"TURNING INFORMATION INTO ENERGY SOLUTIONS FOR INDUSTRY"

Energy Matters

INDUSTRIAL TECHNOLOGIES PROGRAM

Summer 2003

ISSUE FOCUS:
Motor Repair Decisions

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Five levels of motor repair.
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U.S. Department of Energy
Energy Efficiency and Renewable Energy
Bringing you a prosperous future where energy is clean abundant, reliable, and affordable

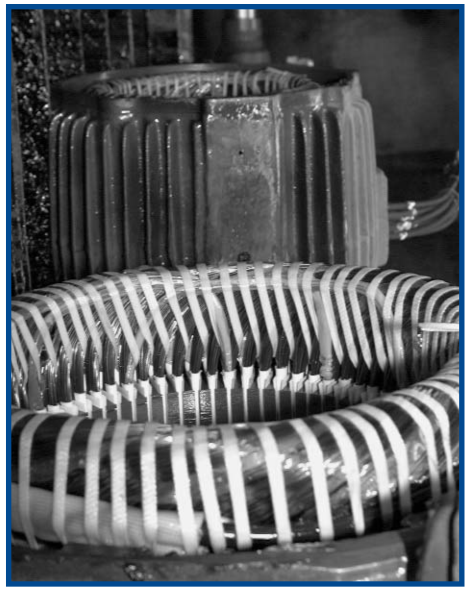
A Flowchart Approach to Motor Repair/Replace Decisions

By Thomas H. Bishop, P.E.
EASA Technical Support Specialist

Many decisions need to be made between the time a motor fails and when the final repair or replace option is chosen.

Using a flowchart like the one on page 3 helps us avoid overlooking any of the key steps in the decision process. Let's go through the flowchart and consider each decision point.

The first step in considering a failed motor is to assess whether it is actually suited for the application. This is a good question to ask regardless of whether the motor is to be repaired or replaced.



A flowchart approach can help with the motor repair/replace decision.

Repair Choices

If the motor suits the application, then the remaining decisions relate to repair choices. The first task is to determine the stator core's condition. If the condition is satisfactory, the decision process moves to assess other repair decisions. But if there is core damage, the cost to repair the damage must be weighed against the replacement cost. Keep in mind that a motor with special features may be significantly more expensive to replace and time-consuming to procure.

Following the core condition assessment, there are a series of questions that should be considered all together. These are:

- Has catastrophic failure occurred?
- Is there evidence of a prior catastrophic failure?
- Is the rotor damaged?
- Is there severe damage to other mechanical parts?
- Is it an EPAct or premium efficient motor?

If a catastrophic failure has occurred, or if there is evidence of a prior catastrophic failure, the repair cost should be weighed against the cost of a replacement. Now is a good time to consider the motor's suitability for the application. The failure may suggest application issues that were not recognized earlier, such as excessive radial load on the shaft and bearings. Catastrophic failures usually involve extreme damage to the stator core and windings, rotor, shaft, bearings, and end bracket. This damage may be so severe that the root cause is not apparent. Even so, possible causes that led to the failure should be identified to prevent a recurrence.

Rotor damage can vary from surface smearing caused by contact with the stator, to bars and end rings melted on a die cast design, or bars lifted out of the slots and endrings broken on a fabricated design. While smearing might be repaired economically, melted bars or bars lifted from their slots will, at a minimum, require rebarring. The downside is that unless the motor is very large or special, rebarring is seldom an economic alternative.

If major core iron damage has occurred, new laminations add to the repair cost. In such a case, the damage can be considered catastrophic, shifting the economics of repair versus replacement more heavily toward replacement.

Other mechanical parts, such as the shaft or frame, can be damaged so badly they

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Comments?

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For address/subscription changes, please contact the editor.

A Flowchart Approach to Motor Repair/Replace Decisions *continued from page 1*

must be replaced. Here again, the economics of buying or making a new shaft, or buying a new frame, may make repairing the motor an unattractive choice.

The EPAct/Premium Efficiency Factor

Each of these motor repair decision points has been well known for more than half a century. In the last decade, a new factor has been added: the energy-efficient motor. These consist of the energy efficient motors included in the Energy Policy Act of 1992 (EPAct), and premium efficient motors.

Regardless of the motor's label, the intent of a motor repair is to maintain the motor's original efficiency.

Energy-efficient motors have a greater volume of material than most earlier motor products. In particular, an energy-efficient motor may have a longer rotor and stator core, and more conductive material than a similarly sized motor that does not meet the definition of EPAct or of a premium motor as defined by National Electrical Manufacturers Association (NEMA).

Energy efficiency also introduces return on investment considerations to the repair-versus-replacement equation. This means considering the economic impact of all costs, including energy, and then determining which option provides the best overall benefits.

Thus, a new motor that is more energy efficient may be selected because of cost projections, based on the expected useful life of the motor or process.

Another key element in decision making is to determine whether funds are available for a replacement motor. This step often comes down to deciding which group within the company or plant is going to pay for the new motor. If the responsible group lacks funds for a replacement, it may opt for a motor repair, so long as the cost is less than that of a new motor.

But let's assume that money is available for a new motor. The next decision point is availability. Standard feature motors, such as those that fall under EPAct rules, are normally stock items. However, larger motors or motors with special features may not be widely available from local suppliers and may have long delivery times.

Decisions, decisions, decisions! To find a White Paper on "Assisting Your Customers with Repair/Replace Decisions and Performance Optimization", visit the Electrical Apparatus Service Association Web site at **www.easa.com**. EASA is an Industrial Technologies Program Allied Partner. To learn more about BestPractices related to motors, visit the Industrial Technologies Program's Web site at **www.oit.doe.gov/bestpractices/motors.**●

Five Levels of Motor Repair

Five levels of repair can be identified for squirrel cage induction motors. The first four represent an expanding scope of repairs. The fifth applies to motors that normally would be replaced, but present other factors to consider.

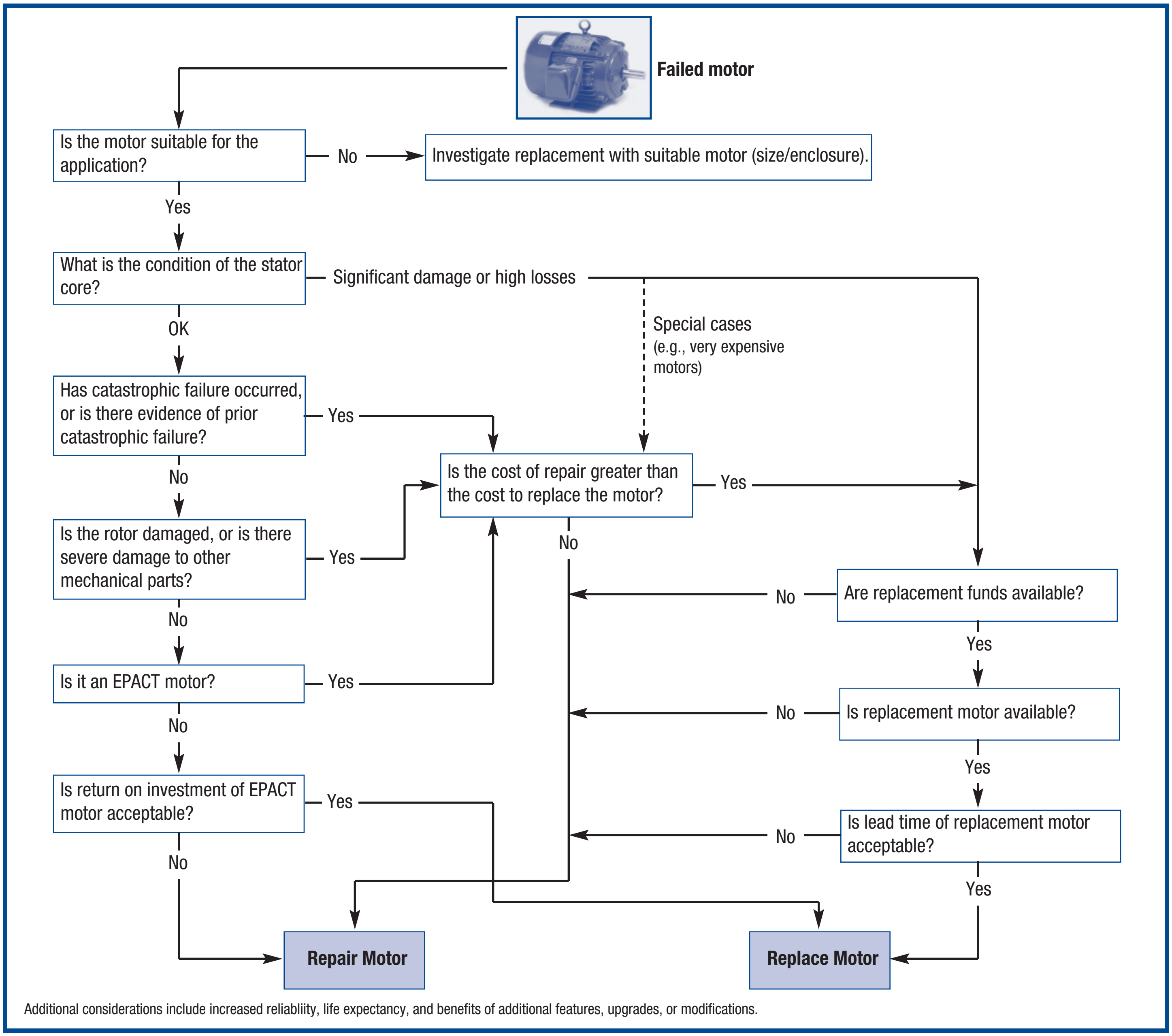
A Level 1 repair is a basic overhaul or reconditioning. It includes cleaning components, replacing bearings, and replenishing lubricants. It also includes inspection and testing during the incoming stage, the repair process, and during final testing.

Level 2 repairs include everything in Level 1, but add stator winding, varnish-resin treatment, worn bearing fit repair, and shaft straightening.

Level 3 adds stator rewinding; that is, replacing the windings and insulation system. Smaller motors with two or four poles are relatively simple to rewind. Special windings such as two-speed, or very low-speed windings, can add considerable time and material to a repair.

Level 4 is the most comprehensive repair level; it encompasses all of the previous levels, and adds major lamination repair and/or rotor rebar. It also may include restacking or replacing the stator laminations, and shaft replacement. Before taking on major repairs at this level, you may first want to consider the motor replacement option. Not only will the cost of repair be high at Level 4, but the uncertainty associated with the size of the repair compounds the risk of successfully completing the job.

Level 5 repairs apply to motors that normally would be replaced except for special circumstances, such as the unavailability of a spare or replacement unit.



Failed motor repair/replacement decisions flowchart.

Level 5 could easily apply to any of the circumstances at the other four levels of repair. This level also includes misapplied motors and vintage pre U-frame motors. This latter group generally is not rated at voltages consistent with modern power systems, and has only Class A original windings.

Remember that motor repair costs generally go up as the scope of work increases. Also keep in mind that no simple ratio exists between the factors of repairs and costs. By recognizing that there are five levels of repairs, decision makers will understand that considering only the cost of a motor repair versus replacement can be too simplistic to yield an accurate assessment.

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10 Questions to Answer Before You Call the Motor Service Center

1. *What is the basic nameplate information? (Include manufacturer, horsepower, speed, voltage, phase, enclosure, catalog, part and/or model number, frame size, and serial number.)*
2. *What does the motor operate? (A fan, blower, conveyor belt, pump?)*
3. *How does the motor drive the load? (Does it have a direct drive, or is it belted?)*
4. *Is there auxiliary equipment attached? (A clutch, gearbox, or brake?)*
5. *Why do you think the motor needs repair? (Does it smoke, not run, or need preventive maintenance?)*
6. *What is the motor's past repair history? (Is it a "problem motor"?)*
7. *How is the motor started? (Across the line, soft start, adjustable speed drive, part winding start, wye start, or delta run?)*
8. *What is the operating environment? (Indoors, outdoors, subject to hazardous fumes or dusts, or water spray?)*
9. *When do you need the motor back? Will you authorize overtime work if necessary?*
10. *Is the motor still under manufacturer's warranty?*

Source: U.S. Department of Energy, Industrial Technologies Program, "Guidelines to a Good Motor Repair", ***www.oit.doe.gov/bestpractices/pdfs/motor_repair_guide.pdf.***

Motor Training Supports Boeing Corporate Energy Efficiency Goals

Energy efficiency can be just as important during a corporate downsizing or restructuring as during a time of growth.

Take the Boeing Corporation, for example.

In early May 2003, 60 engineers and craftspeople from Boeing facilities across the Puget Sound area in Washington State attended motor-efficiency training. Two 2-day sessions cost approximately $12,600, but this investment by Boeing could pay for itself with the $35,000-a-year savings that will result from a single motor efficiency project developed from effective electric motor systems management.

One Boeing plant in Kent, Washington, a 30-building, 2 million+ square-foot facility, has undergone significant changes over the past few years. In 2002, as part of its restructuring, Boeing shut down Kent's manufacturing capability to focus on office, research, and laboratory functions at the site. With the restructuring underway, Boeing management set a goal for ongoing operations: cut energy consumption between 9% and 12% during 2003.

Striking a Chord

The restructuring and the energy reduction goal caused plant managers to renew efforts to conserve energy. Options ranged from building exit sign replacement to installing energy-efficient vending machine controls to evaluating hundreds of motors in use at Boeing operations around Puget Sound. This last option struck a chord with one engineer who works at the Kent plant.

"We cannot directly control utility rates, but if we can make a process more efficient and reliable by replacing inefficient motors, it costs less to operate," said Kenneth O'Donnell, a Lead Maintenance/Reliability Engineer and 17-year Boeing veteran.

According to DOE, motor-driven equipment accounts for 64% of the electricity consumed in the U.S. industrial sector. Within the nation's most energy-intensive industries, motor systems consume some 290 billion kilowatt-hours per year. In these industries alone, improvements to motor systems could yield dramatic energy and cost savings. One key to these savings is applying energy-efficiency equipment or implementing sound energy management practices.

Ken takes a systems approach when it comes to evaluating motors, working to

Gil McCoy of the WSC Cooperative Education–Energy Program teaches Boeing employees how to use MotorMaster+ software.

understand what happens upstream and downstream of a motor. He also considers a motor's life cycle costs. These include not just the motor purchase price, but the overall maintenance and energy costs. Ken's primary job is to ensure that systems run more efficiently and for less money. A mechanical engineer by training, he was naturally drawn toward motors and their potential for savings when Boeing's restructuring was announced.

Saving energy at Boeing has been a company focus for many years. However, the issue attracted increased attention in 2000 when a drought caused Northwest hydroelectric power production to drop, leading to electricity shortages and price spikes. For Ken, part of the answer was to raise awareness for how increased motor efficiency could achieve corporate energy saving goals.

Boeing hosted an energy management summit in 2002, which was attended by representatives from facilities throughout the Boeing enterprise including Washington, Kansas, Missouri, Pennsylvania and California. Ken was asked to provide a presentation on motor efficiency and, since the session was well received, he began to plan a broader training session for a wider, "targeted" audience.

Union Cooperation

Ken worked closely with two principal trade unions, the Society of Professional Engineering Employees in Aerospace (SPEEA) and the International Aerospace Machinists (IAM) to gain support for a 2-day seminar on electric motor systems management. The IAM/Boeing Quality Through Training Program and Ed Wells Initiative joint programs provided funding for the training, a critical factor as the restructuring all but eliminated organizational training budgets in 2003. Obtaining funds from both joint programs made it easier for managers to agree to send people, and, by combining resources, a second two-day training session was offered. This cooperative effort not only doubled the total number of students who could attend the training, but also allowed mixing of craft persons and engineers in the same class. "Having a cross-section of skills in each session was beneficial as several students brought up unique questions or shared interesting experience-based knowledge with the rest of us," said O'Donnell. "Had we had separate classes for each group, this transfer of information and networking opportunity would have been lost."

Both 2-day training sessions, held in early May, were taught by instructors from the Washington State University Cooperative Extension Energy Program. The first day included an introduction to motor basics, including motors and their power systems, different types of motors, power and load calculations, design standards and classification, and efficiency considerations. That was followed with training modules on motor system management, electrical distribution system tune-up, harmonics, maintenance and repair issues, and electronic variable speed drives.

The second day featured hands-on problem solving using computers and the MotorMaster+ motor system management software. Topics on the agenda included motor price and performance database review, energy savings analysis, organizing a motor inventory, maintenance logging, energy accounting features, customizing the software application, life cycle cost analysis, and conducting analyses for multiple motors.

More than 60 people attended the "Day 1" training sessions, including heating, ventilating and air conditioning mechanics; maintenance mechanics; plant engineers; equipment engineers; reliability engineers; electrical engineers; and representatives from local utilities including Snohomish County Public Utility District and Puget Sound Energy. Seating was limited in the computer lab for the second day's training, and, therefore, "Day 2" was available to union-represented employees only (approximately 50 people attended).

Rapid Return

Evaluating training effectiveness sometimes can be tough. But at the Boeing Electronics facility in Renton, Washington, an energy-efficiency project planned for implementation in July may well cover the $12,600 cost of the training, and then some. The project involves ductwork modifications that will allow a 20-horsepower (hp) make-up air fan and a 40-hp scrubber exhaust fan that currently run 365 days a year to be turned off. There is also the possibility of replacing a related motor and installing a variable speed drive for further, future efficiency gains. The improvement could save $35,000 a year and may be supported with a $30,000 grant from Puget Sound Energy, a utility.

As Lead Maintenance/Reliability Engineer at the Kent facility, Ken sees his job as trying to improve corporate assets and processes. "Doing things more efficiently for less money; that's what we do," he said.

Gary Boyett, Boeing Condition-Based Maintenance Technician, examines the effect of "reflected wave," a potential power quality problem that can be induced upon motors by variable speed drives.

To learn more about BestPractices resources that are specific to motor systems, visit **http://www.oit.doe.gov/bestpratices/motors/.** There, you'll find publications, software tools, and training information. Most can be downloaded from this site; others can be ordered from the OIT Clearinghouse by calling 800-862-2086.●

Energy Efficiency Tools Go to School

A variety of energy efficiency tools are making their way into engineering school curricula around the country.

Developed with the support of the DOE's Industrial Technologies Program and in partnership with industry associations, these tools are exposing students to energy efficiency best practices techniques that may influence their careers.

"Our idea was to make DOE's assessment tools the focal point of the class," said Dr. Glenn T. Cunningham, associate professor of Mechanical Engineering at Tennessee Technological University.

Glenn distributed copies of system assessment tools to each of the 22 students enrolled in his energy conversion and conservation class, then set them to work evaluating systems around the Cookeville, Tennessee, campus.

Glenn's students used MotorMaster+, the Pump System Assessment Tool, 3E Plus, the Steam System Scoping Tool, and the *Steam System Survey Guide* in their class work. Later, students formed teams and fanned out across campus to evaluate a variety of systems. One group used an infrared camera to look for degraded insulation in a steam system. Another group used a portable power meter and an ultrasonic flow meter to evaluate pumps. A third group measured voltage levels and speeds of various motors around campus. Data gathered from each effort was fed back into one of the BestPractices assessment tools.

For example, in one university building, students found a chilled water pump that was designed to run at 310 gallons per minute and 160 feet of head. The pump was actually operating at 440 gallons per minute and 133 feet of head. "It was overpumping by a large amount," Glenn said. Using the Pump System Assessment Tool, students learned that by adjusting the motor and the pump they could achieve energy savings.

Energy Efficiency's Potential

Glenn described the BestPractices assessment tools as "state-of-the-art", saying the tools offer the latest in energy efficiency assessment techniques. Students use the tools to gain hands-on experience with real systems and data. When these students graduate and go to work as mechanical engineers, they will be equipped to walk into an industrial plant and understand that it likely contains systems that can be optimized to save money and energy, Glenn said.

"I'd like the students to appreciate the potential" that energy efficiency techniques represent, he said.

(Don Casada, pump system engineer and *Energy Matters* columnist, sat in on two of Glenn's classes. To read his thoughts on the course, see the accompanying sidebar.)

Additional Academic Programs

Tennessee Tech isn't alone in teaching energy efficiency techniques using Industrial Technologies Program tools. Northampton Community College in Bethlehem, PA, plans to establish what it calls an Energy Efficiency Specialist program.

Northampton's project is intended to serve as a national model to create the curriculum for a Community College-based energy efficiency program that can be replicated at community colleges and vocational

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Energy Efficiency Tools

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schools nationwide. The diploma program is being offered in response to industry demand for short-term job training to develop energy efficiency specialists. Students enrolled in the program will gain an in-depth understanding of energy usage in a manufacturing setting. Students will also learn how energy efficient technologies are applied, how different energy assessment methodologies work, what tools are available to assess energy systems (such as the Industrial Technologies Program BestPractices tools), and what methods may be used in energy economic decision making.

In the spring of 2002, Dr. Michael Pate of Iowa State University began offering one of the first graduate level engineering courses on compressed air systems in the United States. Course development was co-funded by the Compressed Air Challenge™ (CAC) and the Iowa Energy Center. Additional technical support came from the Compressor Distributors Association and from members of the Compressed Air and Gas Institute. The first class was overenrolled and highly successful. So a second class was offered in the fall of 2002. Dr. Pate applied for and recently received a grant from DOE to develop a textbook for the course. Iowa State University and the CAC plan to continue their cooperation, including possibly developing a virtual training course for technical universities.

Back at Tennessee Tech, Glenn Cunningham believes the BestPractices tools provide students with the kinds of techniques they will need to make realistic, timely assessments in the real world. The tools are "exactly what people need in the field," he said.●

To download copies of the* MotorMaster+, Pump System Assessment Tool, 3E Plus, Steam System Scoping Tool, *and* Steam System Survey Guide *materials used at Tennessee Tech, visit the Industrial Technologies Program Web site at http://www.oit.doe.gov.

Don Casada's Take on Tennessee Tech

If you were to ask a group of practicing engineers what they consider the most generic weakness in their formal engineering training, you'd likely hear many note the shortage of real-world connections with their analytical training. So when I heard that Dr. Glenn Cunningham's senior mechanical engineering course at Tennessee Tech was using the suite of software tools distributed by the DOE's Industrial Technologies Program (available for free download at http://www.oit.doe.gov/bestpractices/software_tools.shtml) in the study of these energy-intensive systems, my first thought was that it was a really good idea.

I had two encounters with the Tennessee Tech students: 1) doing some field measurements and analysis on a chilled water pumping system at the University, and 2) watching several groups of students give presentations on their findings in the various types of systems they had reviewed. In the student presentations, they discussed issues such as dryers, operating pressure, and receiver capacity in compressed air systems, excess oxygen in stack gases from a boiler, and oversized pump impellers. The fact that these subjects were even being discussed indicated, in my mind, that the class had been successful in bridging the gap between concept and reality; that success alone convinced me that the class wasn't just a good idea – it was a great one.

Interestingly, based on my discussions, the subject that made the greatest impression with students was how the BestPractices software and classroom instruction emphasized the non-engineering measure that drives marketplace decisions—dollars. I found those comments a little odd until I thought back again to my own education, and realized that most engineering classes are so focused on technical issues that economics seldom, if ever, are involved in problem solving. Similarly, even engineering economics classes are often isolated and analytical in their own way. But the vast majority of real-world engineering problems are intertwined with economic issues; the two fields can't be isolated from one another—a reality that often isn't grasped by engineers until they begin their practice.

One student mentioned to me that the course had exposed him to a host of practical issues. But he went on to note a positive practical effect of more immediacy—he included his software tool training in his resume, a fact that was remarked upon with surprise and favor by a job interviewer. Now that is a real-world benefit.

Don Casada is with Diagnostic Solutions LLC, a Knoxville, TN-based firm.

IAC Program Uses Student Engineers to Identify Efficiency Options

Since 1976, university engineering students have helped industry assess its energy efficiency through the Industrial Assessment Center (IAC) program. The IAC program provides small- and medium-sized manufacturers with no-cost individual assessments focusing on energy efficiency, waste reduction, and productivity improvements, resulting in a report for the plant containing specific recommendations. Engineering faculty and students from 26 university IACs across the United States perform these assessments. The Industrial Technology Program sponsors the IAC program as part of its efforts to transfer energy efficient and environmentally sound practices and technologies to U.S. industry.

On average, recommended actions from an assessment result in annual cost savings of $55,000. The university-based IAC team typically conducts the assessment during a 1- or 2-day site visit. Within 60 days a report is sent to the client detailing the analyses, findings, and recommendations. In 6 to 9 months, follow-up calls are made to the plant manager to obtain implementation results. This information is added to the IAC database and thereby provides further insight for future assessment projects.

The program benefits many parties.

- Manufacturers receive unbiased technical assistance at no direct cost. This helps them become more competitive in the global marketplace as a result of implementing cost-saving measures recommended by the IAC teams.
- Universities interact with local industry to maintain a practical orientation in their engineering curriculum and to develop productive relationships.
- Faculty benefit by receiving hands-on experience in applying technical education in a working industrial environment. They often incorporate lessons learned in the field into coursework to benefit future students. Faculty members have also developed ideas for research from their studies of manufacturing processes.
- By implementing IAC team recommendations, the program generates opportunities for energy service companies, equipment manufacturers, vendors, and suppliers.
- Environmental benefits are achieved by

implementing energy-efficient technologies, reducing greenhouse gases, and reducing waste.
- University students benefit through their "real world" exposure to the techniques, processes, and problems associated with assessing plant operations, and also benefit from defining appropriate recommendations for their clients.

Students routinely participate in all aspects of the operation of the centers including working with plant personnel, getting information from vendors, working with the national program database, and a significant amount of report writing.

The students are encouraged to interact with students at other centers, sharing information and ideas. There is a special web site set up for IAC students, which includes a message board allowing the students to post questions, comments, and concerns to be addressed. Each center designates one student as their "lead student" who interfaces directly with the national program management, including a yearly meeting. A subgroup of lead students makes up the "student advisory committee" which formally feeds back ideas for improvements to the DOE.

Since its inception in 1976, more than 2,000 students have participated in the IAC program. Informal surveys have shown that a majority of these students pursue careers related to their work in the center. Currently, about 250 students are trained each year. To find out if your company is eligible to benefit from the IAC program, and/or a list of participating schools, check the IAC Web site at **www.oit.doe.gov/iac/**.

In addition to IACs, you may want to learn about plant-wide assessments, which are also offered through the Industrial Technologies Program. For more information, contact Grace Ordaz, Technology Manager, at 202-586-8350 or by e-mail at grace.ordaz @ee.doe.gov. For details about the plant-wide assessments, visit **www.oit.doe.gov/best-practices/plant_wide_assessments.shtml.**●

Five Levels

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Learn more about making informed motor repair or replace decisions by visiting the Electrical Apparatus Service Association Web site at **www.easa.com**. EASA is an Industrial Technologies Program Allied Partner. To learn more about motors and energy efficiency, and to access a link to the most current MotorMaster+ 4.0 software, visit the Industrial Technologies Program Web site at **www.oit.doe.gov/bestpractices/motors.**●

Energy Matters EXTRA

The Summer issue of Energy Matters Extra offers extra information on managing industrial motors, including links to many BestPractices motor-efficiency tools, such as software, tip sheets, case studies, and other technical publications that you can download directly to your computer. You can also access details on the Process Heating Assessment and Survey Tool (PHAST), learn about DOE-sponsored industrial energy-efficiency training sessions, and view new BestPractices publications. Learn about all these topics and more by logging on to **http://www.oit.doe.gov/bestpractices/energymatters/emextra/**●

10 Tips for Saving Natural Gas

1. Inspect and recalibrate thermocouples in furnaces to obtain more accurate zone temperature measure ments and help increase furnace efficiency.
2. Install removable insulation on uninsulated valves, pipes, and fittings to reduce losses in the process heat distribution system. (Potential energy savings of 2-5%.)
3. Inspect steam distribution systems for leaks and repair where necessary. (Potential savings of up to 5%.)
4. Regularly clean strainers upstream of steam traps to prevent particle accumulation. (Potential boiler efficiency gains of 10-15%.)
5. Measure and manage ventilation in the plant.
6. Reexamine your gas contract. Consider renegotiating terms to gain lower rates from utilities.
7. Minimize surplus combustion air by tuning damper settings on boiler draft fans, installing over-fire draft control systems, sealing doors, and so on. (Potential gain in furnace efficiency of 1% when air and oxygen content are reduced by 15% and 1.5%, respectively.)
8. Lower the water temperature in boilers. (Potential boiler efficiency gains of 1% when the stack gas temperature is decreased by 40°F.)
9. Prevent scale accumulation by ensuring water treatment systems are operating effectively. (Potential gains in boiler efficiency of 10-12%.)
10. Rework schedule of processing operations to reduce delays and reheat requirements.

Source: U.S. Department of Energy, Industrial Technologies Program, "10 Tips for Saving Natural Gas."

About the Office of Energy Efficiency and Renewable Energy

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. By investing in technology breakthroughs today, our nation can look forward to a more resilient economy and secure future.

Far-reaching technology changes will be essential to America's energy future. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a portfolio of energy technologies that will:

- Conserve energy in the residential, commercial, industrial, government, and transportation sectors
- Increase and diversify energy supply, with a focus on renewable domestic sources
- Upgrade our national energy infrastructure
- Facilitate the emergence of hydrogen technologies as a vital new "energy carrier."

The Opportunities

Biomass Program
Using domestic, plant-derived resources to meet our fuel, power, and chemical needs

Building Technologies Program
Homes, schools, and businesses that use less energy, cost less to operate, and ultimately, generate as much power as they use

Distributed Energy & Electric Reliability Program
A more reliable energy infrastructure and reduced need for new power plants

Federal Energy Management Program
Leading by example, saving energy and taxpayer dollars in federal facilities

FreedomCAR & Vehicle Technologies Program
Less dependence on foreign oil, and eventual transition to an emissions-free, petroleum-free vehicle

Geothermal Technologies Program
Tapping the earth's energy to meet our heat and power needs

Hydrogen, Fuel Cells & Infrastructure Technologies Program
Paving the way toward a hydrogen economy and net-zero carbon energy future

Industrial Technologies Program
Boosting the productivity and competitiveness of U.S. industry through improvements in energy and environmental performance

Solar Energy Technology Program
Utilizing the sun's natural energy to generate electricity and provide water and space heating

Weatherization & Intergovernmental Program
Accelerating the use of today's best energy-efficient and renewable technologies in homes, communities, and businesses

Wind & Hydropower Technologies Program
Harnessing America's abundant natural resources for clean power generation

To learn more, visit ***www.eere.energy.gov***

Coming Events

National Insulation Training Program, Philadelphia, PA

- Sep 11-12, 2003

For more information, visit *www.insulation.org/training*, or call the NIA office at (703) 683-6422 ext. 13

Insulation Energy Appraisal Program, Detroit, MI

- Sep 25-26, 2003

For more information, visit *www.insulation.org/training* or call the NIA office at (703) 683-6422 ext. 13

Fundamentals of Compressed Air Systems (Level 1), Syracuse, NY

- Oct 14, 2003

For more information, contact Elizabeth Dudley, (315) 474-4201 ext. 19

Advanced Management of Compressed Air Systems (Level 2), Syracuse, NY

- Oct 15-Oct 16, 2003

For more information, contact Elizabeth Dudley (315) 474-4201 ext. 19

Pumping System Assessment Tool (PSAT) End User Training, Macon, GA

- Oct 20, 2003

For more information, contact Roy Tiley (410) 997-7778 ext. 20

National Insulation Training Program, Houston, TX

- March 4-5, 2004

For more information, visit *www.insulation.org/training*, or call the NIA office at (703) 683-6422 ext. 13

BestPractices

The Industrial Technologies Program's BestPractices initiative and its *Energy Matters* newsletter introduce industrial end users to emerging technologies and well-proven, cost-saving opportunities in motor, steam, compressed air, and other plant-wide systems.

INFORMATION CLEARINGHOUSE

Do you have questions about using energy-efficient process and utility systems in your industrial facility? Call the Industrial Technologies Program's Information Clearinghouse for answers, Monday through Friday 9:00 a.m. to 8:00 p.m. (EST).

HOTLINE: 800-862-2086

Fax: 360-586-8303, or access our homepage at www.oit.doe.gov/clearinghouse.

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