ENERGY MATTERS

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Issue Focus: Reliability-Centered Maintenance

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M.J. Soffe Company Improves Manufacturing Efficiency with Help from North Carolina State University

M. J. Soffe Company—a Fayetteville, North Carolina, based clothing manufacturer—uses a constant supply of hot water to dye, set, and wash its product. But as Soffe's business grew, production increased the need for hot water faster than the 25,000-gallon tank could provide. Dye workers often depleted hot water reserves and were forced to halt production while fresh water was heated in the dye with steam. Not only did the lack of hot water lead to decreased productivity, it also caused problematic issues with material dyes in the fabric.

In 1997, Soffe's Manager of Maintenance Adrian O'Quinn attended energy efficiency workshops hosted by North Carolina (NC) State University's Industrial Extension Service–an OIT Allied Partner. Eager to enhance both manufacturing efficiency and energy utililzation at Soffe, O'Quinn met with NC State University's Energy Programs Director James Parker. Together, they developed solutions that not only are saving Soffe Company money but have led to a significant increase in productivity.

Specialist engineers from NC State examined the Soffe Fayetteville plant's heating, ventilation, and air conditioning systems, chiller and cooling towers, steam traps, and boilers. They noted several areas for improvement, including increasing the efficiency of the air conditioning system, modifying lighting in the company warehouse, and improving air compressor efficiency. The two most obvious energy drains in Soffe's manufacturing process were water heating and steam leaks.

NC State helped O'Quinn and Soffe develop a wastewater heat recovery system using heat from used dye water that the company returned to the sewer system. Wastewater is held in one 25,000-gallon storage tank. As another storage tank is filled with water from the city water system, it passes through a system that runs both cool water and wastewater through a heat exchanger. The heat from the wastewater warmed the fresh water to roughly 120°F—just 20°F below the ideal temperature for dyeing cotton.

Wastewater storage tank (left in photo), warm water storage tank (center), original hot water storage tank (right), with equipment and wastewater sump in foreground.

Steam leaks also remained a problem. The leakages caused steam to escape to the workplace air, heating the buildings and taxing both the workers and the company's air conditioning system, and caused Soffe to run steam inefficiently at high pressure. NC State engineers helped identify the leaks, and O'Quinn's team repaired them and installed a steam trap and condensate return system that keeps leaking steam and moisture in the system.

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COMMENTS?

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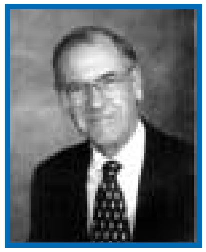
Guest Column

RCM—Gateway to a World Class Maintenance Program

By Anthony M. (Mac) Smith



Over the past 20 years, I have spoken with hundreds of maintenance managers, supervisors, and technicians from Fortune 500 companies, government facilities, international organizations, and others, about their maintenance strategies, costs, and problems. Recurring themes always include one of the following:

1. My preventive maintenance (PM) program just grew over the years; I have no credible reason for it except that "we have done it for 15-20 years, so it must be OK." I know it isn't, but don't know what to do for improvement.
2. Our maintenance program is almost 100% reactive, but I have neither the time nor the smarts to do anything about it. (Incidentally, reactive maintenance is the most expensive option to use.)
3. Downtime and loss of output is eating my lunch, and I don't know what to do. (As you might guess, #1 or #2 causes #3.)

Another recurring theme is the focus on keeping *all* plant equipment 100% serviceable—i.e., up and running or always ready if needed. I call this philosophy *"Preserving Equipment,"* and it is often the principal strategy behind most non-RCM PM programs. At first blush, preserve equipment seems logical. But upon closer scrutiny, it fosters unnecessary problems, such as promoting a tendency to treat all equipment as being equally important and creating conservative or premature maintenance actions. Many times, current PM tasks are *intrusive actions* and can lead to errors and rework as often as 50% of the time!

If you can relate—read on.

What is RCM?

Historically, the preserve equipment strategy was practiced religiously by commercial aviation until the dawn of the first jumbo jet—the B747-100. In the early 1960s, the FAA stipulated a 747 PM program that was to have three times as much preventive maintenance than required for the 707 (because it would carry three times as many passengers). Recognizing the economic difficulties of such a rule, United led a team under Tom Matteson, the VP-Maintenance Planning for United, to reevaluate the concept of PM and determine the correct strategy to achieve both safety and economics of operation with commercial aircraft. The result, successfully employed on the 747 and all subsequent modern day jet aircraft, was what we today know as *Reliability-Centered Maintenance or RCM.*

The key was to abandon the preserve equipment philosophy for a *preserve function* philosophy. The premise is that a system and plant have certain roles or functions to perform, and the job for maintenance is to keep those functions available on demand—or preserve function. Under this philosophy, equipment is the means to the end (not the end in itself), and we can view equipment in a very different light. For example, is all equipment equally important, is it less costly to deliberately run some equipment to failure before we act, is it necessary to maintain an item just because we have access to it, etc.? In other words, *RCM is a decision process* that determines *what* is important and *why,* and only then to define what PM is appropriate.

There are four basic features that define and characterize the RCM process:

1. Preserve system function.
2. Define functional failures and component failure modes that can defeat required functions.
3. Prioritize the importance of failure modes.
4. Select Applicable and Effective PM tasks for the high priority failure modes. Applicable PM tasks will prevent, mitigate, detect onset of (e.g., predictive maintenance or PdM) or discover (when hidden) equipment failure modes. Effective PM tasks are the least costly among competing Applicable PM tasks.

Notice that equipment maintenance, per se, doesn't occur until feature #4. The first three features focus on where our maintenance actions will do the most good and produce the best possible ROI. Also notice that Applicable PM tasks try to emphasize the use of nonintrusive (PdM) actions, and also recognize the need to identify failure modes that are hidden from the operators so that some form of failure-finding PM task can be considered.

Implementing RCM

A 7-Step System Analysis process is used to implement the four RCM features:

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Step 1. System Selection & Information Collection

Large plants and facilities typically have "bad actor" systems that follow an 80-20 rule (80% of the maintenance costs and production losses derive from 20% of the systems). We identify these 80-20 systems for application of the RCM process because they have the highest potential for improvement and a large ROI.

Step 2. System Boundary Definition

Here we specifically define the physical boundary of a selected system so that we can later precisely identify what moves back and forth across the boundary.

Step 3. System Description and Functional Block Diagram

Complex systems are usually divided into two or three functional subsystems. Descriptions and component equipment lists are developed for each subsystem, and a functional block diagram is constructed to show all interfaces (in and out) that occur between subsystems. Out interfaces are the key data because they pinpoint the subsystem functions of interest.

Step 4. System Functions and Functional Failures

Step 2 and 3 data are used to precisely define subsystem functions (what it does) and functional failures (how that can be lost).

Step 5. Failure Mode & Effects Analysis

Functional failures and components for each subsystem are arrayed in a matrix to reveal intersections where a potential component failure could produce the functional failure. This matrix becomes a roadmap to perform a Failure Mode and Effects Analysis at each critical intersection.

Step 6. Logic (Decision) Tree Analysis (LTA)

Each failure mode from Step 5 that might produce a system or plant-level problem is put through the LTA. Using three simple yes/no gates, each failure mode is categorized as safety (CAT A), outage (CAT B) or minor (CAT C); each is also designated as hidden (CAT D) if the operator would be initially unaware of its occurrence. This segregation allows us to focus on CAT A and CAT B failure modes for PM actions, and to consider CAT C for a run-to-failure (RTF) decision.

Step 7. Task Selection

We now focus on defining an applicable and effective PM task for the CAT A and CAT B failure modes. We also perform a further sanity check on the CAT C failure modes before a final RTF decision. Finally, we compare our RCM-based PM tasks with the current PM program in place.

This 7-Step Systems Analysis process, known as the Classical RCM process (see Reference 1 for more detail), should be used with an 80-20 system where the potential ROI is huge. In the less important systems (20-80 systems), an Abbreviated Classical RCM process may be used, if in fact anything more than a common sense review of problem history is warranted. The Classical RCM process is best done by a team composed of craft personnel from operations and the maintenance electrical/mechanical technicians. A facilitator skilled in the RCM process is necessary to ensure that each step is properly performed. A software program is available to support an RCM team in efficiently and easily documenting the results of the Systems Analysis (see Reference 2).

PM Task Types:

Time Directed (TD)*—done at specified intervals, usually intrusive actions.*

Condition Directed (CD)*—measures health non-intrusively and acts only when deterioration is critical.*

Failure Finding (FF)*—non-intrusive test/inspection to verify equipment operability, triggers action only if failed state is discovered.*

Run To Failure (RTF)*—deliberate decision to do nothing until failure occurs.*

Typical Results and Benefits

During the past 20 years, many organizations have conducted RCM programs, most with the assistance of consultants such as myself. I have participated in over 50 RCM projects with clients, such as Electric Power Research Institute, GPU Nuclear, Florida Power & Light, TVA, MidAmerican Energy, Niagara Mohawk, Armstrong World Industries, NASA-Ames Research Center and Stennis Space Center, USAF-Arnold Engineering Center and Cape Canaveral Air Station, General Electric, Westinghouse, Mobil Oil, Shell, and Boeing Commercial Airplane. Let me briefly share some results from these projects:

- Current PM tasks are mostly either TD (see sidebar) or nonexistent. There is virtually no content of CD, FF and deliberate RTF actions.
- In comparison, RCM-based PM tasks result in a significant introduction of CD and FF tasks. For example, in the NASA-Ames project, 27 such tasks were introduced where only 5 existed in the current program.
- RCM focuses on PM for critical failure modes, and eliminates PM where there is no added value. For example, in the TVA project, 11 critical failure modes were "discovered," and 20 conventional PM tasks were eliminated when no critical failure mode could be identified.
- RCM usually results in a 40% to 80% change in the existing PM program. For example, Boeing has seen changes on the order of 70% over ten different RCM projects.

When implemented, these dramatic changes in PM task content produce these results:

- reduction in trouble calls (unexpected failures) of 30% to 50%.
- reduction in system downtime of 30% to 70%.

In addition, the accumulation of non-maintenance recommendations (design, operations, safety, logistics) have led to annual savings of $1 to $10 million per system. In other words, the benefits can be BIG when RCM is properly employed.

The RCM process, as a decision tool, is universally applicable to virtually any plant, system or equipment. This has been clearly demonstrated over the past 2 decades.

I hope this brief discussion has sparked your interest in RCM and clarified just what is meant by the RCM process.

References

1. A. M. Smith, Reliability-Centered Maintenance, McGraw Hill Publishing Co., Inc. 1993, ISBN 0-07-059046-X.
2. "Software Cuts RCM Costs". Maintenance Technology Magazine, Dec. 1999, pgs. 42-44.

Mac Smith has 46 years of engineering experience in design, test, reliability, operations and maintenance. His career includes 24 years with GE in aerospace, jet engines and nuclear power. He has specialized in RCM consulting for the past 20 years. For questions or comments on this article, contact Mac at (408) 532-7126 or email to amsassoc@aol.com.

Predictive Maintenance in the New Millennium

To achieve and sustain world-class performance, plants need to make major changes–cultural, structural and operational.

By Keith Mobley

This article is excerpted from an article that originally appeared in Plant Services Magazine, *July 1999 issue. Reprinted with permission from* Plant Services.

Last July (1998), *Plant Services* conducted a survey to determine the status of predictive maintenance. The results clearly indicated that less than 3% of the respondents achieved a measurable return on investment. Almost all of the 500 companies interviewed expressed concern about this failure, but few had concrete reasons for the program's failure to achieve expected results.

This year, we attempted to confirm the results of last year's survey and to determine how these critical technologies will be used as we enter the new millennium. We convened a focus group comprising a cross-section of industries to gain insight into these issues. The results—few companies are fully utilizing the capabilities that predictive maintenance technologies offer.

Predictive maintenance was defined as the three or four technologies (i.e., vibration monitoring, thermography, tribology, and ultrasonics) that provide the means to improve plant reliability. Furthermore, it is assumed that these technologies, without the inclusion of any other tools, provide this ability.

There are a growing number of your peers that have begun to question this belief, that these traditional technologies—by themselves—are the panacea or the answer to equipment reliability problems. In my opinion, predictive technologies are powerful tools, but they are not enough by themselves. Traditional technologies must be combined with other measurable variables that completely define a critical system's operating condition.

Over the past 3 or 4 years, a few vendors have developed microprocessor technology that can be incorporated into their products. These so-called "smart devices" provide the ability to add direct process input to traditional predictive tools. While these advances are not all-inclusive, their addition to the arena of predictive maintenance is viewed as a positive step. One objective of the focus group was to determine if these new devices are or will be used by industry.

Reality Check

While the participants in the focus group agreed that predictive maintenance is a critical part of a total plant, continuous improvement program, the majority responded that their current program did not meet these criteria. With few exceptions, predictive maintenance continues to be a maintenance-only program in these plants.

The universal reason for program failure was plant or corporate culture. The participants repeatedly expressed their frustration with a culture that precluded proper use of predictive technology and effective performance of the maintenance function.

All agreed that equipment reliability is a prerequisite for acceptable plant performance, but they disagreed on who or which functional groups in the plant control reliability.

The majority of the participants continue to apply predictive maintenance in the traditional, simplistic manner of those surveyed in our 1998 study. The primary diagnostic method continues to be long-term trends of vibration, infrared or lube oil data without any attempt to normalize data for process-driven changes.

Where are We Going?

The greatest surprise from the focus group is that none of the participants plan to change their current methodology in the new millennium. The majority clearly stated that improvement is not possible within the restrictions imposed by the management culture in their plants.

Part of this focus group's mission was to determine if or how predictive maintenance will change as we enter the new millennium. Specifically, we were interested in the impact of the addition of microprocessor technology into control devices, such as valves, actuators, and electric motors.

As the primary proponent of predictive maintenance as a plant optimization tool, I view these new technologies as major technology advances. One restriction of our operating dynamics analysis methodology has been the inability to cost-effectively acquire process variables and other measurable parameters that define the operating condition of critical plant production systems. These new microprocessor technologies are at least a partial answer.

Recommendations

If you use or plan to use predictive maintenance, do it right. The outcome of the focus group clearly indicates that we must change the way predictive maintenance is used in our plants.

Culture Change

The first change that must take place is in the perception that predictive technologies are exclusively a maintenance management or breakdown prevention tool. This change must take place at the corporate level and permeate throughout the plant organization.

The use of predictive technologies should be shifted from the maintenance department to a reliability group that is charged with the responsibility, and is accountable, for plant optimization. This group must have the authority to cross functional boundaries and to implement changes that correct problems uncovered by their evaluations.

Proper Use of Predictive Technologies

System components, such as pumps, gearboxes, etc., are an integral part of the system and must operate within their design envelope before the system can meet its designed performance levels. Why then, do most predictive programs treat these components as isolated machine-trains and not as part of an integrated system? The system must be the primary focus of analysis.

When one thinks of predictive maintenance, vibration monitoring, thermography, or tribology are the normal tools that come to mind. Used individually or in combination, these three technologies cannot

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provide the diagnostics required to achieve and sustain world-class performance levels. To gain maximum benefit from predictive technologies, other changes are needed.

For example, process parameters, such as flow rates, retention time, temperatures, and others, are absolute requirements in predictive maintenance and process optimization programs. In many cases, these data are readily available.

On systems that use computer-based or programmable logic controls, the parameters or variables that define the operating envelope are automatically acquired and then used by the control logic to operate the system. In most cases, these data combined with traditional predictive technologies will provide the data an analyst needs to fully understand the system's performance.

Manually operated systems should not be ignored. While the process data is more difficult to obtain, the reliability or predictive analyst can, in most cases, acquire enough data to permit full diagnostics of the system's performance or operating condition. Analog gauges, thermocouples, strip chart recorders, and other traditional plant instrumentation can be used. If plant instrumentation includes an analog or digital output, most microprocessor-based vibration meters can be used for direct data acquisition. These instruments can directly acquire most proportional signal outputs and automate the data acquisition and management that is required for this expanded scope of predictive technology.

The vendors' role

The new smart devices that are being offered can enhance a predictive maintenance program by providing:

- The means to normalized vibration, infrared and lube oil data.
- Process variables that fully define process operation.
- The means to detect minor deviations in operating condition.

Unfortunately, vendors providing these benefits do not configure these new devices and systems. Instead, they offer them as freestanding asset management systems that do little to improve process system reliability or performance. These systems are usable in their current format, but are limited. Hopefully, vendors will recognize these needs and modify the systems to meet them.

For the full text of the article, access www.plantservices.com.

The Role of Preventive/Predictive Maintenance in the RCM Process

By John M. Machelor, Motor/ Drives Systems Specialist in support of DOE's Industries of the Future, MACRO International Inc.

RCM identifies all of an asset's major functions and possible failure of those functions; the RCM process then identifies the possible results of the most likely failure modes and whether or not those results really matter. (See Guest Column on page 2 for a detailed explanation of RCM.)

The RCM process examines options for managing/maintaining a piece of equipment (asset) by establishing and then implementing procedures for on-line condition monitoring, repair/replace decision making, and failure prevention/prediction. RCM also examines aspects of equipment not directly tied to maintenance, such as hardware/software design, operating procedures, and personnel training.

I have spent the last 10 years of my career "managing" rotating equipment, mainly electric motors and the driven loads. These items are extremely important "assets" of a company's production and related operations. The main tools of RCM used to manage/maintain motors and driven equipment are found in the maintenance department under the umbrella of Preventive/Predictive Maintenance (PM/PdM). For motors and other rotating equipment, a quality PM/PdM program in support of RCM will include:

1. Scheduled routine (preventive) maintenance.
2. Scheduled use of advanced predictive maintenance tools to "trend" equipment condition. Trending identifies whether a piece of equipment is maintaining its original good condition or deteriorating at some rate. Three useful predictive maintenance tools for rotating equipment are Vibration Analysis, Infrared Thermography, and Oil Analysis (Tribology).
3. Performing "Root Cause Failure Analysis" on all equipment failures.
4. Use of Repair/Replace Decision Making on all equipment.

What are the benefits of a quality PM/PdM program to the end user?

1. Reduced equipment downtime resulting in less disruption of production.
2. Reduced equipment repairs by both internal maintenance as well as external service shops.
3. Longer equipment life meaning less frequent need for the purchase of new equipment.
4. Increased product quality due to better maintained equipment meeting specifications more often.

All of these benefits plus intangibles, such as stress reduction in the workforce, result in the greatest rewards of all—major cost reductions and cost avoidance, which directly translate to an improved Bottom Line!

Though the emphasis here has been on rotating equipment, the use of PM/PdM to support RCM can apply to all of a company's equipment (assets).

Readers are welcome to send questions, comments, or suggestions to John Machelor by phone (540) 639-4271; fax (540) 639-4272; or e-mail: jmachelo@macroint.com or macrojmm@aol.com.

Letters to the Editor

Energy Matters welcomes your typewritten letters and e-mails. Please include your full name, address, association, and phone number, and limit comments to 200 words. Address correspondence to:

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We publish letters of interest to our readers on related technical topics, comments, or criticisms/corrections of a technical nature. Preference is given to letters relating to articles that appeared in the previous two issues. Letters may be edited for clarity, length, and style.

To the Editor: in reference to the November/December 1999 article on *Root Cause Failure Analysis on AC Induction Motors* by John Machelor.

The article states that sealed bearings are the best bearing enclosure choice. Sealed bearings add losses. A number of scientific studies have shown that losses associated with a change in bearing type can measurably degrade efficiency.

Another overlooked consideration is that sealed bearings have speed limitations. Operation above the limiting speed will result in premature bearing failure, and additional bearing friction losses.

As a motor rebuilder, we do not allow conversions to sealed bearings unless an engineering analysis indicates that it is viable. And we don't do it without the approval of the customer.

Thomas H. Bishop, Longo Electrical-Mechanical, Inc.
Wharton, NJ

While it is true that sealed bearings work well in some applications, we do not use them on any motor over 10 HP because the bearing has a limited life. That life is limited by the lubricant. In addition, sealed bearings have a lower speed rating than shielded or open bearings, thus limiting their application. We have demonstrated motor life improvements by getting rid of sealed bearings and lubricating on a routine basis. General statements that indicate that sealed bearings are the answer can be misleading, especially when you have motors in the 50-500 HP range, operating in mill and chemical-duty service.

Stan Moore, Solutia, Inc.
Decatur, AL

John Machelor wrote the Root Cause Failure Analysis on AC Induction Motors ***column and provided this response:***

Thank you for your recent "Letters to the Editor." You are correct in that I overgeneralized the case for sealed bearings. I was directing my comments (but did not state clearly) to those maintenance departments that do not have (or plan to have) a preventive maintenance program. In these situations, motors are installed, energized, and then ignored. In my preventive/predictive maintenance career, I have seen literally hundreds of open or shielded bearings fail rapidly due to the results of neglect (lack of lubricant, contamination, etc.). The sealed bearing, even given its limitations, is a far better choice than the totally ignored open bearing. I have been involved in a number of "wholesale changeout" projects in which open bearings were replaced with sealed bearings with a resulting huge increase in bearing life!

Of course, one must carefully choose the sealed bearing that meets the application specifications.

John M. Machelor
Motor/Drives Systems Specialist in support of DOE's Industries of the Future, MACRO International Inc.

Roadmap Underway to Optimize Industrial Process Heating

Process heating is one of the largest and most important uses of energy in industry. It increases the value of materials and products by improving physical properties, enabling separations and reactions, and promoting drying and curing. Optimizing process heating performance can be crucial in controlling costs and maintaining a competitive edge in existing and emerging markets.

Recognizing the importance of process heating in numerous industrial applications, the Industrial Heating Equipment Association (IHEA), with assistance from DOE's Office of Industrial Technologies, sponsored a workshop on November 18-19, 1999, in Orlando, Florida, for key representatives of the process heating community. The purpose was to develop a technology roadmap to provide a logical and comprehensive plan designed to meet customer needs now and in the future.

The 35 participating experts, representing manufacturers, end users, and researchers, worked in small groups to identify the specific needs and challenges for process heating in three temperature ranges: lower than 1250°F, between 1250°F and 1800°F, and higher than 1800°F. Each group explored R&D requirements for generation, transfer, containment, recovery, and systems integration and operation. Participants also identified immediate opportunities to improve performance and apply best management practices in order to increase the use of efficient process heating technology. The roadmap is expected to be published in early 2000.

The process heating roadmap will help identify R&D projects with both industry-specific and industry-wide benefits, ways to improve process heating performance with existing technology and management practices, and opportunities for employing industry collaborations to solve process heating challenges.

Contact Bob Gemmer, U.S. DOE, by phone at (202) 586-5885, or e-mail at bob.gemmer@ee.doe.gov for more information on the process heating roadmap.

Going International—A Motor Systems Management Tool

As international market boundaries continue to fade, the need arises to produce products that are easily adaptable in the global community. This need is evident in the motor systems industry, where motors are rated in different test standards depending on the country. But, there is a move to harmonize these standards and one collaborative project underway—an international motor systems management tool—will help further that movement.

In the 1990s, the United States created a motor systems management tool called MotorMaster+, and the European Union has a similar tool called Eurodeem, both developed to help capture the tremendous energy savings and emissions reductions from following better motor systems management practices. These tools work well in their respective areas, but are difficult to adapt for the global community due to the inherent differences in standards, units, frequency, motor models, and utility structures among the different countries. But that may soon change with development of an international version that would address these differences and be flexible enough to serve the needs of developing and developed countries.

Help is Needed

To maximize the benefits of an international motor systems management tool for the global community, the collaboration of several countries is essential. A collaborative effort will provide a cost-sharing opportunity that will not over-burden a single country, while creating a broad enough market demand to encourage substantial participation by equipment manufacturers in supplying and updating motor data. Collaborating to accomplish the common objectives will also build and strengthen relationships, enhance trade opportunities, and improve communication and information transfer.

The deliverables of this project will include:

- A common software shell that interfaces with each country's database of motors.
- A detailed interface instruction manual.
- Technical support for 4-6 months.

A proposed Steering Committee comprised of sponsors would oversee the development work and decide on the launch, look, and feel of the software tool. Sponsors would designate representatives to a Technical Committee. The Technical Committee would create project specifications, oversee the work of the software developer, and report progress to the Steering Committee.

Interested in Participating?

Participation is open to agencies, trade associations, and manufacturers in all countries. Sponsorship contributions for participation are:

- Organizations in developed countries U.S. $50,000.
- Organizations in developing countries U.S. $20,000.
- Manufacturers U.S. $10,000.

To date, commitments worth U.S. $150,000 have been received from the U.S. Department of Energy, the International Copper Association, and the United Kingdom Energy Technology Support Unit with sponsorship of the U.K. government. The goal is to collect U.S. $300,000 for this effort.

The U.S. DOE hopes this new international tool prompts the motor industry and others to develop a worldwide strategy to tap into the tremendous energy efficiency, environmental, and business opportunities that exist from upgrading outdated, inefficient systems throughout the world. Nationally, this effort will help OIT industrial partners and the U.S economy by promoting U.S. business and trade interests in the energy efficiency product and service markets.

This international software tool is just one example of how countries can work together so all may benefit from the cost savings and emissions reductions achieved through energy-efficient motor systems.

If you would like to participate, contact: Aimee McKane or Riyaz Papar, U.S. DOE's Industries of the Future, Lawrence Berkeley National Laboratory, by phone: (202) 484-0892 (Aimee) / (202) 484-0880 (Riyaz), or e-mail: atmckane@lbl.gov / rapapar@lbl.gov.

M.J. Soffe Improves Efficiency

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O'Quinn also installed an occupancy-based lighting power control system in the company's new 127,000-square-foot warehouse, a system that also uses daylighting as much as possible.

Results

Fuel costs for the water boiler through the first seven months of 1999 were down 42%, saving the company over $100,000, on target to meet the $140,000 projected annual savings. In addition, Soffe did not need to purchase a direct contact water heater (originally considered an option), saving equipment cost and energy costs.

Reduced steam pressure along with improved efficiency provided modest fuel savings—$2,600 over 1998—but the redesigned and modified condensate return system provided annual savings of $14,000. Water conservation upgrades saved $10,000 on the napping machines, despite rate increases in water and sewer service (9% and 3% respectively). Improved air compressor efficiency reduced energy and maintenance costs by almost $11,000.

The new warehouse lighting system is estimated to reduce annual power usage by 158,750 kWh, saving $12,700 annually.

With sufficient hot water available without interruption, dye process workers work more efficiently. "We've shut down quite a bit on Sundays, now," said O'Quinn. "We've increased productivity and saved on overtime." Days worked were down by 23 through the first seven months of 1999, while production per day had increased. Measured another way, the company now produces 1.8 more pounds of product per therm of gas, and a similar improvement per gallon of water used.

Another bonus came in the form of product quality. The constantly hot water produces more precise dyeing—garments washed in 140°F water do not suffer dye bleeds the way they do in 95°F water. "Our dyehouse manager has said that capacity is up 15% and quality, especially on white garments, is up by 15% as well," adds O'Quinn.

Coming Events

How to Get the Performance Out of Your Steam System

- February 15 in Milwaukee, WI, Wisconsin Electric
- February 16 in Milwaukee, WI, Wisconsin Electric
- March 7 and 8 in Wausau, WI, WPS
- March 9 in Madison, WI, Madison Gas & Electric
- March 21 in La Crosse, Northern States Power

Call Renee Abeo-Collinge at (608) 238-4601 x143 for more information.

Fundamentals of Compressed Air Systems

- April 6 in Minneapolis, MN, Northern States Power

Call Sue Streveler at (608) 238-8276 x44 for more information.

Industrial Energy Technology Conference (IETC) and Energy Managers Workshop

- April 4 Energy Managers Workshop in Houston, TX, J.W. Marriott
- April 5-6 IETC in Houston, TX, J.W. Marriott

Call Jim Eggebrecht, IETC, at (409) 845-1508 or Lana Tolleson at (409) 847-8950 for more information. Or, access the Web at www.esl.tamu.edu/ietc/.

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