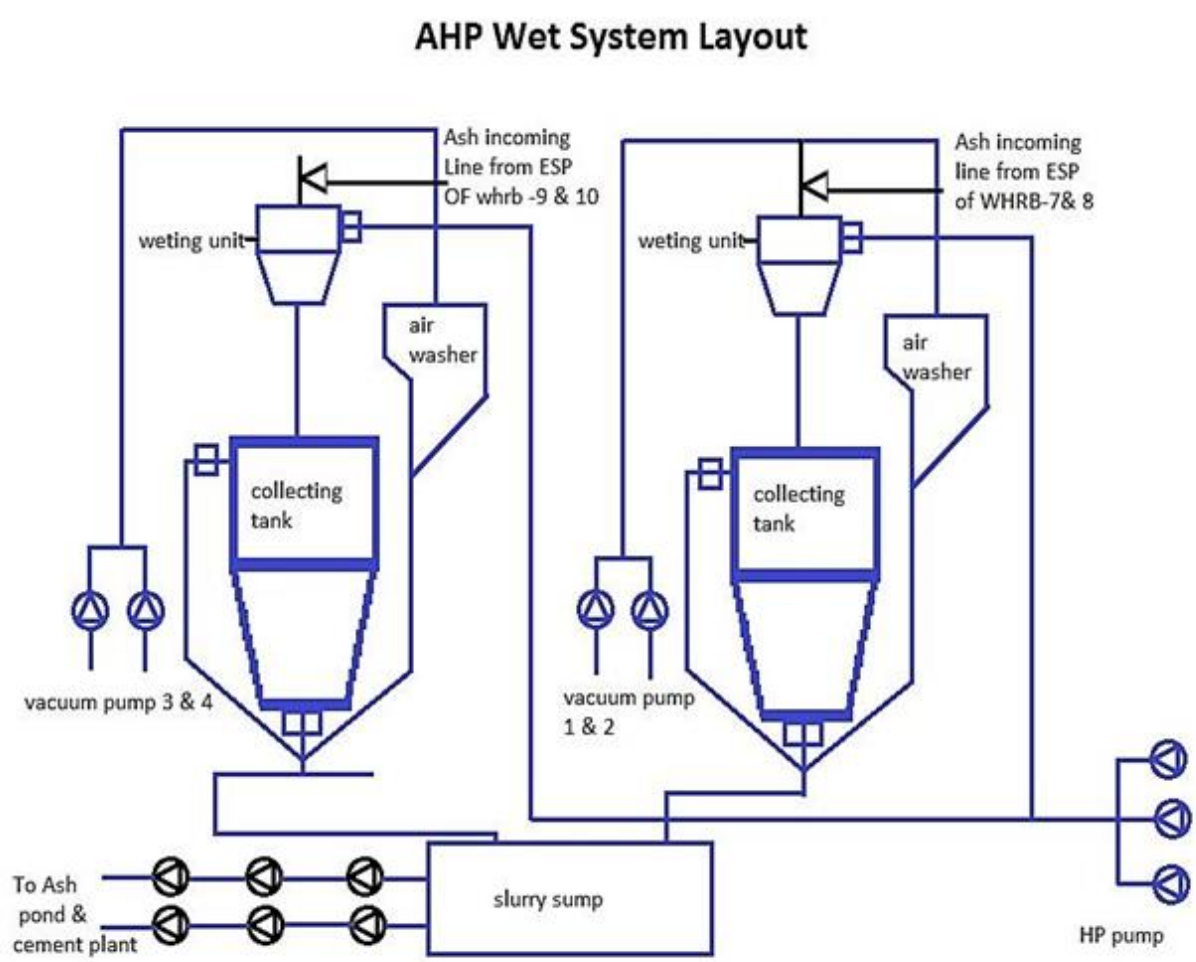
OBSERVATION:

The efficiency of the pump is 47.11% which is on lower side. Check the internal/overhaul the pump to improve the performance. After that also if the performance is not improved then replace the pump with energy efficient pump

5. ASH HANDLING PLANT

The ash generated from the boiler is collected in the ESP hopper. Fly ash is, moved to ash silo by compressed air. Based on availability of transportation, fly as is transported otherwise it is been transported to ash pond through slurry pump. The following equipment is involved in collection and transportation.

- Electrostatic precipitator
- Vacuum pumps
- Slurry pumps
- HP pumps



5. 1. HP Pump

There are three HP pumps installed for higher pressure water supply for ash handling. In normal operation one pump is operated and other is kept as stand by.

Performance analysis of HP Pump

Description	Units	Design	HP Pump-3
Flow rate	M^3/hr	340	210
Suction pressure	Kg/cm^2		0.3
Discharge pressure	Kg/cm^2		10.5
Temperature	°C		108.43
Input motor	KW		157.00
Rated motor power	KW	160	
Motor efficiency	%		90%
Hydraulic power	kW		61.80
Combined overall efficiency	%		39.36%
Pump efficiency	%		43.74%
Input KW to the pump	kW		141.3
Specific power consumption	Kw/CMH		0.748
Percentage loading of pump on flow	%		62%
Percentage loading of pump on head	%		90%
Percentage loading of motor	%		88%

OBSERVATION:

- Efficiency of the pump is found to be less. Check the internals/overhaul the pump to improve the performance .after that also if the performance is not improved then replace the pump with energy efficient pump.

5. 2. Slurry pump

For wet ashing the facility has two lines, each line has three slurry pumps installed in series to transfer the slurry from slurry tank. In normal operation one line is operated and other is kept as stand by. So during wet ashing normally two pumps are in operation. The performance analysis is as follows.

Performance analysis of Slurry Pump

Description	Units	Design	Slurry Pump-4	Slurry Pump-5
Flow rate	m^3/hr	475	199	199
Suction pressure	Kg/cm^2		0.3	6.3
Discharge pressure	Kg/cm^2		6.3	12.6
Temperature	°C		60.44	63.25
Input motor	KW		123.70	117.70
Rated motor power	KW	160		
Motor efficiency	%		90%	90%
Hydraulic power	kW		32.64	34.16
Combined overall efficiency	%		26.39	29.03
Pump efficiency	%		29.32%	32.25%
Input KW to the pump	kW		111.3	105.9
Specific power consumption	Kw/CMH		0.622	0.591
Percentage loading of pump on flow	%		42%	42%
Percentage loading of pump on head	%		121%	127%
Percentage loading of motor	%		70%	66%

OBSERVATION:

- Efficiency of the pump is found less. Check the internal/overhaul the pump.

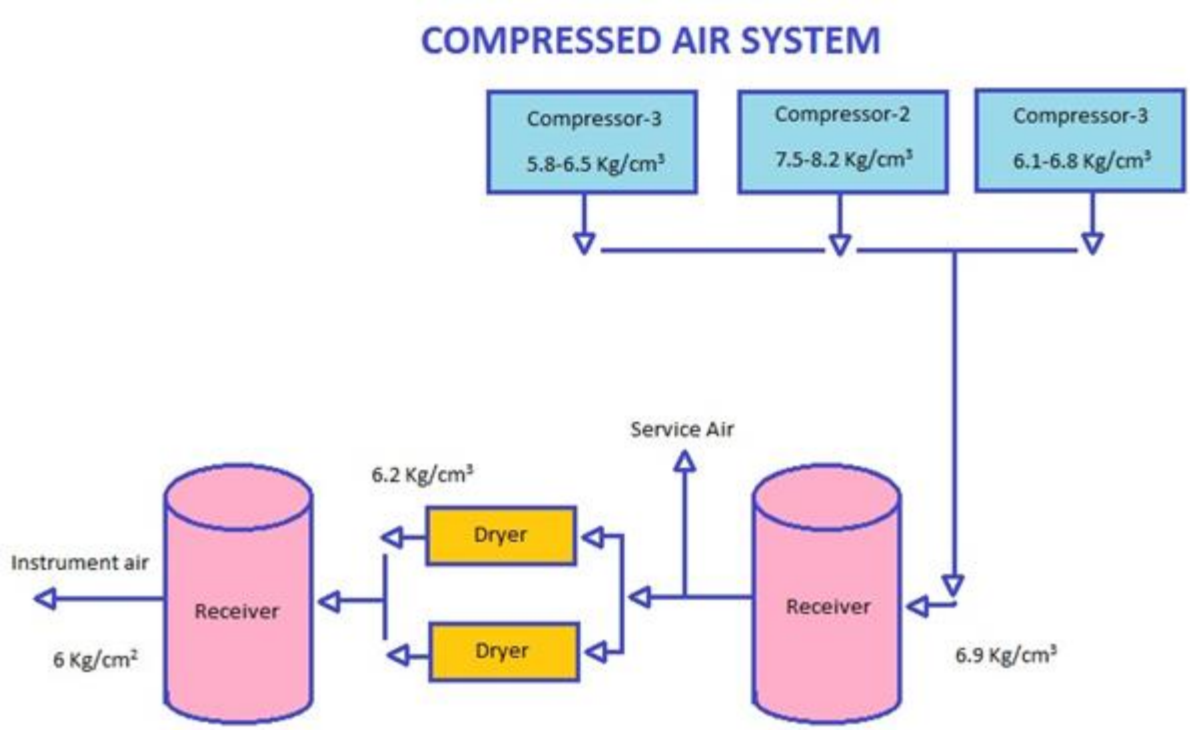
6. CPP COMPRESSOR

The plant has three air compressor installed to take care of the pneumatic and service air operations. All three air compressor are in auto mode with different set pressure. During normal operation comporessor-2 running while other remains as standby.

The operating parameters of compressor-2

Loading power consumption	-98 kW
Set load pressure	-7.5 kg/cm^2
Set unload pressure	-8.2 kg/cm^2

Compressed air layout



OBSERVATION:

- The receiver of the compressor has a manual valve which is kept open for one minute in every 4 hours. This is the practice which the plant regularly maintained. Install compensated drain valve to drain the compensated from the receiver.

7. HVAC

The net refrigeration capacity and specific power consumption of the chiller is evaluated by measuring the parameter. The details of the finding are given below.

AHU performance analysis of PP-2 turbine

AHU Parameters	Units	PP2 (turbine) 13.11.13 & 03:00 pm
Pressure before filter	mmWC	-1
Pressure after filter	mmWC	-6.3
Pressure after cooling coil	mmWC	-8
Discharge pressure of fan	mmWC	36
Pressure drop across filter	mmWC	5.3
Pressure drop across coil	mmWC	1.7
Static pressure developed by fan	mmWC	44
Average velocity	m/sec	1.4
Suction area	m^2	3.8
Measured velocity	m^3/sec	5.4
AHU Heat load		
Return air temperature (DBT)	°C	22.5
Return air temperature (WBT)	°C	14.1

OBSERVATION:

- Average return air temperature is 22.5 °C and average supply air temperature is 9.4.
- The average specific power consumption is 1.2 KW/TR, which is on higher side.
- Increase the return air temperature and increase the chilled water outlet temperature.

8. TRANSFORMER AND MOTOR

The PP-2 generating power with combine of WHRB-7 to 10. Generating voltage of turbo generators are 11 kV voltage to 6.6 kV for MV auxiliary and SST to step down the voltage from 11 kV to 433 volt for LT auxiliary.

Motors

Instantaneous power measurement has been carried out at the motors during the Energy Audit period. Only those motors having rating 22kW and above were covered in the measurement. The power consumption was measured in all auxiliary loads and detail is given below.

Motor Loading

Description	Rating	Voltage	current	power	PF	Loading
	kW	V	A	kW		%
BFP 1A	360	6590	29	296.4	0.9	77.4
BFP 1C	360	6580	28.1	287.5	0.9	75.1
BFP 2A	360	6590	29.2	301.5	0.9	78.7
BFP 2C	360	6580	29.5	303.7	0.9	79.3
CWP 1	660	6590	64	596.9	0.815	85
CWP 3	660	6570	64.2	592.3	0.81	84.4
ID 1B	275	434.4	119.6	75.9	0.81	**25.9**
ID 2A	275	431	117.5	72	0.84	**23.6**
ID 3A	275	423.2	145.7	92.7	0.82	**31.7**
ID 4A	275	422.5	114	70.1	0.87	**24**
CEP 1A	37	419	48.4	30.9	0.85	78.5
CEP 1B	37	421	50.8	32.5	0.88	82.659.3
MOP 1A	75	420.6	71	47.3	0.88	81.6
CEP 2A	37	416	50.5	32.1	0.91	80
CEP 2C	37	428	47.3	31.5	0.88	60.3
MOP 2B	75	429	72.4	48.1	0.9	84.4
FD 1A	90	410.6	132	80.8	0.9	86.2
FD 2A	90	411.4	132.8	82.5	0.86	98.5
FD 3B	90	421	144.9	94.3	0.87	92.7
FD 4A	90	421	137.9	88.8	0.89	91.7
ACW 1	132	414.7	198.6	128.7	0.88	86.9
CT Fan 1	37	415.6	58.4	34.2	0.88	77.2

CT Fan 2	37	414.3	50.5	30.4	0.905	92.0
CT Fan 3	37	415.3	62.2	36.2	0.81	94.5
CT Fan 4	37	415.4	61.7	37.2	0.836	60.2
Make up to PP Pump 2	30	414.3	33.8	19.2	0.790	76.2
Raw water Pump 2	75	414.3	94.7	60.8	0.890	75.8
Side stream filter pump 1	30	415.7	37.5	24.4	0.86	94.5
Side stream filter pump 2	30	415.4	40.7	24.9	0.85	78.0
Sludge disposal pump 1	30	413	46.6	29.2	0.873	91.5
Sludge disposal pump 2	30	430.3	45.2	29.3	0.867	91.8
Compressor 2	132	400.1	165.8	98.1	0.85	69.9
HP Pump 3	160	414.6	245.2	157	0.89	92.2
Ash slurry pump 2A	132	411	207	123.7	0.84	88.1
Ash slurry pump 2B	132	409.9	199.2	117.7	0.83	83.8
Vacuum pump 2	75	414.1	97	60.7	0.87	76.1
Vacuum pump 4	75	409.8	109.3	65.7	0.85	82.3
Air washer fan 1	55	411.3	68.3	41.8	0.855	71.4
Air washer fan 2	55	410.5	50.1	28.1	0.786	48.0
Chiller No.2	75	417	76.7	42.03	0.75	52.7

OBSERVATION:

- It is observed that the loading of the ID fan is less, as the fans are operating with VFD.

Transformers

During Energy Audit study, power measurement was carried out for all the transformer using power analyzer at secondary side to evaluate loading pattern of the transformers.

There are nine Transformers; Three SAT (6.3 MVA, 11kV/6.6 kV) for MV drive of PP-2 & supply power to RMHS and six SST (2 MVA & 2.5 MVA, 11 kV/433 Volt) for plant auxiliary requirement at LT load.

Measurements were carried out on following transformers and the details are as follows.

Transformer losses

The efficiency of the transformer not only depends on the design, but also on the effective operating load. The variable losses depends on the effective operating load to the transformer. The maximum efficiency of the transformer occurs at a condition when constant loss is equal to variable loss. For distribution transformers, the core loss is 10 to 15% of full load copper loss. Hence, the maximum efficiency of the distribution transformers occurs at a loading range of 35% to 40%.

Copper losses of the transformer depends on loading of the transformer and loading is depending on operating power factor of the transformer. So low power factor boost up the copper losses of the transformer.

No load and full load losses of transformer is obtained from standards to calculate the transformer losses.

Power measurement is done for all the transformers during the audit to calculate the present operating loading and losses is as follows.

SST Transformer loading and Load analysis

Description	**Units**	**SST 1A**	**SST 1B**	**SST 2A**	**SST 2B**	**SST 3A**	**SST 3B**
Date		08-06-15	08-06-15	08-06-15	08-06-15	08-06-15	08-06-15
Time		5:36 PM	3:59 PM	3:30 PM	12:59 PM	11:08 AM	5:07 PM
Rating	kVA	2000	2000	2000	2000	2000	2500
No load loss(Assume)	kW	2.33	2.33	2.33	2.33	2.33	2.65
Load loss (Assume)	kW	16.29	16.29	16.29	16.29	16.29	19.64
Maximum operating load	kW	587.2	303.1	168.3	287.1	225.6	229.1
Power factor		**0.833**	**0.855**	**0.856**	**0.791**	**0.792**	**0.808**
Maximum operating load	kVA	704.92	354.5	196.61	362.96	284.85	283.54
Maximum loading percentage	%	35.25	**17.73**	**9.83**	**18.15**	**14.24**	**11.34**
Transformer losses	kW	4.4	2.8	2.5	2.9	2.7	2.9

Sat Transformer loading and Load analysis

Description	**Units**	SAT 1	SAT 2	SAT 3
Date		09-06-15	09-06-15	09-06-15
Time		10:33 AM	4:32 PM	12:22 PM

Rating	kVA	6300	6300	6300
No load loss(Assume)	kW	5.39	5.39	5.39
Load loss (Assume)	kW	41.3	41.3	41.3
Maximum operating load	kW	1234	874.9	1222.3
Power factor		0.847	0.953	0.854
Maximum operating load	kVA	1456.91	918.05	1431.26
Maximum loading percentage	%	23.13	14.57	22.72
Transformer losses	kW	7.6	6.3	7.5

OBSERVATION:

- Loading of the identified transformers are less.
- Power factor of the identified transformers are low.
- Improve power factor up to 0.99 by providing required capacitors

9. LIGHTING

During study lighting DB power measurement has been done, feeder wise detail voltage and power is given below.

Lighting feeder voltage and load

Location	**Phase**	**Day light**	**Day light**	**Day light**	**Day light**	**Night light**	**Night light**	**Night light**	**Night light**
		Voltage	Current	Power	PF	Voltage	Current	Power	PF
LDB-1	**RED**	228	48.2	10	0.91	218	113.3	20	0.81
LDB-1	**YELLOW**	228.3	41.2	7.8	0.83	220	92.5	17.9	0.88
LDB-1	**BLUE**	227.2	39.1	8.3	0.93	219	113.2	22.8	0.92
LDB-2	**RED**	236	44.18	9.8	0.94	228	82.7	18.1	0.96
LDB-2	**YELLOW**	234	58.70	12.5	0.91	228	94.4	19.8	0.92
LDB-2	**BLUE**	238	48.93	9.2	0.79	232	77.1	16.1	0.90

LDB-3 (with beblec)	**RED**	0	0	0	0	208	65.1	12.1	0.89
LDB-3 (with beblec)	**YELLOW**	0	0	0	0	202	76.6	13.5	0.87
LDB-3 (with beblec)	**BLUE**	0	0	0	0	205	64.5	12.6	0.95

OBSERVATION:

- Lighting voltage for lighting at LDB 1 &2 varies from 218 V to 238 V (phase-neutral). The discharge lamps can be operated at 205-210 V with optimum efficiency. The reduction of voltage will slightly reduce the lumens output. Which is negligible. LDB 1 & 2 is already installed with transformers so, adjust tap settings for minimize the lighting voltage.
- Lighting energy saver is installed in the ash handling plant at PP-2. The voltage of lighting circuit varies from 202 V to 208 V.

10. PRESENT ENERGY MONITORING AND METERING SYSTEM

Presently plant officials are logging all energy parameter manually from major HT feeders (Transformer primary side & HT motors) of the plant. Details of major meters inside the plant are shown in the single line diagram of individual plant. Energy meters are not present with most of the major feeders at LT side installed meter details are given below:

Multifunctional meter – for all incomer and outgoing feeder
Make – SATEC, 3 Phase, #/4 wires.

Presently, the energy accounting of the plant is not very accurate. If the recording of the departmental meters is manual, as one person goes around taking the readings and by the time he completes the reading of the last meter, there will be considerable time lag between the reading of the first and last meters. As a result, the readings of different meters will be at different times. There could be considerable difference in the power consumption with respect to time. Moreover, there are number of meters and the manual readings of the meters are prone to human errors by various means. So, any attempt to correlate the readings with the overall energy use pattern of the plant will be erroneous and no decision can be taken for management of energy based on these readings. Also the consumption pattern cannot be analyzed to find the corrective actions to reduce the energy consumption.

Hence it is desirable to install energy meters in main sections and major equipment's and connect them to an Energy management System (EMS) for real time readings. The manual errors can also be eliminated with this system. There is no need to run around for taking readings as the readings of all the meters will be recorded and displayed in a PC on a continuous basis. The most important advantage of the system is that the production can be fed into it and the specific energy consumption can be calculated instantly for any period of time for any area. In addition to the accurate assessment of specific assessment or specific energy consumption, which can lead to control of energy use pattern, it can be used as a tool to minimize wastage of energy also. By obtaining the energy use parameters at all areas constantly, any unwanted consumption of energy like idle operation of pumps fans or even machines can be easily traced and stopped. A more detailed analysis can even throw light on the gradual increase in power consumption in a specific department based on time, which can act as a tool for efficient maintenance management also. The unwanted extra consumption of the air washers, lighting, air conditioners, pumping system, cooling towers etc. are some immediate examples.

Hence, it is desirable that the management may also adopt the use of energy management system for better control and management of energy use in plant.

11. SUMMARY OF ENERGY CONSERVATION MEASURES

- Modify the WHRB FD fan suction duct and then install VFD to reduce the head loss.
- Reduce the pressure drop in the condensate line (TG! & TG2)
- Reduce the pressure drop across FCS in feed water circuit
- Install VFD to reduce the discharge pressure of side stream Filter pump.
- Reduce the temperature setting of thermostatic control of hopper heater.
- Adjust the lighting transformer tap position for reduce the light voltage to save the lighting energy.

12. CONCLUSION

Energy audit being a part of effective energy conservation technique is a methodical method and is technologically advanced procedure. The various instruments used for auditing and measurement devices are technically enhanced and is portable in various uses. The prior intention for usage is easiness in use and mobility as an auditor has to travel all around in pursuit of data collection. Summary of energy conservation measures Modify the WHRB FD fan suction duct and then install VFD to reduce the head loss. Reduce the pressure drop in the condensate line (TG! & TG2),Reduce the pressure drop across FCS in feed water circuit, Install VFD to reduce the discharge pressure of side stream Filter pump, Reduce the temperature setting of thermostatic control of hopper heater, Adjust the lighting transformer tap position for reduce the light voltage to save the lighting energy.

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