

Chapter 1

Electrical Risks

1.1. Introduction

Electrical risks pose a significant threat in work environments, potentially resulting in serious injury or death. These hazards include contact with live conductive parts, short circuits, and arc flashes, which can cause electric shock and fires. Harsh conditions such as working outdoors or in confined spaces increase these risks. To mitigate these hazards, it is crucial to adopt preventative measures such as proper training, use of personal protective equipment (PPE), and strict safety procedures such as lockout/tagout to ensure a safe environment for all employees. Furthermore, an estimated 4,000 people are electrocuted in the workplace each year, highlighting the vital importance of proactively managing electrical hazards.



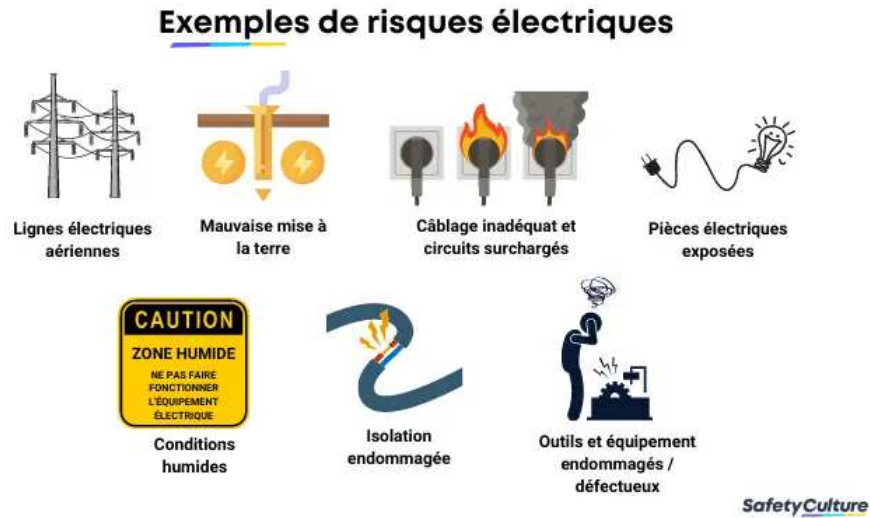


Figure 1.1. Electrical risks.

1.2. Definition and purpose of occupational safety

Electrical hazards include any hazard that can cause death, electric shock, or other injuries that are directly or indirectly related to electricity. These hazards include contact with live conductive parts, short circuits that can cause fires or explosions, and shocks resulting from the "step-and-touch" potential.

1.2.1. Objectives

The major objective of occupational safety in the face of electrical risks is to eliminate or minimize these risks through proactive management.

This involves:

Identification and assessment: Recognizing all potential risks associated with electrical systems and equipment.

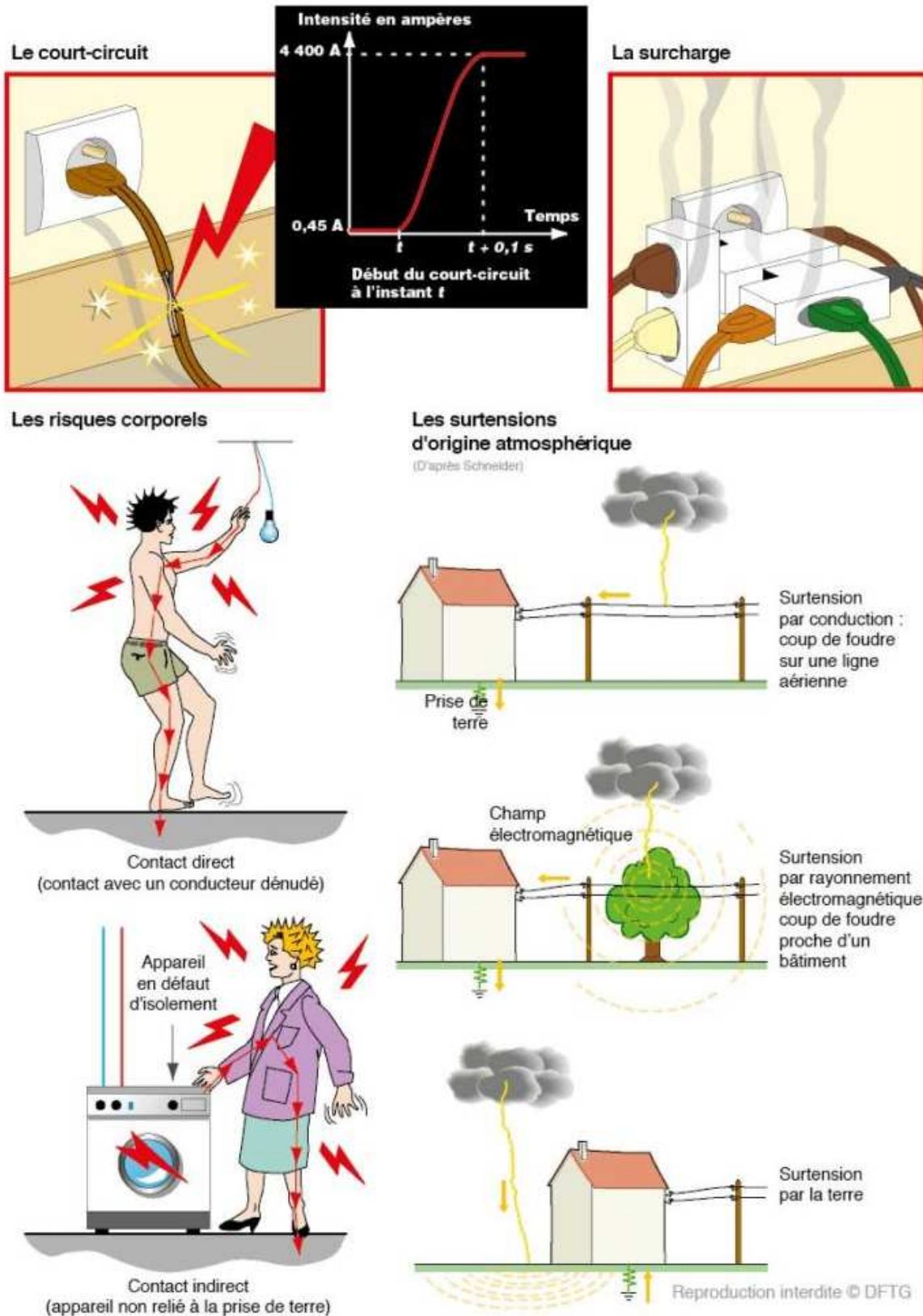


Figure 1.2. Electrical risks identifications.

Implementation of preventive measures: Use of personal protective equipment (PPE), strict compliance with technical standards for installations and maintenance.

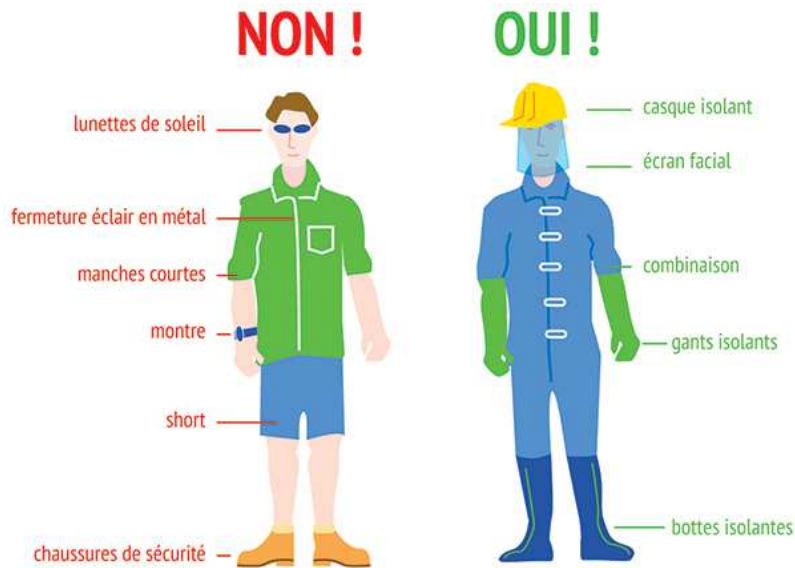


Figure 1.3. Personal Protective Equipment (PPE).

Continuing education: Ensuring that all employees are well trained in safe practices when working with electricity.

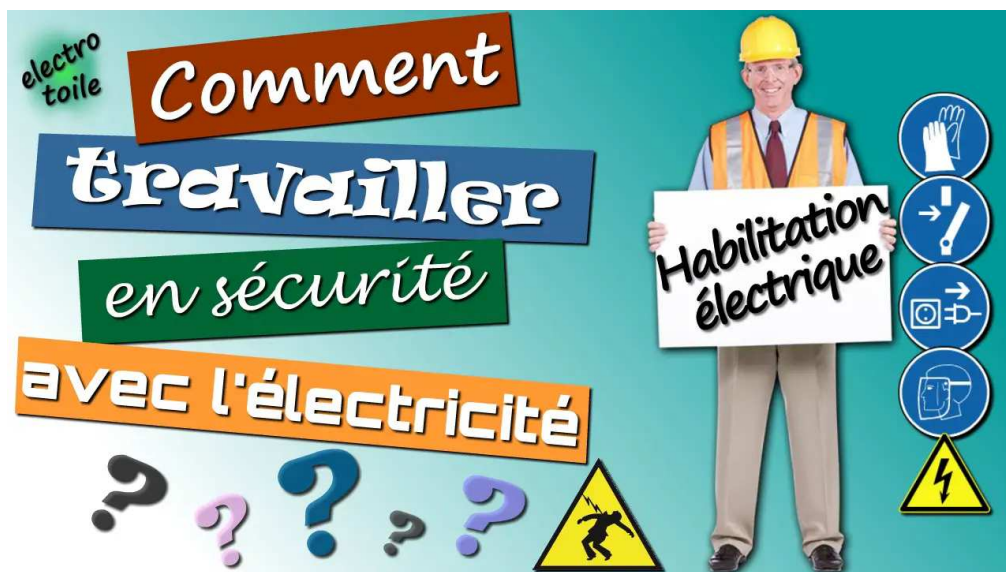


Figure 1.4. Training and organization.

Regular review: Periodically checking the effectiveness of the measures put in place to ensure their relevance.



Figure 1.5. Regular Review.

1.3. Legend and history of electrical risk

Electrical risks have a rich and complex history, marked by scientific discoveries, technological innovations and evolving safety standards. Here is a glimpse into this history:

1.3.1. Ancient Discoveries

500 BC: Thales of Miletus discovered static electricity by rubbing felt on amber.

2750 BC: First observations of natural electricity with electric fish.

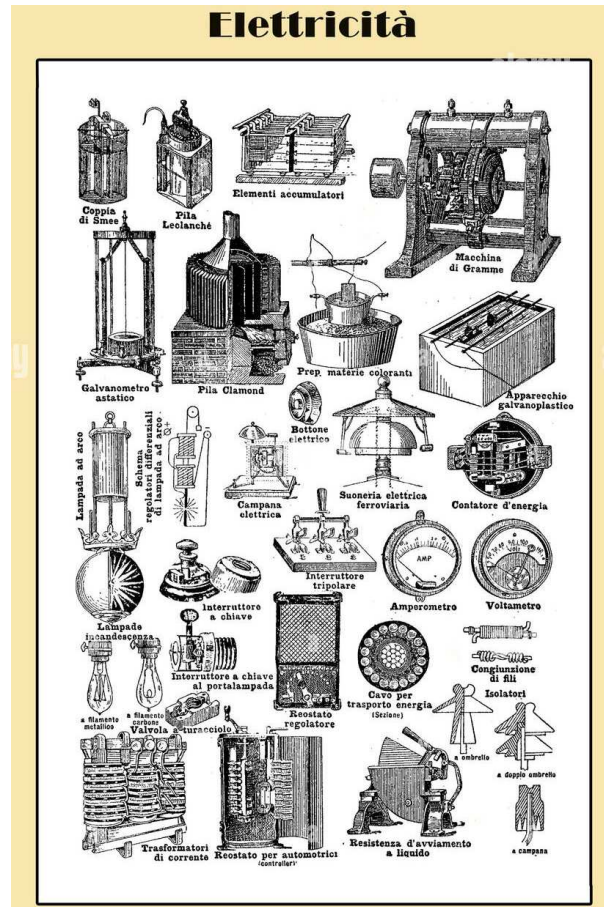


Figure 1.6. Ancient Discoveries.

1.3.2. Modern Developments 1880s:

- 1880: The "power war" between Nikola Tesla (alternating current) and Thomas Edison (direct current) shaped the future of electrical power generation.
- 1882: Thomas Edison launches the first commercial electrical power system in New York City, producing 100 kW to light 50 incandescent lamps

1.3.3. Evolution of Safety Standards

- 1895: Five different codes for electrical installations are developed in the United States, but their multiplicity creates confusion.
- 1897: The National Electrical Code (NEC) is created to standardize national standards.
- 1911: The National Fire Protection Association (NFPA) becomes the sponsor of the NEC

1.3.4. Arc Flash and Modern Safety

- 1980s: Ralph Lee publishes his work on arc flash burns ("The Other Electrical Hazard: Electrical Arc Blast Burns"), marking the modern beginning of arc flash theory.² His research laid the current methodological foundation for estimating incident energy during an arc flash.
- 1990s: NFPA 70E begins to formally address arc flash hazard in its 1995 version.
- 2000s: NFPA 70E introduces tables for selecting flame-retardant fabric and PPE against thermal effects due to an arc flash. IEEE Guide for Performing Arc Flash Calculations publishes which defines precise methods for calculating arc flash short-circuit current and arc flash limit.



Figure 1.7. History of electrical risks.

1.4. Standardization body

Standards bodies play a crucial role in electrical risk management by establishing standards to ensure the safety and reliability of electrical systems. Here are some of the main bodies involved in this mission:

1.4.1. International Electrotechnical Commission (IEC)

Role: The IEC is the primary body responsible for establishing international standards for electrical technologies, including those related to safety.

Notable Standards: IEC 60950, IEC 62368-1.

1.4.2. National Fire Protection Association (NFPA)

Role: The NFPA is a leading organization in the development of standards for fire prevention and electrical safety in the United States.

Notable Standards: NFPA 70 (National Electrical Code), NFPA 70E (Electrical Safety in the Workplace).

1.4.3. Underwriters Laboratories (UL)

Role: UL is an organization that certifies products according to American standards, particularly in the electrical field.

UL544 standard for medical equipment.

1.4.4. Occupational Safety and Health Administration (OSHA)

Role: OSHA establishes and enforces federal regulations to ensure a safe work environment, including against electrical hazards.

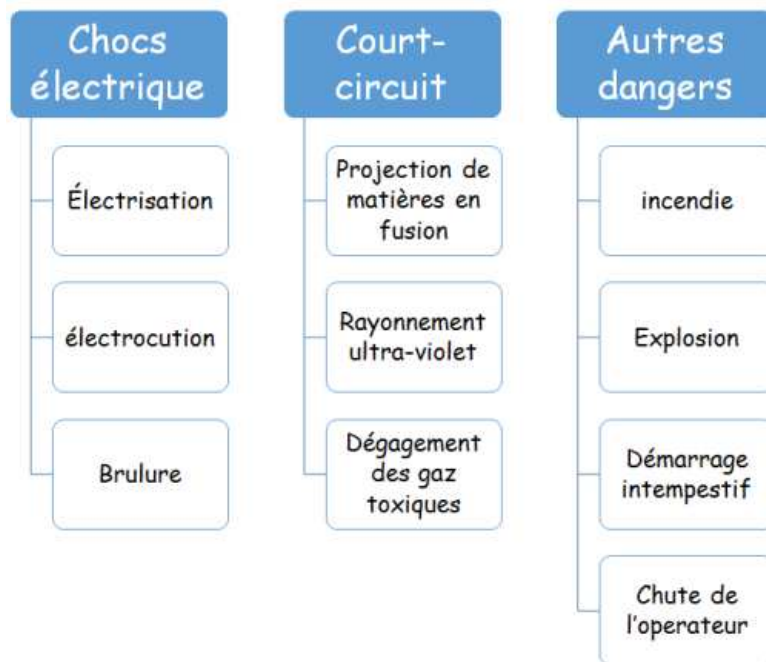


Figure 1.8. Standardization body.

1.5. Statistics on electrical accidents

Here is a summary of electrical accident statistics:

1.5.1. Global Statistics

Annual Injuries: Approximately 1.2 million people suffer electrical injuries each year worldwide.

Mortality: Although global data is limited, it is estimated that there are between 500 and 1,000 deaths each year in the United States due to electrical injuries.

1.5.2. United States Statistics

Household Accidents: Approximately 400 people are electrocuted at home each year, resulting in approximately 200 deaths.

Occupational Accidents: Nearly 4,000 people are electrocuted in the workplace each year. Between 2011 and 2023, approximately 1,940 deaths were recorded due to contact with electricity at work.

Fatality Rate: Electrical accidents accounted for approximately 4% of total occupational fatalities between 2003 and 2010.

1.5.3. UK and Ireland Statistics

Ireland (2001-2020): There were a total of forty cases of electrocution or deaths associated with electricity during this period. Of these, twenty-five occurred in an occupational setting².

United Kingdom (2022/23): Contact with electricity was a significant cause of fatal occupational injuries with a total of one hundred and thirty-five work-related deaths that year

1.6. Conclusion

In conclusion, electrical hazards pose a significant threat in various environments, whether workplaces or homes. These hazards include electric shock, arc flash burns, and fires caused by equipment defects or faulty installations. To mitigate these risks, it is crucial to adopt preventive measures such as proper training of personnel, regular use of personal protective equipment (PPE), and strict procedures to ensure a safe environment. Standards bodies such as the IEC and NFPA play a vital role in setting standards to minimize these hazards. Finally, proactive management of electrical hazards is vital to prevent serious accidents and ensure a safe workplace.