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Motor Diagnostics and Motor Health News

A Reliability, Maintenance, Energy and Environment eMag

SUCCESS by DESIGN
AWARD WINNING CONSULTING

Business of Reliability Edition

A ***SUCCESS by DESIGN***® Publication

5/14/2009

May 13, 2009

Dear Motor Diagnostics and Motor Health News Readers:

Eaton Corporation is in the process of rolling out a family of Intelligent Power Control Solutions focused on improving the energy efficiency and wellness of electric motors and the equipment they drive. We would like your feedback on these products.

Respondents who complete the attached survey will receive a choice of **Fleece, Polo Shirt, Cooler, Baseball Cap, or Coffee Mug.** In addition, respondents who return their survey by **May 28th** will be **eligible to win $500**.

The first member of the family, Motor Insight, is an Advanced Solid State Motor Overload and Power Monitoring Relay providing numerous protection modes, advanced monitoring and diagnostics for across the line and reduced voltage starting applications. This product is available now.

Two upcoming members of the family are:

Pump Insight: An Adjustable-Frequency-Drive-Compatible Advanced Solid State Motor Overload and Monitoring Relay Plus Prognostics that provides real time motor Efficiency estimation, Torque estimation, and Cavitation alarms, all without the need for additional sensors.

Energy Insight: A Companion Module for commonly found Adjustable Frequency Drives with advanced Eaton exclusive energy optimization algorithms providing 2-10% energy savings for step loads, constant loads and slowly changing loads (variable torque loads).

If you work with, or specify, products of this nature please take a few minutes to complete the survey. Your feedback is highly valued and will be carefully considered as we define these products and future members of the Intelligent Power Control Solutions product family.

I very much appreciate your help, and will be happy to respond to any comments or questions you may have.

http://www.surveymonkey.com/s.aspx?sm=dlneRPUqK6jFtkK_2fC9hUnA_3d_3d

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Editorial: Web 2.0 for Maintenance Professionals

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The concepts behind Web 2.0 have pretty much been taken over by the 'social media' and marketing organizations. Yet, the resources and potential available through these tools can have a significant impact on our ability to be more efficient at our jobs. The challenges relate to how they are used.

The abuse of these internet tools by workers have resulted in many companies blocking their use by employees. Take, for instance, YouTube.com: a growing number of companies are blocking the ability to view videos through this medium because of abuse, perceived or real. However, YouTube can provide a powerful training tool by being able to deliver information quickly and cheaply, in five minute, or less, chunks.

Web 2.0 as a business strategy has been thought of in terms of marketing. The ability to use it as a business/engineering/training tool is often overlooked because the appeal is much, much smaller. For instance, on a large social networking site, you are hoping for thousands or millions of views of your material. On a business, or technical, site, those views could be in the tens or hundreds. The real question is: how do you measure the value?

Web 2.0 Defined: a system that depends upon the collective intelligence of the users and the building of applications that support collaboration. This takes the form of a number of types of applications, including:

- Forums: collaborative discussions of topics, or 'strings.' A string is a series of responses and discussions around a single question. Normally, a forum string may be initiated by any member of the forum. Forums are usually moderated in order to keep topics in line and to ensure professional behavior between forum members. Group intelligence is maintained through the ability of each member to discuss and refute statements made with the result being options to explore or an answer. Forums make an excellent tool for debate, when managed properly. The danger of a forum is that the initial statement or question to be discussed, and answers, may not always be correct.

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Editorial: Web 2.0 for Maintenance Professionals (Continued)

- Blog: a blog is an article or statement by an approved 'blogger,' who is technically an electronic journalist. The blog allows members (anonymous or otherwise) to respond and discuss the article or statement.
- Wiki: a collection of web pages designed to enable anyone with access to contribute or modify content.
- Media-Posting Website: online communities for posting media and commenting on the posted media.
- Social Media Site: Members are able to set up individual web pages and then connect to groups or individuals.

Most Web 2.0 sites have combinations of the different types of applications listed above.

Popular Web 2.0 systems include such social networking systems as FaceBook and MySpace; media systems such as YouTube and Flickr; and, blogging systems such as Blogger and microblog systems such as Twitter. The collection of capabilities and websites can be more than overwhelming, even to the experienced Web 2.0 user.

Popular systems can be used by individuals to communicate among friends, access items of personal interest, or provide a social outlet. Used by marketing organizations, it can target individual users with selected messages based upon the users' interests. From a business/technical point of view it can provide a method of outreach to members/new members and online collaboration of concepts, ideas and information.

An example of a professional Web 2.0 site is the IEEE DEIS Web (http://www.ieee.org/go/deis) which contains the following Web 2.0 applications, at the time of this lesson:

1. A professional forum open to the public. Several topics are considered private for group discussion;
2. A Blog with multiple authors and topics; and,
3. A Wiki presently open to the public.

There are videos and information available, including a calendar of conferences and events. However, these are not truly considered Web 2.0 systems because they do not involve direct interaction with the members. As a result, we will focus on these items and how other Web 2.0 systems are used to interact with the IEEE DEIS Web.

From The President: Culture Change Fatigue

On a personal note, I am still trying to figure out when we started rooting for the away team. Events of the past eight months have been along the lines of going to your kid's sports game and rooting for the other team to win. Sure, the visitors may buy a few hotdogs, but it is not even in proportion to the local investment in the field, training, team, and more. However, the away team must be doing something better than the home team… right? So, as our home team struggles, we cheer louder for the other team. Good for us. We should feel proud. And our children should just understand.

There have been changes in philosophy on all levels that have been occurring at a faster and faster pace, especially in our industry. As the philosophy of business changed from engineering-based management to cost-based management, philosophies related to maintenance remained constant through until the 1960s, changing first with the aircraft industry. In the 1970s, our military started making changes to maintenance philosophy which then slowly took hold within industry. With the continued application of information technology, politics, society, and other industry/community changes, business philosophies changed at a rapid pace followed, reluctantly, by the maintenance community.

All aspects of the business community from sales to marketing, engineering to information technology, and operations to finance, each had a variety of business philosophies applied. Reliability and maintenance has been held separately with both the business and R&M sides of industry trying to figure each other out. Most business training exposes modern managers and executives to very little of the R&M industry, other than identifying it in a loss column on the company P&L sheet. Leaders in the R&M community have a focus on the R&M community with limited exposure to the executive levels of corporations. In the present environment, business sees an opportunity to cut expense through the reduction of maintenance while viewing the response from maintenance organizations as 'protectionist.' The fact that the impact from reduced maintenance is not immediately noticed assists in the development of this paradigm.

In reality, the same philosophies used by business can be applied in maintenance. However, it requires an understanding of both R&M and business philosophies in order to bring both parts of the puzzle together. When one side or the other redefines those philosophies in such a way that the other side recognizes the name, but not the process, the activity loses credibility.

One of the most significant and powerful tools in the business chest is the concept of cultural change. The issues related to change has more to do with definition than application. In many cases, we overwhelm an organization with constantly attempting to change the organizations culture, hobbling progress, instead of incremental changes as the company's paradigm adjusts to its environment. An organization must not remain stationary and must constantly be adjusting and evolving in order to remain competitive and flexible.

Often what is required to implement a form of change is awareness. This can come in many forms and styles. Will change result? Yes. The expectations are that the organization will adjust to new awareness. Often there is some level of resistance to the change, depending on the specific environment. The key is to understand the existing culture and needs of the organization, adjusting course versus radical changes in direction.

If you were the captain of a vessel and you had to get from New York to Plymouth, UK, you would start out and make course corrections for foul weather, wind, currents and other events. However, in the world of constant 'radical change,' it is as if the navigating consultant comes in and has them change course to Cape Town, SA, then back to St. Johns, NFLD, then to Keflavik, Iceland, claims it as progress, then sets a course to Somalia where the vessel is hijacked by pirates.

Is this a bad simile? I have had a number of stories related to me over the years where a company brings in a firm that makes recommendations that set back the corporate profit significantly and then returns it to a smaller than original position, claiming the difference between the setback and new point as a success. For example: firm suggests that 'changes will be painful,' so has the company go through 'culture change' that takes the company from a profit level of say 100 down to 40. After the change, the company moves up to 60 and the firm takes credit for improving company profit by 20.

I was literally a participant in a program where a business consultant recommended radical change, so the company took a plant manager of 22 years experience and swapped him with a customer service rep with two years experience to 'shake things up.' No matter the objections, the change was announced on a Friday and was in full implementation by Monday. I don't think I have to describe the excitement that ensued for years afterwards.

When I had lunch with the business consultant (he called us and invited me out for a 30 minute lunch, then billed the company four hours) he explained that 'a company needs to be kept on its toes by constantly shaking things up.' I stared at him incredulously and said, 'shouldn't a company be focused on providing its product or service and not the objective of constant upheaval?' I was not surprised to hear, later, that there was a recommendation to exclude me from the meetings after the lunch. I was not a 'team player.'

Am I against the use of consultants? Of course not, but under some of the present conditions related to the uses of consultants, I prefer to

think of myself as an anti-consultant. In fact, I prefer to think of myself as a man of action, seeing as I am known to occasionally fall asleep in long, boring, non-productive meetings – and I snore loudly. It is one of the reasons I left academia – snail is not my speed. No offense to academia, their part in industry and research is invaluable, just not my style.

I need to get everyone together, see where we are and set where we are going and then assist the captain of the company or division I am working for set the course and make corrections. Look at the present conditions, environment, and context and then work out how to move things in the right direction within the constraints of that context. If the constraints do not allow for the correct course or course corrections, then there would be recommendations of more significant change, but those instances are rare. I suppose I tend to work with intelligent people who know the direction they are looking for and have pointed that direction, just need the different point of view or outside experience to make the fine-adjustments.

In a machine example, we were performing training at a site where the class suggested we take a look at a problem on a DC machine that had existed for a while. The machine could only operate between 40-50% of equivalent machines sitting right next to it and there was a definitive electrical signature. Everyone brought in made major modifications to the drive and the motor had been rewound several times due to damage from the electrical problem. We took some basic ESA/MCSA data and had a screw tightened on a connection. The machine immediately returned to 100% operation. It was just a slight adjustment.

In a corporate example, during the work I was performing on 'A Novel Approach to Industrial Assessments for Improved Energy, Waste Stream, Process, and Reliability,' while I was an Adjunct Professor of Industrial Engineering and the Senior Research Engineer for the University of Illinois at Chicago Energy Resourced Center, I had my students perform a production model of a facility we were working with. In this case, I asked them to take a look and see what operators wanted to do (culture) versus how the facility was set up. This is the opposite of many programs for process improvement which normally require you to review and change the culture in order to make improvements around the facility. We discovered the movement of one piece of equipment that caused a constraint doubled the capacity of the workforce and production. A slight correction to the facility versus a major change to the culture, which would have returned to the same levels as soon as attention was lost. The change was sustainable and extremely cost effective.

Yet, in the R&M world we seem to think that changing the culture would be more effective than adjusting the process. But then again, I suppose keeping things in a constant state of flux keeps people from seeing the results of the recommendations and culture change.

It is my firm belief that many companies are well into a state of 'Culture Change Fatigue.' The enthusiasm for active participation in the front line work, itself, seems to be waning and the real R&M personnel who are trying to get the work done roll their eyes at the latest fads coming down the line, knowing that they only have to wait about 30 days before it completely changes again. R&M is supposed to be the rock that keeps the equipment running and online as effectively and efficiently as possible and most of the professionals in the industry realize that.

When I find that a change is required to a process, it usually only takes handing the key players a new prescription for their glasses – allow them to see the change. Some stick, but most adjust their course when they see things from a different perspective. To suggest major 'culture changes' constantly gives the implication that the R&M professionals are not right, that their organization is sick and on a course for Hong Kong versus Plymouth. Personally, I have more faith in the professionals within our industry and believe that, in most cases, a separate pair of eyes is more important to course correction than scrapping the old ship and building a new one.

What I found interesting when I put 'Physical Asset Management for the Executive' on the market, I got positive comments from the workforce and from management outside of the R&M industry (my greatest area for sales, hence winning the Axiom Business Book Award). I got complaints from all but a few consultants because I suggested that things were not that difficult to obtain positive action. I then made the decision to adjust the price to make it more accessible to those who really need it.

So, what are you up for? Common sense or radical changes? I bet that you will find that some fine tuning will go a lot further, and faster, than fighting against the wind.

Sincerely,
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Theory of Constraints for the R&M Industry

Howard W Penrose, Ph.D., CMRP

Eliyahu Goldratt, the author of "The Goal," numerous other business novels, and the developer of the Theory of Constraints (TOC), is a physicist. The concept behind TOC is simply to apply the scientific understanding of effect-cause-effect on a business system in order to evaluate it and make incremental improvements with a focus on reducing inventory and operating expenses while improving throughput. He places his measurements squarely on those areas as they impact profitability, or, 'what we are really trying to achieve is the making of more money.'

Within his novels and business books, Goldratt defines his view on science:

> *The search for a minimum number of assumptions that will enable us to explain, by direct logical deduction, the maximum number of natural phenomenon. These assumptions can never be proven (ie: gravitational law). Even when they can explain an infinite number of phenomenon, this does not make them 'true.' It simply makes them valid.*
>
> *If one phenomena that cannot be explained makes the assumption false, it does not detract from the validity, it simply puts boundaries where the assumption is valid. Science does not concern itself with truths but with validity, which is why science is open to constant checks and challenges.*

The key to the Theory of Constraints is often identified in five components of a process:

1. **Identify** the system's constraint(s);
2. Decide how to **Exploit** the system's constraint(s);
3. **Subordinate** everything else to the above decision;
4. **Elevate** the system's constraint(s); and,
5. If in the previous steps a constraint has been broken, go back to Step 1. Do not allow **Inertia** to become a constraint.

Is change required as part of TOC? Most certainly, but it is often presented as significant changes that must be forced on an organization instead of the minor changes that, as Goldratt states, usually have major impact.

What is frequently avoided in the discussion related to TOC and consulting practices is that the TOC breaks down three fundamental issues that go along with the process and minor changes:

1. What to change;
2. What to change to; and,
3. How to cause the change.

Throughout "The Goal," it is well established that Jonah, the consultant, provides coaching and guidance, but rarely ever answers or directly intervenes. As stated, these three steps are fundamental expectations of a manager and, "if a manager does not know how to answer those three questions, is he or she entitled to be called manager?" The additional lesson on the second to last line in the book is the realization that: "We should learn to be able to do it without any external help. I must learn these thinking processes, only then will I know that I'm doing my job."

The concept is that the manager should be able to identify the real constraints on the system, often not the actual machines or people, but the actual policies and local measures that have an impact by understanding the root-causes of the constraint. The constraint has to be properly identified and, as in Root-Cause-Analysis (RCA) processes that we use in R&M, identifying the right question for the RCA is half of the process.

If solutions are addressed as dramatic 'culture change,' it will be seen as a perceived threat to security and will generate an emotional response and associated resistance to that change. If radical changes occur often enough, the result is 'culture change fatigue,' or 'change fatigue,' defined as a point where turnover begins to increase or employees /managers hold off on implementing improvements with the perception that it will change again, soon. The response is often the use of fear and insecurity in order to invoke a strong emotional response and corresponding change. Even though there is an impact, it is often short term and will result in 'buyers remorse.'

Incremental changes, or paradigm shifts, must come from the enthusiastic positive emotional responses related to 'made here,' or buy-in, which is a stronger response that carries long-term results. This requires the participation of all parties, or stakeholders, at all levels with problems, solutions, and implementation decided by those participants. The three components involved in TOC change can then be broken down and identified this way:

1. What to change? Pinpoint the core problem;
2. To what to change to? Construct simple, practical, common-sense solutions; and,
3. How to cause the change? Induce the appropriate people to invent such solutions.

One of the interesting points in the book, when focused on the improvements to an 'NX10' machine, was that one of the key core problems were that the local efficiencies, coined in the 1990s as Key Performance Indicators, were actually a huge part of the problem. Inventory piled up and defects were high, and individual practices/workmanship was low because the work was performed to meet those efficiencies. Some of the immediate mistakes were that they attempted to circumvent the machine with machine solutions, such as placing additional machines in parallel with the key machine, and working harder. Overtime and inventory increased, employees and managers were upset, and the future of the factory was in question. With a little coaching, Jonah got them to realize that the solution was counter-intuitive, based upon the present use of measures, and that the entire process was a grid of interlocking chains where the weakest chain needed to be addressed. By changing different links in the chain, including allowing themselves to drop below KPIs in specific areas, they were able to increase their throughput. The antagonist had a fixation with KPI, but the stockholders and senior management were monitoring the true measure, as identified by Goldratt: Profitability.

Goldratt identifies the application of this process through his other books on how to apply TOC at all levels, including adding balance to your personal life and even academia.

How can such a process be applied to the R&M organization in order to have an impact on the company? First, we have to understand that R&M can be identified as one of the chains that interlinks with the other chains within the organization. The key is to be able to identify where R&M provides value and where it does not, with the value being simply how it impacts the profitability of the company and how it impacts inventory (ie: MRO), throughput, and operating costs. To do this, we must be able to identify the constraints in the maintenance organization.

Unfortunately, the latest direction is to apply local efficiencies in terms of R&M KPI and Wrench-time. The goals may be set, for instance, as a percentage completion of maintenance inspections, or driving up 'wrench-time' from 35% to a higher value. However, how do these goals address the actual value of the organization, or the maintenance system, impact on the profitability of the organization?

Let's take two simple measures: 1) Completion of maintenance tasks must be 95%; and, 2) Wrench-time must be more than 50%. What do you think the impact will be on the maintenance organization? First, maintenance tasks will be selected that allow for completion, not necessarily in favor of improved throughput or reduced MRO. Inventory may increase and emergency orders required in order to meet the needs. Also, any tasks that require any level of prep or travel, or any other item that reduces wrench-time, will be low priority or not pursued at all. Nonsense! How could this happen?

Story 1: Implementation of a new CMMS system and the requirement that the maintenance manager had to meet a 95% completion level of maintenance. When visiting the site we noticed the air was extremely stale and that most of the roof-top ventilation fans were inoperative, reducing the air turnover in the facility to a dangerously low level. When asked, we were informed that the reason the fans were not in the system is that they would impact the completion rate and that if they did repair the fans outside of the CMMS, their wrench-time metric would fall.

Story 2: Promotion and raises for planners based upon completion rate of maintenance and wrench-time. They discovered that if they changed water fountain filters instead of pursuing air leaks (one instance of a great many at this location), they could achieve both measures. Air leak maintenance was eliminated from the maintenance organization and they began receiving accolades for meeting their measures from corporate. However, their energy group was chastised for increasing costs and the plant manager for reduced profitability. The plant was closed at a later date.

Does this mean that local measures should not be taken? That we should not work towards a balanced scorecard for our maintenance organization? No, it does not.

Measures are a method of reviewing the 'dashboard' of the operation of the organization. It can be used to help identify the constraints and root causes, but should never be the goal. As I have seen many times, in school, when teaching, in practice: you cannot manage what you cannot measure. However, the measurement is an indicator only.

It is important to remember that R&M is a chain in a group of chains in the organization. What can be done to improve the profitability of the company and what are my REAL constraints. If I state that I must have 55% wrench-time and I am operating at 40% wrench-time, what is the impact on the other links in the chain?

When I taught industrial engineering, and in practical application in my other positions from field service manager, department manager, sales organizations, I have learned that you must take a systems view in order to determine the value of a particular action on the profitability of the company. Sometimes the thought is to throw money or manpower at an issue. However, it has been demonstrated over and over again that there is an optimum solution, most often it requires the correct application of time, energy, or manpower with too little or too much having a negative effect. Other times solutions are often thought to require compromise.

Elyahu Goldratt, as described in his later discussions and books, refers to 'evaporating clouds' as part of the TOC. These are defined as the minimum number of changes required in order to ensure an environment where a problem simply cannot exist. He states that a majority of problems are 'problems that arise whenever we try to satisfy local objectives that do not match, at all, the global goal.' The global goal is, of course, profit.

Whenever we face a situation that requires compromise, there is always a simple solution that does not require compromise. In fact, when the term 'you cannot have your cake and eat it too,' or similar statement, is used, it is often evidence of a compromising solution. The idea is to change your view slightly (paradigm shift) to see that most things are not what they may appear at face value, and we may have just locked ourselves into a limitation because of experience or training. As Goldratt states, 'God does not limit us, we limit ourselves.'

More is better, right? Often not the case. In all of the solutions identified within 'The Goal,' and the following business novels, the biggest leap that each of the protagonists must make is the realization that the answers are obvious and actually make more sense than pursuing the local efficiencies and measures as goals. That it is OK that a resource is 'underutilized,' so long as the underutilization goes along with a value for the company. When measures are used as part of your dashboard, what do they really mean and how are they defined? How are they applied?

The concept of the Theory of Constraints is another tool in your tool box. Make sure that you use the right hammer to put in that screw.

2010 Reliability Gives Voice to Autism Charity Event Sponsor and Donation Request

SUCCESS by DESIGN®, **Maintenance Technology Magazine**, and the **Autism Society of Illinois** have joined together for a charity initiative to take place during **MARTS 2010**. Originally planned as a publishing awards event, we have expanded the scope of this occasion to raise awareness and funds for autism as many professionals in the industrial engineering, reliability, maintenance, energy and environment industries have been touched by this growing disorder.

We are looking for your support.

Today, with autism affecting more than 1 in 150 children, the **Autism Society of America,** and its chapters, such as the **Autism Society of Illinois**, reach out – and are reached out to – more than ever before. The selection of the Autism Society was specific in that it provides immediate support and services to the front line by assisting families affected by autism. This is in direct line with the prospective audience, the industrial engineering, reliability, maintenance, energy and environment communities who work the front line to maintain our essential industrial and manufacturing communities.

Over the next year we are developing awareness for both the engineering, reliability and maintenance community and autism culminating with a dinner and variety entertainment charity event at the **2010 MARTS Conference** (date TBA – planned for the April, 2010 timeframe). We also expect to acknowledge our sponsors through a variety of means based upon the suggested levels of support and sponsorship, below.

The Autism Society of Illinois, founded in 1976 as a 501(C)(3) non-profit, is set up to receive sponsorship funds and donations for the event and activities. Leading up to and following the charity event, all proceeds will be split between the **Autism Society of Illinois** and the **Autism Society of America**. ***Sponsorships are considered tax deductable donations through the Autism Society of Illinois.***

Suggested levels of sponsorship/donations include:

- ***Platinum Sponsor*** (1 only): $10,000: Banner on stage, banner in event hall, literature at tables, prime position of logo on the front page of all direct event literature, paper, website banner and PR events leading up to the charity event;
- ***Gold Sponsors*** (2 only): $5,000: Banner in event hall, literature at tables, logo on all direct event literature, paper, website banner, and PR event;
- ***Silver Sponsors***: $2,500: literature at tables, website banner, logo on PR event materials;
- ***Bronze Sponsors***: $1,000: Literature at tables, website listing with link;
- Personal and company donations and 'donations on behalf' of any other size: Website listing.

*Checks or money orders should be made out as below and must state '***2010 Reliability Gives Voice To Autism***' to ensure that it is counted towards this activity and event*:

Make Checks Out To: Autism Society of Illinois [EIN 36-329613]

Send To: 2010 Reliability Gives Voice to Autism
C/O Autism Society of Illinois
2200 S. Main St, Ste 205
Lombard, IL 60148-5366

Contact Howard W Penrose, Ph.D., CMRP, President, SUCCESS by DESIGN, with questions via email: howard@motordoc.com or phone: 860 575-3087 (direct) or Karen McDonough, Executive Director, Autism Society of Illinois, via email: kmcdonough@autismillinois.org or phone: 630-691-1270, with any questions.

If you are interested in the Platinum or Gold sponsorships, we recommend that you call or email to reserve these positions as soon as possible.

Thank you for your support!

Sincerely,

Howard W. Penrose, Ph.D., CMRP

Also:
Karen McDonough, Autism Society of Illinois
Art Rice, Maintenance Technology Magazine
Kathy Penrose, Committee Chair
Gabriela Galvez, Volunteer Organizer
And the **2010 Reliability Gives Voice to Autism Team**

Cap and Trade: What is it and Why is it an Opportunity for Reliability & Maintenance

Howard W Penrose, Ph.D., CMRP

The principle concept behind cap and trade is the setting of an environmental policy that sets a limit on emissions of some type (in this case we will reference CO_2). Examples of existing cap and trade programs include the Acid Rain Program and regional NO_x Budget Trading programs.

The present plan behind the GHG (Greenhouse Gas) cap and trade program is to set carbon emission limits on a variety of industries through credits. Companies that do not use all of their credits may either 'retire' them (not use) or trade them on the market. Companies with emissions above the set level can choose to purchase credits on the market from those that chose to trade their excessive credits. Because it is an open market, much like Wall Street, others, including environmental groups, will be able to buy up excessive credits and 'retire' them, as well, driving up the cost of purchasing credits.

Presently, it is expected that cap and trade for GHG emissions will happen, and is happening both regionally and within various countries with a high degree of political success. At this point, the global direction is to address industrialized countries and make third world countries exempt.

How does this affect the R&M community? As we have previously presented, the implementation of correct maintenance practices can have a profound impact on energy consumption. It is energy consumption that can be directly related to emissions. We do know that caps will be placed on energy producers, such as powerplants. The question is how these companies will pass through the added costs. If the cap and trade program is directly implemented on facilities, then additional opportunities arise.

You can think of this in terms of vehicle emission limits. If some item in your vehicle is not operating properly, your emissions increase. In the states that do mandatory testing, if you fall under some value you have to get the vehicle fixed and then retested, or lose the ability to drive that vehicle. In this case, if caps are placed directly on industry, then if you have your equipment operating optimally, then you are less likely to have a problem.

The opportunity for R&M in the instance where companies are directly affected by cap and trade involves the ability to monitor maintenance improvements and make decisions in such a way to reduce energy consumption in electricity, natural gas, and other areas that are determined to emit GHG. So, for instance, just the application of a steam trap program can reduce the losses associated with natural gas (for gas-fired boilers) while just performing proper alignment on belted applications or improving you r electric motor rewind program will have an impact on electrical consumption. In the case of electrical consumption, the national average CO_2 per MWh is 0.606 Tons and 1.34 lbs per kWh.

If I then perform a maintenance task on an electric motor that reduces its consumption by 2kW and it operates 4,000 hours per year, then the consumption is 2kW * 4,000 hrs/yr * 1MWh/1000 kWh = 8MWh/year. This times 0.606 Tons CO_2 would be a reduction of 4.8 Tons CO_2. With expected costs to be about $100/Ton, then this would potentially be an income of $480 in real dollars. Proper maintenance of equipment has the ability to reduced energy consumption at most plants by an average of 14%.

What it comes down to is simple: cap and trade will represent an opportunity for the R&M community to land on the P side of the company P&L (Profit and Loss) spreadsheet.

Fox News Cap and Trade Video 1: http://tinyurl.com/captrade1

Fox News Cap and Trade Video 2: http://tinyurl.com/captrade2

Notice

What's Up Doc?

Entrepreneur, adventurer, RME&E expert, engineer, trailblazer, publisher, journalist, award-winning consultant, and award-winning author. Want to know how it is done? It's not done by sitting back waiting for people to ask!

We are now in the process of scheduling Dr. Penrose's speaking engagements for the remainder of the year. Contact us today to have him as a speaker at your next function by emailing kathy@motordoc.com with all of the details. Subjects include: motivational; philosophical; technical; and, writing/publishing.

Kathy

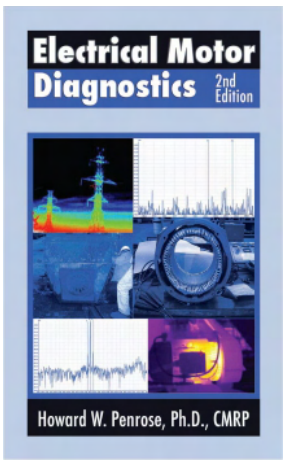
Note: Dr. Penrose is a registered speaker with the Journal of Experts

Note 2: A percentage of speaker fees will be put towards the 2010 Autism Awareness Charity Event (See p. 7).

Electrical Motor Diagnostics 2nd Edition Finalist Book of the Year!

For Immediate Release

March 12, 2009 – Old Saybrook, CT and Naperville, IL – Award Winning author, publisher and reliability and maintenance consulting firm SUCCESS by DESIGN® announces that Howard W Penrose, Ph.D., CMRP, has received notification that Electrical Motor Diagnostics: 2nd Edition has been named a Finalist in the coveted 2008 ForeWord Book of the Year Awards (BOTYA) in the Reference/Textbook Category. The BOTYA is given for books based upon editorial excellence, professional production, originality of the narrative, author credentials relative to the book, the value the book adds to its genre, and where the book offers practical knowledge where none existed before. The judges include a panel of readers, librarians and booksellers who select Finalists and then their position as winning titles. Announcements are to be made on May 30, 2009, at the New York BookExpo America conference. SUCCESS by DESIGN Publishing joins its new peers Yale University Press, Duke University Press, University of Alberta Press, University of Arizona Press, The Museum of Modern Art, Peabody Museum Press, iUniverse, Harvard University Press, SUNY Press, Princeton University Press, Sylvan-Dell Publishing, Turner Publishing, University of Illinois Press and many other past and present recipients of the BOTYA.



http://www.motordoc.com/detailEMD.htm

IEEE DEIS Web

Information on IEEE Standards and Publications related to the electrical insulation and rotating machine industry.

http://www.ieee.org/go/deis

IEEE
Celebrating 125 Years
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Ethics in the R&M Industry

Howard W Penrose, Ph.D., CMRP

One of the items missing in the R&M industry, either consulting, services, or plant, is a Code of Ethics. A few years ago, one was suggested based upon the 125 year old IEEE (Institute of Electrical and Electronics Engineers, Inc.). The IEEE Code of Ethics can be found at http://www.ieee.org/web/aboutus/ethics/position.html, which includes the IEEE position paper on ethics and a link to the Code.

Following is a modified version of the IEEE Code of Ethics that may be applied to the R&M industry:

We, the members of the reliability and maintenance industry, in recognition of the importance of our work in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members, the communities we serve, and clients, we hereby commit ourselves to the highest ethical and professional conduct and agree:

1. To accept responsibility in making decisions consistent with the safety, health and welfare of the public, our employer, or client, and to disclose promptly factors that might endanger the public or the environment;
2. To avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
3. To be honest and realistic in stating claims or estimates based on available data;
4. To reject bribery in all its forms;
5. To improve the understanding of technology, its appropriate application, and potential consequences;
6. To maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or often full disclosure of pertinent limitations;
7. To seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
8. To treat fairly all persons regardless of such factors as race, religion, gender, disability, age, or national origin;
9. To avoid injuring others, their property, reputation, or employment by false or malicious action;
10. To assist colleagues and co-workers in their professional development and to support them in following this Code of Ethics.

IEEE members are required to follow the IEEE version of the Code of Ethics as a condition of membership at all levels. A great deal of trouble could be avoided if the R&M industry followed something similar, such as the Code above.

[Note: the above Code of Ethics is a slight modification of the actual IEEE Code of Ethics]

Customer Service and Ethics

Guest Editorial: Kathy Penrose

Customer service needs to become a major focus for any business. This key topic is becoming something that is hard to find out there. Customer service is a huge part of any business. It could actually be the issue that makes you or breaks you, when it comes to repeat business.

Seeing a company "romance" a customer and telling them everything they want to hear does not seem very ethical. Make your approach, from very first contact, an honest, open and realistic experience for the customer. There are so many companies out there that will do, say or promise the world to you until they get the "sale" and then they drop you like a hot potato. Is that your idea of customer service? Would you give repeat business to that company? I bet you wouldn't. Think about how you would like to be treated as a customer yourself and treat all of yours the very same way.

Some customers are more difficult to deal with than others. That is just the way of the world, so be patient, diligent and make only responsible, reasonable, realistic promises to them. Don't just "live in the moment" and say something or make promises that you will not or can not follow through on. If you can't satisfy this type of personality, let it go and move on. Just know that you tried your best and you feel good about the way you handled the customer and accept that you just can't please everyone.

Here are some keys to having great customer service:

- Listen to the customers needs
- Personalize the experience for them
- Respond to phone calls and emails promptly
- Be open to compliments as well as complaints
- Train your staff to always be courteous, helpful and knowledgeable
- Don't make unrealistic statements or promises
- Go the extra step
- Always let them know that you appreciate their business

Just paying attention to some of these things can improve your business, but think about incorporating all of these and *WOW*, you are going to feel great about your customers and they are going to feel great about the way your business treats its customers. Then in return your customers will recommend you to others and come back to you when they are in need of your services.

Word of mouth is such a powerful thing. The next time you are in need of a service ask around. See what other people's experiences have been with the particular company that you are looking to hire. It doesn't hurt to have someone else's opinion.

SUCCESS by DESIGN Blogs

SUCCESS by DESIGN has been blogging on a number of topics from infrared window issues to our editorials and hybrid vehicles to… well, you name it! Come see what we have to say:

Motor Diagnostics and Motor Health News
http://www.motordoc.com/mdmhblog/

AllAmericanHybrid.com
http://www.allamericanhybrid.com/blog/HybridBlog.htm

Hybrid Tahoe Blog
http://www.motordoc.com/tahoe.htm

R&M Industry and Autism Awareness Charity Event
http://autismbookevent.blogspot.com

SUCCESS by DESIGN Training

Well trained employees increase profitability because when you improve reliability it saves BIG BUCK$. Everyone is looking to improve their skills when it comes to reliability, troubleshooting, ability to analyze data or to just simply understand motor diagnostics.

Our *Electrical Motor Diagnostics* training has a very down to earth, easy to understand approach when it comes to teaching the in depth as well as the basic concepts of Electrical Motor Diagnostics. The EMD course is based on the book that has won *ForeWord Magazine's Book of the Year Award* as a finalist.

Our courses include:

- A very hands-on class that is held in an actual electric motor shop. As part of these classes we actually take you on the shop floor with real motors (not training models) and pull out all of the different technologies in motor circuit analysis and test away. Then all of the data collected is taken back to the classroom for "real data" analysis. We pride ourselves in being "technology neutral". We want to help pinpoint the best technology that fits your needs. So if you really like the hands-on approach, check out our Off-Site Training option.

- Another popular choice is to have us out to your facility; we can train all of your employees at once. We will charge one all inclusive price and come out to you at your facility at your company's convenience. If you have interest in this kind of package you should consider our On-Site Training option.

- If your company is facing budget cuts, travel restraints or just needs a lower cost solution, we offer *Electrical Motor Diagnostics Distance Learning*. Our students really have been enjoying the freedom involved in this course. It is all done at your own pace. Watch each of the six class sections at your leisure. You are assigned homework and then once each section is completed you will be able to access the next part. There are six sections in total and a final exam (if you choose). We have gotten some really positive feedback on this format. Distance Learning .

If you would like to find out more information or talk to us about a customized program that fits your needs or the needs of your company, contact us at Training@MotorDoc.com . Customer service is our #1 priority.

SUCCESS by DESIGN Publishing For New Authors

We have opened up our Award-Winning Publishing Services to new and existing authors. The announcements related to SUCCESS by DESIGN® Publishing are as follow:

1. We will be accepting treatments from potential authors for business, technical, reference books related to Reliability, Maintenance, Energy and Environment. Our intention is to provide appropriate exposure for our contracted authors and the opportunity to win industry awards for their work. Our contracts will follow NWU guidelines, providing a more generous portion of the proceeds for the author, including advances when appropriate (dependent upon risk).
2. We will be re-releasing SBD SF&F (SUCCESS by DESIGN® Science Fiction and Fantasy) on August 16, 2009. This will be the re-release of the SBD SF&F division that was in place from 2001 to 2003.
3. We will be actively participating in book events such as the Book Expo America (BEA) to promote the books of our authors outside of just the R&M industry.
4. We will be participating in special events developed by SUCCESS by DESIGN.

If you are an author interested in publishing through SUCCESS by DESIGN, please feel free to contact us through editor@motordoc.com. If you are already published and do not feel you are receiving fair consideration of your title, you may also contact us to discuss options.

We look forward to serving our authors and the RME&E community.

Forensic Analysis of Oil Filled Transformer Case Study

Howard W Penrose, Ph.D.,CMRP

INTRODUCTION

Unfortunately modern television programs can cause a misunderstanding as to the actual work involved in forensic analysis. They rely upon human interviews in order to develop scenarios then apply science, resulting in significant wasted time. In true forensic analysis techniques, the investigator must start out without a conclusion in mind, determine the actual failure, then work backwards in order to determine what root-cause(s) initiated the fault. In true Root-Cause-Failure-Analysis (RCFA) human intelligence and interviews are considered the least accurate information when developing conclusions and recommendations.

Before starting an RCFA, the level of analysis must be determined. There are a great many flavors to this type of process from a simple 5-Why program, where a simple fault allows an average of five 'why' questions to get to the solution, to far more advanced practices. The key to any forensic analysis effort, however, is to preserve the evidence as quickly as possible, it is also important to ensure that any investigation is performed without finger-pointing. In addition, it is equally important to understand that any failure can have multiple causes which may include:

- Misapplication of the component or system;
- Improper operation;
- Improper or ineffective maintenance;
- Age; and/or,
- Corrective action/repair failures.

The root causes, themselves, will usually fall into one of the following:

- Inadequate or no:
  - Training
  - Procedure(s)
  - Specification(s)
  - Acceptance criteria
  - Vendor review
  - Design review
  - Maintenance practice(s)
- Equipment age (worn out)
- Random reliability failure

The RCFA process, itself, while appearing to take time actually saves significant time and resources. In most cases of RCFA involving the author directly or indirectly, the problem reviewed had existed for years, random testing cost significant resources, and/or communication or finger pointing prevented solutions. In one case, a problem at a steel mill existed for seven years, production and productivity slowed, production/maintenance/vendors pointed fingers and blamed each other causing other maintenance and production problems, third parties threw expensive solutions at the issue, and management expended resources. In a matter of 8 linear hours of RCFA meetings, 4 man-days of investigation, and a few quick tests, it was determined that the commutator bars on the associated DC motors had been damaged in a recorded stall when the problem was first noted. The solution was to replace the commutators on the next failure of each component and then monitor the equipment. The problem was resolved and production levels returned to their higher pre-seven year values.

In the case of the study shown in this paper, several silicone oil filled, sealed, 12.5/25kV transformers failed catastrophically within three years of operation. Oil analysis identified the possibility that more were in various stages of potential failure and communication between the equipment owner and vendor had become confrontational. It was determined that a more advanced form of RCFA would be required.

I. RCFA PROCESS

A properly performed RCFA analysis requires detailed logical steps and following the evidence. It requires significant discipline in not pursuing tracks that are either emotionally driven or do not follow the logical, Socratic method.

The steps involve preserving the data and evidence, organizing the analysis and selecting a team, analyzing data, communicating findings and recommendations, with follow-through and tracking of recommendation results. Understand that it is possible that recommendations and conclusions formed by the team will not be followed if outside sources, events or politics prevent the appropriate measures. However, properly documented RCFA allows application of these measures once the climate changes.

The first step in the process involves preserving data:

- People: Who was involved?
- Parts: What components were damaged?
- Paper and Electronic: Records, information, history, data, logs, tests, emails, etc.
- Position: Where and what conditions?
- Paradigms: What conditions? Lowest bid? Personnel changes? Political climate? Other environmental conditions.

The primary investigator/facilitator (facilitator) should usually be knowledgeable about the equipment but uninvolved with the failure being investigated. The second step is the development of the investigation team, to be selected by the

facilitator, and must consist of all stakeholders in the RCFA. This can include, depending on the climate, buyers, lawyers, operators, maintenance, repair, vendors, managers, etc.

During the investigation, itself, the following steps are followed:

- State the failure event: this is the question to be answered. It must be a statement of fact and not draw any conclusions. For instance, in the case of the transformers: "three transformers have catastrophically failed primary coils during operation."
- Determine the failure modes that could be the direct cause, such as winding shorts, insulation failure, partial discharge, contamination, etc.
- Develop hypothesis around each failure mode.
- Perform tests and investigations to prove/disprove each hypothesis. As soon as a hypothesis is disproved, stop following that path.
- Continue developing failure modes and hypothesis. Multiple branches of investigation are likely and multiple conclusions are likely (it takes an average of seven to eleven events to lead to a failure [1]).
- Determine underlying causes:
    - Physical
    - Human
    - Latent
- How can the problem be prevented in the future: there may be multiple options, some may be discarded for any number of reasons. All such reasoning should be recorded.
- Report findings and obtain decisions with responsibilities assigned and timelines set.
- Track in order to determine impact of corrective actions/inactions over time.

This was the process that was followed for the narrative that is to be the subject of the remainder of this paper. The following narrative will not discuss the process directly but will discuss specific findings and their conclusions. The complete original study progressed over 90 days with laboratory time being the primary delay. The on-site investigation was performed in less than five days.

II. CONDITIONS AND EVIDENCE

Information had been presented to the facilitator that three transformers had failed in less than three years of operation. Upon initial review, it was determined that evidence of the cause of failure had become tainted due to teardowns, repairs, and disagreements between the owner and vendor. Third party investigators had been brought in to evaluate field operation, electrical conditions, interview operators, and had exhausted significant resources with no results. Additional studies and directions were provided with no logical basis for expenses and tests. The only solid facts included test data, location of failure within the transformers in the form of digital photos, the nameplates, the oil, drawings, and oil analysis. Information such as materials used was not available due to the breakdown in communication that had resulted.

It was recommended by the facilitator to identify another transformer that was in poor condition, based upon oil analysis results, and have a third party contractor involved in a tear-down investigation. The facilitator also made overtures to a number of laboratories that had silicone transformer oil experience. Based upon an industry lack of experience and challenges by the vendor, it was determined that two laboratories would be selected.

In Table 1, the test limits as obtained from IEEE Std. C57.146-2005 [2] are provided:

TABLE 1
Dissolved Gas Concentration Threshold Levels (ppm)

	H_2	CH_4	C_2H_2	C_2H_4	C_2H_6	CO	CO_2	TDCG
Threshold Level (ppm)	200	100	1	30	30	3,000	30,000	3,361

It should be noted that the transformers in question are sealed and the lack of venting was noted and expected to result in higher values. It was also determined that samples were to be taken of the transformer under investigation after it had been sitting idle and at room temperature. The results were found in Table 2.

TABLE 2
Oil Analysis Results from Transformer Under Investigation (ppm)

	H_2	CH_4	C_2H_2	C_2H_4	C_2H_6	CO	CO_2	TDCG
Sample 2 (ppm)	21	125	0.9	18	7.9	185	1200	358
Sample 1 (ppm)	22	117	1.0	19	8.8	173	1620	341

Both laboratories reported the test results as severe arcing in the transformer while the results were well below those values that had caused the transformer to be removed from service in the first place (Table 3). According to the standard [2]: partial discharge results in primarily hydrogen and methane with small amounts of carbon monoxide, acetylene and ethane; electrical arcing results in hydrogen, methane, carbon monoxide and low levels of acetylene with a larger amount of hydrogen to acetylene.

TABLE 3
Dissolved Gas Concentration In Operation (ppm)

	H_2	CH_4	C_2H_2	C_2H_4	C_2H_6	CO	CO_2	TDCG
Threshold Level (ppm)	316	4604	10	112	65	747	3769	5854

A filter exam was performed on each sample and identified 0% carbon, 30% fibers, and 70% particulate. The visual appearance was given as the oil being 'clear and bright with fine particles.' It was determined that conditions merited the

disassembly and inspection of the transformer, requiring that the lid be ground off.

III. Dissassembled Inspection

As noted in Figure 1, a grey deposit existed throughout the transformer. Several possibilities were considered and a sample was sent for laboratory review.

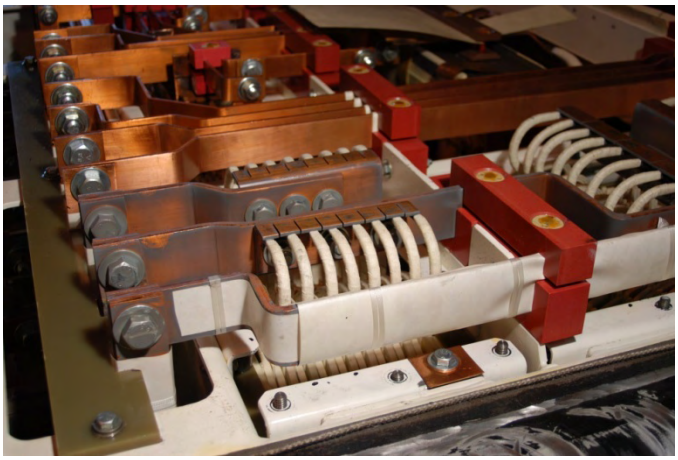


Fig 1: Grey Matter on Bus Bars

The material was identified as mainly made up of silicone, aluminum, copper, iron, zinc, magnesium, calcium, sodium and titanium (Table 4). The material was attracted to the bus bars with the metal being made up primarily of the same material as the bolts/threaded rods throughout the transformer. The generation of the material was estimated as having been the result of movement between the threaded rods and suspension springs located with the component buckets (Fig 2).

A majority of the grey material was on a specific electrical filter that should not have been carrying significant current. This allowed the facilitator to identify potential capacitor filter calibration issues, which were reported.

TABLE 4
Makeup of Grey Material (ppm)

Al	Cr	Cu	Fe	Pb	B	Tn
85	3	25	48	2	2	20
Mg	**Ca**	**Si**	**Na**	**Ti**	**Li**	
10	29	>2926	9	46	2	

Fig 2: Fretted Bolts and Buckets

It was noted that there was no guide or material between the threaded rods and there were visible signs of fretting.

One coil was removed from the transformer in order to evaluate the primary. Once the outer insulating paper was removed, it was noted that the varnish impregnated paper around each bare copper wire was tacky. It was also noted by the facilitator that the enamel on the secondary conductors was sloughing off. It was discussed and determined that the sample coil should be unwound by hand.

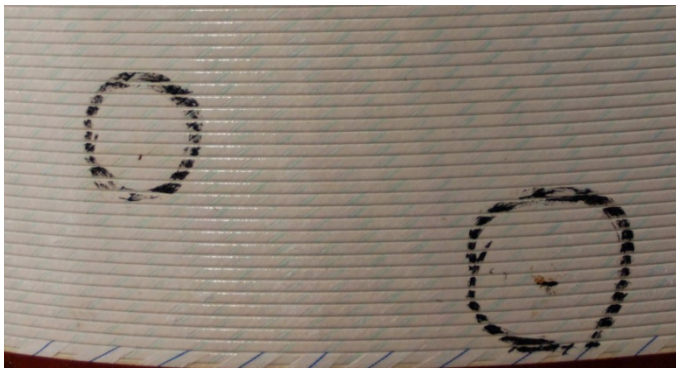


Fig 3: Burn Spots Between Primary Conductors

As identified in Figure 3, there were 'burn spots' throughout the primary between conductors in the center layers, with the copper conductors visibly pitted directly underneath. There were other areas where the grey matter could be found attached to the tacky insulation paper. It was determined that the 'arcing' noted in the oil samples may have resulted from these indicators. It was also noted that the pictures in the first transformer failures showed the faults occurred in roughly the same area as the 'burned' spots in the sample primary. The tackiness was attributed to possible incompatibility of the conductor varnish with either the silicone oil or the dissolved gasses.

The investigation of the conductors in the secondary identified that at all points the enamel could be removed from the copper conductors with a fingernail. It was assumed that this might also be due to incompatibility with either the silicone oil or the

dissolved gasses. While none of the failures had occurred in the secondary, by this point, it was noted that the conditions indicated a high potential of failure in the future. The degradation of the secondary conductor enamel was such that the selected research laboratory was unable to determine its chemical makeup.

Further investigation indicated that the transformer had been reduced in size as the silicone oil allowed for a higher operating temperature while the use of silicone oil in this application was specified by the owner for the purpose of fire safety. Higher temperature materials were used, but no records of an insulation coordination study using the selected insulation materials and silicone oil could, or would, be produced.

IV. CONCLUSION

The overall study, utilizing RCFA techniques, resulted in less than $100k USD total while pre and post studies performed utilizing other types of processes resulted in costs far exceeding that. The full time of the study, less than three months, was also far less than the more than year prior and several years following the study. To date, the conclusions of the RCFA have not been successfully disputed.

The conclusions indicated that:

- Periodic tuning of the filter capacitors would be required versus the one-time set up tuning presently performed;
- Several options for mitigating the existing conductive material were presented, but not pursued, due to additional investigations;
- An insulation coordination study must be specified in the original purchase of future transformers;
- The existing insulation system must be replaced upon failure of each transformer, if not before;
- Acceptance criteria for dissolved gasses and particulate must be agreed to by both the vendor and owner; and,
- The bucket suspension system must be modified to eliminate metal from permeating the oil due to fretting.

The root causes were determined to be a poor purchasing specification and poor practices in design for manufacture.

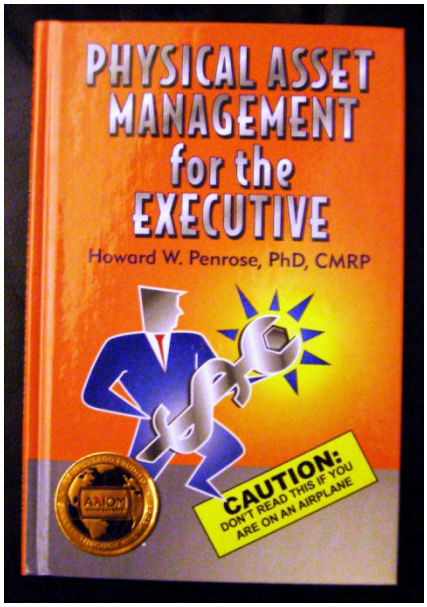
REFERENCES

[1] Robert J Latino and Kenneth C Latino, *Root Cause Analysis: Improving Performance for Bottom-Line Results Second Edition*, Boca Raton, FL: CRC Press LLC, 2002.

[2] IEEE, *IEEE Guide for the Interpretation of Gases Generated in Silicone-Immersed Transformers*, IEEE Std C57.146-2005.

ABOUT THE AUTHOR

Howard W Penrose, Ph.D., CMRP is the President of SUCCESS by DESIGN® Reliability Services and Publishing, President of AllAmericanHybrid.com, Executive Director of the Institute of Electrical Motor Diagnostics, Inc., and is the Web Editor-in-Chief of the IEEE Dielectrics and Electrical Insulation Society Website. He is a Certified Maintenance and Reliability Professional through the Society of Maintenance and Reliability Professionals. Dr. Penrose presently works on hybrid vehicle powertrain design, manufacturing and remanufacturing, as well as rotating machinery management and reliability programs for GM, US Steel and others. He is a Past Chair of the Chicago Section, Past Chair of the Chicago Chapter of DEIS, Past Chair of Fox Valley Subsection, Past Vice Chair Connecticut Section, Past Region 4 USAB Energy Representative, amongst other elected and appointed professional society duties. He has won three consecutive UAW/GM People Make Quality Happen Awards for energy and reliability programs and the 2008 Axiom Business Book Award for his book 'Physical Asset Management for the Executive – Caution: Do Not Read this on an Airplane' and his book 'Electrical Motor Diagnostics: 2nd Edition' is a finalist in the ForeWord Book of the Year Awards to be presented on May 30, 2009. To see both books, go to http://www.motordoc.com/publishing.htm both are available everywhere!



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Date	Event
June 1-3, 2009	Dr. Penrose presenting at IEEE EIC on synthetic transformer oils: http://ewh.ieee.org/conf/eic/
Aug 11-14, 2009	SUCCESS by DESIGN Electrical Motor Diagnostics Level 1. Kalamazoo, MI. http://www.motordoc.com/training1.htm
Sept 16, 2009	AIST Conference – Electric Motor Course
Sept 23, 2009	Keynote Speaker at ENEX in Toronto, Ontario – Energy Expo
Oct 27-30, 2009	SUCCESS by DESIGN Electrical Motor Diagnostics Level 1. Glen Ellyn, IL. http://www.motordoc.com/training1.htm
Nov 23-26, 2009	Energy and Environment – Maintrain Expo in Toronto, Ontario. Energy Round Table

Additional dates and times for training and events will be included in upcoming editions and on the http://www.motordoc.com website.

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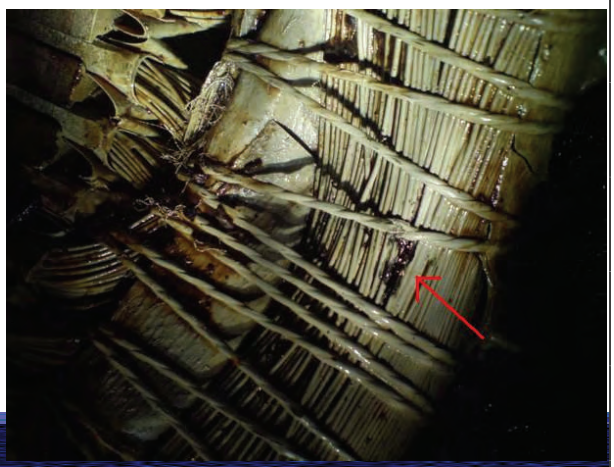

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We come to *your facility* with top experts in the energy, reliability and maintenance fields. Our training program is unique to any other. We apply our hands-on field experience as well as easy to understand theory and applications.

Off-Site Training

Most of these courses are held in centrally located, large electric motor repair facilities, so that the hands-on part of the class is with "real equipment" gathering "real data."

Distance Learning / Self Paced

This course is done via computer through ***WebEx.*** You will be assigned work session by session and then you will be given an optional exam. All work is done at the pace you feel most comfortable with.

Some of our titles include:

EMD - 1
Electrical Motor Diagnostics Level 1

EMD - 2
Electrical Motor Diagnostics Level 2

MSMM -1
Motor System Maintenance and Management Scorecard Level 1

http://www.MotorDoc.com/training1.htm

"We Do What Everyone Else Just Talks About"

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We currently have two locations: Old Saybrook, Connecticut and Naperville, Illinois

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Electric Motor Diagnostics
EMD-1

SUCCESS by DESIGN introduces a series of Electrical Motor Diagnostics classes that are neutral to any one manufacturer's technology. Whether the attendee is using basic technologies, surge testing, MCA, MCSA, or ESA, all will come away with a deeper understanding of the application and the interpretation of these technologies.

Course Instructed by world renowned expert
Dr. Howard W. Penrose, CMRP

Reserve Your Seat Now

Attendance is Limited

See Page 2 and 3 for Registration

Topics Covered In Class:

Basic Electricity and Electromagnetism
Review of motor testing technologies
Commissioning New and Repaired
Condition-Based Testing
Trending
Troubleshooting
Motor Circuit Analysis
Electrical Signature Analysis
Time to Failure Estimation™

Who Should Attend?

Maintenance and Reliability Professionals; Field Service; R&M Managers and Planners; and, Anyone else with electric machine Responsibilities.

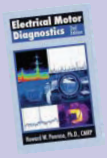
Dreisilker Electric Motors, Inc.
Glen Ellyn, Illinois

March 17 to 20, 2009
October 27 to 30, 2009

Hatfield Electric Company, Inc.
Kalamazoo, Michigan

August 11 to 14, 2009

Starting with the basic principles of electricity and electro-magnetism, the student will experience a series of hands-on demonstration and labs. A review of technologies, and their capabilities, will be covered and how they are applied for commissioning, condition-based testing, trending and troubleshooting and how some of the new insulation technologies will impact results. One day is dedicated to MCA and de-energized testing of AC induction machines and a day and a half is dedicated to ESA/MCSA testing of AC induction motors. EMD-1 is designed for any level of experience and the attendee will come away with an understanding of the impact of motor diagnostics in their industry and the capabilities of the various technologies.



Cost:

1595.00 USD per person

Includes Class Materials

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Payments:

Checks, Visa, MasterCard and Purchase Orders

Make checks and PO payable to SUCCESS by DESIGN
No Refund within 10 business days of class

Dr. Penrose has over 25 years in the electric motor industry from motor repair to advanced reliability research and applications using modern CBM and maintenance technologies. Dr. Penrose is the Executive Director of the Institute of Electrical Motor Diagnostics, Inc. (IEMD) and Web Editor in Chief of the IEEE Dielectrics and Electrical Insulation Society Web.

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See page 2 and 3 for location, dates and Registration

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Electrical Motor Diagnostics—EMD1

Location: Dreisilker Electric Motors, Inc.
352 Roosevelt Road
Glen Ellyn, Illinois

Date You Would Like to Reserve:

_____ March 17-20, 2009

_____ October 27-30, 2009

$1,595 USD per person
Check, Visa/MasterCard or Purchase Order

This Class is Technology-Neutral

Attendees are encouraged to bring their :

1. **MCA/MCSA/ESA Instruments**
2. **A Laptop Computer**
3. **All data-related questions.**

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Electrical Motor Diagnostics—EMD1

Location: Hatfield Electric Company, Inc.
3509 South Burdick Street
Kalamazoo, Michigan 49001

Date You Would Like to Reserve:

_____ August 11-14, 2009

$1,595 USD per person
Check, Visa/MasterCard or Purchase Order

This Class is Technology-Neutral

Attendees are encouraged to bring their :

1. **MCA/MCSA/ESA Instruments**
2. **A Laptop Computer**
3. **All data-related questions.**

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"When you're **prepared**, you're more confident. When you have a strategy, you're more comfortable." *Fred Couples*

"The most **prepared** are the most dedicated." *Raymond Berry*

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