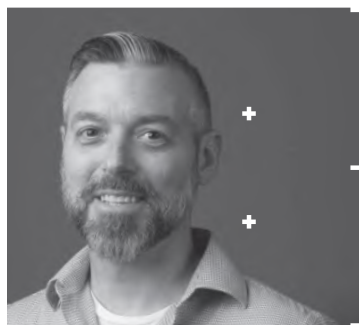


# Cancel Your Subscription to Electrical Safety Issues

by **Michael Riccio**  
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The review of statistics blatantly demonstrates there is a severe lack of safety in the electrical world that results in an incredible amount of injuries, fatalities, and cost.

**Problem solving** is a skill we are all taught from a very young age, and as we mature it becomes more and more of a life requirement, not just as individuals, but as teams, organizations and markets/industries. The electrical world, like most other industries, should be focused first on avoiding problems and then solving any if they arise. That comes down to proper program design, where protection systems and policies are put in place to prevent worker injuries/fatalities, equipment/operational downtime, and lost revenue.



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As noted in the previous article, [Tragedy & Expense: The High Cost of Low Electrical Safety Standards](#), the industry continually falls short of enacting effective protection systems and annually makes OSHA's "Top Ten" for these failures. As much effort as the industry puts into developing and adhering to programs that meet governing bodies' standards, the numbers show failure in worker protection.

According to the Bureau of Labor Statistics (BLS), electrocution is the fifth leading cause of workplace fatalities in the United States. Within the electrical industry where workers are exposed to this possible hazard





daily, this might seem like a basic fact. From a wider perspective, however, the number is surprisingly high when we consider how few people in the overall American workforce perform “electrical-related work” as part of their standard job duties.

Another concern to take note of is that electrical shock is the second leading cause for lost time on the job in the electrical world. Every thirty minutes during the workday, as reported by the Electrical Safety Foundation International, a worker suffers an electrical-induced injury that requires time off the job. Their study further found that 97% of

electricians have been shocked or injured on the job. Arc flash fatalities are not counted in this statistic; they are logged under burn injuries, meaning that the rates are even higher. One of OSHA's recent reports show that 80% of electrical-related accidents and fatalities involving “Qualified Workers” are caused by Arc Flash or Arc Blast.

2,000 workers are treated in specialized burn trauma centers each year from arc flash injuries. These high-tech facilities only treat the most devastated burn victims – those who have sustained incurable third-degree burns over more than half of their body.

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To put the severity of burns into perspective, BLS reports that 60% of workplace fatalities are caused by burn injuries. Arc flash injuries are much higher than reported because workers receiving treatment for trauma and burns that do not require burn unit attention (*i.e.*, second-degree burns or third-degree burns covering less than half their body) are admitted to standard hospitals which do not track the burn source.

The number one killer of IBEW (International Brotherhood of Electrical Workers) trained electricians (admittedly the safest trained electricians overall) is shock and/or falling when changing a 277 V lighting ballast. This is a common task and often the fatality is recorded as a fall death or a heart attack, and not as an electrical incident. However, doctors, OSHA and company officials are becoming aware of the true cause of the fatality. A new part of the NEC prevents this type of incident from occurring by requiring the addition of a disconnect at every lighting ballast on 277 V lighting.

Equipment reliability, along with protection systems, is key to creating a safe and effective operation. Field tests and surveys have shown that 22% of breakers operate at less than 100% efficiency (slow trip), and more than 10% have been shown not to open at all. Even the slightest delay in the operation of a breaker or fuse, will double or triple the available incident energy in an arc flash event.

More accidents occur with 480 V equipment than on higher voltage equipment. Incident numbers with 480 V equipment is often higher than in higher voltage equipment due to the increased current and higher clearing time in these applications

when compared to higher voltage applications.

Incident energy calculations, and therefore PPE selection, are based on equipment that is "properly installed and properly maintained". Most manufacturers recommend exercising breakers at least once per year to lubricate the inner working of the breaker mechanisms [1].

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### The Keys to Driving Safety

The most effective way to achieve success in protecting electrical workers, assets, and operations, is to follow a *Problem* → *Action* → *Solution* approach. The above review of statistics blatantly demonstrate that the Problem is a severe lack of safety in the electrical world that results in an incredible amount of injuries, fatalities, and cost. The next step is to analyze the *Actions* that are causing these problems, or as the electrical world refers to it, do a *Root Cause Analysis* to identify hazards. Once those issues have been identified, the *Solution* is simply to fix them by designing a system that both eliminates them presently and prevents future occurrences. "Simply" is the key, because the solution will only work if the program is designed with enough simplicity that it is teachable, understandable, and repeatable.

What are the Electrical Hazards? The four primary hazards associated with electricity are shock, fire ignition, arc flash and arc blast. Of course, when an electrical incident occurs, other hazards may come into play such as falls from elevated locations and working within a confined space. The results can be direct, such as electrocution, burn injuries, or indirect such as a fall or smoke inhalation. Common conditions that may increase hazards are elevated locations and confined spaces.



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### Worksite analysis

Worksite analysis is key to identifying and understanding current risks. Workers and Management should actively analyze the worksite to anticipate and prevent hazards from occurring. This involves identification of all hazards by conducting baseline worksite surveys for safety and health and periodic comprehensive update surveys. Also included would be an analysis of planned and new facilities, processes, materials, and equipment; and another of routine job hazards. Regular site safety and health inspections should be conducted, so that new or previously missed hazards and failures in hazard controls are identified.

### Hazard Prevention and Control

Once a hazard or potential hazard has been identified, the next step is to determine how to control or prevent that hazard. When feasible, prevent hazards by effective design of job or job site. Where elimination is not feasible, the action is to control hazards and prevent unsafe and unhealthful exposure. A proper risk assessment should be done during this stage, where risk is compared to the effort required for removal. It is reasonably practicable if a risk can be removed at minimal cost and effort, however it is not reasonably practicable if the cost of removal of risk is disproportionately high.

### Asset Management and Design Strategies

The aim of any solution is to provide the "maximum amount of protection" by eliminating or minimizing the exposure or hazard. Elimination and Substitution are the most important levels in NFPA's Hierarchy of Controls, and how you prevent or control a hazard. The main goal for any fix to a hazard or exposure is to eliminate it altogether or substitute a product or method of doing the work to a less hazardous alternative.

A major part of asset design and procurement relies heavily on the input from the Original Equipment Manufacturer (OEM), which significantly impacts the ultimate design, reliability, and success of a project.

### Together, Be "Better"

Some may look around their facilities and think they have electrical safety "best practices" well in hand, but the term "best practices" is a flawed concept itself. "Best" denotes a superlative, where the pinnacle has been reached and nothing can be improved. Instead, a focus on "better practices" should be the top-to-bottom standard. Much like industry innovations for production and distribution never settle for status quo, safety practices should also strive towards perfection with the understanding that it will never be reached.

This can be achieved through an "all-hands, top-to-bottom" approach to designing and implementing an effective and adaptable electrical safety and reliability program. Some may argue that too many cooks in the kitchen will spoil the dish, but without 100% commitment from the entire team, no plan will work. The key is to a shared understanding of who is responsible for what, and how everyone's role fits into the bigger picture.


### Principles of system design in high availability engineering to be aware of:

1. **Elimination of single points of failure means adding redundancy to the system so that failure of a component does not mean failure of the entire system.**
2. **Reliable crossover. In multi-threaded systems, the crossover point itself tends to become a single point of failure. High availability engineering must provide for reliable crossover.**
3. **Detection of failures as they occur. If the first two principles are observed, then a user may never see a failure. But the maintenance and reliability activities must be designed to detect early signs of impending failure.**

1. As much as 60% of failures & safety issues can be prevented by making changes in design
2. 80% or more of a facility's life cycle cost is fixed during the plan, design, and build phases
3. 30-40% of equipment breakdowns are related to poor equipment design or condition

**⚠ CAUTION**

**ARC FLASH AND SHOCK HAZARD**  
Appropriate PPE and Tools Required When Working on This Equipment.



Occupational Health & Safety standards are a clear statement as to the general responsibility of both employer and employee:

#### General duties on the employer

- provide safe place of work
- provide safe plant and equipment
- provide safe systems of work

#### General duties on the employees

- to take reasonable care
- to co-operate with the employer
- not to interfere with safety arrangements

Management commitment and employee involvement go together. Top management involvement should be visible, with the authority and resources to implement program. Their involvement in implementing the program is crucial so that all employees understand it is a serious commitment. This commitment provides the motivating force and resources for organizing and controlling activities within an

organization and ability to get things done and requires that responsible parties have the necessary authority and equipment, so that assigned responsibilities can be met.

Encouraging employee involvement in the program and in decisions that affect their safety and health (e.g., inspection or hazard analysis teams; developing or revising safe work rules;

training new hires or co-workers; assisting in accident investigations) provides the means through which workers develop and express their own commitment to safety and health protection. Making use of everyone's insight not only creates a synergy among participants, but also a shared sense of ownership that leads to participants holding themselves and each other accountable.

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#### References

- [1] NFPA 70E, Standard for Electrical Safety in the Workplace, accessed here: <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70E>

