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ISO-50001: Power Plant needs additional clause for Monitoring, Measurement & Analysis

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ISO 50K standard is very young compared to its mother standard 9K and shall undergo many round of evolutions. Feedback from the EnMS auditors and Industry Experts shall make the standard more refined and much more specific to critical industry. For example, stringent quality parameters of automobile industry generated the need for creating a separate & exclusive standard 16K which is the ramification of basic quality standard 9K. Similarly Power Plants, Refinery and Fertilizer industry demand for sector specific EnMS standard which will be helpful in-

- Determining & Defining baseline
- Operational Control &
- Measurement & Verification (M&V)

Given below a case study of Gas based Power Generating Station (Open Cycle). They are in the process of establishing energy management system in their plant. In 2012 they defined the baseline by taking the average of last three years operational data which are mainly-

1. Total capacity : 84 MW (4 X 21 MW)
2. Average Annual Gross Generation: 660.957 MU (Million units)
3. Average annual Natural Gas consumed: 270.216 Mscm (Million standard cubic meter)
4. Average GCV of NG: 9138.31 Kcal/scm
5. Auxiliary Power Consumed: 1.8%
6. Annual PLF: 89.82%
7. Station gross operative heat rate: 3735.95 Kcal/ kWh
8. Station net operative heat rate: 3804.15 Kcal/ kWh (Baseline)

The plant management was given the **target** to bring down the station net operative heat rate to 3723.75 Kcal/ kWh (2.11% reduction in heat rate) within next three years.

In the assessment year the reported data of the plant were like this-

1. Total capacity : 84 MW (4 X 21 MW)
2. Average Annual Gross Generation: 627.854 MU
3. Average annual Natural Gas consumed: 258.53 Mscm
4. Average GCV of NG: 9173.9 Kcal/scm
5. Auxiliary Power Consumed: 1.4%
6. Annual PLF: 85.32%
7. Station gross operative heat rate: 3777 Kcal/ kWh
8. Station net operative heat rate: 3832.31 Kcal/ kWh (Performance Achieved)

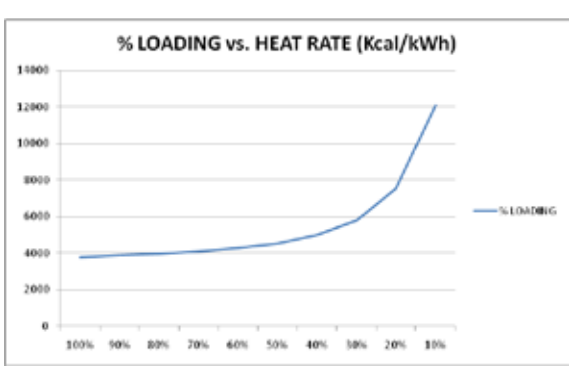
Now from the above mentioned data it can be seen that the "Net Operative Station Heat Rate" has not been improved rather deterioted. However the plant "Energy Manager" was not ready to accept the fact that their energy performance has been worsen. In his support he mentioned about so many factors which had had made adverse impact on the plant capacity utilization factor and turbine loading. It is to be remembered that the turbine heat rate is affected badly when it runs under low load condition. The Energy Manager presented the turbine performance data generated during "Performance Guarantee Test" –

Sl no	Description of Parameters	Guaranteed Value	Test Value	Remarks
1.	Power output (kW)	21010.0	21378.8	Test value is higher by 1.76%
2.	Specific heat consumption (kJ/ kWh) - NCV Basis	13970.0	13967.2	Test value is lower by 0.02%
3.	Inlet air temp (^{0}C)	40	30.5	The guaranteed power output is possible with maximum limit of temp as 40^{0}C
4.	Barometric Air Prss (bar)	1.01325	1.0044	The guaranteed power output is committed at the said temp & prss value of the inlet air.
5.	Thermal Efficiency (%)	25.8	25.8	Guaranteed thermal efficiency was achieved during test.

% loading vs. heat consumption data-

Percentage Loading	Heat Consumption (Kcal)	Heat Rate (Kcal/kWh)
100%	79214286	3772.109
90%	73669286	3897.846
80%	66540000	3960.714
70%	60202857	4095.432
60%	53865714	4275.057
50%	47528571	4526.531
40%	41983571	4998.044
30%	36438571	5783.9
20%	31685714	7544.218
10%	25348571	12070.75

Based on the above data the following curve was drawn-



From the above it can be seen that below 85% loading

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the heat rate tends to rise fast and below 30% it becomes rapid. The Energy Manager mentioned about the below mentioned factors (which are beyond his control) which had adverse impact on turbine loading-

- Short supply of Fuel/ Fuel unavailability
- Scheduling
- Backing Down of plant
- High ambient temp
- Higher ΔP across the air suction filter (due to fog etc)
- Forced outage
- Planned outage

He also presented the record of generation loss and affected period for each turbine. The summary of all four turbines are given below-

	Loss of Generation in MW	Affected Period (hrs)	Loss in MW/hr	Decrease in % loading
Short supply of fuel	2519.465	4775.49	0.527	2.512
Due to scheduling	2021.516	764.8	2.643	12.586
Backing Down	376.75	26	14.490	69.001
Other external factors	1947.376	1151	1.691	8.056

He now asked the EnMS auditor to normalize the baseline and judge the plant performance based on the adjusted baseline.

The EnMS auditor found that-

1. When baseline was drawn all such internal & external factors were not considered at all.
2. It is difficult to retrieve the old baseline year data on factors like scheduling, short supply of fuel, backing down, adverse environmental parameters etc.

This situation made the EnMS auditor perplexed. To avoid such situations baseline of power plant should be drawn after examining all such factors. Furthermore, OEM heat balance diagram and turbine performance test data of commissioning should be brought under compulsory document requirement.

For **coal** based thermal power plants, few more additional factors should be considered while determining the baseline-

- Coal Property: % of ash, moisture and H_2 have substantial impact on boiler energy performance. Higher ash means higher power consumption of the ash handling plant and also higher sensible heat loss thru discharge of hot ash. Similarly moisture and H_2 reduce the NCV of coal. Even coal hardness and size can make considerable impact on power consumption of coal grinding mill.
- Coal GCV: Lower GCV of coal means increased charging rate of coal to the boiler which impacts the power consumption of PA & ID Fans.
- Plant Loading Factor (PLF): Unlike gas based power plant, coal based thermal power plant has substantial percentage of auxiliary power consumption (APC). APC can be in the range of 6.5 to 9% in a typical coal based plant. It is to be noted that APC doesn't reduce proportionately with the PLF. Hence operating the plant at lower PLF adversely impacts the Net Station Operating Heat Rate.
- Number of shut-down & start-up: If this number varies in baseline and assessment year then it calls for normalization. This is to be noted that for starting of the turbine- back-up genset has to be run till the turbine reaches the rated speed. This calls for additional fuel (HSD) consumption which is to be accounted for while comparing the energy performance.

Form the above one may observe that proper recording and analysis of the above variables are pre-requisite both for drawing baseline as well as deriving the energy performance of the assessment year.

Unfortunately, most of the certification bodies have ignored the complexity of the power generation process and are carrying out the assessment without rendering due diligence to the above facts. Hence ISO-50001 certification or recertification are not capturing the true performance of the plant and losing popularity very fast in this sector.