JMKENGINEERING How to Create and Electrical Safety Program

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Revision History

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Table 1 Revision History



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Appendix A - Work Authorization



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1. What is an Electrical Safety Program?

Electricity is a powerful and dangerous tool used by people all over the world. According to the ESFI (ESFI 2015), between 2003 and 2010 there have were 1,635 workplace fatalities related to electricity in the private industry. Between 2003 and 2010 there were also 20,150 nonfatal electrical injuries involving days away from work in the private industry. Although the number of accidents related to electricity has been dropping steadily every year, the fact is that one accident is one too many. It is very important for your workplace to have an electrical safety program to help lower the risk when working around energized equipment.



Figure 1 Industrial Facility

An electrical safety program is a list of rules and procedures that must be followed by employees working with electrical equipment at your facility. You may already have a safety program in place, so why would you want one specific to electricity? There are a handful of excellent reasons for this:



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- 1. An electrical safety program will ensure that employees are well informed and have up-to-date training for their jobs. A major cause of electrical accidents is untrained workers wearing insufficient PPE. Well trained, well informed workers will cause fewer accidents.
- Fewer accidents means money saved. Statistics gathered by the NFPA show that the average electrical accident costs \$80,023 (Richard B. Campbell 2015). This cost includes both workers' compensation (medical bills and wages while unable to work) as well as equipment costs.
- 3. It can increase productivity by causing you to schedule your work better. Before you work on it, equipment should always be de-energized when possible. Having a procedure in place for scheduling this type of work ensures that work on one system is not impacting the operation of another electrical system. This leads to greater uptime for your facility.
- 4. It makes it easier for you to adapt to changing safety standards. When you're on the bleeding edge of safety progress, it will be easier for you to adapt to changes to any standards you currently follow. When it comes to safety, you want to lead from the front, not follow behind.
- 5. Having an accident-free workplace builds trust. You won't have unexpected shutdowns and won't be incurring high accident costs. Your leading stance on safety puts you ahead of the competition. People will want to work with you and invest in you because being accident-free makes you reliable.
- 6. It's very easy and simple to do. There is a wealth of tools and information available to you when creating you electrical safety program, and they're easy to combine with whatever current safety program you might have in place.

Annex A in CSA Z462 has a very quick chart with a lot of key elements needed for an electrical safety program. What follows is a list of steps that you can include when building your own Electrical Safety Program, tailored to the specific needs of your facility or business. These steps have been grouped into "sections" that most safety program documents should have.

- 1. Getting Started
- 2. Document Housekeeping
- 3. General Occupational Health and Safety, Your Roles and Responsibilities
- 4. Planning: Standards, Hazard Identification, and Risk Assessment
- 5. Implementation: Training and Clear Communication
- 6. Special Conditions
- 7. Wrapping it up: Documentation, Evaluation and Corrective Action



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This list is not exhaustive: there is always be more that you can do to keep your workplace safe. This is a simple guide to get you started. If you think of something important that hasn't been mentioned in this report, add it to your electrical safety program!

2. Getting Started

If you're reading this, you must be interested in starting your own electrical safety program for your company. Electrical safety is important.

Before we dive into the nitty-gritty of procedure and policy though, we've got to take care of a couple of things. Before you get started designing your electrical safety program, you need as much information about your job areas as you can get.



Dust off that calculator because it's time to gather some data!

2.1. Electrical Safety Brainstorming

Terry Becker and Chris Davis wrote an excellent article titled "Electrical Safety- A Program Development Guide" (Terry Becker 2015). In it, they highlight an excellent list of questions that you might want to ask yourself before you start developing your electrical safety program. These questions include:





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- 1. What are the electrical hazards in your workplace? Consider things like uninsulated metal tools near energized equipment.
- 2. What jobs require work on energized equipment? An example could be testing circuits to determine that they are working correctly.
- 3. Who performs the work on energized equipment? Only someone qualified through appropriate training.
- 4. How do you currently reduce risk of harm to personnel and equipment? Some ways include wearing protective clothing and establishing safe working distances from energized equipment.
- 5. If you already have a safety program, is it adequate? How long has it been since it has been reviewed?
- 6. How long has it been since the last incident energy study has been done on your workplace? Should your studies be updated?
- 7. Who needs to be trained to work at your facility and what kind of training do they need? Ideally, everyone should have basic electrical safety training as well as job specific training.
- 8. What kind of PPE is required for which types of jobs? Some basic repairs on noncritical equipment might only require insulated tools and insulated gloves, while working near an arc flash hazard might require an arc-protection suit.

2.2. Electrical Safety Program Purpose

Your electrical safety program should be able to answer all of these questions. Asking these questions before you begin creating your new electrical safety program will help you figure out which current safety practices you can keep. These questions also help to highlight problem areas that need to be looked at, giving you a good idea of what you should focus on changing. You aren't limited to just these questions though: you should also look at anything specific to your workplace that isn't listed above. Once you've gathered all possible information on the current safety practices of your workplace, you can get started with the creation of your new electrical safety program.



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3. Document Framework: Housekeeping

Once you have all of the necessary data in one spot for the electrical safety program, you will have to start organizing the binder, or electronic file for the document itself. Let's start with the document housekeeping, this will give you a visual checklist of all the sections that need to be addressed.

The first tasks that need to be covered are what I call the "general housekeeping" portions of the document. In order, these include the **Table of Contents** and **List of Figures**, the **Scope**, **Reference Publications**, and **Definitions**.

3.1. Table of Contents and List of Figures

The **Table of Contents** and **List of Figures** are easy: they're a list at the beginning of your program that lists all of the main items and where to find them. These will usually be created last even though they're the first thing a reader will see. You can look to any book, text, or standard for examples of the Table of Contents and List of Figures. These are important so that you can quickly find any information in your electrical safety program.

Use this section of the document to list out the sections, tables, etc that you want to include in the electrical safety program.

3.2. Scope and Reference Publications

Next, let's talk about the Scope for your electrical safety program.

The scope should include some general information about your program including; what kind of business or facility the program is for and what kinds of accidents the program is trying to prevent. It should state where the electrical safety program can be applied, who is responsible for following the electrical safety program, and what situations the electrical safety program can be used for. It can also include what measurement units are used (as a Canadian I prefer SI units). Any terminology that could be confusing (due to words having multiple meanings) can also be described here.

Reference Publications include any material you may have used when designing your electrical safety program - including SparkyResource. This section describes the sources of information including internal documents, national and international standards, technical papers, etc. This section helps with understanding the frame that your electrical safety program is built upon. By understanding the context of the publications used to make the safety program, you can get a better idea of what the safety program is trying to accomplish.



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3.3. Definitions

Definitions are the big brother to the terminology section in the scope. The definitions section of your safety program serves to clearly explain any words that might not be familiar to new employees, or even to veteran employees who have new responsibilities and have limited experience with a particular topic.

The definitions section helps avoid confusing jargon by defining the exact meanings of words as related to the electrical safety program. Check out our article on the misuse of jargon before you go on to the next section, where Jeff explains the importance of having definitions for the commonly used terms in your workplace.

As far as the less exciting (but still important) stuff is concerned, that's it! Next, we'll get started with the real meat and potatoes of your electrical safety program: The General Occupational Health and Safety System.

4. General OHS, Your Roles and Responsibilities

Now that we've gotten all of the data gathered on your current working situation, and we've finished with all the preliminaries, we can get started with the General Occupational Health and Safety section of your electrical safety program!



This should be your most important concern while developing your electrical safety program Your General OHS should reiterate the purpose of your electrical safety program. It should begin with a general explanation of what your electrical safety program is intended for. Feel free to re-state the **Scope** here. Your General OHS should also describe any non-electrical safety practices that are necessary for employees to follow. Examples include how to deal with paint fumes, how far away to stand from scaffolding, and appropriate waste disposal. You can then talk about Roles and Responsibilities.



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4.1. Roles and Responsibilities

4.1.1. Who does what?

The roles and responsibilities sub-section explains who is responsible for establishing, maintaining, and reviewing the electrical safety program, and outlines the process by which the electrical safety program is measured and monitored. For now we will assume that this person is you. The team creating the electrical safety program should be a healthy mix of corporate management and ground level employees, as well as safety officials. You want to be able to cover as many scenarios as possible, and a large team with a broad range of different experiences can help accomplish that goal.

4.1.2. How are workers affected?

This section will outline how affected workers are involved in the development and implementation of the program. Sometimes very important aspects of an electrical system can be overlooked by someone who is not intimately familiar with the finer details and inner workings of the electrical system. If you know someone with more technical or practical experience than you or your team have, it is always a good idea to consult them before implementing a new safety program.

4.1.3. What is the role of management and the executive?

Another thing that roles and responsibilities needs to explain is the role of managerial and executive staff in the creation of the electrical safety program. It is very important that management be made aware of the risks involved in working with any energized equipment at your workplace so that they can make informed decisions about any jobs taking place.

4.1.4. Self-Discipline is Key

Next, roles and responsibilities should make it abundantly clear that all persons involved in the operation of the facility should have the self-discipline to follow the electrical safety program. Diligence is key to accident prevention: we're not just trying to learn from our mistakes, we're trying to make sure mistakes don't happen in the first place. Because of this, you need to make sure that your electrical safety program defines its qualified workers.

4.1.5. Who is a Qualified Worker?

CSA Z462 defines a qualified worker as "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".



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An obvious example of unqualified persons. After getting the general OHS completed, you're ready to take the plunge into what should end up being the largest section of your electrical safety program: Planning!

5. Planning Your Electrical Safety Program

So, you've gathered your data and finished up with the housekeeping portion of your electrical safety program, and you've now also gotten your program's roles and responsibilities clearly defined. The big question now is: what comes next? That would be the planning section. The planning section talks about what your electrical safety program is going to be dealing with.



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A potentially hazardous work area

5.1. Standards

Here you should outline all the safety codes, regulations, and standards that your electrical safety program adheres to. You want to make sure that your electrical safety program is, from a legal point of view, bulletproof. The odds are high that you will need to adhere to one of CSA Z462 (if you're in Canada), NFPA 70E (if you're in the United States), or EN 50110 (if you're just about anywhere in Europe). Broader organizations that produce standards include OSHA, IEC, IEEE, and ANSI. This is in addition to any standards specific to your location, including provincial and state regulations.

5.2. OHS Goals

Your planning phase also needs to have some occupational health and safety objectives and targets. Consider the types of things you want to prevent, including things like physical harm to workers and damage to equipment. In essence, the question you're trying to answer here is "What is my electrical safety plan going to do to keep people safe, and what kind of safety goals does it have?"

To expand on this, an important part of the planning phase is Hazard Identification and Risk Assessment.



5.3. Hazard Identification

A hazard can be anything at work (an item, a condition, an action, etc.) with an unacceptably high potential to cause either bodily harm to persons on the job, or damage to equipment. CSA Z462 simply defines a hazard as "a source of possible injury or damage to health." Your electrical safety program should clearly outline how to identify a hazard. One example would be a procedure that must be followed to safely determine whether or not equipment is energized. Your program should also indicate who is qualified to identify hazards before work is to be attempted, and should cover any training a person might need to become qualified to identify these hazards.

5.3.1. Shock and Arc Flash

To elaborate, there are really only two types of electrical hazards: shock and arc flash. CSA Z462 gives a short definition for each:

- Shock hazard a dangerous condition associated with the possible release of energy caused by contact with or approach to energized electrical conductors or circuit parts.
- 2. Arc flash hazard a dangerous condition associated with the possible release of energy caused by an electrical arc. Arc flash takes two forms:
- 3. *Arc blast* refers to the pressure wave created during an arc flash incident. This pressure wave can throw molten metal at you at very high speeds in addition to causing physical harm like concussions.
- 4. Arc burn refers to the incredibly high temperature in the area around an arc flash. This temperature can be hotter than the surface of the sun and can cause debilitating burn injuries if you aren't wearing appropriate PPE.

CSA Z462 also mentions that under normal operating conditions, most equipment is not likely to cause an arc flash hazard. It then points to Table 4A for examples of activities with potential for causing an arc flash hazard.

Now that we have hazards out of the way, the next thing we want to talk about is Risk.

5.4. Risk

A *risk* is the chance that a hazard could be unmanageable and therefore cause harm to personnel or equipment. CSA Z462 defines risk as "a combination of the likelihood of occurrence of injury or damage to health and the severity of injury or damage to health that results from a hazard." For example: energized equipment on the job site is a hazard, but working on energized equipment is a risk because that work could cause harm to the worker if they aren't properly protected. A good electrical safety program identifies all of



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the potential hazards on the job site and assesses the risks involved with working on or near the hazards.



Is there a risk associated with using this wet outlet?

5.4.1. What is an Electrically Safe Work Condition?

Probably the most critical part of the planning section is to define what makes for an "Electrically Safe Work Condition". Your electrical safety program should explain procedures for de-energizing equipment here. This section should also outline safe working distances from currently energized equipment including transmission lines, as well as safe practices for testing to see if equipment is still energized or can be confirmed to be de-energized.

CSA Z462 defines an electrically safe work condition as "a state in which an electrical conductor or circuit part has been disconnected from energized parts, locked out in accordance with the established standards, tested to ensure the absence of voltage, and grounded (if grounding is determined to be necessary).

In order to determine whether a working condition is truly electrically safe, your electrical safety program needs to explain how to perform a risk assessment.

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5.5. Risk Assessment

Once a hazard has been identified, your electrical safety program needs to outline a risk assessment procedure. Assessing a risk involves determining the possible injury to a worker, and weighing that against the likelihood of the injury actually happening. Here's a fairly basic example:

An employee is required to work on a piece of equipment. That equipment is energized, and the risk associated with the hazard of working with energized equipment is fatal shock with a fairly high chance of occurring. If you de-energize the equipment, the shock hazard has been removed, lowering the risk associated with the task, and the equipment can be deemed safe to work on.

If the equipment could not be de-energized for whatever reason - such as testing electrical circuits - a worker can reduce risk by wearing the appropriate personal protective equipment (PPE). Unless absolutely necessary equipment should be **always be de-energized** before work is performed.

Your program should clearly explain who is qualified to assess risks and should cover any training a person might need to become qualified to assess risks. Ideally, all employees and employers should be trained and qualified to identify hazards and assess risks. A more thorough explanation of hazard identification and risk assessment can be found in Annex F of CSA Z462-15.

Next, you'll want to get started with implementing your electrical safety plan.

6. Implementation: Training, Job Planning, and the Importance of Communication

The next section to include in your own electrical safety program is Implementation. As they saying goes, you've planned your work and now you have to work your plan. This involves checking all of your available resources (electrical system data, personnel, equipment, cash, etc.) and getting to work at making your working area safe. This phase should outline any precautions and preventative measures that need to be taken, such as setting up warning signs and labels, and making sure all equipment meets the safety regulations defined in the planning phase. You'll also want to make sure you have enough personal protective equipment (PPE) and insulated tools and have a way to obtain them and a method for approving them. PPE should be examined before each use and should be replaced if there are any abnormalities or damage to the PPE.



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On the job training is an important part of implementing your electrical safety program.

6.1. Training

The implementation phase is also where you'll outline your electrical safety program's training plan and schedule. Training methods are varied and can include a healthy mix of classroom and on the job training. Job specific training should be mandatory before performing any new job. If the job is performed infrequently, you should establish a set period of time that can pass before it becomes necessary for an employee to repeat the training for that particular job. If it has been at least a year since an employee has performed a task, **that employee must be trained again**. Something to stress here is diligence: complacency with work can be just much of a hazard as anything else. Everyone should always be up to date on their training for any job.

6.2. Job Planning

Speaking of jobs, you'll also want to outline processes for job planning meetings. These should take place before a job dealing with energized equipment begins. You need to determine who should hold the meetings, identify the hazards involved with the job, perform a risk assessment, develop a plan for actually performing the job, and identify any PPE or tools required to complete the job. A great sample of a job planning checklist can be found in CSA Z462, Annex I. "OSHA mandates five (5) items to be covered prior to any work commencing on any job and new briefings whenever hazards change on a job in progress."

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(John Cadick 2015) These safety mandates are things you definitely will want to cover during job planning, and can be summed up in the acronym S-H-E-P-P, which stands for:

- S Special precautions like trip and fall hazards, interruption of service to other work areas, slippery surfaces, water, lighting, etc.
- H Hazards. For electrical work these are shock and arc flash blast/burn. All other hazards must also be considered
- E Energy Source Controls. Know where your energy sources are and how to shut them off in case of an emergency. This refers to electricity as well as gas or steam.
- P Procedures and Policies: Make sure everyone knows exactly what they have to do and how to do it, as well as company policies and laws that have to be followed.
- P Personal Protective Equipment: Always be sure that everyone wears appropriate PPE for all tasks.

6.3. The Importance of Communication

You'll also want your electrical safety program to stress the importance of clear communication and awareness here. If an employee doesn't understand something related to the work they are going to be doing, they should be encouraged to ask questions. Any questions should only be answered by qualified individuals who are sure that they know the answer. A good rule of thumb is that if you don't know something, confess to not knowing and find someone who does. Never give a false or incomplete answer (Terry Becker 2015). Likewise, if a job is going to be performed around heavy equipment, make sure the communication protocols are clearly defined so that people don't misinterpret information: confusion will lead to human error. And please, try to avoid jargon. "Jargon is a huge problem in the electrical workers' environments. When you hear electricians, say things that sound like: "It's no big deal, it's only a circuit breaker," it is a big problem if and when the device is a motor starter and there is no breaker in sight." (John Cadick 2015)

6.4. Emergency Response

Finally, your electrical safety program will need to explain your emergency prevention and response system for when things eventually do go wrong. All employees should have some basic form of emergency training like first aid and CPR. Procedures should be in place for situations like electrical fires (who do you contact? How do you keep safe while waiting for response teams? Do you have an evacuation plan?) Specific emergency responses (such as responses for accidents around high voltage equipment) should also be outlined.

Now that you've got an idea of how to implement your electrical safety plan, you'll want to start thinking about Documentation Methods, Evaluation and Corrective Action.



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7. Wrapping it up: Documentation, Evaluation, and Corrective Action

Now that you've finished with_Implementation, your electrical safety program is almost complete. The only things left to do are to figure out how to keep track of your electrical safety program, and how to improve it.

You can do this with Documentation, Evaluation, and Corrective Action.



What's left to improve upon?

7.1. Documentation

Documentation is a section of your electrical safety program that outlines how you'll be recording everything. You'll need to sort out how it is that you will be documenting your safety program. This includes training manuals, energy study reports, safety meetings, and accident reports. Ideally, everything should be in writing and have digital and written back-up copies. You'll also want to define who is responsible for keeping this documentation up to date, and you'll want to figure out the optimal documentation format to make sure that everyone is compliant with the electrical safety program. It might be easier to e-mail digital copies of your electrical safety program to everyone, but you might have to hand them physical copies and assign a workshop to confirm that everyone has actually read the document and understands it.



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7.2. Evaluation and Corrective Action

Finally, you need a section for Evaluation and Corrective Action of your electrical safety program. At a minimum, electrical safety programs should be reviewed annually, but this timeline can be customized based on your business.

You need to define how you're going to measure the success of your electrical safety program so that you can come up with a plan to correct any problem areas. Processes like safety audits and accident investigations (including who is responsible for each) can go here.

The best electrical safety programs are not designed perfectly on their first attempt, iteration is key to keeping your work environment safe.

8. Closing

Now you should have a good solid foundation to start building your electrical safety program. You now have an idea about how to:

- 1. Get started with collecting data
- 2. Lay out the frame of your electrical safety program document
- 3. Determine occupational health and safety roles and responsibilities
- 4. Use recognized standards to plan your electrical safety program's hazard identification and risk assessment
- 5. Use clear communication to implement your safety program with training and job planning
- 6. Document your electrical safety program and review it for improvements

Above all, know that this guide is simply a brief overview to help get you started on the right path, and is not even close to an exhaustive list of procedures for creating your electrical safety program. Always consult your national and local electrical safety standards, as well as any extra guides that delve into more detail on the specifics of how you should go about pursuing each of the topics listed above. A great starting resource is "Electrical Safety Handbook, fourth edition", by Cadick, Capelli-Schellpfeffer, Neitzel, and Winfeld."

Thanks for reading and stay safe!

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10. Appendices



Appendix A – Energized Work Permit (Sample)

