International Journal of Latest Technology in Engineering Management & Applied Science (IJLTEMAS)

Energy Audit and Management

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Abstract: Energy Management and audit save money and energy for industries unless the recommendations are implemented. Audit reports are designed to encourage implementation and proper and efficient use of energy. Efficient management and utilization of energy may become a good source of energy for consumers. The purpose of writing an energy report is to achieve increased energy efficiency and energy cost savings for the customer. This paper briefly describe about Energy Audit and Management and their correlated terms.

Keywords: Energy Audit, Energy Management, Energy conservation Act, ISO certification, Energy Assessment

I. INTRODUCTION

Energy is one of the major inputs for the economic development of any country. In the case of the developing countries, the energy sector assumes a critical importance in view of the ever increasing energy needs requiring huge investments to meet them. The fundamental goal of energy management is to produce goods and provide services with the least cost and least environmental effect. Definition of energy management given by Cape Hart, Turner and Kennedy is "The judicious and effective use of energy to maximize profits (minimize costs) and enhance competitive positions". Also it can be said as "The strategy of adjusting and optimizing energy, using systems and procedures so as to reduce energy requirements per unit of output while holding constant or reducing total costs of producing the output from these systems".

Energy Audit is the key to a systematic approach for decision-making in the area of energy management. It attempts to balance the total energy inputs with its use, and serves to identify all the energy streams in a facility. It quantifies energy usage according to its discrete functions.

Energy management in the form of implementing new energy efficiency technologies, new materials and new manufacturing processes and the use of new technologies in equipment and materials for business and industry is also helping companies improve their productivity and increase their product or service quality. Often, the energy savings is not the main driving factor when companies decide to purchase new equipment, use new processes, and use new high-tech materials. However, the combination of increased productivity, increased quality, reduced environmental emissions, and reduced energy costs provides a powerful incentive for companies and organizations to implement these new technologies.

II. CONCEPT AND PURPOSE OF ENERGY AUDIT

Energy audit is refers to the inspecting, examining and analyzing on the physical and the financial activities processes of enterprises and other high energy-using units according to relevant state regulations and standards of energy-saving. Energy audit is conducted by energy utilization units or its competent authorities or entrusted specialist agencies. Energy audit is a kind of scientific management method of energy. Its main content is objectively inspecting on the energy efficiency, energy consumption level and the economic benefit of the energy unit and proposing the energy-saving measures for energy-using units by means of statistical analysis, inspection testing, and diagnostic evaluation.

The targets of energy audit are investigating problem and weaknesses in using energy, tapping the energy-saving potential, giving rectification measures, formulating energy saving goals and plan through the inspecting, examining, diagnosing and evaluating of the enterprise energy management level, energy consumption situation, energy consumption index, financial process, comprehensive utilization of energy. The ultimate aim of energy audit is to encourage enterprises to save energy, reduce production costs and increase economic benefit.

III. ENERGY CONSERVATION ACT 2001

Energy Conservation Act 2001 has been enacted by the Parliament in October 2001.

- This Act provides a legal frame work for an efficient use of energy and its conservation.
- The Act extends to the whole of India except the state of Jammu and Kashmir.
- As per provisions of the Act, the Bureau of Energy Efficiency (BEE) came into force from March 2002 onwards.
- The Act specifies a class of users of energy as designated consumer for the purposes of the legislation.

It provides power to Central Government to:

- Direct any designated consumer to get energy audit conducted by an accredited / certified energy auditor.
- Direct designated consumer has to appoint an energy Manager, the in charge of activities for energy conservation.
- Prescribe minimum qualifications for appointment of energy managers.

IV. AUDITING PROCEDJURE

Energy audit consists with several tasks which can be carried out depending on the type of the audit and the size and the function of the audited facility:

- Establish energy consumption in the organization
- Estimate the scope for saving
- Identify immediate (especially no-/low-cost) improvements/ savings
- Set a 'reference point'

- Identify areas for more detailed study/measurement
- Preliminary energy audit uses existing, or easily obtained data

V. BASIC COMPONENTS OF AN ENERGY AUDIT

To obtain the best information for a successful energy cost control program, the auditor must make some measurements during the audit visit. The amount of equipment needed depends on the type of energy-consuming equipment used at the facility.

Tape Measures

The most basic measuring device needed is the tape measure. A 25-foot tape measure l" wide and a 100- foot tape measure are used to check the dimensions of walls, ceilings, windows, etc.

Light meter

One simple and useful instrument is the light meter which is used to measure illumination levels in facilities. A light meter that reads in foot candles allows direct analysis of lighting systems and comparison with recommended light levels specified by the Illuminating Engineering Society.

Thermometers

Several thermometers are generally needed to measure temperatures in offices and other worker areas, and to measure the temperature of operating equipment. Knowing process temperatures allows the auditor to determine process equipment efficiencies, and also to identify waste heat sources for potential heat recovery programs.

Voltmeter

An inexpensive voltmeter is useful for determining operating voltages on electrical equipment and especially useful when the nameplate has worn off of a piece of equipment or is otherwise unreadable or missing.

Wattmeter/Power Factor Meter

A portable hand-held wattmeter and power factor meter is very handy for determining the power consumption and power factor of individual motors and other inductive devices.

Combustion Analyzer

Combustion analyzers are portable devices capable of estimating the combustion efficiency of furnaces, boilers, or other fossil fuel burning machines.

Safety Equipment

The use of safety equipment is a vital precaution for any energy auditor. A good pair of safety glasses is an absolute necessity for almost any audit visit. Hearing protectors may also be required on audit visits to noisy plants or areas with high horsepower motors driving fans and pumps. Electrical insulated gloves should be used if electrical measurements will be taken, and asbestos gloves should be used for working around boilers and heaters. Breathing masks may also be needed when hazardous fumes are present from processes or materials used.

VI. ENERGY MANAGEMENT CERTIFICATION

The purpose of this International Standard is to enable organizations to establish the systems and processes necessary to improve energy performance, including energy efficiency, use, and consumption. Implementation of this standard is intended to lead to reductions in greenhouse gas emissions, energy cost, and other related environmental impacts, through systematic management of energy. This International Standard is applicable to all types and sizes of organizations irrespective of geographical, cultural or social conditions. Successful implementation depends on commitment from all levels and functions of the organization, and especially from top management.

This International Standard specifies requirements of an energy management system (EnMS) for an organization to develop and implement an energy policy, establish objectives, targets, and action plans, which take into account legal requirements and information related to significant energy use. An EnMS enables an organization to achieve its policy commitments, take action as needed to improve its energy performance and demonstrate the conformity of the system to the requirements of this International Standard. Application of this International Standard can be tailored to fit the requirements of an organization — including the complexity of the system, degree of documentation, and resources — and applies to the activities under the control of the organization.

This International Standard is based on the Plan-Do-Check-Act continual improvement framework and incorporates energy management into everyday organizational practices.

ISO 50001:2011, *Energy management systems – Requirements with guidance for use*, is a voluntary International Standard developed by ISO (International Organization for Standardization).

ISO 50001 gives organizations the requirements for energy management systems (EnMS).

ISO 50001 provides benefits for organizations large and small, in both public and private sectors, in manufacturing and services, in all regions of the world.

ISO 50001 will establish a framework for industrial plants; commercial, institutional, and governmental facilities; and entire organizations to manage energy. Targeting broad applicability across national economic sectors, it is estimated that the standard could influence up to 60 % of the world's energy use.

The standard is intended to accomplish the following:

- Assist organizations in making better use of their existing energy consuming assets.
- Create transparency and facilitate communication on the management of energy resources.
- Promote energy management best practices and reinforce good energy management behaviors.
- Assist facilities in evaluating and prioritizing the implementation of new energy-efficient technologies.
- Provide a framework for promoting energy efficiency throughout the supply chain.
- Facilitate energy management improvements for greenhouse gas emission reduction projects.
- Allow integration with other organizational management systems such as environmental, and health and safety.

ISO 50001 provides a framework of requirements enabling organizations to:

- Develop a policy for more efficient use of energy
- Fix targets and objectives to meet the policy
- Use data to better understand and make decisions concerning energy use and consumption
- Measure the results
- Review the effectiveness of the policy
- Continually improve energy management.

VII. ENERGY PERFORMANCE ASSESSMENT

Energy Performance Assessment of various equipment connected used in electrical utility are now done. By this assessment it will be find out that how can we save energy in various equipment.

A) Energy Performance Assessment Of Boilers:-

Performance of the boiler, like efficiency and evaporation ratio reduces with time, due to poor combustion, heat transfer fouling and poor operation and maintenance. Deterioration of fuel quality and water quality also leads to poor performance of boiler. Efficiency testing helps us to find out how far the boiler efficiency drifts away from the best efficiency. Any observed abnormal deviations could therefore be investigated to pinpoint the problem area for necessary corrective action.

IS 8753: Indian Standard for Boiler Efficiency Testing Most standards for computation of boiler efficiency, including IS 8753 and BS845 are designed for spot measurement of boiler efficiency. Invariably, all these standards do not include blow down as a loss in the efficiency determination process.

Basically Boiler efficiency can be tested by the following methods:

1) The Direct Method: Where the energy gain of the working fluid (water and steam) is compared with the energy content of the boiler fuel.

2) The Indirect Method: Where the efficiency is the difference between the losses and the energy input.

The various factors affecting the boiler performance are listed below:

- Periodical cleaning of boilers
- Periodical soot blowing
- Proper water treatment programme and blow down control
- Draft control
- Excess air control
- Percentage loading of boiler
- Steam generation pressure and temperature
- Boiler insulation
- Quality of fuel

All these factors individually/combined, contribute to the performance of the boiler and reflected either in boiler efficiency or evaporation ratio. Based on the results obtained from the testing further improvements have to be carried out for maximizing the performance. The test can be repeated after modification or rectification of the problems and compared with standard norms. Energy auditor should carry out this test as a routine manner once in six months and report to the management for necessary action.

B) Energy Performance Assessment of Motors and Variable Speed Drives:-

The two parameters of importance in a motor are efficiency and power factor. The efficiencies of induction motors remain almost constant between 50% to 100% loading. With motors designed to perform this function efficiently; the opportunity for savings with motors rests primarily in their selection and use. When a motor has a higher rating than that required by the equipment, motor operates at part load. In this state, the efficiency of the motor is reduced.

Replacement of under loaded motors with smaller motors will allow a fully loaded smaller motor to operate at a higher efficiency. Information needed to Evaluate Energy Savings for Variable Speed Application is

i) Method of flow control to which adjustable speed is compared:

- Output throttling (pump) or dampers (fan).
- Recirculation (pump) or unrestrained flow (fan) .
- Adjustable-speed coupling (eddy current coupling) .
- Inlet guide vanes or inlet dampers (fan only).
- Two-speed motor.

ii) Pump or fan data:

- Head vs flow curve for every different type of liquid (pump) or gas (fan) that is handled.
- Pump efficiency curves.

iii) Process information:

- specific gravity (for pumps) or specific density of products (for fans).
- System resistance head/flow curve.
- Equipment duty cycle, i.e. flow levels and time duration.

iv) Efficiency information on all relevant electrical system apparatus:

- Motors, constant and variable speed.
- Variable speed drives.
- Gears.
- Transformers.

C) Waste minimization and resource conservation:-

Traditionally, waste is viewed as an unnecessary element arising from the activities of any industry. In reality, waste is a misplaced resource, existing at a wrong place at a wrong time. Waste is also the inefficient use of utilities such as electricity, water, and fuel, which are often considered unavoidable overheads. The costs of these wastes are generally underestimated by managers. It is important to realize that the cost of waste is not only the cost of waste disposal, but also other costs such as:

- Disposal cost
- Inefficient energy use cost
- Purchase cost of wasted raw material
- Production cost for the waste material
- Management time spent on waste material
- Lost revenue for what could have been a product instead of waste

- Potential liabilities due to waste. Waste minimization can be defined as "systematically reducing waste at source". It means:
- Prevention and/or reduction of waste generated
- Efficient use of raw materials and packaging
- Efficient use of fuel, electricity and water
- Improving the quality of waste generated to facilitate recycling and/or reduce hazard
- Encouraging re-use, recycling and recovery.

Waste minimization is also known by other terms such as waste reduction, pollution prevention, source reduction and cleaner technology. It makes use of managerial and/or technical interventions to make industrial operations inherently pollution free.

It should be also clearly understood that waste minimization, however attractive, is not a panacea for all environmental problems and may have to be supported by conventional treatment/disposal solutions.

CONCLUSION

Energy audit can help to excavate the maximal energy-saving potential in production and management process, give proposals on energy-saving management and energy-saving technical renovation, promote the progress of management and energy saving technology, and ensure the rapid and healthy development yet developed far enough to be as effective as it needs to be. It will be great once it advances a bit farther, but for the time being, it is not effective enough beyond people who want one in their home to reduce their electricity bills.

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