Eltrix Degradation Analysis

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White Paper

Introduction

Perusing through 24-December-2017 and 8-June-2018 data, just when you think that the plant efficiency has gone down by 30.79 kcal/kWhr (Table 1), Eltrix software interprets the results differently, and accurately. Eltrix shows (Table 2) that the plant has improved in heat rate by 11.75 kcal/kWhr in the corresponding period. This is reflected as a corresponding decrease in Equipment degradation as calculated by Eltrix. Such a situation is a common occurrence in power plant. How to compare readings when the operating condition can differ every day, season and year?

Without Eltrix

Items	Dec	June	June - Dec
Actual MW	660.56	660.55	
Time (mmm-yy)	Dec-17	Jun-18	
Rated in kcal/kWhr	1,842.55	1,842.55	
Actual in kcal/kWhr	1,879.81	1,910.60	30.79

Table 1: Plant status without Eltrix

With Eltrix

Items	Dec	June	June - Dec
Actual MW	660.56	660.55	
Time (mmm-yy)	Dec-17	Jun-18	
Rated in kcal/kWhr	1,842.55	1,842.55	
Actual in kcal/kWhr	1,879.81	1,910.60	
Equipment degradation in kcal/kWhr	(60.94)	(49.19)	11.75
Op condition Dev in kcal/kWhr	23.68	(18.86)	

Table 2: Plant status interpreted by Eltrix

Methodology

Performance measure, commonly defined as the deviation of the Actual value from Rated (Design) value, can be misleading if the impact of operating condition (load, ambient, etc.) is not accounted for separately.

Operating condition deviation

As expected, in the month of December, the winter helped the plant improve its efficiency by 23.68 kcal/kWhr (Table 2). This is attributed to the favorable winter conditions that influences the cooling water, refer to Table 3.

Similarly, in the month of June, Eltrix shows that the operating condition reduced the plant efficiency by 18.86 kcal/kWhr (Table 2). In Table 3, cooling water temperature due to summer heat and reduction in Main Steam (MS) temperature can be attributed to this negative deviation.

To compare the Actual Heat rate of December'17 and June'18 shown in Table 1, Eltrix corrects the actual reading by adding back the operating condition deviation. This corrected value is then comparable. Please see Table 4.

In summary, from Dec'17 to June'18 there has been a reduction of 11.75 kcal/kWhr as compared to the initial understating of 30.79 kcal/kWhr increase. See Table 4.

Parameters	Rated	Dec	June
Flow (kg/s)	593.93	568.70	578.60
MS Presr (bar A)	242.22	225.64	224.68
MS Temp (deg C)	565.00	566.61	561.19
RH presr (bar A)	54.33	49.32	50.28
RH Temp (deg C)	593.00	(49.19)	591.50
Cooling water inlet Temp (deg C)	33.00	22.86	32.89
Cooling Water intermediate Temp (deg C)	37.76	28.55	38.75
Cooling water outlet Temp (deg C)	42.50	34.76	45.14

Table 3: Operating condition parameters from DCS

With Eltrix

Items	Dec	June	June - Dec
Actual MW	660.56	660.55	
Time (mmm-yy)	Dec-17	Jun-18	
Rated in kcal/kWhr	1,842.55	1,842.55	
Actual in kcal/kWhr (1)	1,879.81	1,910.60	30.79
Op condition Dev in kcal/kWhr (2)	23.68	(18.86)	
Corrected Actual = (1) + (2)	1,903.49	1,891.74	(11.75)

Table 4: Comparing two Actual readings

Equipment Degradation

Eltrix software's Table 2 and Table 5 gives a wealth of information on equipment degradation to the plant operator. Eltrix calculates equipment degradation as 60.94 kcal/kWhr and 49.19 kcal/kWhr for Dec'17 and June'18 resp. Break up of this degradation is shown in Table 5, where we see that the equipment degradation has significantly reduced in June'18 due to maintenance work in the Condenser.

Table 5 thus baselines the equipment degradation that can be targeted and measures the impact of maintenance activity (before and after) on the degradation.

Items	Dec	June	June - Dec
Degradation Break up from Eltrix reports			
HPT in kcal/kWhr	1.46	0.63	(0.83)
IP/LPT in kcal/kWhr	0.55	1.10	0.55
LPT in kcal/kWhr	(1.90)	(2.25)	(0.35)
LPH1 in kcal/kWhr	(6.02)	(5.66)	0.36
LPH2 in kcal/kWhr	(5.90)	(5.50)	0.40
LPH3 in kcal/kWhr	(1.34)	(3.08)	(1.74)
LPH4 in kcal/kWhr	(1.30)	(1.74)	(0.44)
HPH6 in kcal/kWhr	0.32	0.08	(0.24)
HPH7 in kcal/kWhr	0.24	0.28	0.04
HPH8 in kcal/kWhr	1.74	0.39	(1.35)
CondenserA in kcal/kWhr	(23.80)	(17.18)	6.62
Condenser B in kcal/kWhr	(24.97)	(16.25)	8.72
Total in kcal/kWhr	(60.94)	(49.19)	11.75

Table 5: Degradation break up

Conclusion

Eltrix software can build a time trend (e.g. hourly) of the equipment degradation, plant heat rate after correction and operating condition deviation with its corresponding controllable parameters. The mentioned time trend is calculated from DCS data after accounting for bad/missing data and thermodynamically matching the heat and mass balance in the turbine cycle. This time trend and report tables will help the plant engineers to accurately determine the cause of heat rate deviation, i.e. how much of the heat rate deviation is due to equipment degradation and/or how much is it due to operating conditions. Such information will help plant engineers and management to deploy and justify the resource to mitigate the problem. Eltrix can also help check the compliance of PAT targets.

About Kalkitech

Kalkitech helps energy utilities around the globe in enabling and transforming grid communications, improving reliability and energy efficiency. Its solutions enable customers to implement mission-critical applications ranging from advanced metering and distribution automation to wide area monitoring, substation automation and power plant optimization. Kalkitech invests extensively in research and development in areas such as power systems engineering, thermal engineering, control theory and communication and information technology. By building expertise, the company creates robust standards-based communication and optimization solutions and products for modernization of utilities, helping them to harness the power of grid data.

Kalkitech has been implementing strategies for optimising the efficiency of thermal plants to improve heat rates using Eltrix, which is its advance power plant analytics and optimisation software. Eltrix, with over 20,000MW experience in power plant calculation and optimisation, has been implemented in several power stations in India as well as across Middle East, and South East Asia.

References

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