Energy Management for Motor Driven Systems

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Chapter 1

Energy Management for Motor-Driven Systems

Introduction

This energy management course is designed to assist the industrial facility engineer to reduce energy costs through:

- Identifying and analyzing motor driven system energy conservation opportunities,
- Troubleshooting and tuning the in-plant electrical distribution system,
- Correcting for power factor,
- Understanding utility billing statements, and
- Establishing a preventative and predictive maintenance program.

Why should industrial plant staff work to save energy? One answer is money.[1-1] Ever-increasing utility costs reduce profits, erode capital and maintenance budgets, increase product costs, and reduce competitiveness.

A common misconception within industry has been to equate an energy reduction or conservation program with the concept of turning off equipment and shutting down processes. Instead, the program of energy management challenges plant staff to produce the products or services with the absolute minimum energy consumption.[1-2] The objective is to minimize energy usage through production efficiency gains, while procuring the lowest cost and most reliable supplies of fuel and power.[1-3]

In addition to reduced energy costs and potentially increased profits, industries that take advantage of energy efficiency opportunities often gains additional benefits such as:[1-4]

- More productive state-of-the- art-technology that improves a facility's competitive edge and improves global competitiveness;
- Improved environmental performance and compliance with environmental and pollution abatement regulations; and
- An enhanced public image as an environmentally friendly or "green" company.

Energy management is not a one-person responsibility or a one-time investment in conservation measures. Energy management is an ongoing effort marked by gradual improvements in energy-efficiency.[1-2] A successful energy management process is marked by:

- Maximizing production efficiency,
- Minimizing energy consumption,
- Maintaining a high energy load factor,
- Correcting for low power factor, and
- Acquiring and using economical supplies of energy.

Energy management does not just happen. Effective energy management occurs when the idea and practices associated with energy management become part of the "corporate culture."

A rule-of-thumb is one person-year for each $1 million of annual energy expenditures. As progress is made, the commitment can be reduced to one person-year for every $2 - $5 million spent annually.

Elements of a Successful Energy Management Program

Energy-management consists of a well- structured team effort to create energy awareness: collect and organize energy cost and consumption data; identify, analyze and implement energy conservation opportunities; and monitor results. The program must be accomplished without placing an undue burden on plant maintenance or engineering staff.[1-2]

Ten "Key Elements" that are crucial to success of an energy management program are:

1. Secure Top Management Commitment

Top management must be committed to a motor-driven systems energy conservation program.[1-6] To a substantial degree, management's attitude toward energy conservation will determine the success of the energy plan.[1-1] Management must be willing to provide both personnel and financial resources.

Employees will apply their best efforts to an energy conservation program only if their management displays awareness of the program's importance.[1-6]

2. Appoint an Energy Coordinator

A plant energy coordinator should be appointed to guide energy management efforts.[1-2] The energy coordinator should have an energy back- ground with energy management being a primary duty.[1-7]

The energy coordinator can be likened to a coach: mobilizing resources, providing sound advice, motivating others, and providing support.[1-1] The coordinator should be responsible for energy management activities such as:[1-2]

- Making energy management an integral part of every department.
- Providing operators, foremen, and maintenance staff with tools they need to be part of an energy management team.
- Analyzing trends in energy use and efficiency and identifying areas of concern.
- Informing plant management of roadblocks to energy use reduction while suggesting ways to remove them.
- Stimulating interest in the installation of energy saving measures.
- Assisting in the development of energy use standards.
- Reviewing plans for plant expansions, process modifications, and equipment purchases to ensure that energy is used efficiently.
- Directing the activities of outside consultants, and
- Preparing monthly or bi-monthly facility energy efficiency reports so that management can be continuously updated on motor-driven system improvements, energy savings, and cost reductions.

3. Obtain Employee Cooperation

The cooperation of operations and maintenance staff is vital to the success of any energy management effort.[1-2] In most cases, the effectiveness of an energy improvement program is proportional to the effort and time the energy coordinator and department representatives are allowed to spend on it.[1-6] Recognize and support internal "idea champions". An idea champion is the prime mover: the person with the vision, desire, and persistence to promote a conservation project or approach and to see it through to completion.[1-1]

An energy committee should be established, with representatives from each department expected to make recommendations and conduct investigations. Participants in an energy committee help create that "critical mass' that is crucial for success. A sense of "ownership" develops commitment.[1-1] A typical energy management team organizational chart is depicted in Figure 1-1.[1-6]

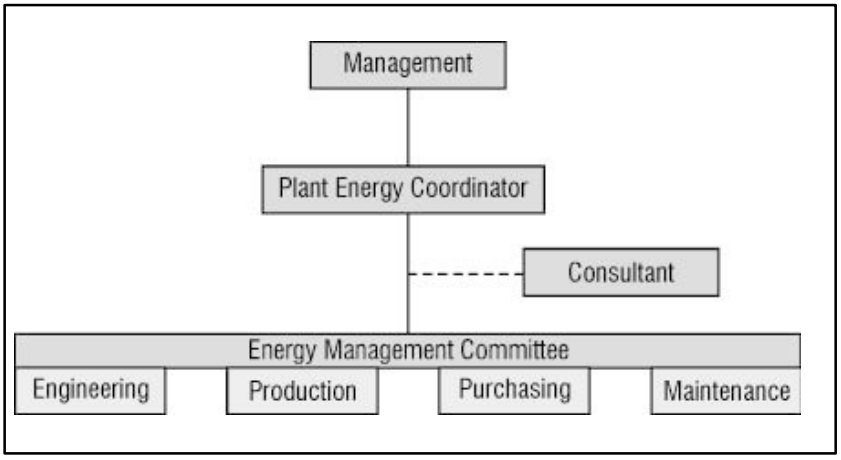
4. Conduct Energy Surveys

An initial plant energy survey shows where and how energy is being used and/or wasted.[1-6] An inventory of energy-using equipment should be prepared, showing basic energy use data (usually obtained from equipment nameplates) and indicating typical running time and operating profiles. Without basic audit information, it is impossible to tell whether equipment is operating unnecessarily or waste- fully. The basic survey information is also needed to set standards, and to measure the performance of an individual piece of equipment, a processing line, or a department.[1-6]

Survey information also assists the energy coordinator to "target" and focus efforts on the most energy-intensive equipment in a facility. Potential conservation savings are greatest where losses are the largest. Auditors should concentrate on motor-driven systems where:[1-8]

- The motor running time exceeds 1,000 hours per year;

Figure 1-1 Typical Energy Management Team Organization Chart



- Applications require larger horsepower motors. Typically, motors above 20 hp represent only 20 percent of the overall motor population yet consume 60 percent of motor driven equipment energy.
- Loads are nearly constant and operation is at or near the full-load point for the majority of the time.
- Energy and power or demand charges are high. In some locations, energy rates are as high as $.12/ kWh. With higher electrical rates, expenditures for conservation measures yield a much more rapid payback on investment.
- Utility rebate or demand management program incentives exist.

The initial physical plant survey should be conducted department by department. It should document wasteful operations and identify obvious sources of losses that can be corrected immediately. The survey will also reveal where energy and/or process flow metering should be installed. (One rule of thumb states that in- plant metering is economically justified when the annual cost of energy exceeds five times the cost of the meter.)[1-6]

One survey approach is to:[1-2]

- Determine the energy consumption rates and costs for major equipment in each department.
- Ask the department-level energy committee members to determine how long equipment operates and how long it is in service without performing a useful task.
- Determine the cost of energy wasted.
- Request that department-level energy committee members develop procedures to reduce waste or to identify barriers or equipment limitations that prevent waste reduction.

5. Organize Energy Data

To convince plant management of the value of motor systems management, you must make them aware of energy's impact on operations. High-energy costs may not be perceived as a concern until energy costs can be compared with other costs at the facility level.[1-1] In order for energy conservation opportunities to compete for resources, top level managers must understand the scope of the problem.

The logical place to begin gathering information on energy use is with utility bills. Obtain a copy of your rate schedule from your electric utility and determine whether alternative schedules are available for your facility. Obtain electrical energy consumption and cost data for at least a one-year period in order to establish a base period.[1-5] Check whether patterns exist in the use and cost of energy. Is the amount of money spent for energy higher during certain portions of the year? It is helpful to graph energy use and costs using an energy accounting or spreadsheet program.

Chapter 2 shows you how to interpret your utility's rate schedule and use billing data

Purchase this course to see the remainder of the technical materials.