A PRACTICAL APPROACH TO
ELECTRICAL ENERGY MANAGEMENT IN INDUSTRIES

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BACKGROUND

Industries account for over 55% of the total electrical energy consumption in India. During the last few years they have been facing two serious problems on the electrical energy front:

* Escalating cost.
* Growing shortage

One way to cope with the escalating cost is to pass it on to the consumer. However, this may not be desirable or practicable in a competitive market. The alternative then is to optimise energy usage and keep costs under control.

The way to cope with shortage is to make the best of what is available; which again boils down to optimising energy. And the key to optimisation is effective management of the electrical energy resource.

AN ELEMENTARY CLOSED LOOP SYSTEM

As in the management of any resource, optimisation is best achieved through closed loop system of control. Fig. 1 illustrates an elementary closed loop.

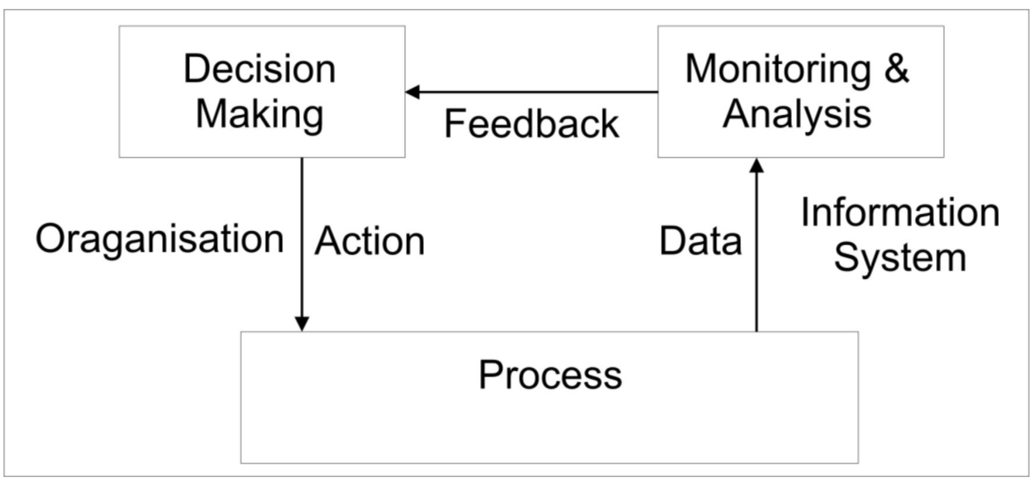

Fig. 1 - Elementary Closed Loop

Decisions regarding utilisation of the resource are taken at appropriate levels. The decisions are implemented in the process which handles the resource. The implementation is monitored, analysed and the data is fed back to the decision making level, thereby closing the loop. Thus the decision making level is aware of how the implementation is progressing, and can initiate corrective action if any inadequacies are shown up by the data. Because of feedback and corrective action, implementation gets progressively refined and a high level of efficiency is achieved.

ELECTRICAL ENERGY MANAGEMENT LOOP

In the case of Electrical Energy, the closed loop needs some refinement. This is illustrated in Fig. 2. In effect there are three closed loops within each other.

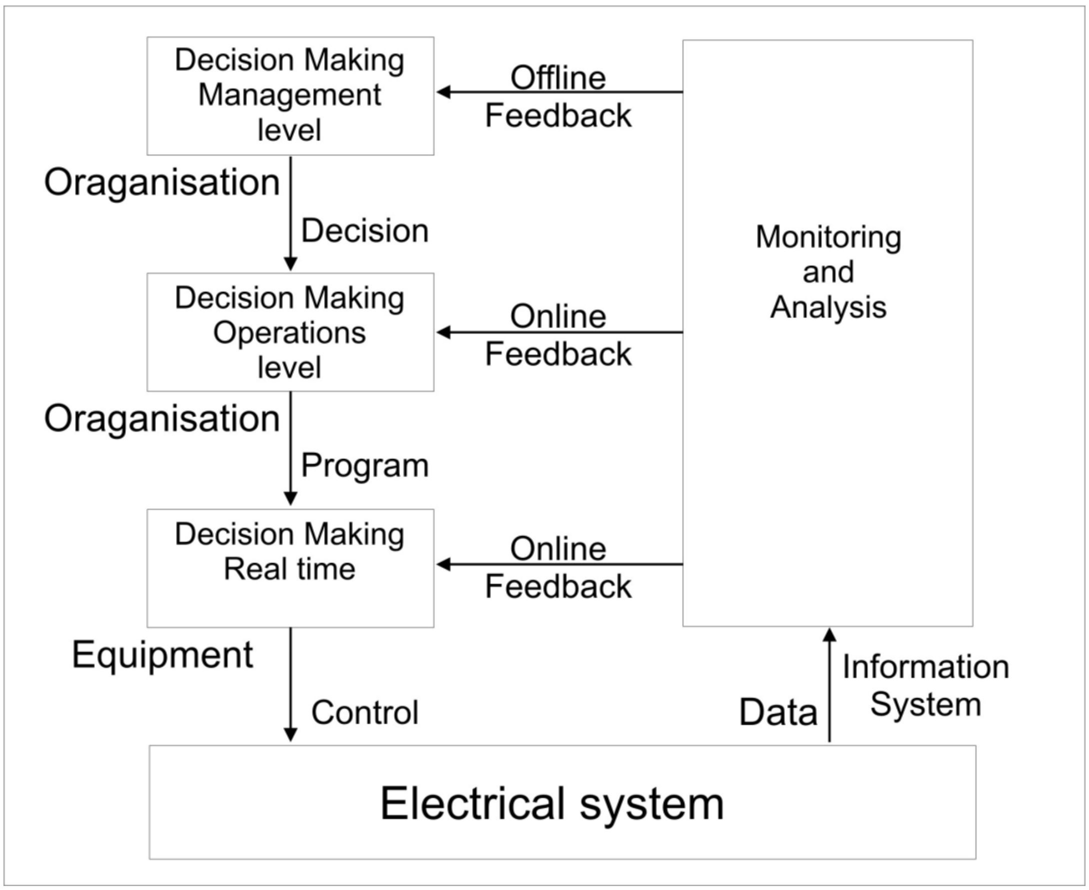

Fig. 2 - Electrical Energy Management Loop

The outer loop, which includes Energy Audits, provides off line feedback for management level decisions. These decisions are generally of an overall nature, for example, strategy, targets, investments etc.

Energy Audit does not by itself lead to optimisation or savings. The decisions arising out of Energy Audits provide a framework within which further control measures need to be taken for optimisation. It is only when these measures are taken that savings accrue.

The middle and inner loops provide on line feedback necessary to implement control measures.

The middle loop generally provides adequate on line data based on which operations level personnel can take control decisions and implement them. Decision making requires certain level of skills. In many cases therefore decision making is also included in the middle loop. The manual implementation then becomes virtually an unskilled job.

The inner loop provides for automatic implementation, which in certain cases is highly desirable, for example, in Demand Management.
The functional block designated ‘Monitoring and Analysis’ together with the feedback mechanism represents an Information System, essentially comprising instrumentation and people. Good instrumentation is therefore the key to effective energy management.

ROLE OF INSTRUMENTATION

In the past instrumentation had a limited role :

? To monitor the health of the electrical system - for which Voltmeters and Ammeters were adequate
? To record electricity consumption for costing or billing purposes - through energy meters

For this limited role electromechanical meters were adequate and cost-wise attractive.

However, in the context of optimisation, instrumentation has acquired a new role. Emphasis has shifted

? from Monitoring to measurement, and
? from Recording consumption to controlling consumption.

For this enhanced role inadequacies of electro-mechanical instruments pose major constraints. On the other hand, electronic technology, more precisely, digital technology offers immense possibilities and cost effective solutions. Apart from advantages like high accuracy and resolution, True RMS measurements, excellent stability, user programmability, large dynamic range with auto scaling and automatic placement of decimal point etc., the most important feature is the ability to be integrated into a network for centralised monitoring and control.

CENTRALISED MONITORING AND CONTROL

For effective management of electrical energy in an industry it is not enough to confine monitoring only to the incomer and the feeders connected to it. Optimisation has to be achieved at each stage and in each process or operation and for this it is necessary to monitor several nodes comprising all the major feeders and loads. Typically these may number from, say, 20 or 30 to 200 or even more. And generally these are dispersed over a vast area.

Installing stand alone instruments at these nodes will not be meaningful for three reasons:

? Readings from these instruments will be in the nature of raw data - for example, log books containing hourly voltage and current readings - and this has very limited use.
? Because of the geographical spread and the resulting time lag between readings from different instruments the data is not correlated in real time. For example, when assessing shift-wise performance, if reading of one instrument is at the start of the shift and another 30 minutes later, the results could be totally misleading.

- ? For effective implementation of control measures, which only leads to significant savings, the middle and inner loops have to be in place. These operate with on line data. Data collected manually from sand alone instruments spread over a vast area can never be on line.

For effective monitoring and control, therefore, there is no alternative to a Centralised System which inherently takes care of all the three closed loops.

Conzerv Systems is one of the established manufacturers who can offer a variety of Centralised Systems tailor made to suit different types and sizes of industries.

A CASE STUDY IN OPTIMISATION

To bring home the significance of optimisation and illustrate how it is generally achieved in practice a case study is presented.

Within a month of commissioning of the Centralised System the Industry cited in this study had established norms for assessing the energy efficiency of various operations. The Management happened to notice that in one shift the product output of a particular operation was 80% of the norm but the energy consumed was 95%. The question was raised why? A little investigation revealed that because of some mismatch in loading the conveyor system was running idle for a long time. It was then that the Management realised for the first time that an idle running conveyor system was an energy guzzler because of the high inherent friction. Then the question was how to detect idle running. One of the engineers suggested that the kW consumption of the driving motor is a good indicator. So what is the kW consumption during idle running ? There was no data on this.

The conveyor system was run idle for some time and it was observed that the consumption was around 130 kW. It was agreed that allowing for some margin 150 kW be set as the threshold for detecting idle running. Then the question arose what should be done if idle running is detected. Quickly came an answer - trip the motor. But somebody pointed out that even during normal operation the conveyor runs idle for a short time and it would be disastrous if every time this happens the motor is tripped. The question then was how long should it be allowed to run idle ? A new dimension - the time factor - came into the picture. And so it went on. But within a week a reasonably foolproof system for optimising the conveyor operation was put in place.

CONCLUSION

The case study highlights the following:

a. Information is power. Reliable information is the starting point for the optimisation process
b. While off line data helps initiate an optimisation process, actual optimisation is achieved through on line control
c. Optimisation is not a one time but an ongoing activity. New opportunities keep coming and the Centralised System should be flexible enough with user programmability to implement a variety of control actions.
d. Each step towards optimisation may result in some small saving but together they can add up to substantial savings