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# Improving Electrical Safety with Audits

One Program Element  
That Can Improve Electrical Safety Compliance by 40%

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## CONTENTS

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The Problem: Learning or Doing?	2
How Do I Gain >40% Compliance?	4
How Auditing and Training Lead to Such Great Results?	6
Summary	6

## The Problem: Learning or Doing?

I walked into the room to do electrical safety training like I have done thousands of times before and looked around the room. It was a Saturday; I was in my hometown. We do training all over the world but when I train at home I can't help but wonder if these guys are someone I know. Are they husbands or wives of friends? Do my kids go to school with them?

Like so many times before, I walked into a company which had received an OSHA citation due to an employee complaint. So they decided to improve their safety program and become an OSHA VPP (Voluntary Protection Program) site. These programs began in California under Cal-OSHA in 1979 followed by Federal OSHA in 1982. After years of experimenting, Federal OSHA offered the program to all employers in 1998. Basically VPP sets performance-based criteria for a managed safety and health system. One of the current issues they are focusing on is electrical safety. Companies which clear the hurdles of improvement in VPP are not cited by OSHA since OSHA is regularly auditing and helping improve their program. Electrical incidents are the fifth leading killer of employees so it is an important focus and especially so since the 2000 version of NFPA 70E made arc flash a household word and common in safety circles. Interestingly enough this site had been in the process for VPP for some time and just identified the electrical safety need after an OSHA consultation. The problem is the same I see everywhere and it affects all safety.

Most companies trying to comply with safety standards start with PPE or a written program. PPE is important and should be put into place quickly but as the old adage goes "PPE should be the last resort," so from a program perspective a company should quickly standardized approaches. The disadvantage of these standardized methods is they are theoretical and don't get to the most "bang for the buck" quickly and most people see them as an exercise in futility or just "more paperwork without results". We have had clients who had employees die while they were commissioning arc flash studies, so don't ignore the PPE but don't stop there. Some common processes for building a safety program focus on hazards and programs while others focus on behavior. Each of these has merits but a good program must do all these things. A common outline for developing a safety program is below:

1. Establish the value of safety, not just a priority that can be shifted.
2. Create a safety program by:
  - a. Hazard Identification
  - b. Hazard Evaluation
  - c. Hazard Control
3. Educate management and supervision so they support, value and grow the program (commonly skipped step).
4. Begin measuring safety as a part of job performance.
5. Make safety, and planning for it, a job site priority.
6. Make all employees responsible for, and accountable for, safe behavior.

The problem with most safety programs from an electrical standpoint is that the safety departments often do not have the technical expertise to do electrical safety. But electrical safety must be managed as part of an overall safety program.

OSHA has electrical safety requirements, but they are insufficient to build an electrical safety program around except in the case of electric utilities (29 CFR 1910.269 especially since 2014 when this standard superseded the NESC). Most OSHA 10 Hour courses have an electrical safety component but they tend to be *very* cursory (they

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are adequate in most cases, if a plant does not have electricians or do its own electrical work). NFPA 70E Standard for Electrical Safety in the Workplace® is recognized as the consensus standard related to electrical safety and outlines requirements for an electrical safety program in article 110.1.

To be effective, electrical safety programs must have an overall safety improvement process built into the technical electrical safety program. The NFPA 70E committee recognized this factor and included informational notes (IN) which are non-mandatory but encompasses a whole range of changes in how electrical safety will be done in the future. A version of the first two INs have been included since the 2009 edition, the others were added in 2015. In article 110.1(A), they simply state,

**“Informational Note No. 1:** Safety-related work practices such as verification of proper maintenance and installation, alerting techniques, auditing requirements, and training requirements provided in this standard are administrative controls and part of an overall electrical safety program.

**Informational Note No. 2:** ANSI/AIHA Z10, *American National Standard for Occupational Health and Safety Management Systems*, provides a framework for establishing a comprehensive electrical safety program as a component of an employer’s occupational safety and health program.

**Informational Note No. 3:** IEEE 3007.1, *Recommended Practice for the Operation and Management of Industrial and Commercial Power Systems*, provides additional guidance for the implementation of the electrical safety program.

**Informational Note No. 4:** IEEE 3007.3, *Recommended Practice for Electrical Safety in Industrial and Commercial Power Systems*, provides additional guidance for electrical safety in the workplace.”

They are simple but using the ANSI Z10 and the IEEE standards listed brings a holistic approach to electrical safety. Note that even though IN’s are non-mandatory, they often foreshadow upcoming moves by the committee or very important understanding the committee assumes are good practices. OSHA VPP normally includes requirements to use the Z10 standard. Consider some of the requirements of ANSI Z10-2012:

1. Requires a safety management system. This is a proactive, standardized process for continuously assuring and improving element effectiveness.
  2. Requires establishing policy and objectives that use an organizational structure with systematic documented roles, responsibilities, processes and resources to obtain objectives.
  3. Emphasizes continuous improvement and systematic elimination of root causes of deficiencies.
  4. Requires management leadership and employee participation.
  5. Requires planning and ongoing review, assessment and prioritization of objectives by implementation of plans and allocation of resources.
  6. Implementation of the OH&S System which includes the following elements:
    - a. Hierarchy of Controls
    - b. Design Review and Management of Change
    - c. Procurement
    - d. Contractors
    - e. Emergency Preparedness
    - f. Education, Training, and Awareness
    - g. Communication
    - h. Document and Record Control Process
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7. Evaluation and Corrective Action
  - a. Monitoring and Measurement
  - b. Incident Investigation
  - c. Audits
  - d. Corrective and Preventive Actions
  - e. Feedback to the Planning Process
8. Management Review: Outcomes and Follow Up

Many companies have their safety program operating in the ANSI Z10 format to some extent but they often place electrical safety under the engineering department and only parts are actually “owned” by safety. In order to get real compliance improvement, the safety process must infiltrate the electrical maintenance world. Implementation of a strong consensus standard (NFPA 70E/CSA Z462 for the US and Canada, respectively) within a continuous improvement process framework will bump up the quality of any electrical safety program.

***We recommend the following elements for an electrical safety program (See NFPA 70E, Annex E):***

1. Inspect/evaluate the electrical equipment for code compliance
2. Maintain the electrical equipment’s insulation, enclosure integrity and operational reliability: esp. breakers and fuses.
3. Plan every job and document first-time procedures
4. De-energize whenever possible
5. Anticipate unexpected events
6. Identify and minimize the hazard
7. Protect the worker from shock, arc and other hazards
8. Use the right tools and PPE for the job
9. Assess, audit & document worker’s skills
10. Audit the principles of the applicable standards
11. Audit both employees, contractors and service personnel for proper electrical safety (contract employees are not covered under your company’s worker’s compensation insurance and represent a greater liability if not working safely)
12. Report and investigate incidents and near misses
13. Put action items in place from audited issues and improve, the program document, written procedures, PPE and any other findings from audits and incident root cause analysis.

## **How Do I Gain >40% Compliance?**

1. **Train.** Training raises compliance by 10-50% depending on the behaviors. The general study was on basic behaviors like hard hats etc. Electrical safety habits are new and often not as well-known as basic safety.
  2. **Set Goals and Measure.** You have to measure the RIGHT things. Measuring behaviors like flash suit use might take years to develop baseline data but measure behaviors like:
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- a. De-energizing, Lock Out/Tag Out,
- b. Wearing of rubber insulating gloves
- c. Verification of meter and absence of voltage
- d. wearing of basic arc rated daily wear
- e. Wearing flash suits for higher level exposures
- f. Use of insulated tools
- g. Testing of rubber insulating gloves, blankets and other insulated equipment

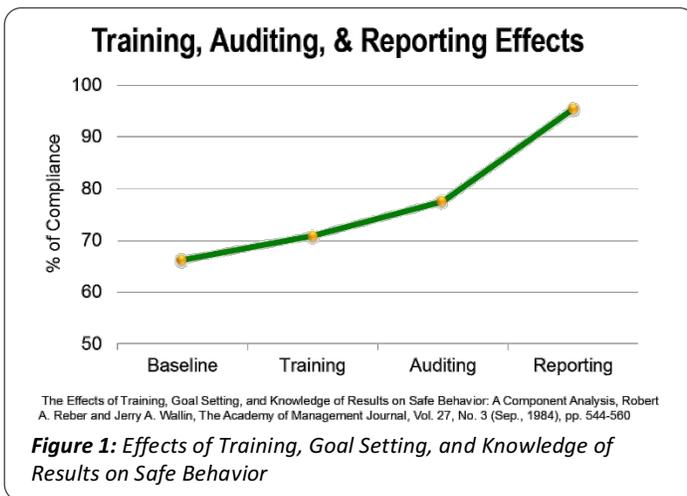
This list isn't inclusive but these behaviors are easy to measure and give BIG results. Most incidents involved no injury when the elements above are used.

3. **Audit, Audit, Audit.** We recommend a three tier auditing strategy.

- *Year One:* Have an outside firm audit giving you a framework for audit.
- *Year Two:* Audit your own site as a safety person.
- *Year Three:* Have another safety person/electrical person from within your company audit your site and you audit their site (cross-pollination).

Start the process over again.

This three step approach to auditing will be more cost effective AND get better results. Auditing is a learning tool. Outside firms and other people have different approaches, and you can learn and teach others about what you have learned or seen. Training is great but it isn't a "be all, end all." When I say training here, I mean event training. High impact training can get some results; it gets attention and introduces concepts. Detailed technical training also is effective but goes over the heads of some workers and is no more successful in changing behavior than high impact training. Training increases compliance by about 10-40% up to about 77% at the best. Training, auditing and retraining takes you over the top to much better compliance. *People don't do what you expect; they do what you inspect.* The chart above is based on the data in *The Effects of Training, Goal Setting, and Knowledge of Results on Safe Behavior* by Reber et.al. <sup>1</sup>



*The Effects of Training, Goal Setting, and Knowledge of Results on Safe Behavior* by Reber et.al. <sup>1</sup>

In simple safety behavior like "horseplay" Reber et. al. found the workforces studied were about 65% compliant (common in basic safety). Training alone improved compliance by about 12%. Measurement of clear goals and knowledge of results could improve compliance to about 95%. The baseline for electrical safety we have found is not this high but statistically we use their argument as we continue our studies. The greatest results come from measuring AND sharing the results. Again, people don't do what you *expect*, they do what you *inspect*. Historically, electrical safety was only

<sup>1</sup> The Effects of Training, Goal Setting, and Knowledge of Results on Safe Behavior: A Component Analysis, by Robert A. Reber and Jerry A. Wallin, The Academy of Management Journal, Vol. 27, No. 3 (Sep., 1984), pp. 544-560

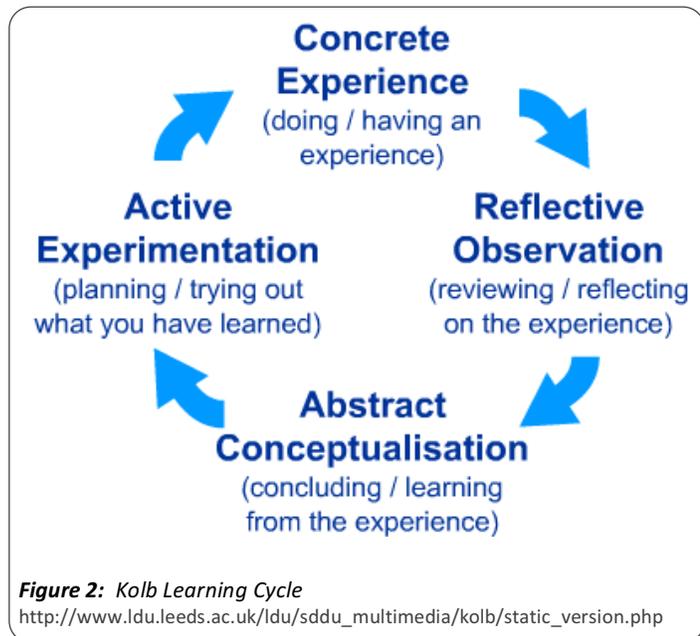
inspected by the journeyman or the manager of that department. No one came in from the outside to audit electrical safety. If safety audits were done, little in the audit related to electrical safety and almost nothing related to electrical safe work practices. That is changing.

## How Auditing and Training Lead to Such Great Results?

To really succeed in the safety profession, we must be students of learning and adult psychology. Kolb developed a learning cycle after extensive research and it can help with understanding why auditing is so important.

All learners go through phases of learning. Some of these phases happen quickly if the behavior is readily understandable or easy to implement. Behaviors can change quickly but individual differences and differences in behaviors can make behavior change more difficult. Even if a new behavior takes less effort initially some people may reject it because they don't believe it's important. Change itself is difficult and other issues can affect change.

How do adults learn? Kolb says, we experience, reflect/review, learn/conclude and try it out every day. In event training, if the learning can't be implemented because of hindrances in the workplace, peer pressure or whatever, it will often be unlearned or forgotten.



Goal setting and auditing help training get implemented. When you set goals and audit them it helps identify failures in motivation, systems (you can't wear rubber insulating gloves if you don't have them), and understanding (frequently with new behaviors, especially complex ones, people don't fully understand the requirements). Auditing basically becomes more training and helps clarify the behavioral goals and tweak the system so these objective goals can be met and have the desired effect of no injuries.

## Summary

Companies who want to operate safely must have systems which allow for learning, and evaluation of behavioral change. Training alone is not enough to reach compliance in most cases. Statistically it has been shown that Training, Goal Setting, Auditing and Communication of Results have been effective in increasing company compliance to safety standards. Implementing both training AND auditing into your compliance toolbox will raise the bar in your company more than most methods.

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