Electrical Injuries in the Workplace

What Role Does the Normalization of Deviance Play?

By Richard Campbell

According to statistics from U.S. Department of Labor, more than 12,000 workers experienced an electrical injury between 2011 and 2015, averaging more than 2,500 injuries a year. More than 750 workers in the U.S. were killed in workplace electrical incidents over the same 5-year period (BLS, 2018). These numbers identify electrical injury as a substantial workplace safety and health concern made all the more significant by the severe nature of many electrical injuries (Arnoldo, Purdue, Kowalske, et al., 2004; Noble, Gomez & Fish, 2006). Understandably, these statistics underscore the need for ongoing attention to injury prevention.

In truth, there is no mystery about the best way to avoid electrical injury. As codified in NFPA 70E, Standard for Electrical Safety in the Workplace, and common in electrical safety training, standard safety procedure calls for turning off the power before beginning work on electrical equipment, effectively eliminating the hazard at the source (NFPA, 2014). While this sounds like a simple step to take, research indicates that many workplace electrical injury victims were aware that equipment was energized at the time of injury, but performed the work anyway (Cawley, 2003; Wellman, 2012). For those whose injuries were not fatal, the experience plausibly served as a warning about what not to do next time. But how do we explain why someone would do something s/he already knows is highly risky?

Decisions to take shortcuts with safety are often influenced by a host of pragmatic concerns such as time pressure, fear of reprisal if work does not get done on time or reluctance to take a chance on losing a customer. Despite those factors, the descriptions of electrical injury incidents suggest that something else is often going on when workers do not turn off the power, namely, that working on equipment while it is energized is accepted as normal procedure in many situations when formal safety procedures say otherwise. That is, what comes to serve as standard safety practice is not always based on formal protocols, but instead may be guided by unwritten norms that are developed through work experiences and interactions with coworkers, supervisors and others. While not formally codified, the influence of such off-the-book standards may be instrumental in influencing safety practices.

In her study of the ill-fated *Challenger* launch incident of 1986, sociologist Diane Vaughn (1996) coined the term *normalization of deviance* to describe how gradual deviations from normal or acceptable practice by space shuttle engineers came to constitute a new normal, even if it was clearly divergent from prevailing standards.

Vaughn's analysis focused on the assessment of joints on solid rocket boosters of the space shuttle. In brief, O-rings on the shuttle's solid rocket boosters were sealed with putty to provide protection from hot gas inside, and it was discovered during test flights that bubbles would form in the putty. The bubbles were not an anticipated outcome, but because simulations showed that the primary O-ring could still do its job with observed levels of erosion and that a second O-ring was capable of sealing the solid rocket booster if a higher degree of erosion was experienced, the unanticipated result was deemed acceptable and did not require any interruption in shuttle flights. A change in the putty composition provided higher confidence that the integrity of O-rings was not a critical concern.

Space shuttle flights continued to experience issues with O-rings as the space shuttle program proceeded, but erosion was generally within the range

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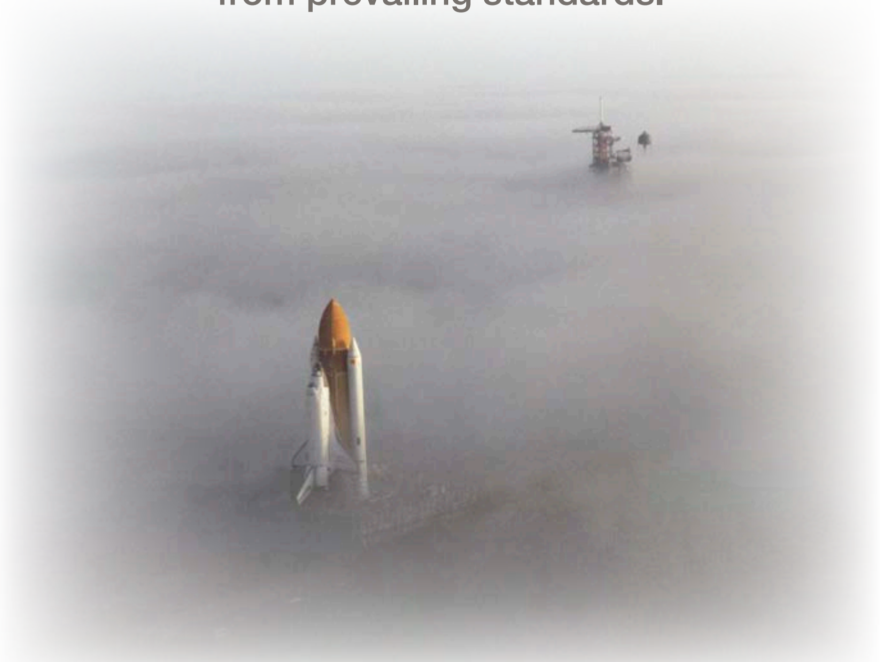

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of past experience and considered to be within acceptable safety margins, a conclusion that was tacitly reinforced each time a flight returned safely.

Even as the 12th mission raised a new issue after a tiny amount of soot was detected behind the primary O-ring, indicating penetration by hot gas, the response was to make an informal adjustment in the assessment of acceptable risk, this time because the secondary O-ring was unaffected by the blow-by. In subsequent missions, erosion and blow-by continued, with new anomalies arising, and new tolerances became incorporated into assessments of acceptable risk.

In sum, each time a deviation with no harmful consequences occurred, the limits of acceptability were stretched, and what should have raised red flags became normal performance, until a disaster eventually occurred.

Application to Electrical Safety

A similar dynamic may be at work when workers fail to lockout and tagout energized equipment, wear appropriate PPE or follow other safety practices. Adhering to safety procedures can be time consuming and may feel less satisfying than accomplishing the work task, which produces a tangible result and a sense of achievement. Rather than going through the laborious process of prejob planning, shutting off the power or retrieving the right gear that was left in the truck, it may be tempting to repeat a shortcut that was used in the past without incident. After all, the thinking goes, not every failure to follow electrical safety guidelines results in injury, and undoubtedly most times it does not. If shortcuts with electrical safety have worked without incident in the past, they may easily be seen as normal rather than deviant.

Suggesting that this may be common in electrical safety practice is not just a speculative exercise. In fact, many electrical injury studies indicate that taking liberties with safety procedures is not unusual. For example, a study by NIOSH researchers of arcing injuries in the mining industry found that in 55% of cases studied, workers were aware of a hazard but engaged in risky behavior anyway (Kowalski-Trakofler & Barrett, 2007). In interviews, electrical injury victims indicate that the injuries could have been prevented; the prevention method most often referenced was to turn the power off. Another study of arc flash injuries found that the most common work task leading to injury was replacing fuses, and that a considerable number of these injuries occurred while changing fuses without first turning off the power. Similarly, a study of electrical deaths of construction workers found that working on or around energized equipment or wiring was a major cause of injury, and that in many instances, the injury events did not require working on live equipment (McMann, Hunting, Murawski, et al., 2003). Such findings are an indication that the risks of unsafe work practices are not being recognized because they have become acceptable and normalized.

Electrical injuries are not just an unfortunate by-product of hazardous work. Injuries are preventable and methods for preventing them are well established. But safety procedures can only be effective if they are recognized as necessary and legitimate by all parties and are consistently practiced. Employers can help by establishing expectations for complete compliance with safety protocols, including with supervisors, who may otherwise be torn between delivering on productivity and ensuring safety.

As part of this effort, it is critical to ensure that adequate time is factored into job assignments to allow implementation of safety procedures, and also to ensure that all job assignments include personnel with appropriate safety training. It is important for those who work with electrical hazards to understand that although safety shortcuts might not always end badly, the negative results far outweigh the ephemeral gains reaped from shortchanging safety.

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References

Arnoldo, B., Purdue, G., Kowalske, K., et al. (2004). Electrical injuries: A 20-year review. *Journal of Burn Care Rehabilitation, 25*(6):479-484.

BLS. (2018). Occupational injuries and illnesses and fatal injuries profiles. Retrieved from https://data.bls.gov/gqt/InitialPage

Cawley, J.C. (2003). Electrical accidents in the mining industry, 1990-1999. *IEEE Transactions on Industry Applications*, *39*(6), 1570-1577.

Kowalski-Trakofler, K. & Barrett, E. (2007). Reducing noncontact electric arc injuries: An investigation of behavioral and organizational issues. *Journal of Safety Research*, *38*(5), 597-608.

McMann, M., Hunting, K.L., Murawski, J., et al. (2003). Causes of electrical deaths and injuries among construction workers. *American Journal of Industrial Medicine. 43*(4), 398-406.

NFPA. (2014). Standard for electrical safety in the workplace, 2015 edition (NFPA 70E). Quincy, MA: Author.

Noble, J., Gomez, M. & Fish, J.S. (2006). Quality of life and return to work following electrical burns. *Burns, 32*(2), 159-164.

Wellman, C.M. (2012). OSHA arc-flash injury data analysis. *IEEE IAS Electrical Safety Workshop*, 1-5. doi:10.1109/ESW.2012.6165547.

Vaughan, D. (1996). *The Challenger launch decision: Risky technology, culture and deviance at NASA*. Chicago, IL: University of Chicago Press.

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