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BOEM-S a Tool to Measure the ISO 50001

Part III - Procedures

White Paper
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The Technique of M&T

3.2. Procedures

Before the implementation of M & T measures some preparatory steps are needed as described below:

a) Identification of the major energy consumers in each sub-process. Usually the primary energy consumption is due to a small number of devices or in processes or machines (Paretto rule). Usually this step requires a site visit to survey the equipment and systems, and some measurements of the level of consumption of the various equipment.

b) During this step of the M & T program it is necessary to define other process variables that can help to characterize it, such as production, temperatures and flow rates. Once the variables are defined and the necessary measuring equipment is installed the remaining steps of the M & T program can be initiated.

3.2.1. Measurements

The first step is to compile the data of the measuring equipment. This compilation is usually performed electronically, although it can be carried out manually if the number of measurement points is small.

The frequency at which data is read changes according to the interval in which the reports are issued, ranging from once a month to such small ranges as every minute. Some of these measurements can be performed directly while others have to be calculated. This feature is automatically performed by the system BOEM-S.

3.2.2. Definition of reference intakes

The compiled data must be represented to define a baseline or reference energy consumption graph. Specific consumptions are graphed as a function of the production or function of other process variables previously identified and are used to determine the function which correlates with the production or other process parameters. The equation of the curve obtained by the technique of "best fit line" constitutes the mathematical model of the process, then allowing the determination of its behavior even in conditions different from those found in normal operation.

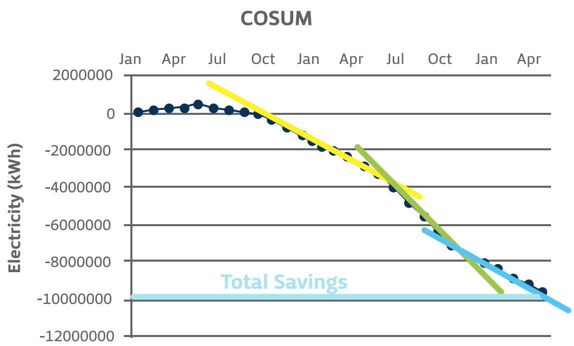
The graph of the function thus determined, as well as its mathematical model, is a valuable tool for managing data can provide the following information:

- The intersection with the vertical axis gives the consumption in the absence of the variable (without production). It is the same as saying it represents the consumption of the system base load (or reference) or its sub-processes even if they are not producing.
- The slope represents the relationship between consumption and the previously identified variable. The slope represents the process efficiency.
- The dispersion represents the level of the process consumption variability or dependence of that consumption and operational or environmental factors.
- A high value of intersection with the y-axis may indicate that there is a malfunction in the process, causing a power consumption without any benefit or production.
- In the other hand, widely dispersed points indicate that there may be other significant factors which are causing energy consumption variations, such as poor process control, misoperation, etc.

3.2.3. Monitoring of energy consumption variations

This step identifies the differences between expected and current consumption. One of the tools used to perform this analysis is called "CUMULATIVE SUM OF THE DIFFERENCES" or COSUM.

First, it consists in calculating the difference between the expected performance and measured performance (differences between the graph of the predetermined function and the found values). Then the COSUM can be plotted on a graph to give more information to the expert in rational use of energy. Variations scattered around zero mean that the process is operating normally without efficiency gains and no losses.



Img. 4

Large variations (upward and downward) mean that the process has been subject to disturbances of its normal operating conditions.
The slope of the graph (see image 4) COSUM function particularly interesting because it is a very important indicator of the achieved savings.

A consistently negative slope indicates that savings are consistently achieved. Any variations in the slope indicate variations in the process. For example, in the graph of image 4 it can be seen that the first portion indicates no savings; however, from September (beginning of the yellow line) due to the implementation of an energy saving measure, it begins to occur savings.

The green line indicates greater savings, however the red line indicates a change in the process since the savings decreased slightly.

- The more negative the slope, the bigger the savings;
- The less negative the slope, the lower the savings;
- If the slope equals zero (horizontal) there are no savings or increase in consumption;

The graph of the image 4 allows performing the projection savings, therefore being an important tool for analysis management.

3.2.4. Identification of causes

The experts of rational use of energy decode the signs of the cumulative sum of the graph indicates, identifying the causes of variations and suggesting corrections.
This attitude represents a change of behavior in most industrial structures.
The encouragement of good practices and discourage of the bad ones is the following task.

3.2.5. Definition of goals

Once established a baseline, and identified the causes of excessive energy consumption, there are fixed future goals for the reduction of energy consumption.
The goals may be based on two variables:

- The extent to which the consumption should be reduced realistically;
- The time frame in which it is anticipated that these reductions in energy consumption are obtained.

Energy savings have two sources, those that are originated by the best operation of the facilities and therefore have a lot to do with the knowledge and training of operators, and those savings that come from effective improvements of systems and machinery.

Of course that there are those savings which come from fluctuations in market prices of fuels and lubricants, but this does not go directly to the M&T program.

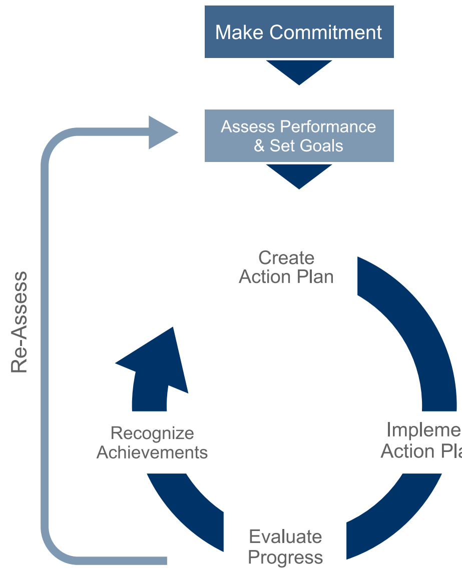
In good practice it is established a period of 6 years, in which consumption should be reduced by at least 6%,i.e. at least 1% / year. However due to the technologies of data acquisition and monitoring of installations with regard to their energy consumption and many of the facilities are old and poorly optimized in the design phase of the installation, very high and interesting reductions can be achieved above 6%.

Typically, only due to optimized operation of facilities it is possible to obtain 5% of energy savings, which can be concluded that training and awareness of the operation and all involved personnel in it is crucial.

With the successive advances in technologies for energy saving, it can be said that many improvements that a few years ago were not economically viable, are today interesting options.

Other factors such as market disturbances or the price of fuel and energy, can be the basis of not achieving economic savings goals even if there have been significant reductions in energy consumption through the M&T program.

Another cause for not reaching savings goals may be due to certain equipment being optimized for a given "load" and for market reasons having to operate under non-optimal conditions of efficiency (it is the case of diesel generators having higher power and have to be operated at reduced load with Consumption. The same applies to systems with gas turbines and steam).



Img. 5

In any case the most modest aim is to consume no more than the baseline or base determined in the second step of implementing the consumption control system.

3.2.6. Monitoring results

The results can be monitored automatically (without human intervention) and graphically by the system BOEM-S. Image 5 summarizes the methodology described in the text.

As defined in step 1 for the implementation of M & T process, once accomplished the proposed goals for reducing energy consumption, it is time to start re-evaluating the targets in order to successively achieve a more and more optimized consumption.

This process (depicted in image 5) also functions as a feedback for managers to be sure that the various processes are running smoothly but also if they have potential for improvement.