A.3 Assessment on SEU

Assessment on Significant Energy User (SEU) of Co-Gen TK 3 was conducted by focusing in auxiliaries. In power plants, auxiliaries keep the steam-water cycle safely circulating.

Electricity for Auxiliaries of Co-Gen TK 3 is supplied by Trafo HV Aux and distributed by M01 Panel and N-102 Panel. The assessment onf SEU is done at the Switchgear Room 3.3 kV and Switchgear Room MCC 380 V.

Total auxiliary consumption of Co-Gen TK 3 is shown in the figure below:

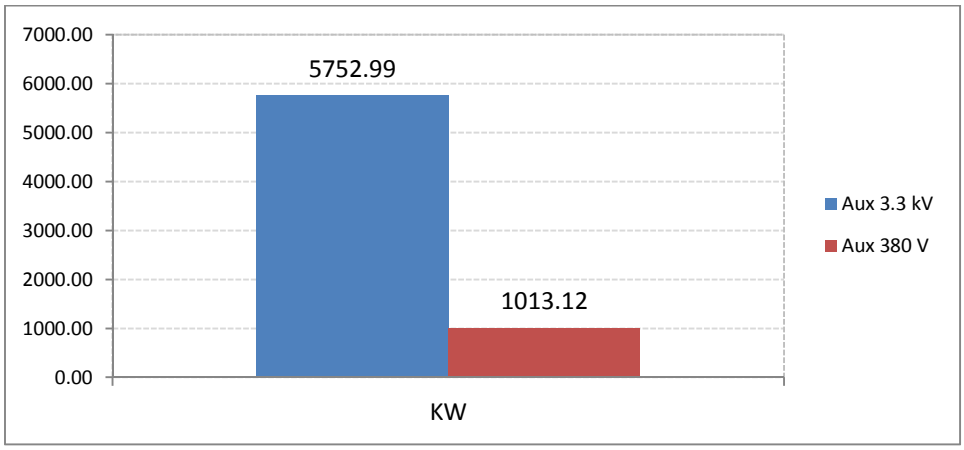
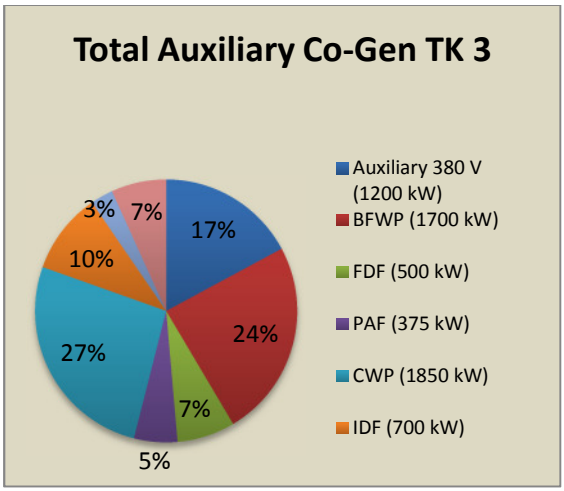
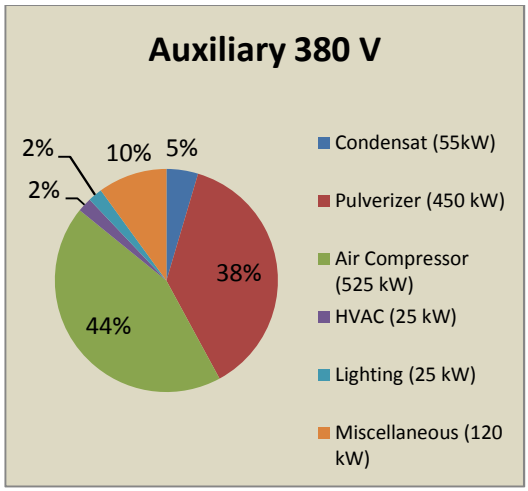


Figure … Total Auxiliary Consumption of Co-Gen TK 3

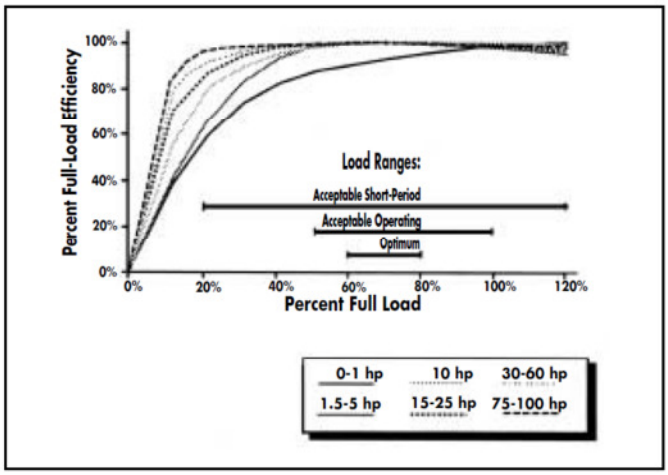
From the figure above, total energy consumption at measurement period is 6760 KW, where the percentage energy consumption of Auxiliary 3.3 KV is 85% and Auxiliary 380 V is 15 %.





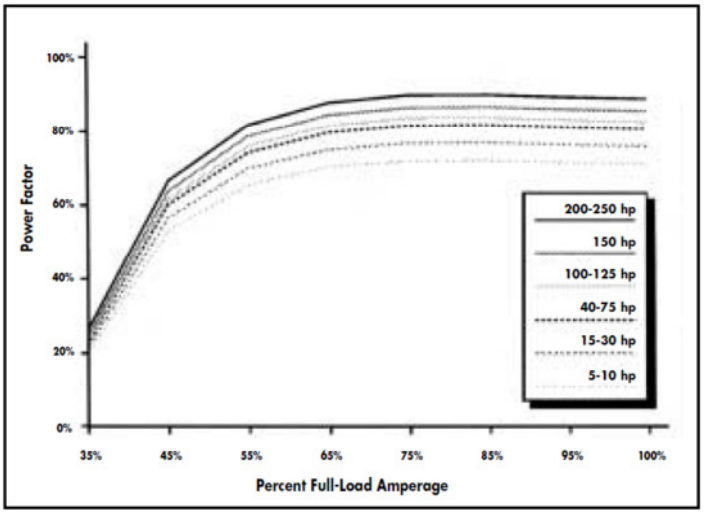
A.3.1 Assessment on Motor

Most of electric motors are designed to run 50% to 100% of rated load. Maximum efficiency is usually near 75% of rated load. A motor efficiency tends to decrease dramatically below about 50% load.
How ever, the range of good efficiency varies with individual motors and tends to extend over a broader range for larger motors, as show in figure ….



Figure….Motor Part-Load Efficiency (as a function of % Full-Load Efficiency)

A motor is considered underloaded when it is in the range where efficiency drops significantly with decreasing load. Figure… shows that power factor tends to drop sooner, but less steeply than efficiency, as load decreases.



Figure….Motor Power Factor (as a Function of % Full-Load Amperage)

Overloaded motors can overheat and lose efficiency. Many motors are designed with a service factor that allows occasional overloading.

Assessment on motor was conducted by direct measurement to determine the motor load.

$$P_i = \frac{V\ x\ I\ x\ PF\ x\ \sqrt{3}}{1000}$$

Where :

$P_i = Three - phase\ power\ in\ kW$

$\mathrm{V} = RMS\ voltage, mean\ line\ to\ line\ 3\ phase$

$\mathrm{I} = RMS\ curent, mean\ of\ 3\ phases$

$\mathrm{PF} = Power\ Factor\ as\ a\ decimal$

$$\mathrm{Load} = \frac{P_i}{P_{ir}} x\ 100\%$$

Where :

$Load = Output\ power\ as\ a\ \%\ of\ rated\ power$

Following the measurement result of motor:

Auxiliary 380 V									
No	Equipment	Rating (kW)	V (Volt)			I (Ampere)			P (kW)
			U1	U2	U3	I1	I2	I3	
1	Condensat A	37	382.54	383.54	382.06	53.34	56.88	53.22	26.38
2	Condensat C	37	382.35	383.45	382.25	52.25	54.45	53.22	25.58
3	CWP Boiler	19	382.56	383.82	382.24	27.84	28.62	27.72	17.20
4	Diesel Oil Pump	22	382.22	383.52	381.94	8.40	10.08	8.88	3.43
5	Pulverizer A	280	379.98	376.59	383.08	233.50	235.60	231.60	142.64
6	Pulverizer B	280	384.34	385.50	383.92	210.54	248.64	237.78	136.25
7	Pulverizer C	280	384.76	386.40	384.26	229.62	244.26	245.88	144.29
8	Compressor ZT200	200	389.34	390.50	388.92	324.00	349.50	333.00	130.20
9	Compressor No. 1	132	387.49	354.57	375.49	191.67	209.33	197.67	103.97
10	Compressor No. 3	132	386.90	366.70	387.72	236.00	249.00	235.50	139.80
11	Compressor Mill Air	132	386.34	387.50	385.92	226.00	242.00	228.50	127.30
12	Control Oil Pump	15	388.26	389.90	387.76	11.00	11.00	11.00	2.70
13	Main Oil Pump A	19	387.09	370.96	387.09	23.00	24.00	23.00	13.40

Table….Measurement result on motor auxiliary 380 V

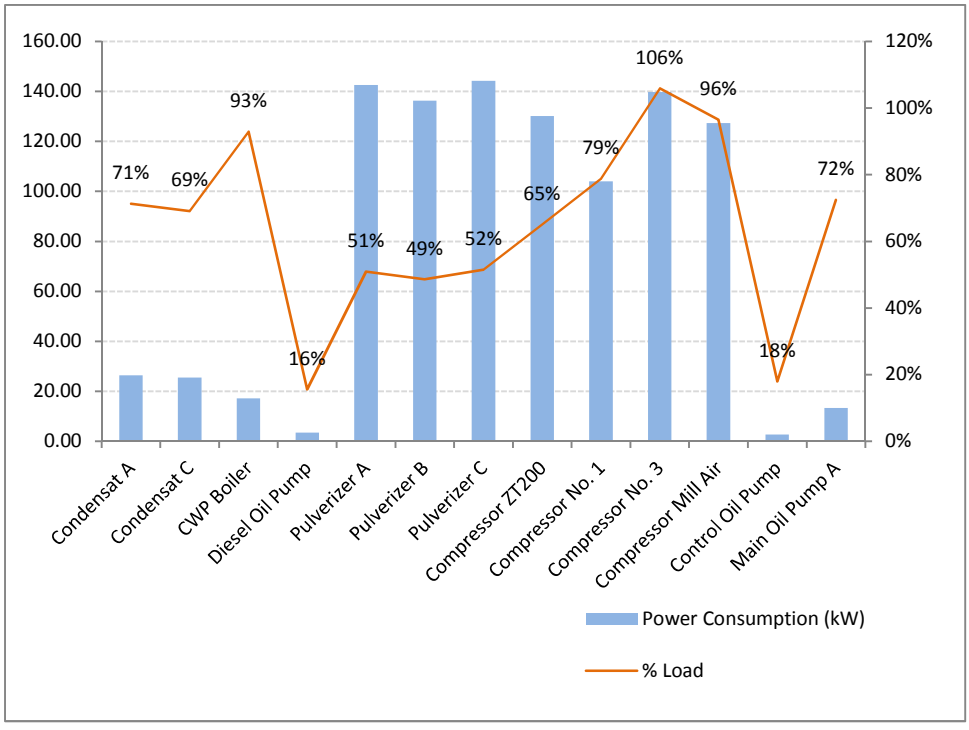
Auxiliary 3.3 kV									
No	Equipment	Rating (kW)	V (Volt)			I (Ampere)			P (kW)
			U1	U2	U3	I1	I2	I3	

1	BFWP #A	1750	3440.28	3431.16	3442.32	305.27	307.40	303.53	1696.66
2	FDF	800	3439.44	3429.66	3441.42	100.62	102.40	100.34	491.71
3	PAF #A	150	3441.18	3431.16	3443.34	22.51	22.85	22.54	124.07
4	PAF #B	150	3441.18	3431.34	3442.78	22.56	22.73	22.51	122.34
5	PAF #C	150	3441.78	3433.26	3445.74	22.61	22.90	22.40	122.55
6	CWP#B	1120	3438.08	3434.10	3442.58	183.80	188.40	189.60	912.60
7	CWP#C	1120	3437.48	3433.74	3442.52	191.40	197.40	188.20	917.20
8	IDF	830	3442.32	3434.30	3438.14	145.20	144.00	142.00	706.27
9	Dearator A	200	3435.62	3431.74	3440.62	36.60	37.60	35.60	196.20
10	Cooling Tower #B	1120	3438.48	3434.68	3443.32	31.00	32.40	29.60	152.40
11	Cooling Tower #C	1120	3438.06	3434.54	3443.12	32.20	33.00	30.80	161.20
12	Cooling Tower #D	1120	3437.88	3434.04	3442.62	30.00	31.40	28.40	149.80

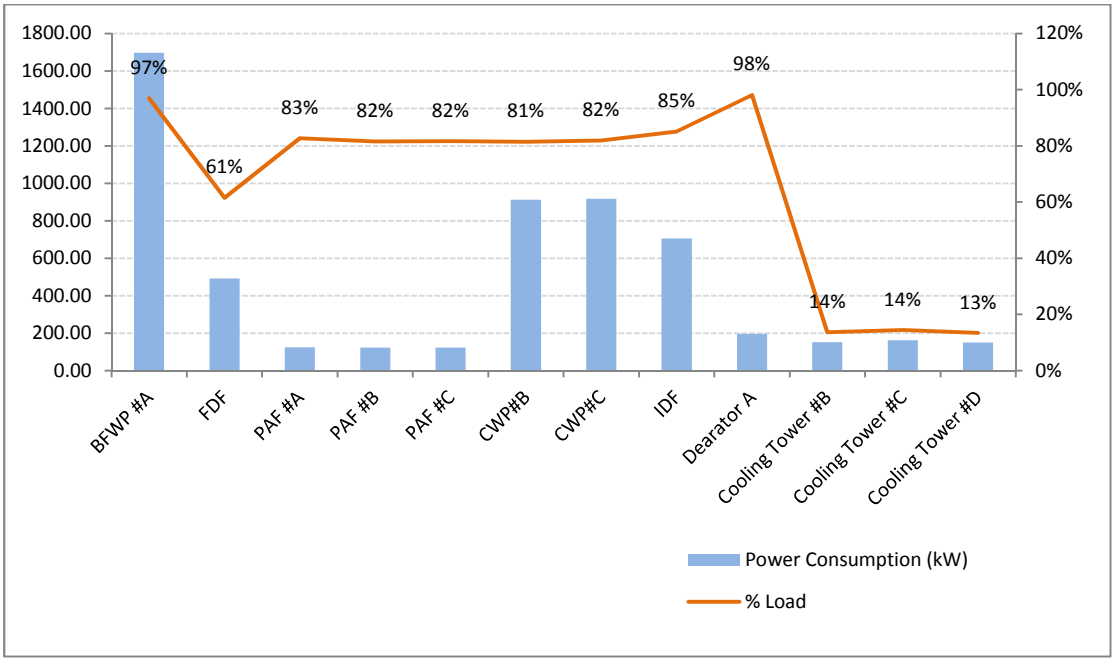
Table….Measurement result on motor auxiliary 3.3 kV

Analysis:

From table of measurement result on motor auxiliary 380 V and 3.3 kV, we can determine % load as follows:



Figure….Graph of % load motor auxiliary 380 V



Figure….Graph of % load motor auxiliary 3.3 kV

From two graphic above, it is shown % load of motor auxiliary 380 V and 3.3 kV. The measurement results are only preliminary judgement, because the measurement only done in short period.

Motor that operate for extended periods under 50% load, consider making modifications. Sometimes motors are oversized because they must accommodate peak conditions, such as when a pumping system must satisfy occasionally high demands. Optons available to meet variable loads include two-speed motors, adjustable speed drives, and load management strategies that maintain loads within an acceptable range.

Determining if the motors are properly loaded enables you to make informed decisions about when to replace motors and which replacements to choose.
We recommend you to survey and monitor motor's working hour and energy consumption periodically to get real energy profile. Using the analysis result, devide your motors into the following categories :

- Motors that are significantly oversized and underloaded – replace with more efficient, properly sized models at the next opportunity, such as scheduled plant downtime.

- Motors that are moderately oversized and underloaded – replace with more efficient, properly sized models when they fail.
- Motors that are properly sized but standard efficiency – replace most of these with enegy-efficient models when they fail.
- Motors that are overloaded. Overloaded motors can overheat and lose efficiency. Many motors are designed with a service factor that allows occasional overloading. Service factor is a multiplier that indicates how much a motor can be overloaded under ideal ambient conditions. For example, a 100-hp motor with a 1.15 service factor can handle an 115-hp load for short periods of time without incurring significant damage