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MRC NEWSLETTER

Maintenance & Reliability Center
The University of Tennessee
"where industry & academia meet"

Editor
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Call For Papers - MARCON 2009

May 5-7, 2009 (presentations May 6-7) Knoxville, TN

This year's Maintenance and Reliability Conference (**MARCON)** will be a forum for all – practitioners, specialists, educators, students, and managers – to exchange information on new emerging technologies as well as on tried and proven methods and techniques in the area of maintenance and reliability engineering. Cutting edge research topics, case studies of real applications and the latest thinking in the managerial/ financial aspects of the maintenance & reliability field come together in this multi-track, highly informative conference. **You are invited to provide a 300 – 500 word abstract for consideration by the Technical Review Committee for presentation at MARCON 2009.**

Why participate and present at MARCON?

- *Inspiring keynote addresses* including **Dr. Peter G. Martin, Vice President, Invensys**, who will discuss how real time business strategies are driving new horizons in the maintenance, reliability and operations of industrial assets
- *Informative papers* in multiple parallel tracks such as: Asset Management; Best Practices/Case Studies; New Technologies
- *Workshops; Reliability tutorials; special sessions; and more*
- *Speakers receive complimentary conference attendance (1 per paper)*

Submission Requirements:

- 300—500 word abstract
- Clear, descriptive title
- Author's name, e-mail address, phone & FAX number, company affiliation
- Agreement to attend and present the paper if selected
- Electronically sent to MRC by November 5, 2008

Critical Dates:

November 5, 2008	**Abstracts Due**
December 22, 2008	**Authors Notified of Selection**
April 4, 2009	**Papers & Presentation Slides Due**
May 6-7, 2009	**Presentations at MARCON**

Abstracts should be transmitted electronically to kkallstr@utk.edu. Preferential weight will be given to practitioner papers. Successful authors will be sent paper and presentation preparation guidelines when notified of selection. Final papers and presentations must be submitted electronically.

The primary goal of **MARCON 2009** is to provide information that attendees can take back and apply in their workplace. We welcome abstracts that correspond to the MRC's mission of bridging classic reliability and industrial maintenance, as well as abstracts focused on additional topics pertaining to the field of maintenance and reliability. Selected authors agree to provide an educational paper and corresponding presentation slides that are free of commercial content. These will be included on the conference proceedings CD that will be distributed to each MARCON 2009 attendee.

Inside this issue:

Director's Corner

Tom Byerley

Belt-tightening got you in a squeeze? – Find solUT**ions by leveraging with the MRC!** It's almost a certainty that our recent economic situation has resulted in you being asked to tighten your belt. There is no doubt that times are tough at most companies and it is more important than ever to optimize performance. That means reliable equipment, processes, and people in place performing at their best. It means planned, scheduled maintenance conducted by competent and trained skill-workers. It means alignment of strategic objectives from top management down through departments to the individual workers, whether blue collar or white collar.

Often, when the belt-tightening ultimatum comes down from the top, people go into the cost-cutting mode, slashing almost indiscriminately at the largest expense item (normally headcount). However, there are usually better approaches and solutions that could and should be employed. Many of the MRC companies have lived through the ups and downs of the economy and have discovered tried and true techniques to optimize their performance. And, they are willing to share their experiences and solutions with other MRC member companies in order to foster improvements and to help leverage better approaches for all MRC members.

We just had a MRC members' meeting where several of our companies did just that – made presentations about their company's best practices that could help everyone learn and leverage themselves. We will be sending out copies of the presentations to our MRC member companies, in case you did not attend. You will also find similar information in several of the articles in this newsletter. I hope you will take advantage of these opportunities to leverage and develop better sol**UT**ions for yourself and your company. If you want more information – or copies of previous presentations, do not hesitate to contact us.

On another note, the Fall semester is underway and our 27 interns have all returned to the classroom. They are now much better prepared to understand some of the practical value of their classroom work. We offer a huge THANK YOU to those of you who sponsored and mentored our 2008 interns. They truly are the future of your companies. And we encourage all our MRC companies to start planning right now to employ some MRC interns in 2009. This is one of the great benefits of MRC company membership!

Regards,

Tom

Wireless Condition Monitoring - It's all about the Dollar$!

The Business Case for Wireless Sensor Systems

By: Buddy Lee, CMRP, Windrock, Inc.

> *"Unscheduled downtime is the largest single factor eroding plant performance. Over $20 Billion, or almost 5 percent of total production, is lost each year in North America alone due to unscheduled downtime."*
>
> ~ ARC 2002

Today's hot topics of plant management discussions concern business continuity, machinery reliability, Overall Equipment Effectiveness (OEE), Reliability-Centered Maintenance (RCM), Preventative and Predictive Maintenance (PM or PdM) and a host of other acronyms relating to improving plant operations. In support of these program initiatives, companies are finding that their existing Maintenance, Repair and Operation (MRO) programs can be improved by employing wireless remote monitoring and diagnostic systems. Indeed, remote monitoring via the Internet can help companies cut production costs, improve quality, minimize downtime and increase their operational efficiency.

In fact, remote monitoring and the Internet have gained widespread use by plant condition monitoring personnel over the past few years, as evidenced by the following survey:

Results of a survey conducted by Philip Higgs, Research Student at Loughborough University, UK

Is your condition based monitoring system connected to a network for remote access?	
Yes	84 (39.81%)
No	127 (60.19%)

Can your condition based monitoring system be accessed through a company Intranet or over the Internet ?	
Yes	80 (38.10%)
No	130 (61.90%)

Just 5 years ago, these numbers were a fraction of what they are today. In addition, these numbers have room to grow over the next 5 years.

Thanks to the Internet and telecommunications networks, plant personnel can collect and analyze data from remote or offsite locations, providing the ability to monitor and protect plant assets. Cutbacks in maintenance staff and the new wave of computer literate maintenance technicians are driving the adoption of new technologies in condition monitoring. Unlike their predecessors, the new breed of maintenance technician is more likely to adopt new wireless technologies. In addition, the growing shortage of maintenance experts is creating a parallel demand for remote access to vital condition data. The new wave of maintenance technicians is demanding remote access to machinery condition information.

Constantly asked to do more with less, technicians are turning to wireless technologies to perform their jobs effectively. This "grass roots" approach underscores the acceptance of wireless technologies even while their management does not fully understand the benefits of these technologies. Indeed, there is a great degree of confusion among consumers and corporations regarding the value, applications, reliability, security, and maturity of wireless technologies.

For example, Deloitte Consulting surveyed more than 650 business executives across Europe, North America, and Asia recently. Deloitte found that 51 percent of respondents did not understand the benefits and uses of wireless technology. Twenty percent of those surveyed blamed the maturity of wireless technology, saying that companies are not confident it has been developed sufficiently. However, 75 percent of executives in the survey stated that wireless could increase revenues and productivity and 79 percent stated wireless could improve their roles.

Although wireless sensors have been around for years, they have been in an infancy stage until recently due to primitive radios and bulky, complicated sensors. Now that advanced radio frequency integrated circuits are available (less than $3 in high volumes) and smart sensor integrated circuits are becoming widespread, the wireless sensor market is poised to take off.

Within the next ten years, wireless sensors will be used in a range of applications that are only limited by our collective imagination. According to a report by emerging wireless research firm ON World, more than half a billion nodes will ship for wireless sensor applications in 2010. ON World also projects that by 2010, wireless sensors will also be widespread for consumer markets such as monitoring and controlling heating, lighting, venting and appliances. This Machine-to-Machine (M2M) market will help drive down the cost of wireless sensors for industrial plants because of the sheer size of the M2M market.

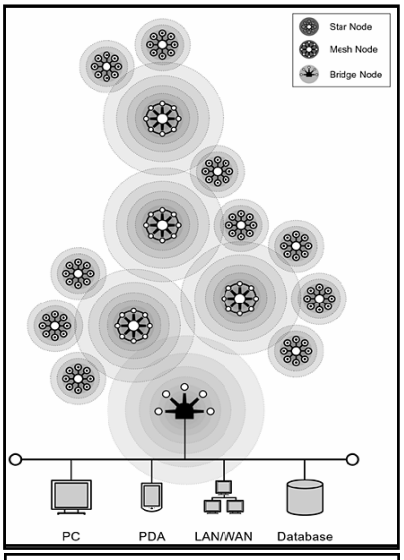
Looking specifically at Asset Management and Condition Monitoring, the worldwide market, which totaled almost $900 million in 2002, surpassed $1.3 billion at the end of 2007. It is expanding at a Cumulative Annual Growth Rate (CAGR) exceeding 7 percent, according to a study by the ARC Advisory Group.

Wireless sensor technology will greatly reduce the complexity of linking the outputs of condition monitoring sensors to current Process Control Systems. The population of equipment able to be monitored continuously will expand, and control room operators will be able to determine the current condition of the bearings or alignment or balance or gears on an individual machine.

Certain standards, such as OLEPC (Object Linking and Embedding for Process Control) are currently used for integration of Process Control Data with Condition Monitoring Data. In order to achieve greater integration, wireless systems for Condition Monitoring and Process Control must be able to interface with one another using common standard protocols.

In summary, we now have new maintenance technicians using the Internet for remote diagnostics, while at the same time the markets for condition monitoring are growing, and we have a need for standards to communicate between the plant floor and remote diagnosticians and management. Fortunately, most of the "backbone" of standards is in place with the current state of the Internet. That leaves only the so-called "last mile" for communications standards, and the IEEE (among others) is working with vendors to establish this connection.

A new architecture called mesh networking is based on low-cost, low-powered radio transmitters and combines the performance of wired networks with the economy of wireless networks. Mesh networks can carry data in short "hops" between radio powered modules embedded with networking intelligence. These hops enable mesh networks to bypass interference by finding new paths around any interference the signal encounters.

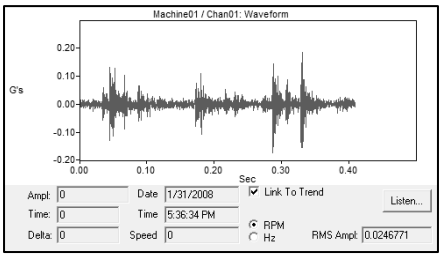


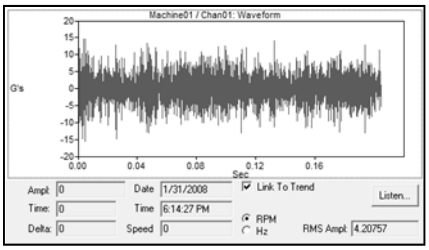
Wireless Mesh Sensor Network

Wireless Mesh Sensor Networks are being deployed today in various monitoring and control applications. Low-cost RF components, advances in low-level system integration and protocol standardization have made deploying mesh sensor networks affordable. Wireless building control systems that form multi-hop, self-configuring networks are monitoring air-quality levels and securing valuable assets in commercial buildings. In the Industrial sector, applications are being pursued in asset management, industrial safety and condition-based monitoring. Wireless mesh sensor networks resemble a canopy over industrial machines, when viewed from the top, as shown in the picture on page 4. (*Picture courtesy of Sensicast Networks, Inc.)*

Wireless System Case History – Paper Machine Suction Roll Drive Side

In January 2008 a suction roll was tested in a rebuild facility using a wireless system. The system consisted of a wireless node with six regular accelerometers wired to it, along with a power cord. The node was wirelessly connected to a laptop computer where the analysis is performed in real time. The total set up time was less than 10 minutes and in actual practice would be less than 1 minute. Data was taken at a series of roll speeds since this was an acceptance test. The wireless range is approximately 1 mile to the receiver, without using any other nodes. If other nodes had been used, the range would be extended through the mesh network capability of the nodes, effectively indefinitely.





A bad bearing was found on the drive side of the roll. When the suction roll was at slow roll, we can clearly see that impacts are the dominate energy content of these waveforms. The vibration peaks increased about 5-fold from the peaks recorded at 200 RPM to the final speed of the roll, which was considered excessive. The bearing was replaced with a new one, which was tested and accepted.

Note that the end user (paper plant, in the above case) demanded that vibration analysis be performed as a test of acceptance of the roll (fortunately, as it turned out). Wireless condition monitoring techniques are witnessing strong demand as organizations across the globe are using such solutions for improving their performance from plant assets. Technological developments such as circuit miniaturization, battery power, faster processing capabilities and open communication protocols, as well as advanced software, are resulting in less expensive, enhanced condition monitoring solutions. Improvements in wireless and sensor technologies, along with the market acceptance of modular, open-architecture systems are expected to further drive down costs.

The expanding use of the Internet as a prominent report delivery mechanism (pdf's) and medium for plant personnel and management interaction (WebEx, Glance, IM) is also aiding wireless sensor system expansion. Plant technicians will want to drill down to the sensor system, grab the data and collaborate (or in some instances, commiserate) with each other, perhaps in the same room, perhaps remotely.

Intelligent, informed repair or replace recommendations, made by experienced analysts (either remote or in-house) to management, will enable them to make sound decisions that apply to, and are integrated with, the overall business strategy of the plant or corporation. Development of the wireless sensor system "canopy" (mesh network) will be an enabling technology to the plant in achieving these goals, which will in turn provide them with a path to world-class performance. Sure beats the alternative – encountering premature machinery failure, which was narrowly avoided in the case history presented here. Cost avoidance is hard to quantify, but it really is all about the dollars!

The Perfect Storm of Change

By: Ed Williams, Sandia National Laboratories

This past February, at the winter meeting of the Maintenance and Reliability Center (MRC), change became the unplanned theme for the meeting and caused me to reflect on the reasons this occurred. People in the maintenance environment are all too familiar with change. However, there has not been an industry and media focus on change to this degree since the early 1990's. We may wonder, why now? What's different? Will this too pass? In my opinion, there is a fast approaching convergence of several elements demanding we challenge ourselves on how to approach, and manage the maintenance function at our plants and sites; and in essence make significant changes to the basic philosophy of the maintenance function.

Feb '08 MRC Members Meeting at Sandia

The one constant pressure driving us is the relentless "do more with less" directives we all face. But, today the mantra is really, "do less with less!" Helping our institutions become more competitive in the world market by reducing costs is but one factor in the fast approaching future. Other elements will have an equal or greater prominence, including: globalization, energy and environment, technology, people, and management systems (companies). All of these are coming to a head at the same time, providing for the impending perfect storm of change. I will discuss each of these and offer some thoughts and questions on meeting these new challenges.

Globalization

Where were they? Where did they go? Did I miss them? I'm talking about the American beer drinkers, rioting in the streets, protesting to Congress, lamenting the loss on CNN of our iconic brew, Budweiser, which is now owned by a Belgian company. If the French farmers let it be known McDonald's is not welcome, how can Americans not mark the passing of Anheuser-Busch; the source of the best Super Bowl commercials and the once proud sponsor of NASCAR's #8? Will the "Bud"-"weis"-"er" Frogs now have a European flavor (a European delicacy, I hear)? This transaction clearly demonstrates how quickly the business world can change, with firms being bought and sold, and with the ability to move manufacturing across the globe in pursuit of the best deal and lower costs. Globalization will keep constant pressure on maintenance for short-term, bottom-line savings, even at the expense of long-term institutional health.

So, are you ready? If your firm was purchased tomorrow, would your maintenance story describe your approach and demonstrate your efficiency and value to the organization?

Energy & Environment

Sandia has been very fortunate to have low electricity rates for a number of years, based on a long-term contract. However, next year it comes to a screeching halt and electrical rates will increase by 100% or more, and natural gas costs will increase approximately 30%. The increased cost of utilities will be reflected in a lower budget for maintenance. We also run a fleet of several hundred service vehicles and support equipment. The soaring cost of fuel is decimating our equipment budget.

The cost of energy and reliance on petroleum-based fuels are driving fundamental changes in how we approach maintenance management. New executive orders and DOE strategic direction are requiring Sandia to reduce energy consumption by 30% and water consumption by 16% over 10 years, based on a FY 2003 baseline. Improved maintenance practices and

equipment efficiency gains are the cornerstone for achieving these lofty goals.

In addition, new facilities at Sandia will be designed and constructed to Leadership in Energy and Environmental Design (LEED) gold certification levels and 15% of our total square footage must be LEED Certified by 2018. The LEED Green Building Rating System™ encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria. "LEED for Existing Buildings: Operations & Maintenance," provides a benchmark for building owners and operators to measure operations and improvements and includes a large segment concerning maintenance and maintenance practices. The LEED requirements will require us to alter our maintenance fundamentals to establish more cost-effective and energy-efficient maintenance operations in the future.

From my point of view the focus on energy, environment and stewardship is going to increase and maintenance activities will come under more scrutiny in the future. Are you ready to answer the call? Here are some questions to ask yourself to see if you are "green" enough. Is environmental and energy cost savings included when analyzing the benefit of maintenance? Do we track and analyze our environmental, utility, and energy costs on a regular basis in the maintenance department? Are there plans for additional compliance costs in our annual budget? How does our work affect energy use and costs?

Technology

There is a consensus among maintenance professionals that we have experienced three distinct eras of maintenance since World War II. The first is what I term the reactive or "corrective era"; fix it when it breaks. The second is the "preventive era" with a focus on preventive maintenance, scheduled maintenance and the early applications of work planning and control. The third era is the "proactive era" with the focus on predictive maintenance, introduction of Reliability Centered Maintenance and the use of computer-based tools and processes to enhance the maintenance function. I propose we are entering a new era that will cause us to fundamentally examine and change how we approach and manage the maintenance function. I call this the "design (it out) era".

One good example of the evolution to the design era is our automobiles. Those of us who grew up in the 103 octane, 33 cents per gallon gasoline generation can easily recall bias-ply tires lasted 25,000 miles; oil needed to be changed every 3,000 miles; points, plugs and condensers were changed every 12,000 miles. That was the corrective era. We could even work on our own cars, imagine that! With the introduction of engineering design changes and improved technologies (such as electronic ignition, radial tires, disc brakes, and synthetic oil) we moved into a preventive stage where the frequency of maintenance was extended; the ability for the owner to perform service was reduced; and the life of components was extended significantly. In the predictive era, computers managed the operations for improved efficiency, captured data and reported failures (through a code number provided to the mechanic). Some service intervals were extended to 100,000 miles and owner service went from turning a wrench to downloading new performance curves. We are now in the design era. There is not much maintenance we can perform. With the computer systems and monitoring sensors, the car can determine when you need the oil changed based on condition, notify the service center and they send a reminder to have the car serviced. We have run-flat tire technology and the ability to measure the inflation pressure continuously and notify the driver that the tires need service. There are no points, plugs, condensers, or owner-serviceable components under the hood (on the Porsche Boxster, you can't even open the hood to showoff for the neighbors). So in the last 50 years the need for automobile maintenance has been designed out and the skill set required to perform maintenance has changed, from the good ol' shade-tree mechanic to a highly-trained, computer-based technician.

Industrial and facility maintenance functions are going through a similar renaissance as computers and sensors become more sophisticated. We can quickly analyze massive amounts of data and use the data to project failure or detect failure conditions. New tooling and systems will be designed to reduce or eliminate routine maintenance functions, while continuously monitoring conditions, determining the health of a machine, and requesting the appropriate service activity through an integrated computer program. We won't wait for it to break; the machine itself will predict failure ahead of time. Time is no longer the basis for service, the machine itself will schedule maintenance based on running conditions. We will not need PdM specialists walking the systems, recording thermographic and vibration readings. The machine will capture, record and analyze data and request maintenance based on pre-determined criteria.

The future is very exciting; how can we plan to take advantage of advances? Is the expected life of a machine now determined by the software and firmware instead of mechanical and electrical components? This leads to the last two discussion areas, people and companies.

People

There is a small random failure pattern to the human machine that is unpredictable. However, there is also a clear degradation and retirement curve for these same machines that is readily identifiable and should be planned for. Baby Boomers have now entered the retirement phase and over the next decade we should anticipate a large number of our skilled workers will be leaving the work force. The replacement pool is very limited. The baby boom introduced approximately 4 times more workers into the system than the following generation. Although we may supplement our traditional workforce with non-traditional resources, such as immigrants, there are still not enough bodies to go around. The design era also has a human impact that is not readily discernable. Our young people no longer get the opportunity to develop basic mechanical and troubleshooting skills and abilities by working on cars and similar activities. These basic skills were the cornerstone for the development of our current maintenance workers. In addition, the Industrial Arts programs at many of our secondary schools have been abandoned or significantly reduced; again, leaving the candidate pool of future workers unprepared to enter the maintenance trades. We have also hurt ourselves by eliminating apprenticeship programs and using training budgets as the first target of opportunity when the budget axe starts falling. Not a pretty picture. Some of the questions we must ask ourselves concern the workforce of the future. Do our remaining apprenticeship and training programs provide the new skills required or are we still training 20th Century workers? What are the basics for the new skills? How do we capture and disseminate the knowledge of our current workers to future candidates? And the last two questions lead to the final topic - do we really need to care about this if the future workforce is mobile and able to transition skills to a multitude of employment opportunities? Will they even be our workers?

Companies

When most of us went to work for our current employer we looked for a lot of things. Perhaps subconsciously we looked for a values match because we anticipated a long-term relationship and most companies were looking for that same match…a company person. In return for your loyal efforts to help the company succeed, you were offered a degree of stability and promised post-career support in the form of retirement and other benefits. But times have changed. A career is now the culmination of a series of jobs, most-likely at multiple firms. The mantra of "people are our most important asset" now has a parenthetical statement included "(only while you're here)". You are now the total package and used by the employer for specific results,

with the full expectation that the relationship is short-term; nothing promised, nothing given. The new questions for a firm may be more immediate. What skills and background do I need for a specific task, and for how long? How will we entice the right people to apply? What strength or experience will we add to their portfolio so they are ready to move when it is time? Is there a new benefits package consisting of move allowances, housing assistance, enhanced education, or network of references? How do we effectively adopt a transitional labor management philosophy? Can we even call them our workers?

Tip O'Neil, a famous politician, once said, "all politics is local." Today, a not-so-famous maintenance manager says, "all business is global." The effects of this globalization are driving new behaviors in maintenance management and the role of maintenance in the corporation. The global demand for energy resources and environmental stewardship is changing how we value and measure the maintenance organization. The application of technology is changing the skills and knowledge required from maintenance workers on the floor. The lack of a sufficient replacement workforce for the impending rush of retirees, leaves us struggling to meet the future. And the workers that are available are transitional and no allegiances are owed. This is a perfect storm of change. Within the next decade we will need to develop a new set of management principles to meet the needs of the maintenance profession. My final question - what is your legacy going to be…the last of the dinosaurs or the first into the brave new world?

Editor's Note: Every year in the Fall newsletter, we try to include a couple of reports from our MRC Interns to give you some insight into the intern program and the mutual benefits it provides to both students and the host companies. The following are reports from two of our 27 interns for 2008.

Peabody Energy - Evansville, IN

By: Greg Warren, Sophomore, Mechanical Engineering

This summer I had the opportunity to work with the largest coal mining company in the world. I was working directly for the Maintenance Services Director for U.S. operations. Peabody operates several coal mines in Illinois, Indiana, Wyoming, Arizona, and New Mexico. Peabody also has mines in Australia and offices in China for consultation purposes. I was primarily involved in corporate level maintenance strategies. It was very interesting to see how maintenance practices were valued and considered for the overall goals of a large company.

Mining is an interesting animal when it comes to maintenance and reliability. Most systems to evaluate maintenance operations are designed for fixed facilities. Mining has much rolling stock and many of the fixed facilities must move in order to keep pace with the product being mined. This causes the company to adapt the available systems to fit their processes and structure, which can be different at each mine. The company must be able to gather reliable information from the mine sites and compare data in order to develop best practices throughout the company. This is complicated by many different variables, including: weather, product conditions, type and amount of material removed to gain access to the product, underground or surface operations, requirements of the customer, facilities, and equipment utilization. Due to the size of the company, Peabody also has many opportunities to evaluate maintenance and reliability information to increase efficiency, lower costs, and increase productivity. And there are opportunities to investigate new products and practices to determine if they are in line with the company's goals.

One of my primary projects was to gather and evaluate material lists charged to maintenance costs at each and every mine. There was a new system put in place last year that incorporates the expenses of all departments, creates work orders, plans for scheduled maintenance, and other actions beyond the scope of my internship. When this system was put in place, not all of the expense items were coded correctly. There were many items that where coded to maintenance that were part of other departments. Also there were many one time use items that were being erroneously charged to various maintenance centers on a daily basis. This caused the maintenance costs of the company to skyrocket after putting this new system in place. Also it created problems with developing root cause failure analysis projects and determining which mines were truly having maintenance issues. In addition, each piece of equipment was supposed to be associated with its duties and then have maintenance cost allotted to it. During this project we discovered that some of the equipment was listed as an overall general maintenance cost. Anything charged to that piece of equipment fell in the general maintenance cost bucket, regardless if it was an operating or maintenance cost. We developed a list of the major offending items, talked with mine managers about tasks certain equipment performs, and either changed the information in the system or submitted it for approval.

I came in on a second project this summer that was well under way, and was still moving forward when I left. There was a problem with the undercarriage life of large dozers being dramatically shortened. A team was created to evaluate all the factors that could affect the life of the undercarriages. They discovered that the dozers had started pushing at a steeper grade and needed to return to shallower grade. So during the middle of the summer the grade was changed and we recorded the life of the undercarriages after the change. We also developed a cost analysis of replacing the undercarriages comparing the longer and shorter life spans. A few more months of evaluation is necessary to guarantee that the reduction in grade will return the increased lifespan of the undercarriages. When enough data is collected, there will be an evaluation to see if the financial gain of increased undercarriage life is more valuable than pushing more material at a steeper grade.

Greg and one of Peabody Energy's dragline excavators

Another project on my agenda was a device that claims to offer fuel efficiency improvements and emissions reductions. The device has not been scrutinized by an independent source, but seems sound in theory. We tried to test the product through a third party, but their test equipment was not accurate enough to give quantitative data. We were still interested in the product, so I had to develop a testing regimen and then source an outside expert with equipment sophisticated enough to further our research. We also began to develop a field test of the device on some of our equipment. The project is still underway and I am excited to hear the final results.

It was a productive and educational summer for me and for Peabody Energy. I was able to gain experience in the processes, structure, and systems in maintenance while addressing some of the issues that affect the overall maintenance plan. Being around some of the largest heavy equipment on the planet and occasionally getting my hands dirty was something I looked forward to at the beginning of the summer and was able to enjoy throughout the internship. I have been fortunate to tie my personal maintenance experience with my degree to develop my career.

DuPont TiO_2 Technologies - New Johnsonville, TN

By: Michael T. Saale, Graduate Student, Mechanical Engineering

This is the third summer I have interned through the MRC at DuPont's TiO_2 Technologies facility in New Johnsonville, Tennessee. As usual, my supervisor was Eddie Bozman. He assigned three projects this summer: the analysis of pipe erosion in an Olympic swimming pool-sized heat exchanger, a plant-wide equipment piece mapping project, and the task of creating a database for all the state inspected pressure vessels on site.

The first project was to find a method to extend the lifespan of the pipes (called legs) in the heat exchanger (called the flue pond) and use statistical data to justify this method. The problem is that flow inside the legs erodes the walls. It costs between $11,500 and $61,500 to replace one of the legs. Three to four legs are replaced a month.

Every time a leg is removed, ultrasonic pipe wall thickness measurements are taken on twelve locations of each flue leg. The data appears as a spreadsheet that lists all twelve measurements in a single column. However, that month's readings also appear in the same column as every other set of readings, dating back to 2006.

Due to the large amount of data, I worked with a programmer to write a macro in Excel that would auto-format the raw material. Gaining the ability to program in Visual Basic, the language that Excel is built upon, was worth a month's pay.

A Meridium software package was then used to determine the general erosion rate per area and to identify events that caused rapid erosion. It was discovered that erosion took place at a significantly higher rate inside the bottom 45º of the pipe. This meant that the life span of each leg could be increased by rotating each leg at 45º increments. Using the statistical data, an equation was developed to determine when each leg was to be rotated based upon its current pipe wall thickness and its location in the flue pond. The first legs will be rotated on July 29. A conservative estimate of the savings to the plant over the next year is $45,500.

The second project was to create equipment piece layout drawings of all the major areas of the plant for use as maps. This required me to learn Microstation, the drawing software used by DuPont. I then collected all the existing structural steel drawings for each area and created new drawings for the area we did not have. The equipment piece layouts were then put on top of the steel drawings. The resulting files were then compressed into a printer friendly PDF and stored on the share drive.

The final project was to gather the state certificates of inspection and related data for all of the licensed pressure vessels in the plant. I then contacted vendors and fabricators to find any missing information. The database started at 15% complete. It is now 70% complete.

Maintenance & Reliability Center
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"where industry & academia meet"

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We're on the Web!
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MRC Calendar of Events

Oct 20-23	SMRP Annual Conference (Cleveland, OH)
Nov 5	MARCON '09 Abstracts Due
Dec 8-11	International Maintenance Conference (Bonita Springs, FL)
Apr 14-17	MARTS (Rosemont, IL)
May 5-7	MARCON '09 (Knoxville, TN)

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