

CHILLICOTHE'S ARC FLASH STUDY INCREASES ELECTRICAL SAFETY AT WATER AND WASTEWATER PLANTS

"We always try to be a leader when it comes to safety," explains municipal utilities manager for the city of Chillicothe, Jim Gillilan. "Over the years, our City has received recognition for excellence in safety by the American Public Power Association (APPA) multiple times. Chillicothe is a progressive city and we believe if you have employees who work with electricity, you have a responsibility to protect them. Certainly, one thing employers should never take for granted is basic electrical safety. We recently focused on our water and wastewater plants to reduce the dangers of arc flash."

WHAT IS ARC FLASH?

About five to ten times a day across the United States, a dangerous arc flash incident occurs in the workplace. Usually the electrical current pumping through the wiring system to the company's transformers, fuse boxes, outlets and equipment is safe. But, sometimes a short circuit mishap causes something terrible to happen instead. What happens? When an electrical circuit short circuits or faults, an arc of electricity literally jumps out of the power line, open fuse box, or piece of exposed live equipment into the air like a violent flash of lightning—this is called an arc flash. When an arc flash happens, it is unspeakably fast and produces a flare of heat that is hot enough to melt steel. Typically, expensive equipment is immediately destroyed, fire breaks out, and innocent people nearby can be severely injured or instantly killed.

WHAT CAUSES AN ARC FLASH AND WHO SHOULD BE CONCERNED?

Arc flash incidents can occur in any commercial setting, especially those requiring constant, uninterrupted electrical power like wastewater plants, power plants, factories, hospitals, high-rise offices, department stores, and data centers. A variety of ordinary



Photo (top): Water plant filters and a filter control console at the water plant in Chillicothe, Mo.

Photo (above): Jim Gillilan, municipal utilities manager for the city of Chillicothe and Ray Blakely, professional engineer and CEO of Blakely and Associates Consulting Engineers, Inc.

reasons can cause an arc flash to occur.

- Dropped tools of workers
- Improper work procedures or training
- Accidental contact with electrical systems
- Voltage testing with inappropriate equipment
- Lack of maintenance
- Corrosion of electrical equipment
- Installation failure

Professional Engineer Ray Blakely, who performed the arc flash study for the water and wastewater plants for the city of Chillicothe, explains: "The cause of most arc flash incidents is directly people-related. Thankfully, that means that with the right safety precautions, arc flash explosions are largely preventable. The city of Chillicothe understands that even low-voltage equipment can be dangerous because it may be supplied by an electrical system that can unexpectedly unleash incredible amounts of energy during a short circuit or other default. Through the arc flash study with Chillicothe, we were able to work together to identify potential safety hazards, calibrate equipment settings to reduce employee risk and raise the level of safety and awareness for everyone that works there."



labels throughout the workplace. Conducting an arc flash study is a complex process that requires professional electrical engineers who are familiar with the particular intricacies of arc flash. The comprehensive study has five key

steps with a multitude of goals at each stage. facilities is that they lack electrical one-line diagrams,” said Blakely. If you do not have a one-line diagram, you don’t possess the most basic knowledge to consider the potential issues surrounding electrical risk. Once you do have one, it will be valuable in a myriad of ways, including eliminating the need for additional field time in the future, like during routine maintenance of your electrical system. The one-line diagram allows you to take a strong fresh look at your overall design and make sure that your electrical drawings include up-to-date details.”

According to Gillilan, the big-picture goal of the arc flash study is simple: to increase electrical safety for his employees. He said, “Ultimately, it’s about making sure our people are safe in our workplace. If clear and concise warning labels do not exist in a facility, then the company is not meeting industry-recommended safety standards. If you don’t have warning labels posted, you are vulnerable to workplace accidents and potential lawsuits.”

The arc flash study is more than the strategic placement of detailed warning

steps with a multitude of goals at each stage.

WHAT ARE THE FIVE STEPS OF THE ARC FLASH STUDY?

STEP ONE: The One-Line Diagram

Properly collecting your facility’s electrical data is the first phase of the project. The electrical data is placed in a one-line diagram. This CAD-type drawing details all the electrical components in the facility, including cables, breakers, motors, transformers, lighting panels, switchboards, outlets, and more. “The problem for so many

STEP TWO: The Computer Model

After the one-line diagram is created or updated, the electrical information is transferred to a computer model. This step in the arc flash study utilizes sophisticated computer software to determine the level of electrical current at each and every point in a facility’s electrical system. All node voltages and transformers are identified, including primary and secondary voltage. Connection types are identified, as well as methods of grounding primary and secondary windings.

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Blakely explains, “When you know the levels of electrical current at each point in the electrical system, you can calculate the potential severity of an arc flash if an accident occurred anywhere. That information opens the opportunity for us to consider special ways to reduce arc flash risks for the business.”

STEP THREE: The Protective Device Coordination

After the computer model is designed, the entire electrical system is analyzed and the coordination of protective devices occur. The goal of this step is to minimize the effect of a short circuit problem and confine it to the smallest area possible. “Businesses are built on strategic planning. But many companies don’t realize that good electrical systems also are built with strategic planning. If something happens, it is possible to limit the area of your outage to the most practical related area. We can do that by collecting data for all protective devices like fuses, protective relays, low-voltage circuit breakers and reclosers. Proper coordination of electrical distribution systems can reduce the potential for damage, extended downtime, and most importantly, it reduces the risk to human life,” says Blakely.

STEP FOUR: The Arc Flash Analysis

In this step, data will be analyzed to determine flash protection boundaries

and the type of personal protective equipment that people within a flash protection boundary should use. The levels of protective equipment range from cotton clothing to highly insulated heavy attire with hoods and face shields. “It’s important for companies to understand how important this protective equipment truly is,” says Blakely. “Using personal protective equipment can make an arc flash incident survivable for an employee if an accident occurs. The proper gear typically can limit injuries to second-degree burns. There is no gear that can withstand the greatest blast effects of an arc flash.”

Without proper protective equipment, the types of injuries that can result from an arc flash incident can include severe burns, as well as eye and face injuries, broken bones, punctures and lacerations, hearing damage and loss, brain injuries, blindness and death.

STEP FIVE: The Labeling

The final step in the arc flash study involves labeling. The big idea behind labeling is to align the level of risk with the proper level of personal protective equipment. Appropriate labeling is placed throughout the facility to warn people who work on or near power system equipment to be aware of the specific hazards involved. The labels detail the appropriate level of personal protective equipment required for each particular work zone.

“These labels provide a critical cornerstone for our electrical safety – not just for current employees, but also for future employees and the contractors that we bring in any time to do work for us,” says Gillilan “Everyone in the workplace needs to be highly aware of safety issues. Unqualified workers must be trained on the basic hazards of electricity so that they understand how to take fundamental precautions to be safe. Qualified workers need to be formally advised about meeting specific safety requirements, too. We believe safety in the workplace should be a primary focus for every employee and every business.”

IS YOUR WORK PLACE SAFE?

One of the best reasons for increased awareness and understanding of arc flash hazards is to prevent injuries. A first step to meeting industry-recommended guidelines for electrical safety is asking yourself and your team the following questions:

- Do we provide warning labels on our equipment?
- Are our work areas labeled with the correct personal protective equipment for our workers?
- Do we provide appropriate tools for working safely?
- Do we offer an electrical safety program with defined responsibilities?
- Do we provide electrical safety training on the hazards of arc flash?

Blakely and Associates Consulting Engineers, Inc., has completed hundreds of arc flash studies across the nation, including studies for data centers owned by Amazon and Facebook, as well as studies for the water and wastewater plants for the city of Chillicothe, Mo. and the electric, water, and wastewater plants for the city of Jackson, Mo. www.blakely-eng.com.