How to Protect Against Electrical Fire Losses
Electricity: The Most Dangerous Industrial Fire Hazard

Electrical distribution and equipment failures are the leading causes of fires in industrial properties, according to the National Fire Protection Association. In fact, they account for one-quarter of all industrial fires.

Electrical hazards lead to property damage, business interruption, and worker injuries. Mitigating electrical risks and getting compliant with NFPA 70 standards are essential to creating a safe workplace.

In today’s hard insurance market reducing accidents is even more critical. New claims add challenges to insurance renewals and could lead carriers to decline coverage. Thin examinations of electrical equipment just won’t cut it. Instead, we recommend a holistic approach featuring a short circuit study, coordination study, arc flash assessment, and infrared thermography. Such a thorough approach gives you the best possible chance of detecting problems in your electrical equipment and preventing fires.

In this whitepaper, we will explain common causes of electrical fires in industrial settings. We will also discuss the dangers of electrical fires, the importance of proper personal protective equipment, and practical ways to mitigate risks. We will also share a case study from Detroit Diesel Remanufacturing, a company that used risk engineering to reduce fire risks and make its facilities safer.
Dangers of Electrical Fires

Property damage

Electrical fires lead to damage in your electric panel, critical equipment, or machinery. Extinguishing a fire can lead to even more harm in the form of water or smoke damage.

25% of all industrial fires are electrical in nature¹

Unsafe working conditions

Electric shock, extreme pressure and other problems can lead to injuries and the high workers compensation and medical bills associated with them. In some instances, fatalities can even occur.

Business interruption

Electrical fires can cause a business to close for an extended period of time – leading to lost revenue and market share.

$4 million cost of treating a severe electrical burn²

Reputational damage and talent attraction difficulties

In today’s war for talent, many companies are struggling to recruit quality employees. If those workers see that your facility has previously had a fire, they may deem it an unsafe workplace and choose to work elsewhere.

Difficult insurance placement

In today’s hard insurance market, it is critical to tell a good safety story to carriers backed up with data. A solid risk mitigation plan to protect against electrical fires may help you showcase your facility as a safer risk — while accidents and new claims may lead to higher premiums or underwriters declining to cover you at all.

Non-compliance

OSHA, NFPA, NEC, and IEEE have standards governing arc flash and electrical fire prevention. Non-compliance could lead to fines and unsafe work environments.

$13,653 cost per day of OSHA fines for serious safety violations³

Causes of Electrical Fires

- Arc flash
- Short circuits
- Lack of routine maintenance
- Old or defective wiring
- Overloaded circuits
- Loose connections, faulty fuses
- Imbalanced electrical loads
- Overheating

¹ 25% of all industrial fires are electrical in nature
² $4 million cost of treating a severe electrical burn
³ $13,653 cost per day of OSHA fines for serious safety violations
A short circuit occurs when two energized wires touch and energy gets transferred to the wires rather than the equipment. It can happen during construction, testing, or maintenance — and can be the result of equipment failure or other problems.

In some cases, the short circuit transfers more thermal energy than the wire can handle, so it burns and creates a fire.

A short-circuit study determines the thermal energy and magnetic forces that are released into an electrical system which can cause insulation and conductor melting — as well as explosions and major equipment burndowns. Magnetic forces can bend bus bars and cause violent conductor whipping and distortion.

These conditions have grim consequences on electrical systems and equipment. Each piece of equipment within the electrical distribution is evaluated to determine the short-circuit withstanding rating.

Risk engineers use a mathematical model to determine what the highest potential calculated short-circuit current is at each piece of equipment and make sure it’s lower than the short-circuit rating. It is designed to make sure any short circuit for any given piece of equipment does not exceed the interrupt rating.

**The Benefits of Short Circuit Studies**

- Prevents equipment from catching fire or exploding
- Reduces the probability of injuries
- Lowers the probability of property damage
- Helps workers understand short-circuit danger
Coordination Study

To understand what a coordination study is, let’s use this simple example: Imagine that your home has a 100 amp main breaker in the electrical panel with 20 amp branch breakers in each room. If an outlet in the kitchen trips, it should cause that outlet to lose power – not your entire home. Why? The breakers and circuits are coordinated.

Now apply that example to a large industrial plant with much more complexity. It may have multiple electric panels, different bus types, various electrical feeds, and even power generators. It’s common that highly technical equipment could overload the circuit breakers and cause trips.

The whole plant could lose power if the electricity flow is not coordinated correctly. Conceivably, a small piece of equipment in one area could cause a trip that shuts down the entire plant. Finding the source of the problem could take days or weeks — and then fixing the problem could take even longer. That could lead to days or weeks of downtime and millions in lost productivity and revenue.

If the electricity was properly coordinated, the outage would be relegated to one specific location.

A protective coordination study, sometimes called a selectivity study, is performed to improve the reliability of the electrical distribution system.

Coordination studies help you understand how electricity is flowing and plan for trips at the proper times, so you can isolate a problem and get it fixed without losing power to the entire plant or critical equipment.

This serves a life safety function too. If you lose your whole plant, you could lose your fire pump too and a small little fire could turn into a huge fire because there are no sprinklers to stop it.

Avoiding a fire impairment is critical to keeping your plant safe.
Arc Flash Assessments Are Required if:

- Your equipment is greater than 50 volts.
- Your state adopted the 2017 edition of NFPA 70.
- You haven’t had an assessment in five years.
- You made significant upgrades or modifications within five years.
- You can’t de-energize equipment remotely.

Arc Flash Analysis

An arc flash is like a short circuit, but the wires don’t touch. Instead, they come very close to each other creating a bolt of electricity between the wires called an arc.

That arc produces an immense amount of heat and energy with temperatures at 35,000 degrees, hotter than the surface of the sun.⁴ The pressure from a 50,000 amp arc standing two feet away is 1,700 pounds.⁵

An arc flash analysis or arc flash assessment identifies code or electrical safety violations in your facility.

The assessment determines the incident energy to which a worker may be exposed and how to protect the worker from an arc flash accident and other electrical hazards.

The most effective assessments provide a short circuit analysis, a protective device coordination study, and a one-line electrical diagram.

Risk engineers will create models and write reports to tell people how much energy can be emanated from a piece of equipment, and this tells the workers what kind of personal protective equipment (PPE) they need to wear. Arc flash analysis can protect workers from catastrophic accidents by displaying labels that explain the hazards and PPE requirements.
**Arc Flash Boundaries & PPE**

**ARC FLASH REGULATIONS**

An arc flash risk assessment is required by government regulations like OSHA, NFPA 70E and NFPA 70. Those regulations can be difficult to follow, so here is a handy breakdown:

**NFPA 70E** provides guidance on safety requirements for workers engaging in the installation, inspection, operation, maintenance, and demolition of electric conductors and other equipment. It requires an arc flash analysis every five years, or if major modifications have taken place to determine safe boundaries and work processes. It also requires that each panel be marked with an Arc Flash Hazard Warning Label.

**NFPA 70** has been adopted in all 50 U.S. states as the benchmark for safe electrical design, installation, and inspection. It addresses PPE, labeling, and electrical handling procedures.

**The Institute of Electrical and Electronics Engineers (IEEE) 1584** provides formulas and methods for determining arc flash boundaries and incident energy.

**OSHA 29 CFR Part 1910** requires that an employer conduct an assessment to determine if hazards are present which necessitate personal protective equipment (PPE). It also requires that employees wear appropriate PPE for protection and use insulated tools or handling equipment.

**THE IMPORTANCE OF PROPER PPE**

Arc flash boundaries establish areas where employees can safely approach energized equipment. The boundaries determine the types of PPE and training required for each area.

Establishing proper PPE is critical. The suit, gloves, and helmets can be bulky and makes it difficult for employees to work with small, fine parts. If you can reduce the level of electricity or hazards, you can lower the PPE requirements and give workers a more comfortable, efficient environment in which to work.
Infrared Thermography

Infrared thermography inspection services use high-tech cameras to detect areas of abnormal temperature, diagnose problem areas, and determine severity in electrical systems and mechanical equipment. It is effective, cost-efficient, and non-destructive.

Electrical and mechanical infrared thermography inspections can deliver savings many times greater than the initial investment.

Infrared Inspections Involve:

**Comprehensive Reports.** Engineers from TÜV SÜD Global Risk Consultants utilize infrared and airborne ultrasound technology for electrical testing. IR inspections can detect abnormal or unexpected thermal patterns that may cause equipment failure (i.e. “invisible” threats). Our formal comprehensive reports not only locate problems with extreme precision but also recommend cost-effective solutions.

**Severity and Impact Ratings.** TÜV SÜD Global Risk Consultants provides severity and impact ratings for each finding in an infrared thermography inspection. Our reports include a summary of findings, equipment inventory listing, and business impact analysis. All findings and metrics are made available in our online data management system GRC Connect.

**Ultrasonic Testing.** Ultrasonic testing is an additional tool enabling us to identify critical loss exposures such as internal and external tracking/arcing problems in high voltage equipment that are not detectable when using infrared imaging.

**Thermographic Imaging Analysis.** Thermographic imaging analysis is used to diagnose problem areas and determine their impact and severity. It also enables us to pinpoint abnormal temperatures and resolve variances and deficiencies.

**Immediate Delivery of Findings.** Clients can access comprehensive on-site reports through our online client data management system. These include a quantifiable operational cost-saving action plan as well as severity and impact ratings for each finding.
Case Study: Detroit Diesel Remanufacturing

ABOUT DETROIT DIESEL REMANUFACTURING
Detroit Diesel Remanufacturing offers a full line of heavy-duty diesel engines, axles, transmissions, safety systems and connected vehicle services for the commercial truck market. A subsidiary of Daimler Truck North America, the company has products and services supported by a parts and distribution network of over 800 locations in North America.

GOALS
With heavy machinery and complex equipment, Detroit facilities have plenty of property risks. Leaders at the company chose to address them through risk engineering and created an ambitious list of goals.

Top-Notch Employee Safety Processes. Reducing the risk of worker injuries was the No. 1 priority for company leadership.

Identify Electrical Hazards. Detroit wanted to detect electrical safety issues at various plants to reduce risks of fire, arc flash, or electrocution. The team was intent on addressing even the smallest problems to catch them before they manifest into something larger.

Reduce the Need for Cumbersome Personal Protective Equipment. Detroit hoped to reduce electrical hazard risks so workers could approach equipment without heavy PPE.

Continue Being an Employer of Choice. Detroit hoped to enhance their reputation as a safe workplace and use it to continue recruiting top talent.

SOLUTION
Detroit partnered with TÜV SÜD for property risk engineering inspections at four sites in Ohio, Utah, Minnesota, and Indiana.

Arc Flash Study. Examining electrical panels and equipment to identify risks of arc flash – intense light and heat resulting from an electrical explosion resulting from connection problems in an electrical system. Current arc flash labels were installed on all appropriate electrical equipment.

Infrared Thermography Inspections. Using non-destructive testing to identify electrical and mechanical risks. The infrared thermography scans helped to detect any abnormal temperature, potential problem areas, and determine severity in electrical systems and mechanical equipment.

Expert Consultation on Fire Risks. TÜV SÜD helped Detroit get a more robust understanding of their fire risk exposure and offered a list of recommendations to improve its risk profile.

RESULTS
Reduced Risk Profile. Fire and electrical risks are greatly reduced after Detroit followed the TÜV SÜD recommendations.

Safer Workplaces. Employees working on equipment are now even safer when working at Detroit facilities.

Improved Data Management. With risk assessment data readily available in the TÜV SÜD data management system, Detroit has easy access to its most important metrics.

Compliance with NFPA 70E and Other Standards. Detroit facilities are up-to-date with safety and compliance standards.

Eased PPE Requirements. Workers can approach most equipment with minimal PPE, allowing them to work as efficiently and comfortably as possible. Of course, workers will utilize heavier PPE when necessary.

Improved Safety Reputation Among Potential New Hires. With a proven culture of safety, recruiting top talent is easier.

“The recommendations helped us to build a list of action items to address minor problems before they become major problems. The entire team at TÜV SÜD was easy to work with, well organized, and thorough. They made it very easy for us and saved us lots of time.”

- Jason Wells, Safety Environmental Engineer at Detroit Diesel Remanufacturing
TÜV SÜD Global Risk Consultants

**INDEPENDENT**
TÜV SÜD Global Risk Consultants pioneered unbundled loss control — independent risk assessments not tied to insurance. We offer truly consultative expertise that is always independent and never bundled to underwriting. With TÜV SÜD GRC, you own your data — not insurance companies. That empowers you to take on more risk if you desire, helps you shop for appropriate insurance coverage, and negotiate premiums with confidence.

**EXPERIENCED**
GRC provides sound, cost-effective fire protection engineering services to some of the world’s most successful businesses. Our worldwide staff of engineers has pioneered advances in fire protection by applying their in-depth expertise to developing new methods to address today’s escalating concerns. Some have even been instrumental in writing NFPA standards. We work with major insurance organizations, the engineering staff of global brokers, and the engineering departments of major industrial firms.

**QUALITY SERVICE**
We perform thousands of inspections each year, varying on the unique property risk engineering requirements of our clients. They range from basic property reviews and short summary reports, to full “HPR (Highly Protected Risk)”-style inspections in which all protective equipment is operationally tested, and detailed narrative-style reports are issued with COPE (i.e. construction, occupancy, protection, exposures) data supplements. With our help, you can develop a custom-tailored Fire Loss Prevention Service Plan.

**CONTACT US**
Contact us to discuss your risk engineering needs. We conduct the following fire protection services:
- Arc flash analysis
- Fire inspection surveys
- Electrical equipment inspections
- Short circuit studies
- Coordination studies
- One-line diagrams
- Infrared thermography

**GRC at a Glance**
- 87 Fortune 500 clients
- $683 billion in loss exposure reduction
- $4 trillion in value of facilities serviced
- 210,000 fire impairments

**Sources:**
1. NFPA: Fire in Industrial or Manufacturing Properties
3. OSHA
4. Industrial Safety & Hygiene News: What you should know about an arc flash
5. Internal GRC research
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With TÜV SÜD GRC, you own your data — not insurance companies. That empowers you to take on more risk if you desire, helps you shop for appropriate insurance coverage, and negotiate premiums with confidence.

TÜV SÜD Global Risk Consultants is dedicated to providing sound, cost-effective Fire Protection Engineering services. From arc flash to explosions, we address all potential property losses from fire, and keep you compliant with National Fire Protection Association standards.

Find out more at: http://www.tuvsud.com/grc