Technical Paper EE 06

N.M.Majhi
Senior Technical Services Manager
Guwahati Refinery, Indian Oil Corporation Limited

E-mail
majhinm@satyam.net.in, majhinm@iocl.co.in

ENERGY MANAGEMENT SYSTEM FOR IMPROVING ENERGY PERFORMABCE

1. Aspects of Energy Management

1.1 Introduction

Energy management is one of the key strategies for sustaining competitiveness in to day's business environment. Energy conservation leads to reduction in operating cost with corresponding increase in profitability and helps in achieving societal goal of environment protection.

1.2 Energy management Aspects

Energy management is attaining the objective of an industry with judicious and effective use of energy for minimising operating cost and maximising profitability to sustain competitive position. The aspects of energy managements are briefed as under:

- Technical – the energy consuming equipments and systems
- Organisation- the structure and energy management system to achieve the goals of efficient use of energy
- People – attitudes and practices of individuals in the organisation, which influence the use of energy.

2. Industry experience

2.1 Technical Aspects

The technology absorption, modernisation, installation of high efficient equipments and modifications are carried out to achieve objective of energy conservation. All this is done with capital investment.

The equipments installed generally operate below the design efficiency level to have operational flexibility. At times redundancy is allowed in the name of reliability, which leads to operation of energy consuming systems at lower efficiency.

2.2 Organisational structure

The organisational structures seen in industry are briefed as under.

- There does not exist formal energy policy for energy management for revealing top down approach on energy management.
- The organisations do not exhibit awareness of benefits of energy efficiency through out the organisation.

- There is no integration of energy management with over all management structure of the organisation.
- The top management does not demonstrate leadership on energy management.
- There are no champions for energy management systems.
- There are no small group activities for spearheading energy conservation activities at shop floor.
- The energy conservation activities are mostly investment oriented and it lacks involvement of people.
- Most of the companies have ISO systems but it remains bounded in documents.

2.3 The People

Technology and operation of technical systems is an essential element of energy management. Industry experience reveals that technological solution alone do not achieve sustained energy savings in long run. Installation of high efficiency equipment does not yield desired result unless operated and maintained by the people involved. Thus the focus on people, awareness of people on energy efficiency, their values and attitudes towards use of energy and their skill and knowledge related to use of energy system has significant impact on energy performance of an industry.

2.4 Energy Conservation Cell & Energy Manger

In some industries formal energy conservation cells do exist. Executives from middle management cadre head the energy conservation cells. This cell monitors the current energy performance, reports to management and ministry wherever applicable and coordinates with various functions in the industry. The energy conservation responsibility lies entirely with the person concerned in energy conservation cell.

However the line managers and operators who operate the plant and know much about the behaviour of energy consuming systems have little accountability on energy conservation. If energy consumption pattern deviates from the target, manager heading energy cell is questioned for deviation and action plan for corrective actions.

The line managers of production units have prime responsibility of continuous operation of plant and the priority of energy conservation takes back sit. Some times some wastage and inefficiency is allowed to sustain the operation of plant.

The energy management is not embedded to core function of the business, as all the departments are not accounted for the energy performance. The energy performance is restricted to energy manager and to some extent for heads of operation. The maintenance group are never asked for energy efficiency.

2.4.1 Factors that affects Role of Energy Manager

The energy manager co-ordinates activities of energy conservation with some of the difficulties cited above. Some other difficulties of energy manager are laid down as under.

- It is very difficult to gather accurate data in industry in spite of instrumentation with ISO systems.

- The data gathered need to be validated based on experience and supporting data based on design.
- There are no statistical tools such as SPC, SIX sigma or CUSUM for analysing variability and identifying proactive energy management opportunities.
- Lack of tools for energy auditing as it requires investment for procuring. It takes time and energy to convince management for utility of energy auditing instruments.
- At times energy manager faces neighbours envy as he finds out some operational problem, which leads to energy inefficiency. Generally people do not like audit.

Some of the favourable factors of energy manager are:

- Energy manager is close to top management.
- Opportunity of knowing the industry and organisation in totality.
- Drives the ENCON efforts for profitability.
- Energy manager is preacher for waste reduction
- Energy manager is torchbearer for innovation and future development.

3.0 Suggestion for improving energy management system

3.1 Organisational

- Assess the organisation profile with respect to energy policy, energy conservation objectives and targets, skill and knowledge, information system.
- The energy manage system needs to be supported financially with an objective of value addition.
- Necessary action can be drawn after identifying gaps.

3.2 Technical Aspects

- Benchmarking of technical systems for identifying gaps.
- Operation of technical systems to design level involving people.
- Absorption of technology
- Knowledge management for nurturing and seeding energy management.

3.3 People

The people are the softer aspects of energy management. The operating people are the greatest asset of an organisation. Thus people based energy management is best option for implementing energy management systems. It can pay rich dividend without any investment by operating the technical systems to its design level. Some of the suggestions are as under:

- Energy manager is a change agent and he or she must know the culture in which he or she is working.
- Effective co-ordination with people by demonstrating the energy conservation gains at site by working with the people at site.
- Energy manager has to develop team spirit with operating personnel. This would help energy manager in accessing information more quickly.
- Provide appropriate management information to all levels of opeople in the organisation.
- Organise energy related training programme for skill up gradation.

- Identify energy barriers through interacting with people.
- Energy is an organisation wide management issue and not a technical speciality. Make all managers understand that energy conservation is one of their managerial responsibility at the work place.
- Motivation of people by financial awards.
- Motivation of people by job enrichment and recognition in public for good job done for energy conservation.
- People at all levels need motivation for energy management.

4.0 Conclusion

About 20 % of energy consumption in an organisation can be reduced by involving people for good house keeping and adopting better operational and maintenance practices.

Since this does not require investment and increases synergy and team spirits this should be given as priority for implementing energy management.

5.0 Case study

A case study on energy conservation by involving people is briefed in the subsequent section as Annexure I.

ANNEXURE I

GUWAHATI REFINERY

CASE STUDY ON EXTRACTION OF LOW PRESSURE STEAM FROM STEAM TURBINE INVOLVING PEOPLE ALONE LEAD TO FUEL SAVING

Introduction

Guwahati Refinery is the first refinery of Indian Oil Corporation Limited, which came into operation in 1961. With the change in time and business environment, Guwahati Refinery has sustained its effort towards continual improvement on energy conservation by enhancing the efficiency of energy intensive equipments and energy consumption systems such as furnaces, steam turbine, heat recovery systems, steam systems and increased efficiency of insulation.

Integration of Organisation, Technology and People has been the energy management aspects of refinery for sustaining profitability, economic development and achieving societal goal of environment protection through energy conservation.

Efficient use of energy through modernisation and improved operational practices has been the norm for energy conservation and identification of opportunities through in house energy audit is one of the steps for continual improvement.

Though there have been numerous energy conservation activities at Guwahati Refinery, the energy conservation efforts of recent time **involving people alone** is presented as case study.

Thermal Power Station

Guwahati Refinery has its own Thermal Power Station (TPS) for meeting the power and steam requirement of process units and other facilities. The TPS has boilers, which produce steam at 38 ATA. The steam thus generated is used for generation of power through steam turbine. TPS has two operating turbines having capacity of 8 MW each. Normally one turbine remains in operation and other as stand by at the existing activity level of refinery. The steam turbine has built in facility for extraction of medium pressure steam and low-pressure steam and condenser as well. TPS also has facility for pressure reducing unit for meeting the requirement of low-pressure steam demand.

In TPS, low-pressure steam is fed to a common L.P. steam header, which is generated from the following sources of supply.

1. MP to LP steam PRU (Pressure reducing station)
2. LP extraction from TG 3
3. LP extraction from TG 4
4. Lower H.P. steam header drain

This LP steam is distributed to following consumption centers.

1. Heating of Fuel Oil day tanks in TPS
2. Fuel oil heaters
3. Fuel oil & gas tracing lines
4. Deaerators

Constraints

Though the steam turbine has facility for low-pressure extraction, but it could not be extracted due to the following constraints.

Constraints in commissioning of LP bleed in TG 4

The turbine TG 4 was commissioned in February 1998. Since commissioning, its LP bleed could not be commissioned due to the following reasons.

1. When LP bleed was commissioned & MP to LP pressure reducing unit was isolated, de-aerator steam pressure controller became 100 % open and the temperature of boiler feed water from deaerator came down due to non-availability of required LP steam and resulted in excess dissolved Oxygen in feed water.
2. The MP to LP pressure reducing unit was opened to increase the availability of low-pressure steam for maintaining de-aerator temperature. This resulted in limitation of low-pressure steam extraction from turbine and the flow of L.P. bleed from turbine stopped.

Because of the above, the practice during normal operation became supplying of low-pressure (LP) steam through MP to LP Pressure Reducing Unit. The LP steam pressure is maintained at 3.7 to 4.0 Kg/cm^2 which is the required level of pressure for maintaining the de-aerator temperature at 105 ^{0} C. At this pressure de-aerator steam pressure controller remains 80 to 90 % open.

Subsequently, it was suggested to increase the size of de-aerator steam control valve so that the temperature of de-aerator could be achieved with the low-pressure steam from turbine. The procurement of this valve is in process.

Commissioning of L.P. bleed

As a thrust on energy conservation and sustaining profitability in competitive environment, a brain storming session was done in the office of Chief Power and Utility Manager on 10.12.2000 to find out the solution of commissioning low pressure extraction from turbine with existing facilities.

During the session two suggestions came up:

1. To keep the De-aerator steam pressure control valve by-pass valve crack open and commission the L.P. bleed so that de-aerator steam control valve would come into the range of 60-70 % open and de-aerator temperature will be maintained. This scheme could not be implemented because of various technical reasons.
2. Another suggestion was to segregate the deaerator steam header from other low-pressure steam consumption header with available facility for isolation.

   This scheme was implemented successfully on 11.12.2000 by segregating the low-pressure steam header. The header could be segregated in such a way that deaerator steam was supplied fom pressure reducing station and steam requirement for fuel oil tanks, fuel oil heater and tracing could be feed by low pressure extraction from turbine. The sketch of this scheme is enclosed as Annexure IA.

Energy Savings

The benefits derived was improvement in power generation efficiency of turbine, lower steam generation through MP to LP pressure reducing unit. This has resulted in lower fuel consumption in TPS by 893 MT per year, which is equivalent to RS, 80 lakhs per annum. This benefit could be achieved through integration of people with process.

The operating conditions before and after commissioning of low-pressure extraction from turbine and fuel savings achieved by implementation of this scheme is indicated in the Table 2.

Table 2: Reduction in fuel consumption by extracting LP steam from turbine

Sl No	Parameter	Unit	TG performance	
			Before	After
1	Power Generation	MWH	7	7
2	HP Steam			
	Steam flow to turbine	MT / Hr	63	63
	Steam pressure	Kg/CM^2 (A)	38	38
	Steam temp	o C	425	425
	Enthalpy	K cal/kg	784	784

3 MP Steam			
Steam flow to turbine	MT / Hr	37	35
Steam pressure	Kg/CM^2 (A)	11	11
Steam temp	o C	325	325
Enthalpy	K cal/kg	740	740
4 LP Steam			
Steam flow to turbine	MT / Hr		3.5
Steam pressure	Kg/CM^2 (A)		5
Steam temp	o C		300
Enthalpy	K cal/kg		731
5 FUEL Consumption	Mt/hr	2.2012	2.0934
6 Power Energy Factor	MT SRF / MWH	0.3145	0.2991
7 **Fuel savings**	MT/Hr		0.1079
	Mt/Month		80.2
	RS in Lakhs per month		7.2
	Mt/Year		**893**
	RS in Lakhs per Year		**80**

Annexure – IA

SKETCH OF LOW PRESSURE STEAM SYSTEM