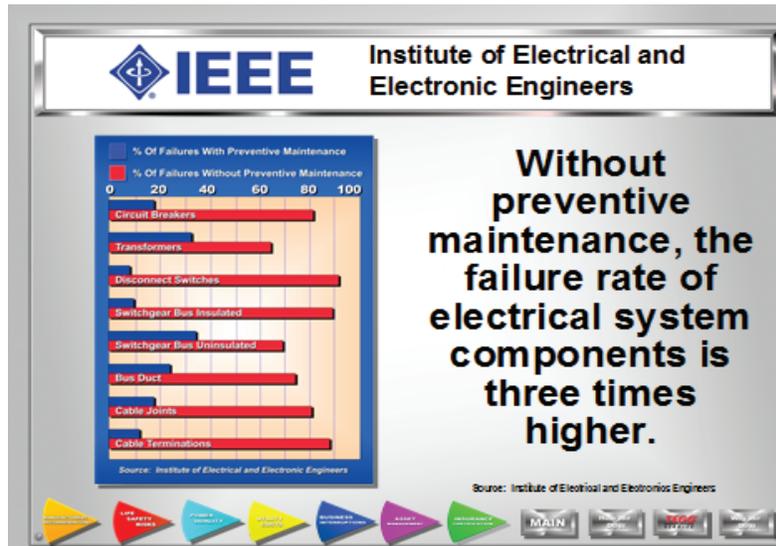


"Electricity is just organized lightning"

George Carlin

- Approximately **4,700** injuries are reported every year in the U.S. as a result of working on or around electricity.
- Electrical accidents are also blamed for an average of **one death per day**, everyday, in the workplace.
- OSHA has dubbed electrical hazards one of their '**Fatal Four**' violations found in workplaces.



The Second Law of Thermodynamics, a Universal Law, states that an isolated system moves constantly from order to disorder. This applies to all systems, from battle ships to buildings, from space stations to space heaters. Man attempts to counteract electrical entropy by developing and administering protocols such as OEM Manuals and NFPA Standards.

HOW DO YOU MINIMIZE RISKS ASSOCIATED WITH SYSTEM ENTROPY?

1. Risks Defined

OSHA : You are a building owner or manager. It doesn't matter if the people in your building are manufacturing widgets, or providing healthcare, or teaching, or just conducting general business, you are responsible for maintaining a safe indoor environment for employees and visitors. This is not new: the Occupation Safety & Health Act was enacted in 1970, including a General Duty Clause requiring that "...employer(s)...furnish to its employees...a place of employment which (is) free from recognized hazards that...are likely to cause death or serious physical harm...". On a personal note, all of us would like to go home at the end of the day in about the same condition that we were at the beginning, plus a few more miles and maybe a few more grey hairs, and we want the same for our employees, tenants, or clients. Beyond that, both OSHA and SCOSH (South Carolina Office of Safety & Health) must propose penalties when the violation is "serious in nature". We are most familiar with recordable, reportable incidents that are ad hoc "serious in nature", but even without a regrettable incident, penalties will be proposed for violations based on: (a) the size of the business; (b) the gravity of the violation; (c) the good faith of the employer or manager; and (d) the employer's or manager's history of previous violations. It's a slippery slope.

National Fire Protection Association (NFPA) 70E : Otherwise known as "Electrical Safety-Related Work Practices" focuses on implementing and documenting an overall electrical

safety program as part of an employer's overall occupational health and safety management program. This is a National Consensus Standard, meaning that OSHA regards this as vital for ensuring electrical safety. Conversely, if an incident occurs and OSHA or SCOSH determines that compliance with the standards would have prevented or lessened the severity of the injury, they may add insult to injury by fining the employer or manager according to the vague but very real scale noted in items (a) through (d) above. Note that for employers with multiple sites that have a recordable incident investigated at just one site, any penalty imposed for that one site will be duplicated for all other sites if they are on the same safety plan as the incident site!

Risk Management : You may have direct or indirect employees responsible for risk management. More likely, you have outside consultants, as part of your insurance coverage or not, who are in a position to take a targeted approach to the risks inherent in your business. We are seeing more attention being paid to potential electrical failure modes by risk managers, because they are recognizing the costs associated with injury or death, lost production, premature failure of capital equipment, and fire. Many are hitting a great number of 'best practices' that are part of NFPA 70E and 70B (Electrical Equipment Maintenance), including breaker coordination and short circuit analyses. The best news is that, when these protocols are implemented, there is an immediate and significant reduction in cost for insurance premiums (or an avoidance of cost increases).

2. Electrical Preventive Maintenance

Both NFPA 70B and the International Electrical Testing Association (NETA) have recommended scope and frequency for electrical preventive maintenance. They are quite similar in that they call for both energized and de-energized testing of electrical distribution components, and both have frequencies ranging from every 3 months to every 3 years. NFPA 70E refers to NFPA 70B throughout, and, in the 2015 edition, emphasizes the need for periodic maintenance in articles 200-230 *because if protective devices don't operate as designed then arc flash potential calculations (described below) are out the window and employers and managers could be sending employees and contractors into harm's way without proper PPE based on the true risk.*

Electrical Distribution Preventive Maintenance (EDPM) then is vital for these reasons, but what does it look like? Whether you do it in-house or if you outsource, these are the key components:

Establish a baseline – conduct and document infrared and visual images, highlighting: hot spots, their reasons for being hot (harmonics, arcing, overloading, phase imbalance, improper grounding, etc), and repair priorities; typical installation problems such as bonding, grounding, grounding to neutrals, inadequate neutrals, double lugging, phasing tape, missing knockouts, etc; and if you are able, utilize ultrasonic scans. Just as infrared is looking at wavelengths longer than we can see, ultrasonic is listening at frequencies higher than we can hear. At these high frequencies, one can hear arcing, tracking, contact resistance, destructive corona, and other anomalies on a molecular level in advance of IR (if it sees it at all), providing longer lead times before failure.

Prioritize repairs – not all problems are created equal. At the low end of the scale, things heard with ultrasonic and temperature differentials between phases under similar load found with infrared that are less than 14.4 degrees F are lower priority; they are deteriorating but it will be weeks or months before they fail. Most visual problems as noted above should be treated as a high priority as they lead directly to failure, are often safety related, and are cheaper to fix. Temperature differentials of 14.4 degrees F to 27.0 degrees F are “severe”, and greater than 27.0 degrees F are “critical”: failure and its consequences are just around the corner and need to be addressed promptly.

NFPA 70E as relates to preventive maintenance – while you or your contactor are conducting the above described energized service, the electrician is qualified, is wearing proper PPE, and the covers are open. Take advantage of this. Gather information on line side ground fault potential, and conductor types, lengths, and sizes; capture breaker manufacturer, model numbers, and trip settings if variable; get load side fed from/to data; and note all motor horsepower by circuit. This provides multiple benefits, two of the biggest are that you now own the data and you avoid costly engineering surveys to capture the same information. A consulting engineer can then perform calculations, print labels, and provide electrical one-lines required by the standard; and you will retain the data for faster, less costly arc flash updates that are required when you make major changes to your system or every 5 years, whichever occurs first. One last thought: heaven forbid, but if you ever had a recordable incident and OSHA investigates, they will be looking not only for arc flash labels and calculations, but also PM records including repair data.

3. NFPA 70E

The Standards Council of the National Fire Protection Association announced on January 7, 1976, the formal appointment of a new electrical standards development committee. Entitled the Committee on Electrical Safety Requirements for Employee Workplaces, NFPA 70E, this new committee reported to the Association through the Technical Correlating Committee on National Electric Code. This committee was formed to assist OSHA in preparing electrical safety standards that would serve OSHA’s needs and that could be expeditiously promulgated...

The 2015 Standard can be boiled down to 6 key points: (1) plan, conduct and document regularly scheduled electrical preventive maintenance, repair found anomalies; (2) perform arc flash risk assessment and apply labels; (3) generate and post updated one-line diagrams; (4) maintain an updated NFPA 70E safety plan; (5) train and qualify employees in NFPA 70E compliance; (6) provide employees with Personal Protective Equipment (PPE).

A few comments: all 6 key points can serve to either increase or decrease OSHA proscribed penalties, so you want to be on the right side on all of them; item (3) is to assure that technicians have ready access to information critical to their safety, they need to be sure that when they lock out and tag out the circuit serving a particular piece of equipment and that equipment is not and cannot be back fed from a different source; item (5) a Qualified Person is one who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and

installations and has received safety training to identify and avoid the hazards involved (this can come from an apprenticeship program or via a card-carrying Journeyman or Master Electrician, but it is best to have attended specific 70E training from an accredited NFPA trainer); item (6) appears benign on the surface, but the selection of PPE is dependant upon the engineered risk categories which can be lowered with breaker coordination, and furthermore, you don't want to burden technicians with Category 4 space suits that can contribute to mishaps on the job.

4. What if you don't comply?

Good question, glad you asked. If you are not able to comply with all six key points due to lack of manpower, expertise or funding, it is recommended that you have all technicians dress out in Category 4 PPE for all energized work. In addition, the *Energized Electrical Work* Permit should be completed for every job, acknowledging in Part II Sections (3) and (4) that these risk assessments are not available. Only if management, maintenance engineering, and the electrically qualified person commit to and document that the work can be done safely (with Cat 4 PPE) should you proceed. Note that penalties can be mitigated if you can demonstrate that you have at least started the process by showing evidence of proactive PM's and repairs, or an electrical safety program, or having qualified persons and PPE in house.

5. The Best News

It looks like this is a lot of time and expense, and for what benefit in addition to preserving life and limb. Here is a summary of some financial benefits to going down this road:

- Avoid OSHA penalties for your site and sister sites
- Reduce insurance premiums (or avoid premium increases)
- Reduce risk of fire
- Reduce costly business interruptions
- Reduce workers compensation claims and premiums
- Reduce spare parts inventory
- Reduce maintenance costs by 25%-35% (planned maintenance costs 1/5 to 1/10 of unplanned emergency repairs)
- Increase Return on Assets (an increase of just 2%-5% in availability and yield increases earnings by over 75%)

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