The Locomotive

Implementing Electrical Preventive Maintenance – A Guide for Business and Industry

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Introduction
In today’s world we seem to take so many things for granted. Water flows from the faucet. Cool air blows from the ventilation ducts. There is a dial tone when we pick up the telephone and the lights turn on at the flick of a switch. Electric power is at the root of each of these basic services, yet electricity is almost always the most overlooked and under-appreciated utility in our daily lives. Without it, almost everything stops, including your business.

Electrical losses continue to top the list as the equipment category with the most premature breakdowns, which cost business and industry through extra expense, disruptions and lost profits. Implementing an effective Electrical Preventive Maintenance (EPM) program will go a long way to improve those statistics; however, it is no small task for the average business owner. Dealing with the numerous jurisdictional requirements, manufacturers’ recommendations, suppliers, published standards, safety requirements, and acquiring the technology required, can be overwhelming. In this article we will provide information and recommendations to help you move forward.

Why is Electrical Preventive Maintenance Important?
In our competitive business environment, with just in time delivery systems and maximized productivity, facility up time is not only critical to business continuation, but to maintaining a leadership position in your market. Over the past two decades we have seen alarming increases in frequency and severity of electrical system failures. Estimates on the annual costs to industry from power related anomalies have ranged from $30 billion to $200 billion. When an electrical system malfunctions, it is not only expensive to make repairs, but can be a disaster in terms of fire loss as well. Electrical system malfunctions are the leading cause of fire in commercial buildings.

Do I Need an EPM Program?
It is a logical question and should be asked. The answer to the question lies in your assessment of your individual business. If your business will not be negatively impacted by an unscheduled and unwanted electrical outage of your facility, and there is little risk of an electrical fire consuming the property, then the answer is likely no. However, if you are like most business facilities, if the lights go out, production is significantly reduced, or it comes to a stop.
Here are some things to consider:

- Our experience shows that on average you may expect a minimum of six hours of business interruption caused by even a small electrical failure in your distribution system.
- Today’s businesses often rely on computers or sophisticated electronically controlled production equipment that are sensitive and require a high level of power quality.
- The average business may see a 1 percent to 4 percent savings in energy costs over a non-maintained system, according to Infrared Research Inc. ("Infrared Thermography Can Prevent Energy Losses," Maintenance Technology, June 2001).
- There is increasing concern for personnel safety with electrical distribution systems.
- Do you wish to reduce your overall risk of a breakdown and the financial impacts of that breakdown?
- Statistics from the Institute of Electrical and Electronics Engineers, Inc. (IEEE) (www.ieee.org) show that you can effectively reduce your risk of an unscheduled outage by as much as 66 percent with an effective electrical preventive maintenance program (Figure 2).

How Much Do I Need?
This answer lies in the many variables you must consider for your business. There is no “one size fits all” EPM program. Every EPM program is custom-designed to fit the characteristics of the facility and vulnerability of the business. It must be driven by such things as:

- Type of business
- Redundancy in production
- Sensitivity to disruptions (customers)
- Business interruption costs
- Potential loss of good will
- Spoilage of product (consequential)
- Age of equipment
- Changes in system loads over the years (design and expansion)
− Type of loads (increasing digital loads)
− Sensitivity to power quality
− Geographical consideration (weather)
− Environmental conditions in which your facility operates (moisture, dirt, dust)

There is a balance of risk vs. reward when designing an EPM program. A cost benefit analysis is a valuable tool and your EPM service contractor should be able to help you evaluate your system, estimate costs and business impact. Always include the most critical areas of the facility. However, start at the incoming service and move down stream to those most critical areas. If any area of the facility is critical, then logic tells us that the incoming service shares that same level of criticality. Loss of main service means everything shuts down.

Do I Outsource or Perform In-House?
Many larger companies that have in-house maintenance engineers choose to perform several aspects of EPM with internal staff. It is important to remember that performing EPM tasks does require specialized training in both testing technology and safety. It cannot be overstressed that safety must be a prime factor in your decision to perform EPM with in-house engineers. Energized predictive testing is a key component of any EPM program and anytime your staff is working on live energized equipment, safety should be your primary concern.

The National Fire Protection Association’s (www.nfpa.org) NFPA 70E is the recommended standard for electrical safety. It requires certain safety protocols and specifies protective clothing design and material requirements. It requires specialized procedures, documented safety training and a working knowledge of electrical distribution systems and their components. If you do not have the skills with in-house staff, it is better to leave tasking to the professionals who use licensed electricians and technicians. They are often better trained and better equipped to handle the equipment safely.

Cost is always a consideration and the acquisition costs alone for the required testing and safety equipment can easily reach up to $200,000. It clearly does not make sense for the average small to medium sized company to make the investment. Qualified electrical service contractors have the trained people, expertise and technology to support your needs in a way that is very cost effective.

Selecting a Contractor
Experience is important. Look for a contractor that has a full-time commitment with staff and resources dedicated to electrical maintenance. The fact that a person is a licensed electrician does not, in itself, qualify someone as an EPM specialist. By the nature of their trade, most electricians typically work more on de-energized systems during new construction, retrofits or expansions. As such, the frequency of their contact with energized equipment is much less than someone who specializes in maintaining electrical distribution systems. It is estimated that 70 percent of the maintenance work is completed while systems are energized.

The test technicians and maintenance electricians require specialized training and certification to The American National Standards Institute (ANSI), U.S. Occupational Safety and Health Administration (OSHA), IEEE and NFPA 70E standards. Ask for documentation from a third party source to assure certification in such areas as infrared thermography, ultrasonic technology and safety. Power quality analysis is a complex subject requiring specialized engineering training and certification from organizations such as the Association of Energy Engineers. Ask for the credentials of their power quality experts.

Does the contractor have Professional Engineers to assist in the analysis and troubleshooting that may be required, or to assist in designing solutions when problems are found? Do they have the staff to implement those solutions when corrective action is required? Do they stand behind their work with repair or replacement guarantees if a maintained component should fail?
Testing vs. Maintenance
Predictive testing, such as thermography, ultrasonics and oils analysis are all significant components of any EPM program, but by themselves they do not make a complete maintenance program. Testing provides the feedback to the specialist before conducting the maintenance. A solid EPM program should include de-energized maintenance at least every three years on critical equipment, including the incoming electrical service from the utility. Cleaning, exercising, lubricating, relay testing and breaker testing are conducted during a de-energized state. Getting deep inside the equipment to check cable connections and torque bus connections is done only in the de-energized mode.

Where Do I Start?
First, any maintenance program must include an inventory of the system and then identification of critical loads. That helps you set your priorities. If you have up-to-date one-line diagrams of your electrical distribution system, it will help tremendously and save time. If you do not have current up-to-date one-line diagrams, then it should become a priority to develop them when you contract with the electrical service company. One-line diagrams are particularly important if a failure occurs and there is a need to install temporary power or to wire around in order to return the facility to operation. In general, an EPM program starts at the main service entrance and works its way down into the distribution system. Identify critical areas and loads that must be protected. This again helps you set priorities assuring you are focused on the most important exposures.

Many testing companies are available and provide quality colorful test reports and recommendations. There are reputable thermographic testing firms available with certified technicians; look for The American Society for Nondestructive Testing (www.asnt.org) ASNT-TC2a accredited training certification credentials. Unfortunately, with testing companies the corrective actions are often left in your hands. We suggest you look for a contractor that can test and implement recommendations and/or provide on-the-spot repairs and retest before leaving the premises.
requirements for every piece of equipment serviced. Be sure your contractor can show you his system for tasking. Ask for its safety certification as well.

An automated computerized tasking program is a real plus, because it helps to assure that every component is properly tested and maintained. It should track the progress and schedule required tasking in advance. It will house historical data for trend analysis and even keep a history of your infrared thermographic images.

**Reporting Findings and Taking Corrective Action**

Documentation is critical with electrical systems. Your contractor should provide you with a comprehensive report on every component maintained, with the results of all testing and a complete record of maintenance performed. The best programs can provide it on your desk top computer workstation, giving you detailed information on every component in your system, such as nameplate information, history, loading and trend analysis. It should provide you with a one-line equipment tree to help you understand the interconnection between electrical components.

Such electronic inventory and reporting can prove to be invaluable should a component fail. When you call your contractor, you can advise him or her of the exact detail of what is broken and in all likelihood, the contractor can have the parts on the truck when they arrive.

![Image of a computerized tasking program](image-url)
How Much Will it Cost?
Cost is always important and will vary by the size and complexity of the system, the environment in which it operates and the budgetary considerations of the business. While there are many published articles on cost justification, industry experts believe a good EPM program will pay for itself through energy savings, improved power quality, improved plant up-time and reduction in risk. A good EPM service contractor can help you develop a cost benefit analysis to justify implementation costs.

In Summary
Electrical distribution systems are the most critical segment of any facility infrastructure because, without this equipment, almost everything else stops. Whether it's the HVAC system or expensive production machines, they all need electric power to operate. Yet electrical distribution systems are often the most overlooked equipment. Through education and awareness, we see a clear shift in understanding of the need for an EPM program and a desire to change.

Look for a professional EPM contractor to help you. They are well positioned with trained and certified staff and stay current on regulatory or jurisdictional requirements. They have made the capital investment in technology, and maintain the expertise and experience to assure quality service and maximum return on your investment.

About the Author
Stephen R. Laskey is a vice president for Hartford Steam Boiler with more than 33 years of experience in HSB’s engineering, claim, loss control and loss prevention organizations. He has served in a number of capacities, ranging from field inspector to division vice president of inspection services. He currently is executive vice president of TEGG Corporation (www.tegg.com), an HSB joint venture that provides electrical preventive maintenance services to business and industry. Laskey is a graduate of St. Mary’s College in California.