STUDENT GUIDE

Energy Industry Fundamentals

CEWD
CENTER FOR ENERGY WORKFORCE DEVELOPMENT

MODULE

2

SAFETY

STUDENT GUIDE

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Center for Energy Workforce Development

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MODULE 2

SAFETY

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UNIT A: REGULATORY/ PROCEDURAL/SECURITY

General Safety and Regulatory Agencies

We rarely think about the vital presence of energy in our daily lives until there is some type of interruption in service that makes our modern-day conveniences not so convenient. Energy provided by utility companies has become an integral part of our everyday lives. Just as most people take for granted the amenities of modern energy, most people also take for granted the safety and security of the energy system.

Behind the convenience of our home heating and cooling systems, toaster ovens, and televisions, the energy that powers these systems can be very dangerous and even deadly. People die each year in accidents involving electricity, in both industrial and home settings.

It is the obligation of the government and the utility companies to provide efficient, reliable, and *safe* service to the public and to maintain safe workplaces for their employees as well.

Quick Facts

The most recent Electrical Safety Foundation International (ESFI) data covers the 23-year period from 1992–2016, but mainly focuses on 2003–2016.

- The 154 electrical fatalities that occurred during 2016 represents a 15% increase over the 2015 total.
- Electrical accidents rank sixth among all causes of work-related deaths in the United States.
- 98% of fatal electrical injuries occurred in the Private sector, and 2% occurred in the Government sector.
- The nonfatal workplace incidents that cause the highest number of days away from work are contact with an electrical current or a machine, tool, appliance, or light fixture (38 percent); and contact with wiring, transformers, or other electrical components (33 percent).
- Nonfatal electrical injury occurs most often to those who work with machines or tools and around electrical wiring other than power lines.
- Over the last 10 years, more than 46,000 workers were injured from on-the-job electrical hazards.
- During the work day, a worker is hurt by electricity every 30 minutes so severely that it requires time off the job.

—Electrical Safety Foundation International (ESFI)

Dangers of Electricity

When working with power tools or on electrical circuits, there is always a risk of electrical **hazards**. Anyone can be exposed to these hazards at home or on the job. Utility workers are exposed to more hazards, especially electrical hazards, on the job due to the use of a variety of tools and machinery, dynamic outdoor weather situations, differing levels of coworkers' experience, and other factors not usually encountered in a home setting.

As mentioned in the introduction, electricity is often used without much thought about safety. Because electricity is a familiar, convenient part of our lives, it often is not treated with enough caution. As a result, an average of one worker is electrocuted on the job every day of every year.

Energy and electrical trades workers encounter a variety of occupational hazards due to the nature of their work. Although many of these occupational hazards are particular to the specific electrical trades job, electricity is the most common source of occupational fatalities and serious injuries.

Electrical trades workers must pay special attention to electrical hazards to prevent injury and maintain a safe working environment. Contact with electrical voltage can cause **current** to flow through the body, resulting in electrical shock, burns, or even death.

Introduction to Occupational Safety and Health

Critical Thinking 

As a class, discuss what you know about occupational safety and health.

Have you ever had a job that had safety training as part of the orientation?

Do you know anybody who was hurt on the job? Describe the details.

Have you heard of OSHA?

What do you think OSHA does?

What regulations are you aware of that cover safety?

History of Occupational Safety Regulation

In 1903, the U.S. Bureau of Labor began publishing studies of occupational fatalities and illnesses in certain trades, as well as other safety and **health** topics. In 1912, the U.S. Bureau of Labor released an **occupational safety** study of industrial accidents in the iron and steel industry in addition to a survey of safety and health conditions in the American workplace.

Additional Bureau of Labor studies of other industries and safety and health topics followed, but it was not until the late 1930s that recordkeeping was accurate enough to permit the collection of nationwide work injury data.

During the 1960s, **occupational injuries** and illnesses were increasing in both number and severity. Disabling injuries increased 20 percent during the decade, and 14,000 workers were dying on the job each year.

Amid increasing public outcry against rising injury and death rates on the job, the government saw the need for the creation of some type of national safety regulatory agency. After nearly a century of endeavors by local and federal government to mitigate the vulnerabilities of employees exposed to workplace hazards, on December 29, 1970, President Richard Nixon signed the Occupational Safety and Health Act (OSHA) into law.

Since the inception of OSHA, overall workplace fatalities have been cut by more than 60 percent, and incidence rates of occupational injury and illness have declined by 40 percent. Even with the dramatic advancements in health and safety established through local and federal regulations such as those created through OSHA, thousands of work-related fatalities and life-altering injuries still occur each year.

Additional regulatory agencies have been created to protect consumers, employees, and the community at large from occupational hazards.

Other Safety Issues

When we reflect on safety regulations, we usually think about regulations that protect a worker's *physical* safety. It is important to remember that safety regulations and standards not only address the physical elements of workplace safety; they also address the safety and security of information, the environment, and the community in general.

Effective local, state, and national regulations promote and enforce safe and secure operations for the protection of people, data, the environment, property, and institutions.

Federal Agencies and Regulatory Requirements

A variety of regulatory agencies are involved in the creation, administration, and **enforcement** of occupational safety, information safety, and environmental protection protocols. The energy and utilities industry has additional specialized agencies and regulations that provide for enforcement of safety and security practices.

Entities that Affect Safety Regulations in the Energy and Utilities Industry

U.S. Department of Labor
http://www.dol.gov

Mission: To foster, promote, and develop the welfare of the wage earners, job seekers, and retirees of the United States; improve working conditions; advance opportunities for profitable employment; and ensure work-related benefits and rights.

DOL Agencies: OSHA, BLS

Occupational Safety and Health Administration
http://www.osha.gov

Mission: To save lives, prevent injuries, and protect the health of American workers.

To accomplish this, federal and state governments must work together in partnership with the more than 100 million working men and women and their 6.5 million employers who are covered by the Occupational Health and Safety Act of 1970.

U.S. Bureau of Labor Statistics
http://www.bls.gov

Mission: To collect, analyze, and disseminate essential economic information to support public and private decision-making. As an independent statistical agency, BLS serves its diverse user communities by providing products and services that are objective, timely, accurate, and relevant.

National Institute for Occupational Safety and Health
http://www.cdc.gov/niosh

Mission: To generate new knowledge in the field of occupational safety and health and to transfer that knowledge into practice for the betterment of workers.

Entities that Affect Safety Regulations in the Energy and Utilities Industry

U.S. Department of Transportation
http://www.dot.gov

Mission: To serve the United States by ensuring a fast, safe, efficient, accessible, and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future.

U.S. Environmental Protection Agency
http://www.epa.gov

Mission: To protect human health and safeguard the natural environment.

National Fire Protection Association
http://www.nfpa.org

Mission: To reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating consensus codes and standards, research, training, and education. Codes and standards include:

(NPFA 70) National Electric Code: A U.S. standard for the safe installation of electrical wiring and equipment.

(NPFA 70E) Standard for Electrical Safety in the Workplace: A standard for electrical safety requirements for employees.

Entities that Affect Safety Regulations in the Energy and Utilities Industry

National Safety Council
http://www.nsc.org

Mission: To save lives by preventing injuries and deaths at work, in homes and communities, and on the roads, through leadership, research, education, and advocacy.

American Society of Safety Engineers
http://www.asse.org

Members manage, supervise, and consult on safety, health, and environmental issues in industry, insurance, government, and education.

U.S. Nuclear Regulatory Commission
http://www.nrc.gov

Mission: As a collegial body, to formulate policies, develop regulations governing nuclear reactor and nuclear material safety, issue orders to licensees, and adjudicate legal matters.

Entities that Affect Safety Regulations in the Energy and Utilities Industry

U.S. Department of Homeland Security
http://www.dhs.gov

Mission: To lead the unified national effort to secure the country and preserve our freedoms.

While the Department was created to secure our country against those who seek to disrupt the American way of life, its charter also includes preparation for and response to all hazards and disasters.

North American Electric Reliability Corporation
http://www.nerc.com

Mission: To ensure the reliability of the North American bulk power system. Develops and enforces reliability standards; monitors the bulk power system; and educates, trains, and certifies industry personnel.

U.S. Office of Health, Safety and Security
https://energy.gov/ehss/environment-health-safety-security

Mission: Responsible for health, safety, environment, and security; providing corporate-level leadership and strategic vision to coordinate and integrate these vital programs.

HSS is responsible for policy development and technical assistance; safety analysis; corporate safety and security programs; education and training; complex-wide independent oversight; and enforcement.

The United States Department of Labor

The United States Department of Labor (DOL) is a department of the United States government. The DOL is responsible for services related to occupational safety, wage and hour standards, unemployment insurance benefits, and re-employment.

Agencies within the DOL include:

- Bureau of Labor Statistics (BLS)
- Occupational Safety and Health Administration (OSHA)
- Office of Labor-Management Standards (OLMS)
- Office of Workers' Compensation Programs (OWCP)

The U.S. Bureau of Labor Statistics

The U.S. Bureau of Labor Statistics (BLS) is a unit of the United States Department of Labor. The BLS serves as the main fact-finding agency for the U.S. government in the field of labor economics and statistics. The BLS collects, processes, analyzes, and disseminates statistical data to federal and local governments as well as the American public at large.

National Institute for Occupational Safety and Health

The National Institute for Occupational Safety and Health (NIOSH) is a federal agency that conducts research and makes recommendations for the prevention of work-related injuries and illnesses. NIOSH is part of the Centers for Disease Control and Prevention (CDC) within the U.S. Department of Health and Human Services.

NIOSH was established to help ensure safe and healthful working conditions by providing research, information, education, and training in the field of occupational safety and health.

U.S. Department of Transportation

The U.S. Department of Transportation (DOT) oversees federal highway, air, railroad, and maritime and other transportation administrative and regulatory functions. The DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) coordinates activities involving oil and natural gas pipelines.

The U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (EPA) is a federal agency tasked with protecting human health and the environment. The EPA conducts environmental assessment, research, and education. The agency is responsible for researching, writing, and enforcing environmental regulations, as well as leading in pollution prevention and energy conservation efforts. The EPA is responsible for guidelines relating to radiation exposure.

The Department of Energy also collaborates with the EPA on air quality and fuel-related emissions issues.

National Fire Protection Association/National Electric Code

The National Fire Protection Association (NFPA) publishes many different safety standards. Two that directly affect the energy and utilities industry are the NFPA 70 and the NFPA 70E.

The National Electrical Code (NEC), or NFPA 70, is a U.S. standard for the safe installation of electrical wiring and equipment. The NEC is not itself a U.S. law, but NEC use is commonly mandated by state or local law.

The Standard for Electrical Safety in the Workplace (NPFA 70E) is a U.S. standard for electrical safety requirements for employees in workplaces that necessitate special electricity-related safeguarding.

NFPA 70E addresses electrical safety requirements for employees during activities such as the installation, operation, maintenance, and demolition of electric conductors and electric equipment in or on buildings and other structures, and the installation of conductors and equipment that connect to the supply of electricity.

National Safety Council

The National Safety Council (NSC) is a nonprofit, nongovernmental public service organization that is committed to promoting health and preventing injuries and deaths at work and at home in the U.S. through leadership, research, education, and advocacy. The NSC works with government agencies to strengthen workplace safety and help reduce the number of workplace injuries and fatalities.

American Society of Safety Engineers

The American Society of Safety Engineers (ASSE) is the oldest professional safety organization. The ASSE is committed to protecting people, property, and the environment through management, supervision, and consultation activities related to safety, health, and environmental issues in industry, insurance, government, and education.

The U.S. Nuclear Regulatory Commission

The U.S. **Nuclear Regulatory Commission** (NRC) has the responsibility of ensuring the peaceful and safe use of nuclear energy. The NRC is responsible for programs that promote defense and security, environmental protection, and protection of public health and safety in regard to nuclear energy. The NRC regulates programs relating to special nuclear material, radioactive wastes, and nuclear power facilities.

The NRC ensures safeguards and security specifically by regulating operations accounting systems for nuclear materials as well as the security and contingency programs.

The United States Department of Homeland Security

The United States Department of Homeland Security (DHS) is a department of the United States federal government. The DHS is tasked with protecting the territory of the United States from terrorist attacks and responding to natural disasters. Responsibilities of the DHS also include preparation for and response to hazards and disasters.

The DHS works directly with energy companies to ensure adequate security measures are enacted to ensure the reliability and security of the infrastructure of the energy industry. The DHS also directly coordinates nuclear power and hydroelectric dams. The DHS Transportation Security Administration oversees pipeline security and collaborates with the Department of Transportation on issues where pipeline safety and security issues overlap. The DHS Office of Cyber Security and Communications also manages security issues with the energy sector's cyber infrastructure.

North American Electric Reliability Corporation

The North American Electric Reliability Corporation (NERC) is certified by the Federal Energy Regulatory Commission (FERC) to establish and enforce reliability standards for the bulk-power system. NERC is responsible for developing standards for power system operations; monitoring and enforcing compliance with those standards; assessing resource adequacy; and providing educational, training, and certification resources.

U.S. Office of Health, Safety and Security

The U.S. Office of Health, Safety and Security (HSS) is part of the U.S. Department of Energy. The HSS is responsible for policy development and technical assistance in the areas of health, safety, environment, and physical and information security as they pertain to the initiatives of the Department of Energy. The HSS manages education and training programs; enforcement programs including nuclear safety, worker safety, and health; and information security programs.

State and Local Agencies

From reviewing the list of regulatory bodies in the previous paragraphs, it is easy to see that the power and energy sector is large and diverse and that no single entity could be responsible for all regulations. In addition to federal agencies and industry groups, there also are many state and local agencies that play a role in regulation.

State Government Energy Offices

State government energy offices are typically responsible for coordinating responses to energy emergencies as well as for developing practices and procedures to improve energy security and reliability.

State Governors' Offices

State governors' offices typically develop policies that address energy security and reliability and emergency preparedness.

Local Government

Local government agencies play a varied role in energy security, protection, and emergency response issues.

☼ ACTIVITY: Occupational Safety Agencies

Break into student groups. Each group will be assigned a specific occupational safety and health agency and will be responsible for researching it and presenting it to the class as a whole. Examples of agencies to research include:

- OSHA
- EPA
- National Fire Protection Association
- National Electric Code
- National Safety Council
- American Society of Safety Engineers

Each group should prepare a presentation on their assigned agency's impact on them, their coworkers, and their community, and present it to the class.

Reports should include at least the following:

- The contact information, including a local contact
- The website and summary of info found on site
- Mission statement
- Specific regulations and guidelines related to the energy and utility industries

A Closer Look at Community and Environmental Safety Legislation

Numerous existing standards and programs under the federal government affect the electric power generation industry. A few specific examples of environmental regulations that affect the energy and utilities industry include the following.

Clean Water Act

The Clean Water Act (CWA) is a federal law that was passed to govern water pollution by restoring and maintaining the nation's waters.

Wastewater discharges from electric power generation facilities released to waters of the United States are covered under the Clean Water Act. Facilities must obtain a permit from the EPA to help regulate point source discharges. The permitting program establishes pollutant limitations and other special conditions.

Main elements of the Act include:

- Water quality standards
- System of minimum effluent standards for each industry
- Discharge permit program (translates standards into enforceable limits)
- Provisions for special problems
- Construction loan program for publicly owned treatment works.

Clean Air Act

The Clean Air Act (CAA) is a federal law that was passed to govern air quality through the reduction of smog and air pollution in general.

Main elements of the Act include:

- Regulation of hazardous air pollutants
- Reductions in power plant emissions for control of acid rain
- Operating permit program
- Stratospheric ozone protection
- Enforcement power and penalties.

Regulations for National Ambient Air Quality Standards (NAAQS) do not *directly* affect the electric power generation industry. However, these standards are applied to the ambient air in particular areas. Electric power generators may be *indirectly* affected if they are located in or near an area that is not in compliance with the quality standards.

☼ CAREER PROFILE: Air Pollution Control Technician

Carmen P. is an Air Pollution Control Technician. She works for a state air quality-control agency. She is primarily a field technician, so she installs, operates, and sometimes repairs air-sampling equipment. She also collects air samples that are analyzed to find out if harmful gases or particles are in the air. She takes readings of wind speed, humidity, and temperature because these factors affect pollution.

Carmen began her career by getting a two-year degree in chemistry. For a couple of years, she worked in the state air pollution laboratory. She says, "I really like the outdoors, and I like working with equipment and tools. I decided I would be a lot happier as a field technician. So I went back to our local community college and took another year of courses in instrumentation. That prepared me for the field job." Carmen still works part-time in the lab, but much of her time is spent driving around to the different air-sampling stations, checking instrumentation, and taking readings.

"Using our instrumentation, I can take readings of sulfur oxides, nitrogen oxides, carbon monoxide, carbon dioxide, and other gases. We also analyze for solid particles—particulates," says Carmen. She goes on, "A lot of the pollution in this area is related to auto emissions. Our city doesn't have a very good public transportation system. People are out there in their own cars, not thinking too much about what they put into the air."

Clean Power Plants

On December 16, 2011, the Environmental Protection Agency (EPA) finalized the first national standards to reduce mercury and other toxic air pollution from coal- and oil-fired power plants. The Mercury and Air Toxics Standards provide regulatory certainty for power plants. Additionally, these standards level the playing field so that all plants will have to limit their emissions of mercury as newer plants already do. Use of widely-available controls will reduce harmful air toxics and help modernize the aging fleet of power plants, many of which are over 50 years old.

Hazardous Materials Transportation Act

The Hazardous Materials Transportation Act (HMTA) is a federal law that was passed to regulate the transportation of hazardous materials, including radioactive materials.

Main elements of the Act include:

- Procedures and policies
- Material designations
- Packaging requirements
- Operational rules

Nuclear Regulatory Commission

The U.S. Nuclear Regulatory Commission (NRC) was created as an independent agency by Congress in 1974 to ensure the safe use of radioactive materials for beneficial civilian purposes while protecting people and the environment. The NRC regulates commercial nuclear power plants and other uses of nuclear materials, such as in nuclear medicine, through licensing, inspection, and enforcement of its requirements.

Emergency Planning and Right-to-Know Act

The Emergency Planning and Right to Know Act (EPCRA) is a federal law that was passed to encourage and support emergency planning efforts at the state and local level.

Main elements of the Act include:

- Rights for members of the public and local governments to obtain information concerning potential hazardous substance threats in their communities
- Establishment of mechanisms to enable states and communities to prepare to respond to unplanned releases of hazardous substances.

☼ ACTIVITY: Environmental Responsibilities

Break up into two groups to research the responsibilities associated with environmental regulations**.** One group should research employers' responsibilities, and the other group should research employees' responsibilities.

Each group should present their findings to the class. Be sure to look at the impact on noncompliance with environmental regulations on:

- Employees
- Employers
- The community

A Closer Look at Physical Safety Legislation

The Occupational Safety and Health Act

The Occupational Safety and Health Act was signed into law December 29, 1970. The OSH Act established the following agencies:

- The Occupational Safety and Health Administration (OSHA) to set and enforce workplace safety and health standards
- The National Institute for Occupational Safety and Health (NIOSH) to conduct research on occupational safety and health

- The **Occupational Safety and Health Review Commission** (OSHRC), an independent agency to adjudicate enforcement actions challenged by employers

The Occupational Safety and Health Act is administered by the U.S. Department of Labor's Occupational Safety and Health Administration (OSHA). Safety and health conditions in most private industries are regulated by OSHA. Some small businesses have certain exceptions, such as exemptions from inspections and log maintenance. OSHA requires employers under their jurisdiction to provide a safe workplace. OSHA does not cover the self-employed, some farming family workers, and some employees of state and local governments.

Under the OSH Act, employers have a general duty to provide employees with a place of employment that is free from recognized hazards that can cause death or serious physical harm, and to comply with all OSHA standards, rules, and regulations.

OSHA standards establish requirements designed to protect employees against workplace hazards. OSHA's safety standards are intended to protect against injury, while health standards are designed to address potential exposure to harmful substances and possible subsequent illnesses.

OSHA covers most private sector employers and workers in all 50 states, the District of Columbia, and the other U.S. jurisdictions either directly through OSHA or through an OSHA-approved State Plan. State Plans are OSHA-approved job safety and health programs operated by individual states instead of federal OSHA. In those states, the OSHA-approved state plans must enact standards at least as effective and rigorous as the federal standards.

Did you know?

The term "OSHA 10" refers to a basic 10-hour outreach training program that gives an overview of OSHA-required policies and procedures that play a role in prevention and elimination of work-related illnesses and injuries. Information about employer and employee rights, reporting, recordkeeping, and inspection are covered as well. Training is available for general industry or the construction industry. Personnel in attendance at the training receive their "OSHA 10" certification.

Workers' Rights Under the OSH Act

In accordance with the OSH Act of 1970, workers have the following rights:

Under federal law, you are entitled to a safe workplace. Your employer must provide a workplace free of known health and safety hazards. If you have concerns, you have the right to speak up about them **without fear of retaliation**. You also have the right to:

- Be trained in a language you understand
- Work on machines that are safe
- Be provided required safety gear, such as gloves or a harness and lifeline for falls

- Be protected from toxic chemicals
- Request an OSHA inspection, and speak to the inspector
- Report an injury or illness, and get copies of your medical records
- See copies of the workplace injury and illness log
- Review records of work-related injuries and illnesses
- Get copies of test results done to find hazards in the workplace

Request information from your employer about OSHA standards, worker injuries and illnesses, job hazards, and workers' rights.

- Request information from your employer on safety and health hazards in your workplace, chemicals used in your workplace, tests that have been done to measure hazards, and precautions and procedures to follow in the event of exposure to hazardous substances.

Request action from your employer to correct hazards or violations.

- Ask your employer to correct hazards even if they are not violations of specific OSHA standards. Keep copies of any requests made to your employer to correct hazards.

File a complaint with OSHA if you believe that there are either violations of OSHA standards or serious workplace hazards.

- File a complaint and request OSHA to conduct an inspection if you believe serious workplace hazards or violations of standards exist in your workplace. You can file a complaint online, in writing, by telephone, or by fax.
- By law, employees are protected from retaliation for reporting legitimate unaddressed hazards directly to OSHA.

Be involved in OSHA's inspection of your workplace.

- Have an authorized employee representative accompany the OSHA compliance officer during the inspection tour and respond to questions from the compliance officer and tell the compliance officer about workplace hazards.

Find out the results of an OSHA inspection.

- Find out the results of OSHA inspections and request a review if OSHA decides not to issue a citation.

Employers' Rights Under the OSH Act

Receive compliance assistance from OSHA.

- Seek advice and off-site consultation as needed by writing, calling, or visiting the nearest OSHA office.

Be involved in OSHA's inspection of your workplace.

- Request and receive proper identification of the OSHA compliance officer prior to inspection.
- Be advised by the compliance officer of the reason for an inspection.
- Have an opening and closing conference with the compliance officer.
- Accompany the compliance officer on the inspection.

Find out the results of an OSHA inspection.

- File a Notice of Contest with the OSHA area director within 15 working days of receipt of a notice of citation and proposed penalty.

Industrial Safety Regulation

Examples of critical changes in industrial safety regulation enacted by OSHA:

- **Guards on all moving parts**—Requirement of guards on all moving machinery parts where contact is possible
- **Permissible exposure limits (PEL)**—Maximum concentrations of chemicals stipulated by regulation for chemicals and dusts
- **Personal protective equipment (PPE)**—Required use of respirators, gloves, coveralls, eye and ear protection, and other protective equipment in industrial environments
- **Lockout/tag out**—Requirements for locking out energy sources when performing repairs or maintenance
- **Confined space**—Is large enough for an employee to enter fully and perform assigned work; is not designed for continuous occupancy by the employee; and has a limited or restricted means of entry or exit. These spaces may include underground vaults, tanks, storage bins, pits and diked areas, vessels, silos, and other similar areas. 10CFR1910.146
- **Permit-Required Confined Space**—Permit-required confined space has one or more of these characteristics: Contains or has the potential to contain hazardous atmosphere; contains a material with the potential to engulf someone who enters the space; has an internal configuration that might cause an entrant to be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section; and/or contains any other recognized serious safety or health hazards. 10CFR1910.146
- **Hazard communication**—Requirements for the development and communication of information on the hazards of chemical products used in the workplace
- **Process safety management**—Requirements for the management of hazards associated with processes using highly hazardous chemicals

- **Bloodborne pathogens**—Regulations to prevent healthcare (and other) workers from being exposed to bloodborne pathogens
- **Excavations and trenches**—Regulations specify that employees working in trenches and excavations must be provided with safeguards to prevent collapses and cave-ins
- **Exposure to asbestos**—Established requirements for occupational exposure to asbestos

☼ ACTIVITY: OSH Guest Speaker

Invite members of your community who serve in roles such as firefighter, hazmat first responder, or OSHA representative to speak with your class about their careers and backgrounds.

All students should develop questions based on research you have done that you would like to ask a guest speaker concerning careers in occupational safety and health.

Take notes and use the information to examine possible career choices.

OSHA and Electrical Standards

OSHA regulations for general industry (29 CFR 1910) are published in Title 29 of the Code of Federal Regulations (CFR). These regulations contain several sections pertinent to electrical work.

Part 1910, Subpart S–General, Electrical. This subpart addresses electrical safety standards and covers the practical safeguarding of workers.

Four main divisions include (1910.301–1910.398):

- Design safety standards for electrical systems (1910.302 – 1910.308)
- Safety-related **work practices** (1910.331 – 1910.335)
- Safety-related maintenance requirements (1910.361– 1910.380)
- Safety requirements for special equipment (1910.381 – 1910.398)

Part 1910, Subpart I—**Personal Protective Equipment** (PPE)

- General requirements (1910.132)
- Electrical protective devices (1910.137)

Part 1910, Subpart J General Environmental Controls

- Permit-required confined spaces (1910.146)
- The control of **hazardous energy** (lockout/tag out) (1910.147)

OSHA and the Energy and Utilities Industry

The Occupational Safety and Health Administration (OSHA) determined that there was a significant risk to the health and safety of workers in the areas of electric power generation, transmission, and distribution due to their exposure to electrical hazards. To protect workers from the unique hazards encountered in these work environments, OSHA updated the regulations for general industry (29 CFR 1910) to include standards addressing the work practices to be used during the operation and maintenance of electric power generation, transmission, and distribution equipment and facilities.

© U.S. Department of Labor

Part 1910, Subpart R—Special Industries.

- Electric power generation, transmission, and distribution (1910.269)

The new standards included requirements relating to:

- Training
- Job briefings
- Confined spaces
- Hazardous energy control
- Working on or near **energized** parts
- Live-line tools
- **Grounding** for employee protection
- Work on underground and overhead installations
- Line-clearance tree trimming
- Work in substations and generating plants
- Other special conditions and equipment unique to the generation, transmission, and distribution of electrical energy.

OSHA regulations and standards are developed for the protection of people in the workplace. Compliance with these regulations is mandated by OSHA to prevent injuries to employees working with electrical power systems.

☼ ACTIVITY: Electrical Safety Regulations

Form three groups within your class. Group one will research federal electrical safety regulations, group two will research state electrical safety regulations, and group three will research local electrical safety regulations.

Groups should develop checklists for each level of electrical safety regulations. Groups should compare findings and discuss where regulations overlap. In case of regulatory discrepancies, determine which regulations take precedent.

Nuclear Regulatory Commission Occupational Guidelines

OSHA, the EPA, and the U.S. Nuclear Regulatory Commission (NRC) have established regulations for safety in the workplace. The NRC has created occupational safety and health guidelines that establish standards for radiation protection of workers who may be occupationally exposed to radioactive materials.

OSHA and the NRC have defined their respective roles for their responsibilities in occupational safety regulations for employees who work with radioactive materials. Through the coordination and collaboration of activities between the two agencies, both agencies work to achieve employee protection at facilities licensed by the NRC.

Examples of NRC, OSHA, and EPA Jurisdictions

The U.S. Nuclear Regulatory Commission (NRC), OSHA, and the EPA have established regulations for safety in the workplace. The NRC has created occupational safety and health guidelines that establish standards for radiation protection of workers who may be occupationally exposed to radioactive materials.

NRC Jurisdiction

- Radiation risk produced by radioactive materials
- Chemical risk produced by radioactive materials
- Plant conditions that affect the safety of radioactive materials
- Power reactor site inspections

OSHA Jurisdiction

- Radiation risks from radiation sources not regulated by the NRC
- Plant conditions that result in an occupational risk but do not affect the safety of licensed radioactive materials
- OSHA standards cover employee exposures from all radiation sources not regulated by the NRC.

EPA Jurisdiction

- Among other things, the EPA is responsible for setting air emission and drinking water standards for radioisotopes.

Looking Back

We have the right to a safe environment, in our communities or on the job. The government and other alliances have provided laws, standards, and regulations in an attempt to provide all Americans with safe and healthful communities and workplaces. Regulatory agencies continue to work to promote and enforce standards that protect Americans by reinforcing frequent education and training opportunities and encouraging continual improvement of workplace safety, community awareness and preparedness, and environmental preservation.

The collaboration between federal agencies, industry alliances, local governments, and private industry is imperative to provide for the safekeeping of our environment, our communities, and our workplaces.

Creating a Workplace Safety Culture

It is the obligation of all employers, employees, and customers to work together to create a culture of safety for the energy and utilities industry. Employers must consider the safety of their employees, employees must consider the safety of customers, and everyone must consider the safety of their communities in general.

The National Safety Council estimated the costs of workplace injuries to be at $206.1 billion in 2015. The costs of workplace injuries go beyond monetary costs. Workplace injuries have physical, operational, and financial consequences.

Potential Costs of Accidents

Physical

- Injury
- Disability
- Death

Operational

- Decreased operational effectiveness
- Repair and replacement of equipment
- Public image implications
- Regulatory implications

Quick Facts

An effective workplace safety and health program:

- Improves employee morale and performance.
- Enhances company profitability.
- Reduces employee turnover.
- Reduces the extent of work injuries.
- Reduces workers' compensation costs.

Financial

- Decreased operational productivity
- Cost of lost production

Creating a workplace safety and health culture goes beyond the goal of the reduction of physical injuries. A safety culture promotes safety and well-being through continuous prevention and systematic awareness and assessment of hazards, consistent safe work practices, and a commitment of personal responsibility from all in creating and maintaining a safe and healthful workplace.

Companies should be committed to creating and maintaining a culture of safety and wellness. Safety at all levels and sectors of a company is integral to personal well-being and operational effectiveness. Companies must make it a priority to create a workplace atmosphere that places a prominent emphasis on safety and well-being for all.

Employer Responsibilities

All levels of a company must be engaged in establishing a company safety culture. However, management should be committed to being the driving, motivating force of safety leadership. While employee involvement is vital, management is ultimately responsible for establishing opportunities for employee action and commitment to safety.

Employees must know that company management is fully committed to safety, regardless of financial or other business conditions. Management should demonstrate consistency in all actions. Adhering to established policies and procedures confirms an unwavering commitment to safety. Management must enforce the clear expectation that all employees in the company must adhere to safety policies and procedures, without exception, to ensure the safety of all.

Examples of Employer Responsibilities

- Ensure compliance with occupational safety and health standards and regulations.
- Ensure that employees have the training, tools, and equipment needed to perform tasks safely.
- Develop safety and health programs, policies, and procedures.
- Conduct regular work observations and analysis.
- Keep records of all monitoring data.
- Ensure effective and timely resolution of safety and health issues.
- Inform workers of their rights and responsibilities related to occupational safety and health.
- Investigate and resolve all allegations of unsafe conduct or violations of policies and procedures.
- Maintain confidentiality and privacy of employees.

Although many utility companies have designated safety professionals who serve as the point-persons for safety issues and resources, it is important to establish a company culture of safety by encouraging all employees to be safety specialists in their own right. All employees should feel responsibility for the creation and maintenance of safe and healthful workplaces.

Safety Administration and Management

Employers should ensure that all employees are trained, qualified, and equipped with the necessary personal protective equipment (PPE) tools, knowledge, and skills to safely perform their duties.

Quick Facts

Common Characteristics of Exemplary Workplace Safety and Health Programs

Leadership: Assign responsibility to managers, supervisors, and employees

Action: Inspect regularly for, analyze, and control hazards

Education: Train all employees in safe work practices

Major Elements for an Effective Workplace Safety and Health Program

Leadership

Awareness

- Safety committees
- Safety posters
- Safety bulletin boards

Commitment

- Management and employee involvement

Incentives

- Rewards for exemplary safety performance
- Awards for maintaining safe work practices

Action

Hazard Prevention and Control

- Worksite/job hazard analysis
- Toolbox safety meetings at all jobsites
- Daily jobsite briefings

Education

Established Protocols

- Safety rules, standards, and procedures

Training

- Effective safety and health training for all categories of employees

Safety Policy/Statement

The creation of a **safety policy**, mission, or statement can become a guiding principle for all levels of employees and management of the fundamental safety beliefs and policies of the company. OSHA provides examples of sample policy statements on its website. Examples include:

"The Occupational Safety and Health Act of 1970 clearly states our common goal of safe and healthful working conditions. The safety and health of our employees continues to be the first consideration in the operation of this business."

"It is the intent of this company to comply with all laws. To do this we must constantly be aware of conditions in all work areas that can produce injuries. No employee is required to work at a job he or she knows is not safe or healthful. Your cooperation in detecting hazards and, in turn, controlling them is a condition of your employment."

ACME POWER CO.

Company Policy Statement

SUBJECT	Number	
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SAFE WORK POLICY	Original Issue Date	Revision Date
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Policy:
ACME Power Company, as part of its continuing commitment to employee safety, prohibits violations of the Company's safety procedures, policies, practices or any other unsafe acts. The Company will not permit conduct that creates an unsafe work environment, whether intentional or otherwise, to occur by an employee or between employees and co-workers, contractors, customers or members of the public.

Implementation:

1. CRITICAL VIOLATIONS

   All employees are responsible for their own safety and adherence to ACME Power Company's safe work methods, rules and procedures. Managers, supervisors, persons in charge and co-workers share in the responsibility of creating a safe work environment and for ensuring employees are working safely. As such, in the event safe work methods, rules and/or procedures are violated, any individual being a party to the violation will be held accountable.

   Violations of any type can be serious and must be dealt with appropriately. However, confirmed violations of certain safe work methods, rules, and/or procedures or unsafe behaviors can result in death or serious injury to employees and will be subject to discipline up to and including discharge. Incidents resulting in injuries, where unsafe behaviors are evident, are not exempt from discipline consideration. While some may believe that the injury itself is sufficient "punishment" for unsafe behaviors, the actions nevertheless must be addressed and disciplinary intervention may be appropriate. These violations include, but are not limited to, the following:

   - **VEHICLE OPERATION** – Operating the vehicle in a **pattern of unsafe or clearly reckless behavior such as a failure to wear seat/lap belts where vehicle or equipment is so equipped.**
   - **RUBBER GLOVES** - Failure to use the appropriate insulating rubber gloves.
   - **MINIMUM APPROACH DISTANCE** - Failure to cover all energized parts and grounded surfaces which would result in minimum approach distance requirements being violated.
   - **GROUNDING** - Failure to treat all conductors and equipment as energized until properly grounded.
   - **CONFINED/ENCLOSED SPACE** - Failure to comply with the Company's confined/enclosed space procedures.
   - **EXCAVATION/SHORING** - Failure to use approved protective systems or proper sloping methods when entering an excavation.
   - **CLEARANCE, SWITCHING AND TAGGING** – Failure to comply with the Company's clearance, switching and tagging procedures and/or operating a switch or piece of equipment in violation of procedures.
   - **FALL PROTECTION** - Failure to utilize appropriate fall protection equipment when working from poles, structures, platforms, aerial lift devices, etc., as specified by the Company's fall protection programs.
   - **FLAME RESISTANT CLOTHING** - Failure to utilize the appropriate flame resistant clothing.
   - **CRANES/FORKLIFT OPERATION** - Operating cranes and forklifts without proper training, certification (if required) or established qualifications.
   - **DIELECTRIC FOOTWEAR** – Failure to wear dielectric footwear as specified by the Company's policies.

   Violations shall be addressed through the Company's Performance Management process.

2. INDIVIDUAL RESPONSIBILITY

   - All employees are responsible for creating a safe work environment. All parties present shall immediately warn others when they witness an unsafe act or violation of the Company's safety

procedures, policies, or practices. Employees are expected to take the necessary actions to stop the unsafe behavior of others.

- All employees are required to act in accordance with this policy and to bring to the Company's attention any violations.
- If an employee is asked or instructed to perform an unsafe act, that employee should notify his or her supervisor immediately. Any employee who feels uncomfortable discussing the issue with his or her supervisor should notify an appropriate member of management, any member of Safety and Health, or a member of the Ethics and Concerns Committee. The names and phone numbers of the Ethics and Concerns Committee are posted on company bulletin boards.
- Each employee is expected to cooperate fully and honestly with investigation of possible violations of this policy. Deliberately furnishing inaccurate information to investigators will be grounds for disciplinary action, up to and including discharge.

3. **MANAGEMENT RESPONSIBILITY**

- All levels of management are accountable for ensuring compliance with this policy in their respective areas of operation.
- Management shall ensure all employees have the training, tools and equipment needed to perform job tasks in a manner consistent with the Company's safety procedures, policies or practices.
- Management of business units, which have implemented the Safe Work Observation process, will regularly conduct and document quality safe work observations utilizing the Safe Work Observation Form. Management will retain observation documentation for the current year plus three additional years. Observations will be discussed with the employee.
- Management will review this policy with all new employees hired within their respective areas.
- The Company will take appropriate action to investigate and resolve where possible all allegations of unsafe conduct or violations of the Company's safety procedures, policies or practices. Appropriate steps will be taken to maintain the confidentiality and privacy of individuals who report unsafe conduct or violations of the Company's safety procedures, policies or practices.

It is the Company's intent to ensure all employees understand that adherence to these rules ensures their safety and is a clear expectation of the job.

_____

President and Chief Executive Officer

ACME
POWER
CO.

Company Policy Statement

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I have received a copy of the foregoing policy and have read it. The policy was reviewed with me and I am familiar with and understand the requirements of this policy.

Date	Employee Signature	Printed Name

Date	Supervisor Signature	Printed Name

Safety Plan

OSHA safety regulations require a wide variety of documented plans and safety procedures. Some workplaces (depending on certain characteristics) are required to create and maintain written safety plans.

A safety plan is a document that describes the process for identifying physical and health hazards that could harm workers, procedures to prevent accidents, and steps to take when accidents occur. Many companies compile their activity-specific safety plans into a single safety manual or handbook.

Safety Plans Can Help To:

- Increase worker productivity
- Prepare for special emergencies
- Increase workplace security

Basic Safety Plan Elements:

- Policy or goal statement
- Hazard identification
- Hazard controls and safe practices
- Emergency and accident response
- Employee training and communication
- Recordkeeping

Commonly Required Safety Plans:

- Chemical handling and storage
- Emergency action and fire prevention
- Hazardous energy control (lockout/tag out)
- Confined spaces
- Fall protection
- Injury and illness recordkeeping and reporting
- Respiratory protection
- Training documentation systems
- Vehicle accident prevention

- Workplace violence
- Process safety management
- Hazard communication—**Safety Data Sheet** (SDS)/Worker Right-to-Know

JOB SAFETY PLAN

ACME
POWER
CO.

Job Location and Description:	Date: Date: Date:
Feeder Information	
Job Being Performed	

Required Procedures and Safe Work Practices

5 STEP RISK ASSESSMENT	TASK TYPE
1. Identify All Hazards **2. Identify the Type of Task Activity** **3. Ask Questions** **- What Can Possibly Go Wrong?** **- What Is The Risk To Me, My Co-worker Or The Public?** **- What Is In My Scope Of Control?** - Do I Have the Knowledge, Tools and Equipment To Complete the Job Safely? **- What are my Personal Limitations?** **4. Adjust Your Work and JSP Accordingly** **5.Repeat Assessment When Conditions Or Personnel Change**	**HIGH DANGER/ HIGH ACTIVITY ( )** *Perform well, seldom have injuries.* **HIGH DANGER/ LOW ACTIVITY ( )** *Recognize the danger. Pay attention.* **LOW DANGER/ HIGH ACTIVITY ( )** *Done so often we don't think about it.* **LOW DANGER/LOW ACTIVITY ( )** *Our focus is increased because we don't perform the tasks that often.*

ENERGY SOURCE CONTROL: ( ) Not Applicable ( ) Hot Line Tag ( ) Clearance ( ) Individual Control

VOLTAGES BEING WORKED: ( ) 4KV ( ) 12KV ( ) 25KV ( ) 120/240 ( ) 120/208 ( ) 277/480 ( ) OTHER ___

ARC RATING: ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) ENERGIZED WORK ( ) TESTED DEAD AND GROUNDED

JOB HAZARDS & BARRIERS

ELECTRICAL CONTACT:	( ) Guts	( ) Blankets	( ) Live Line Tools	( ) Proper Rated Gloves
FALLING FROM HEIGHTS:	( ) Harness	( ) Lanyard	( ) Climbing Tools	( ) Ladder Secure
PPE:	( ) Hard Hat	( ) Safety Glasses	( ) FR Clothing	( ) Work Gloves
TRAFFIC CONTROL:	( ) Vest	( ) Cones/Signs	( ) Flagger	( ) WZTC#_____
DRIVING:	( ) Safety Belt	( ) Pre-Trip Insp.	( ) Weather	( ) Load Secure

OTHER HAZARDS ASSOCIATED WITH JOB

GRAVITY	ELECTRICAL	MECHANICAL	KINETIC	OTHER
Falling objects	Induced voltage	Equipment failure	Moving & shifting loads	Asbestos
Falling structures	Back feed	Conductor/Cable tension	Rotating machinery	Chemicals
Climbing obstructions	Flash potential	Loaded springs	Vehicle stability/setup	Confined spaces
Dangerous trees	Step potential	Moving parts		Hot surfaces
	Difference of Potential	Rigging & crane loads		Extreme heat or cold
	Static			Pressurized fluids/gas

FOUR RULES FOR PROPER COVER-UP

1. Always cover neutral and energized conductors in the order you first come to them.
2. When practical, cover the neutral and energized conductors and devices before covering grounds.
3. Before working on an energized apparatus, Stop and Check to ensure that grounds in your work area are covered.
4. Before working on a grounded apparatus, Stop and Check to ensure that energized conductors and devices in your work area are covered.

IF ANY CHANGES OCCUR TAKE A TIMEOUT AND CHANGE THE JSP!

SPECIAL PRECAUTIONS

TIME OUT? ( ) YES ( ) NO	BROTHER SISTER'S KEEPER? ( ) YES ( ) NO
Brief stoppage of the job when conditions change or if unsure of next action. Apply added barriers and ensure everyone clearly understands the work. Reason:_____	A review of the task by others. Needed when critical or hazardous work is being performed. Requires full attention and participation by coworker(s). Reviewed By:_____

HAVE YOU CONSIDERED:

Workplace Procedures ***People*** ***PPE*** ***Tools/Equipment*** ***Your Next Move*** ***Power To Perform***

(See Back Cover)

EXITING JOB

JOB SITE CLEANUP	WALK AROUND	BACKING ASSISTANCE	OBSTACLES IN TRAVEL PATH	MERGING INTO TRAFFIC
Scrap Material Hardware Pole	Visual Check around front Rear & Sides of vehicle	Utilize co-worker, law enforcement, If needed	Stationary Objects Overhead clearances Vehicles Pedestrians Soil Type	Clear view of approaching traffic Turn with the flow of traffic Avoid crossing lanes

OTHER COMMENTS

PERSON LEADING JSP:

CREW MEMBERS PRESENT:

IF ANY CHANGES OCCUR TAKE A TIMEOUT AND CHANGE THE JSP!

☼ ACTIVITY: Elements of an Effective Safety Plan

In addition to the safety plan provided in this unit, review the following safety plan content suggestions:

The safety plan should include the following sections:

- Management, leadership, and employee involvement
- Worksite analysis
- Hazard prevention and control
- Training

Within the four major sections, the following can be included:

- Emergency response plan
- Emergency phone contact numbers
- Emergency response to hazardous substances
- First aid
- Policy statement
- Goals
- Management commitment
- Assignment of responsibility
- Discipline/enforcement
- Control of hazards
- Fire prevention
- Training and education
- Recordkeeping and OSHA log review
- Accident investigation
- Safety rules and procedures
- Employee emergency action plan for small construction sites

Visit the OSHA website to review their sample safety plan:

https://www.osha.gov/dcsp/compliance_assistance/sampleprograms.html

If possible, work with local companies to obtain copies of or additional information from job/company-specific safety plans.

As a class, review the different safety plans. How are they similar? How are they different? Identify what characteristics or content make an effective safety plan.

Employee Handbooks

Employee handbooks are an excellent way to provide written documentation regarding company safety and health policies and procedures in addition to general employment policies. Employee handbooks can serve as an official record of a company's safety and health system, and are also a good indicator of the existing safety culture.

An employee handbook is an integral part of employee/employer communication and can be used to convey the following:

- Structured set of rules and guidelines
- Clearly explained employment expectations
- Clearly explained employment policies
- Consequences for violations
- Established expectations
- Consistent management
- Commitment to fair and equal treatment of personnel
- Culture of fairness and integrity.

Documentation—Notices, Recordkeeping, and Reporting

The OSH Act mandates that certain recordkeeping and reporting procedures be followed in the workplace.

Notices

Employees, former employees, and their representatives have the right to review the OSHA Form 300, Log of Work-Related Illnesses and Injuries. “Employers are required to post the Summary of Work-Related Injuries and Illnesses (Form300A) no later than February 1 of the year following the year covered by the records and keep the posting in place until April 30” in a visible location, in accordance with 1904.32(b)(6).

Posters

All covered employers are required to display the OSHA “Job Safety and Health: It’s the Law” poster unless the employer’s workplace is located in a state that operates an OSHA-approved state plan, in which case the state-approved poster should be posted. There is a separate poster for federal agencies. The OSHA poster must be displayed in a conspicuous place where employees and applicants for employment can see it.

Records for Employers with Ten or Fewer Employees

Employers with ten or fewer employees at all times during the last calendar year are not required to keep OSHA injury and illness records unless OSHA or the Bureau of Labor Statistics (BLS) informs them that records must be kept. However, all employers covered by the OSH Act must report to OSHA any workplace incident that results in a fatality or the hospitalization of three or more employees.

Records for Employers in Certain Industries

If an employer's business is in an industry that is classified as low-hazard, the employer is not required to keep records unless OSHA asks them to do so.

All Other Employers

Employers are required to use the Form 300 Log of Work-Related Injuries and Illnesses to classify work-related injuries and illnesses and to note the extent and severity of each case. When an incident occurs, the log is used to record specific details about what happened and how it happened.

Employers must record work-related injuries and illnesses that result in:

- Death
- Days away from work
- Restricted work activity or job transfer
- Medical treatment beyond **first aid**
- Loss of consciousness

Employers must also record the following conditions when they are work-related:

- Any needle-stick injury or cut from a sharp object that is contaminated with another person's blood or other potentially infectious material
- Any case requiring an employee to be medically removed under the requirements of an OSHA health standard
- Work-related cases involving hearing loss under certain conditions
- Tuberculosis infection as evidenced by a positive skin test or diagnosis by a physician or other licensed healthcare professional after exposure to a known case of active tuberculosis

Reporting of Injuries

Federal OSHA requirements direct all employers to report any workplace incidents to OSHA within eight hours after the death of any employee from a work-related incident or "Within twenty-four (24) hours after the in-patient hospitalization of one or more employees or an employee's amputation or an employee's loss of an eye, as a result of a work-related incident, you must report the in-patient hospitalization, amputation, or loss of an eye to OSHA" 1904.39(a)(2).

You must report the fatality, inpatient hospitalization, amputation, or loss of an eye using one of the following methods: 1904.39(a)(3)(i)

- By telephone or in person to the OSHA Area Office that is nearest to the site of the incident.1904.39(a)(3)(ii)
- By telephone to the OSHA toll-free central telephone number, 1-800-321-OSHA (1-800-321-6742).1904.39(a)(3)(iii)
- By electronic submission using the reporting application located on OSHA's public Web site at www.osha.gov.

In addition to completing the required OSHA report, most companies require employees to complete an internal accident report form including the time, date, and location of the incident; eyewitness statements; and other pertinent information that would assist in an **investigation**.

Even if medical treatment is not required, many companies require that employees complete some type of injury form or log, in addition to reporting the injury to their supervisor.

Safety Training and Education

Companies have the challenge of relying on an increasingly newer, less experienced workforce to handle an ever-increasing customer base with high expectations.

Training sources:

- OSHA
- Utility companies
- Trade unions
- Trade associations
- Industry alliances/agencies
- Private training companies

Training should be provided:

- To all new employees before they begin working
- To all existing employees at least once a year
- When new equipment, materials, or processes are integrated
- When procedures have been updated or revised

Key Components of Employee Safety Training:

- Mandatory attendance for *all* employees
- Addresses the safety and health responsibilities of all personnel
- Comprehensive to ensure coverage of all pertinent material
- Hands-on, pragmatic exercises to replicate authentic tasks and environments
- Ensures that all employees understand the hazards to which they may be exposed
- Ensures that all employees know how to prevent harm to themselves and others
- Training includes prevention, recognition, and correction of:
    - **Housekeeping** issues
    - Fall hazards
    - Electrical hazards
    - Chemical hazards
    - Mechanical hazards
    - Fire hazards
    - Duty-specific hazards
    - Additional health hazards

☼ ACTIVITY: Employee Training

Form student groups within your class. Within your group, prepare a PowerPoint presentation and a handout to train utility workers on a specific task such as proper use of selected PPE items; proper use of ladders and safety cones; or other safety procedures.

Student groups should present their PowerPoint and distribute handouts to the class.

New Employee Safety

New workers are more likely to be injured in the workplace in comparison to their more senior coworkers. Unfortunately, research shows that many new workers do not receive adequate training to perform their jobs safely.

Many employers choose to conduct preemployment safety training. Before workers are assigned *any* duties or tasks, they receive training to effectively and safely perform their assignments.

Focus on …

"Forty percent of workers injured have been on the job less than one year."

- U.S. Bureau of Labor Statistics

Safety Meetings

Accidents result from unsafe acts or unsafe conditions. Safety meetings serve as an effective measure for preventing unsafe acts by reinforcing employees' knowledge regarding safe work practices.

Regular safety meetings are a good indicator of a company that places priority on keeping its employees safe. Safety meetings are an opportunity for employers to communicate to employees how they can do their jobs more safely and better. Not only do safety meetings allow employers to pass on valuable information to employees, but they provide structured times for employees to speak with their supervisors about safety concerns or questions. This opportunity for conversation and collaboration from all employees helps to create a company culture that builds morale, excels at productivity, and, above all, values safety.

Most companies schedule safety meetings at least once a week, but will conduct additional meetings as the need arises, such as at the beginning of any new operation. Most meetings last up to thirty minutes, providing time for active participation and a question-and-answer session.

Safety meetings also provide management with a record of what topics have been discussed and which employees were in attendance. This information can be used to influence the direction of content covered as well as to target specific groups of employees needing content-specific training.

Topics covered in safety meetings might include:

- Company **safety program** policies
- Accidents and identification of specific hazards
- Inspection results and subsequent changes
- Work tasks or procedures

Effective safety meetings should provide quality instruction and create motivation for safety awareness. Safety meetings are an effective tool for fostering a company culture that promotes safety awareness and education.

© U.S. Department of Labor

Safety Inspections

Under the OSH Act, OSHA is authorized to conduct **workplace inspections** and investigations to evaluate and determine compliance with safe and healthful workplace practices. OSHA workplace inspections and investigations are conducted by OSHA compliance safety and health officers.

Documents typically reviewed by OSHA inspectors:

- Injury and illness prevention plans and supporting documentation
- OSHA Log 300
- Lockout/tag out procedures
- Emergency and fire plans
- Respiratory protection plans
- Hearing conservation programs
- Hazard communication programs
- Safety data sheets

OSHA inspections are typically either un-programmed (due to employee complaints or in response to reported accidents) or programmed (due to classification as a high-hazard industry, workplace, or occupation).

To be better prepared in the event of an OSHA inspection, in addition to using all methods available to create a safer workplace, many companies create their own internal self-inspection checklists.

Self-inspection safety checklists can be an effective part of a company's safety program through their use in conducting regular inspections to ensure safe workplace conditions.

The most widely accepted way to identify possible hazards is to conduct safety inspections. Self-inspection is an essential part of a regularly scheduled safety audit to document the existence of hazards to be corrected. Self-inspections help to identify where probable hazards exist, to classify hazards according to severity, and to create recommendations for fixing the hazards.

OSHA provides a few sample safety inspection forms, and other compliance tools on their website.

OSHA Suggested Self-Inspection Scope

Self-inspections should cover safety and health issues in the following areas:

- **Processing, Receiving, Shipping, and Storage**—equipment, job planning, layout, heights, floor loads, projection of materials, material handling and storage methods, training for material handling equipment.
- **Building and Grounds Conditions**—floors, walls, ceilings, exits, stairs, walkways, ramps, platforms, driveways, aisles.
- **Housekeeping Program**—waste disposal, tools, objects, materials, leakage and spillage, cleaning methods, schedules, work areas, remote areas, storage areas.
- **Electricity**—equipment, switches, breakers, fuses, switch-boxes, junctions, special fixtures, circuits, insulation, extensions, tools, motors, grounding, national electric code compliance.
- **Lighting**—type, intensity, controls, conditions, diffusion, location, glare and shadow control.
- **Heating and Ventilation**—type, effectiveness, temperature, humidity, controls, natural and artificial ventilation and exhausting.
- **Machinery**—points of operation, flywheels, gears, shafts, pulleys, key ways, belts, couplings, sprockets, chains, frames, controls, lighting for tools and equipment, brakes, exhausting, feeding, oiling, adjusting, maintenance, lockout/tag out, grounding, work space, location, purchasing standards.
- **Personnel**—training, including hazard identification training; experience; methods of checking machines before use; type of clothing; PPE; use of guards; tool storage; work practices; methods for cleaning, oiling, or adjusting machinery.
- **Hand and Power Tools**—purchasing standards, inspection, storage, repair, types, maintenance, grounding, use and handling.
- **Chemicals**—storage, handling, transportation, spills, disposals, amounts used, labeling, toxicity or other harmful effects, warning signs, supervision, training, protective clothing and equipment, hazard communication requirements.
- **Fire Prevention**—extinguishers, alarms, sprinklers, smoking rules, exits, personnel assigned, separation of flammable materials and dangerous operations, explosion-proof fixtures in hazardous locations, waste disposal, training of personnel.
- **Maintenance**—provide regular and preventive maintenance on all equipment used at the worksite, recording all work performed on the machinery and by training personnel on the proper care and servicing of the equipment.
- **PPE**—type, size, maintenance, repair, age, storage, assignment of responsibility, purchasing methods, standards observed, training in care and use, rules of use, method of assignment.
- **Transportation**—motor vehicle safety, seat belts, vehicle maintenance, safe driver programs.
- **First Aid Program/Supplies**—medical care facilities locations, posted emergency phone numbers, accessible first aid kits.
- **Evacuation Plan**—establish and practice procedures for an emergency evacuation, e.g., fire, chemical/biological incidents, bomb threat; include escape procedures and routes, critical plant operations, employee accounting following an evacuation, rescue and medical duties, ways to report emergencies.

☼ ACTIVITY: Safety Checklist

- Prepare a safety checklist to evaluate a specific work environment or work task.
- Present your checklist to the class and get feedback on its accuracy and comprehensiveness.

Enforcement

It is imperative for all levels of management to be consistent in executing their safety and health enforcement responsibilities. All employees must be held accountable for meeting their safety and health responsibilities.

All employees should be aware of enforcement and discipline policies regarding safety rules and procedures. Many companies consider any violation of safety protocol grounds for immediate dismissal. Safety violations are documented in an employee's personnel record.

Company Health and Wellness Programs

Many utility and energy sector companies offer special health and wellness programs for their employees. Healthy employees have better work attendance than unhealthy employees, and healthy employees are also more likely to have better morale and be more productive than unhealthy employees.

Health and wellness programs promote healthy and safe lifestyles both on and off the job. Companies that have implemented health and wellness programs have reported increased employee morale in addition to increased company productivity and profitability.

Some programs offer help in promoting positive lifestyle changes such as:

- Weight loss
- Smoking cessation
- Stress management
- Fitness and exercise
- Healthy nutrition
- Ergonomics

Examples of common health and wellness program activities:

- Lunchtime lectures
- Group classes
- Counseling sessions

- Access to fitness facilities
- Education sessions
- Health screenings

Happy and healthy employees are the foundation of a company culture focused on a safe and healthy workplace. Many companies who have enacted health and wellness programs have reported increased employee loyalty, commitment, and personal responsibility.

Safety Administration

All members of a company are responsible for understanding and following safe and healthy workplace practices. Many companies employ safety specialists to help employees better understand and apply complex safety rules and regulations.

There are many careers in the energy and utilities industry that require knowledge of safety policies and procedures. There are inspection, compliance, coordination, consultation, management, and many other safety-related career opportunities within government, public, and private entities.

☼ CAREER PROFILE: Health and Safety Engineer

Mike G. is a health and safety engineer for a local power plant. Mike's primary duty is to prevent harm to people and property by using his knowledge of systems engineering and mechanical, chemical, and human performance principles in relation to occupational activities. As a safety and health engineer, Mike says, "I identify and measure potential hazards, recommend prevention measures, and develop procedures and designs to reduce the risk of illness, injury, or damage."

Health and safety engineers are required to have knowledge in engineering and technology, mathematics, administration and management, education and training, public safety and security, law and government, sciences, and customer service. Health and safety engineers must be able to apply critical thinking, time management, and active listening skills, along with having high reading comprehension levels. Oral expression, oral comprehension, problem sensitivity, and speech clarity are all highly desired skills.

"I enjoy the opportunity to spend time outdoors, and travel to plants or other worksites," says Mike. Mike works with tools such as air pollutant samplers, air sampling pumps, dynamometers, physiological recorders and decibel meters, and analytical or scientific software.

"I've always been a good problem solver," says Mike, "so I really enjoy the critical thinking and investigative aspects of my job." Health and safety engineers should have a keen sense of attention to detail and a genuine concern for others. "My job is to keep other workers safe. It's a big responsibility, but definitely worth all the work to know that I have helped keep someone from getting injured."

☼ ACTIVITY: OSH Career Exploration

The American Society of Safety Engineers (ASSE) identifies the four primary functions of the safety professional as follows:

- Anticipate, identify, and evaluate hazardous conditions and practices which include:
  - Safety inspections
  - Accident investigation
  - Analysis of individual tasks people perform
  - Studying building layouts
  - Interviews/discussions with people who are exposed to hazards
- Develop hazard control designs, methods, procedures, and programs.
  - Analyze events, conditions, and behaviors
  - Deductive reasoning
  - Problem-solving
  - Creativity
- Implement, administer, and advise others on hazard controls and hazard control programs.
  - Communication
  - Persuasion
  - Leadership
- Measure, audit, and evaluate the effectiveness of hazard controls and hazard control programs.
  - Gathering data
  - Analyzing data

What example tasks and characteristics do you feel matches your personality and skills? In what types of companies or industries would you be interested in applying these skills? What types of jobs using these skills in the utility and energy industry might be a good fit for you?

Creating a Personal Safety Culture

As mentioned previously, all levels of a company must be engaged in establishing a company's safety culture. Just as employers have a responsibility to drive a company's safety culture, employee cooperation and commitment are vital to the success of workplace safety and wellness.

Employee Responsibilities

Examples of standard employee responsibilities:

- Follow safety rules, policies, and procedures to create a safe work environment
- Ask questions about any rules, policies, and procedures you do not understand
- Report any hazards, unsafe actions, or violations of safety policies or procedures

- Help coworkers recognize unsafe actions or conditions
- Stop the unsafe behavior of others
- If instructed to perform an unsafe act, notify a supervisor immediately
- Report all injuries and illnesses to your supervisor

As mandated by federal law, employees must comply with the OSH Act. In accordance with OSHA, employees who knowingly commit unsafe acts or create unsafe conditions, disregard the safety policy, or are repeat offenders will be discharged.

Grounds for immediate termination at most companies include:

- Drinking alcohol and/or drug abuse prior to or during working hours
- Fighting
- Theft
- Willful damage to property
- Failure to wear eye/hearing protection, safety helmets, other required PPE
- Failure to comply with appropriate tool and equipment operation policies
- Inappropriately altering safety guards, barriers, and/or guardrails
- Failure to follow recognized industry practices
- Engaging in dangerous horseplay
- Failure to notify the company of a hazardous situation
- Failure to notify the company of injuries at the time of occurrence
- Deliberately providing inaccurate information in safety/incident investigations

Importance of Employability Skills

Many employers today are placing more emphasis on personal responsibility, ethics, integrity, and other employability skills. Employers need to be able to depend on employees to be responsible for their actions and make the right decisions to maintain a safe and healthful workplace.

Employers can look for certain characteristics in an employee that are indicators of a person who will be a safe and healthful worker and contribute to a company's safety culture.

Ethics and Integrity

Employees with good ethics and integrity are committed to conducting themselves in a professional and safe manner. Employees should be committed to working within the highest standards of legal and ethical conduct to ensure their personal safety and the safety of others.

Employability Skills

Ethics and Integrity
Communication
Team Building
Critical Thinking
Personal Responsibility
Personal Management

☼ ACTIVITY: Professional Ethics

Individually conduct research on professional affiliations for the energy and utilities industry.

After compiling a list of professional organizations, use the library, Internet, or personal interviews to research the organizations and what they stand for. Specifically, review organizations' codes of ethics.

After you have had a chance to review codes of ethics and discuss how they apply to the different organizations, work to create a personal code of ethics.

Communication and Team Building

Employees should strive to be good communicators who are skilled in listening and speaking. Good communication fosters knowledge and awareness that help to prevent accidents and maintain safe workplaces.

All employees must treat each other with respect and maintain a collaborative work environment. A true cooperative workplace is one that is without unlawful discrimination or harassment of any kind and provides equal opportunities for all.

☼ ACTIVITY: Employability Skills—Communication

Discuss what types of communication are needed on the job. For example:

- Written (reports, memos, e-mails, forms, letters)
- Oral (phone calls, interpersonal communication, presentations, interviews)
- Combination of written and oral (accident investigations, training workshops, inspections)

Discuss and identify the communication processes needed for effective communication.

- Know your audience
- Know your subject
- Pick the best communication type for your audience (oral, written, or combination)
- Tell your audience what you are going to tell them (Intro)
- Tell your audience (Body)
- Summarize (Closing)
- Depending on medium selected, ask for feedback

Break into groups. Discuss an industry scenario in which a company has had a safety violation and needs to be warned/informed of the proper course of action. Each group should respond to the violation with one type of communication. For example:

- Memo or e-mail
- Personal conversation with a manager
- Presentation with a demonstration and handouts

Groups should compare communication methods and evaluate their effectiveness.

Change the hypothetical situation and repeat the exercise to demonstrate that different methods are needed to communicate effectively in different situations.

Critical Thinking

Employees with critical thinking skills have the ability to analyze and react appropriately to possible hazards and unsafe working conditions. Good observation, sound judgment, and reasoning abilities prevent accidents and maintain workplace safety.

☼ ACTIVITY: Employability Skills—Critical Thinking

The instructor should assign a problem, scenario, or case study for students to discuss.

OSHA Fatal Facts Accident Reports
https://www.osha.gov/Publications/fatalfacts.html

OSHA Success Stories and Case Studies
http://www.osha.gov/dcsp/compliance_assistance/success_stories.html

Students should read, review, and discuss the selected case study. Students should apply critical thinking skills in evaluating the case study and form logical conclusions about what went wrong, what safety standards weren't followed, what preventative measures should have been followed, and what preventative measures should be reinforced.

Apply the following critical thinking skills:

- Researching and reading critically
- Correctly identifying problems
- Analyzing problems
- Evaluating evidence
- Making distinctions between relevant and irrelevant information
- Making connections
- Comparing similar situations
- Noting similarities and differences with other problems
- Raising significant questions
- Generating solutions
- Assessing costs and benefits of solutions
- Exploring implications and consequences

Personal Responsibility and Personal Management

Employees should work in accordance with applicable safety and health laws and embrace safety and health as a way of life, on and off the job.

Employees should be self-motivated to make safe choices for their own benefit and the benefit of others. Employees must take personal ownership of being safety conscious. Employees should acknowledge when their abilities or alertness are impaired by fatigue, illness, or other causes that might expose the individual or others to injury and act accordingly by reporting to a supervisor that they are unfit to safely perform their duties.

In accordance with standards of good health and personal responsibility, employees should live drug-free lifestyles. Possession or use of illegal drugs or alcohol on company time or property and reporting to work unfit for duty from off-the-job use or consumption are illegal acts and can cause serious safety violations resulting in injury or death.

Drug-Free Lifestyle

Substance abuse places a major burden on the workplace. However, employers can work to protect their businesses from the negative impact of substance abuse by educating employees about its dangers and encouraging individuals with substance abuse problems to seek help. The Department of Labor conducts a public outreach initiative called *Working Partners for an Alcohol- and Drug-Free Workplace* that assists employers to develop drug-free workplace programs.

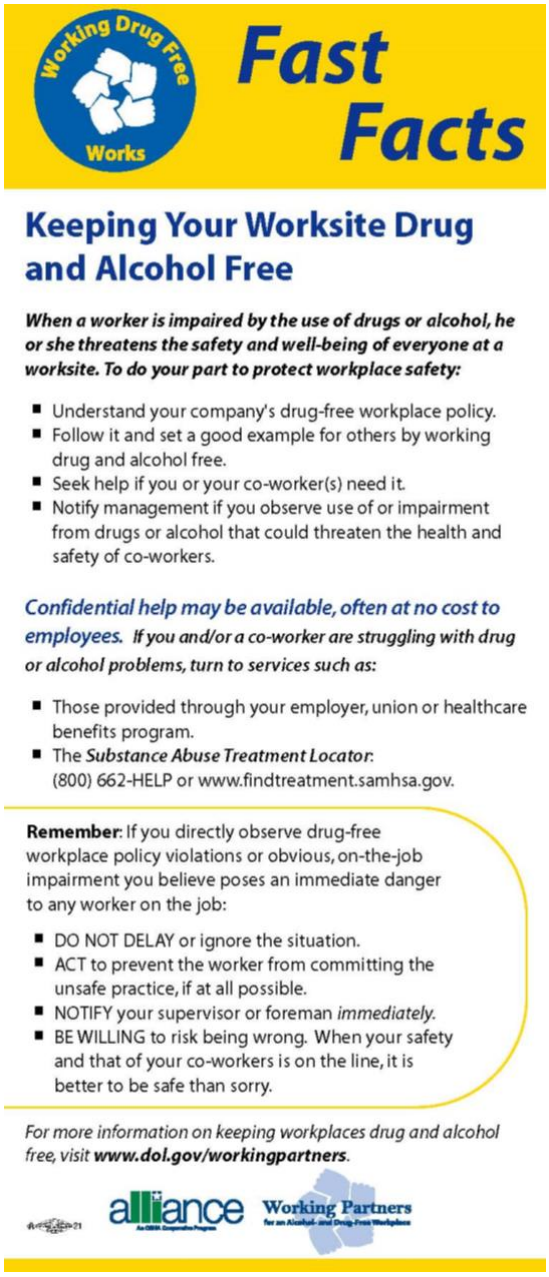
The impact from employee substance abuse extends beyond the individual employee. Drugs and alcohol can impair a worker's judgment and coordination, which can lead to an increased risk of accidents and injuries.

Coworkers can often be a powerful influence on those who are abusing drugs and/or alcohol. By knowing what to do and what not to do, coworkers can make the workplace safer and help their coworkers seek help.

It is the responsibility of all workers, supervisors, and employers to be aware of their surroundings and to do what they can to make the work environments safe for everyone.

Workplace substance abuse is a serious problem, especially in environments where coworkers rely on each other for safety.

All workers should take action and be willing to show concern for fellow employees, the workplace, and themselves. All employees should help coworkers get the assistance they need.



Implementing and enforcing a drug-free workplace program is one way to help protect and assist employees in dealing with substance use as a safety hazard. Drug-free workplace programs help improve workplace safety and health in organizations of all sizes and in all industries.

Generally, drug-free workplace programs include the following components:

- Drug-free workplace policy
- Supervisor training
- Employee education
- Employee assistance
- Drug testing

Employee Education

Effective employee education programs provide information such as the details of the drug-free workplace policy; the nature of alcohol and drug addiction; its impact on work performance, health, and personal life; and types of help available for individuals with related problems.

The Drug-Free Workplace Alliance

The Drug-Free Workplace Alliance is a DOL cooperative agreement focused on improving worker safety and health through drug-free workplace programs. The Alliance is led by DOL's Working Partners for an Alcohol- and Drug-Free Workplace program and managed cooperatively with OSHA and Mine Safety and Health Administration (MSHA).

Participation in Health and Wellness Programs

Employees should actively participate in health and wellness programs to take part in activities that promote healthy and safe lifestyles both on and off the job. In addition to participating in health and wellness programs, employees should also actively participate in offering suggestions for improvements to the safety culture of the workplace.

How Employees Can Help:

- Identify ways to improve existing policies and procedures.
- Help develop company safety and health goals.
- Recommend resources necessary to achieve safety and health goals.
- Recommend training/education topics.
- Help develop training/education plans.
- Provide constructive evaluations of training/education sessions.

Creating a Community/Citizen Safety Culture

Just as energy and utilities company employers and employees work to create company and personal safety culture, they should also work together to create a community safety culture. All employees should be committed to partnering in community outreach initiatives to provide energy and public safety education to ensure safe, prepared, and knowledgeable communities.

Citizens also have a responsibility to participate in outreach activities to be aware of possible hazards and learn necessary skills to perpetuate a community culture of safety.

Community Education and Outreach

Companies have a responsibility to ensure safe, reliable, and efficient operations within the communities they serve. Through educational outreach activities through schools or other public community venues, companies can provide invaluable safety, prevention, and preparedness information. Educating the public on how to act safely and responsibly around energy helps to foster a thriving community safety culture.

All citizens should be encouraged to be knowledgeable about energy safety issues including how to safeguard their families, homes, and communities.

Topics for Energy Safety Educational Outreach

Power Outages

General Electrical Safety Inside the Home

General Electrical Safety Outside the Home

- Downed Lines

Digging and Yard Safety

- Call 811 before you dig!
- Power line safety and trees
- Right tree, right place
- Pole clearing

Children-Specific Education

Natural Gas Safety

Right-of-Way Management

Disaster Preparedness

- Fire safety
- Flood safety
- Nuclear emergency

Examples of Educational Activities

Educational materials, videos, publications, presentations, speakers' bureaus, workshops, safety fairs

Possible Community Partners

Schools, local civic groups, neighborhood associations, businesses, nonprofit organizations

Employers and employees who are actively involved in education in the community send a clear message that developing a community safety culture is a fundamental part of a company's comprehensive safety program**.**

☼ ACTIVITY: Community Education and Outreach

In student groups, select an energy safety topic for which to create a community outreach product or educational activity.

If possible, contact a local organization to see if they could benefit from your creation of materials on a specific energy safety topic.

Use the library, Internet, or personal interviews to research the topic.

Present your products to the rest of the class.

Law Enforcement/First Responder Education

In addition to the safety education topics covered with the community at large, special information should be provided to local law enforcement and other first responders. Companies should ensure that they have provided adequate information for first responders to work safely in emergencies where electric and natural gas utilities are involved.

Special topics to cover with first responders:

- Downed power lines
- Car/pole accidents
- Substation fires
- Natural gas leaks
- Natural gas fires

Emergency Preparedness

Companies have the responsibility of maintaining **emergency response plans** to protect the communities in which they operate and serve. An emergency response plan provides direction in the event of an emergency.

Emergency plans:

- Provide a unified response to disasters and emergencies
- Establish a comprehensive approach to incident response
- Protect life and safety
- Reduce property and environmental damage
- Minimize disruption and economic losses
- Shorten the recovery period

Emergency preparedness responsibilities of state and local entities:

- Identifying hazards and assessing potential risks
- Enforcing regulatory standards
- Creating and coordinating emergency plans
- Establishing warning systems
- Stocking emergency supplies and equipment
- Establishing evacuation procedures
- Taking care of the injured and displaced

The federal government can provide resources to augment state and local efforts through educational materials, financial grants and loans, and technical assistance.

Emergency preparedness is a shared responsibility. Just as companies have the obligation to create and maintain emergency preparedness plans, citizens should take the initiative to become informed about local emergency plans and learn how to identify possible energy and utilities-related hazards in their communities.

General Safety Procedures

OSHA recognizes that the risks faced by some energy industry workers are greater than the risks faced by workers in other industries. Many employees in the energy and utilities industry are exposed to hazards that are specific to that industry. However, even within the energy and utilities industry, some workers are at a much greater risk than others due to the nature of their work.

As mentioned in the previous sections, federal agencies, industry alliances, unions, and private entities establish and enforce safety standards and procedures. To ensure a safe and secure workplace, workers should comply with safety procedures and follow established protocols when performing work.

Federal guidelines such as OSHA offer general safety guidelines and standards for a broad audience. However, due to uniquely hazardous risks that exist in the energy and utilities industries, it is important for workers to follow established safety procedures created to address specific work situations they may encounter.

Safety Rights and Responsibilities

As mentioned earlier, both employers and employees have responsibilities in maintaining a safe and healthful workplace by complying with federal and state safety and health standards.

Under the OSH Act, employers and employees must work to maintain a workplace free from recognized hazards. Although OSHA does not cite employees for violations of their responsibilities, all employees should comply with all occupational safety and health standards and all rules, regulations, and orders issued under the Act to fulfill their responsibilities in maintaining a safe and healthy workplace.

Safety Rights and Responsibilities Review

Safety Responsibilities

- Read the OSHA poster at the job site
- Observe and comply with safety and health standards and regulations
- Wear or use prescribed protective equipment while working
- Report hazardous conditions promptly
- Report any job-related injury or illness, and seek treatment promptly
- Report emergencies using proper procedures

Safety Rights

- Right to a safe workplace free from recognized hazards
- Right to request information on safety and health hazards in the workplace, safety precautions to take, and procedures to be followed if injury or exposure occurs
- Right to refuse a task that requires you to disobey safety rules standards
- Right to refuse a task that puts you or someone else in unnecessary danger
- Right to refuse a task for which you have not been trained to safely perform
- Right of freedom from retaliation for exercising safety rights

Safety Rules and Safe Practices

Safe work practices and procedures are created with the intention of preventing hazardous situations and accidents. While established general procedures have been written to cover a wide array of workplace situations, it is impractical to assume that every possible workplace situation can be addressed. Therefore, it is important to be knowledgeable and compliant with general foundational safety rules.

Basic Safety Rules and Safe Practices

- Read and follow safety notices, signs, and posted information
- Observe and comply with all safety instructions, regulations, and operating procedures
- Never take shortcuts; follow safety procedures precisely
- Assist other employees when they ask for help or when needed for their safety
- Never participate in horseplay
- Clean up spills immediately
- Report all unsafe conditions and hazards immediately
- Warn other people of hazards so that they can avoid them
- Wear personal protective equipment (PPE) as required to reduce injury potential
- Never stand on chairs, furniture, or anything other than an approved ladder
- Never use intoxicating beverages or controlled drugs before or during work
- Prescription medication should be used at work only with your doctor's approval
- Report all injuries immediately
- Be familiar with emergency procedures to be prepared in the event of a crisis

Safe Practices

All employees should be committed to working in compliance with all applicable environmental, health, and safety rules and established operating procedures.

All workers should have the knowledge, skills, and abilities to carry out their work safely and efficiently. Employees should discuss safety and health questions or concerns with their employers, other workers, or union representatives (if available). Hazard assessments provide employers with the information they need to address and correct unsafe conditions and in turn provide employees with the information, training, and support they need to safely perform their jobs.

Quick Facts

Frequently Cited OSHA Standards (Electric Services Industry Group)

- Guarding floor/wall openings and holes
- Permit-required confined spaces
- General requirements (electrical)
- Wiring methods, components, and equipment for general use
- Hazard communication
- Mechanical power-transmission apparatus
- Forms

Hazard Assessment

The first step in creating a safe workplace by minimizing workplace hazards is to perform a thorough hazard assessment. OSHA requires hazard assessments to identify and address conditions that pose actual or potential safety hazards. Once hazards are identified, they can be removed or addressed by design changes, procedural controls, personal protective equipment, or other methods to protect workers from identified hazards that cannot be eliminated.

OSHA Hazard Assessment Requirements:

- Before any work begins, analysis of worksite conditions that could affect safety
- Assessment to identify the potential hazards to eyes, face, head, feet, and hands and the personal protective equipment (PPE) needed for a task

Potential Hazards to Be Assessed:

- Electrically related exposures
- Pipe/pipelines in/near the worksite
- Traffic
- Weather conditions
- Confined/enclosed spaces/trenches/manholes
- Falls/heights

Hazard assessment through worksite and **job task analysis** involves worksite examinations that identify existing hazards in addition to conditions that could develop into possible hazards. Worksite analysis should occur before work begins and continue as long as employees are working in that particular environment. Worksite facilities, processes, tasks, materials, and equipment should be a part of the analysis. If a worksite analysis identifies an existing or potential hazard, the hazard should be eliminated or controlled in a timely manner.

☼ ACTIVITY: Worksite Analysis – Accident Investigation

To examine the impact of workplace accidents, search through local newspapers (either hard copy or via Internet) for recent accidents.

Using the article and also possibly interviewing a source from the article, collect enough information to fill out an accident report.

NOTE: The Accident Investigation Report Form can be found in the sample safety and health plan on OSHA's website. http://www.osha.gov/recordkeeping/RKforms.html

Hazard Identification

Inspection checklists are the most commonly used method of hazard identification. Employers should perform self-inspections on a routine basis to identify where probable hazards exist and whether they are under control or need to be addressed.

☼ ACTIVITY: Worksite Analysis – Inspections

Using information previously covered in this course, and with additional research, create a site inspection checklist that addresses the following hazards:

- Fall hazards
- Electrical hazards
- Housekeeping issues
- Fire hazards

Review the self-inspection checklists on OSHA's website for additional ideas.
https://www.osha.gov/SLTC/etools/machineguarding/appendices/appendix_g.html

Job Safety Briefings

Once the hazards have been identified through a hazard assessment, workers must be informed of the hazards and how they will be eliminated or controlled. This information should be provided to workers through job safety briefings. Job briefings, also known as "tailgate" or "toolbox" briefings, communicate existing or potential hazards to workers before work begins.

Job briefings promote a healthy and safe work environment through coordination and communication of employees' responsibilities. Job briefings provide the opportunity to review accident prevention instructions, rehearse safety drills, and practice safe work skills.

Job Briefing Topics:

- Worksite hazards
- Worksite procedures
- Energy control procedures
- Personal protective procedures
- Any additional special precautions

OSHA requires that at least one job briefing occur at the start of every shift. It is important to note that if any procedures or conditions change during a shift that creates new hazards, additional briefings must occur before work continues.

Employees who have positions that require them to work alone should conduct their own job briefings before beginning each job.

☼ ACTIVITY: Job Briefing

Using information previously covered in this course, and with additional research, create a job briefing to cover a safety issue relevant to the energy and utilities industry. Examples include:

- Fall hazards
- Electrical hazards
- Housekeeping issues
- Fire hazards

Review the example briefing provided for additional ideas.

ACME
POWER CO.

SAFETY TAILBOARD

4 Cone Placement Policy

ZERO IN ON SAFETY

- **Observe the flow of traffic and park vehicle in a safe area.**
- **Evaluate the best method to place out cones.**

Method 1

1). Place a cone at the rear of the truck parallel with bumper on traffic side.
2). Place a cone directly behind your vehicle at midpoint of bumpers, min. of 2ft.
3). Place a cone directly in front of vehicle at the midpoint of bumper, min. of 2ft.
4). Place cone on the front traffic side of truck parallel with the bumper on the traffic side.

Method 2

1). Place the first cone on the front traffic side of truck parallel with the bumper.
2). Place a cone at the rear of the truck parallel with bumper walking in the direction of exposed traffic. This will allow you to view traffic heading in your directions.
3). Place a cone directly behind your vehicle at midpoint of bumpers, min. of 2ft.
4). Place a cone directly in front of vehicle at the midpoint of bumper, min. of 2ft.

When a vehicle is either backed into or pulled into a parking space, cones shall be placed at the corners of the vehicle exposed to traffic. When removing traffic cones remove rear midpoint cone last. The cones shall be kept in place until the driver is ready to move the vehicle.

Both methods will complete the circle of safety and allow the employee to make a total walk around the vehicle and scans the front, back and sides of the vehicle before it is operated. Additional cones shall be used based on vehicle size and traffic conditions or as required by the work site protection plan. The two different options are given based on traffic conditions and the storage placement of cones on the vehicle.

Personal Safety

As mentioned earlier, some hazards are unique to the energy and utilities industry. Special precautions and work protocols must be followed due to the dangers of working around electricity. The next few sections will describe elements of common safety procedures used in the energy and utilities industry.

Electrical Hazards and Personal Protection

Electrical Shock

Electrical shock occurs when a person's body completes the current path between two energized conductors of an electrical circuit or between an energized conductor and a grounded surface or object.

The severity of electrical shock depends on several factors:

- Body resistance
- Circuit voltage
- Amount of current flowing through the body
- Current path through the body
- Area of contact
- Duration of contact

Focus on ... 

Personal responsibility for electrical safety is not a new concept. It's been around from the beginning of the industrialization of electric power. "Ultimately, safety lies within an individual. Personal caution is the greatest of all safeguards."

– Magnus W. Alexander, Consulting Engineer, General Electric Company, *Safety in the Foundry*, 1917

☼ ACTIVITY: Electrical Safety Myths and Misconceptions

Form collaborative groups and research myths and misconceptions of electrical safety.

Research and verify basic rules of electrical action. (Visit http://www.cdc.gov and search for "electrical safety." You will find numerous resources.)

Example myths:

- When a live wire falls, it makes sparks.
- As long as a ladder isn't touching a power line, it's safe.

Effects of Electrical Current on the Human Body

One ma (milliamp): Tingling sensation

More than 3 ma: Disturbing shock

Five ma: Maximum harmless current

More than 10 ma: Sustained muscle contraction “no-let-go” danger

More than 30 ma: Lung paralysis—usually temporary

More than 50 ma: Possible ventricular fibrillation (heart dysfunction, respiratory arrest, usually fatal)

One hundred ma to 4 amps: Certain ventricular fibrillation, nerve damage, fatal

Over 4 amps: Heart paralysis; severe burns, fatal. Usually caused by >600 volts

Specific Types of Electrical Injury

- Electrical shock
- Electrical burns
- Arc-flash burns
- Arc blast
- Falls
- Fire

© U.S. Department of Labor

Electrical Safety Rules

General Electric Safety Rules

- Purchase safe equipment. Select portable electrical equipment that is grounded with a three-prong plug or is double-insulated. Look for the “UL” label, indicating that the equipment has been tested and approved by Underwriters Laboratories, Inc.
- Follow the manufacturer’s instructions for installation and use of all electrical equipment
- Never disconnect or damage an electrical safety device that is provided by the manufacturer
- Avoid damp working areas. Never handle electrical equipment with wet hands or while standing in a wet or damp place. Do not touch electrical appliances, boxes, or wiring with wet hands

- Ground electrical equipment. All 120-volt electrical equipment should be equipped with a three-prong grounding-type plug or be double-insulated. Never cut off a grounding prong just to make the connection work
- Keep metal cases of electrical appliances grounded
- Use electrical cords safely. Do not hang electrical cords on nails or run them under rugs or around pipes. Avoid using extension cords as permanent wiring installations
- Inspect and repair cords periodically. Inspect all extension cords and electrical appliance cords periodically for exposed wires, faulty plugs, poor insulation, and loose connections. Correct all hazards found on electrical cords
- Discontinue using any extension cord that feels warm or smells like burning rubber
- Do not leave heat-producing appliances such as soldering irons unattended
- Unplug electrical tools. Do not leave a tool plugged in when it is not in use, unless it is designed for continuous operation
- Protect each circuit. Be certain that each circuit is protected with either a circuit breaker or a fuse of proper amperage
- Do not overload circuits. When new equipment is installed, make sure it is protected by a circuit of proper amperage rating
- Ground each circuit properly. Each circuit must have a ground (neutral) wire and a grounding wire to be properly grounded
- Use **ground-fault circuit interrupters (GFCI)**. To protect the operator who works outside or in damp locations, make sure the electrical source is protected by a ground-fault circuit interrupter
- Disconnect the main switch. Before making any repairs on an electrical circuit, always make certain the current has been disconnected
- Correct the source of trouble. If a fuse is blown or a breaker is tripped, find and correct the problem before installing a new fuse or resetting the breaker
- Never make temporary repairs. Make sure all repairs are as good as new. When splicing wires, be sure all strands are twisted together, the connections are strong, and the splice is fully insulated
- Open circuits with switches. Never pull a plug from an outlet while the equipment is in operation. This creates an arc and will eventually foul the plug or the outlet, which can cause electrical shock or a possible fire
- Keep electrical motors lubricated and free of grease and dirt

- If attempting to rescue a person being electrocuted, touch him only after the circuit has been opened, or use an insulated object to move him off the hot wire
- Do not use any switches, outlets, fixtures, or extension cords that are cracked or damaged in any way

Safety Measures in Electrical Wiring

- Install all electrical wiring according to the National Electrical Code
- Open the circuit before touching any point on the circuit
- Do not touch bare wires with hands or tools while the circuit is closed
- Do not touch wires together to see if they are hot
- Do not touch switches or fixtures with wet hands or while standing on wet ground
- Do not connect a new circuit to the breaker box until all the wiring is completed
- Do not install fuses or breakers with an amperage larger than recommended, or they will not protect the circuit from overheating
- Do not overload a circuit with too many fixtures and outlets
- Use only double-insulated portable tools or tools with three-prong plugs
- Insulate splices with electricians' tape or solder-less connectors
- Install ground fault interrupters in kitchens, bathrooms, laundry, and outdoor circuits, or wherever moisture may increase shock hazard
- Use proper color coding of wires when installing a new circuit

Product Safety Testing

- Underwriters Laboratories (UL) tests sample products, such as electrical appliances and tools, to see if they safely do the job for which they were designed
- UL's listing of products tested indicates only that they have performed safely. It is not an endorsement or statement of quality
- The manufacturers of these listed products display a UL label indicating that they have been tested

Personal Protective Equipment

Personal protective equipment (PPE) refers to items worn by a worker to provide protection from hazards. The proper use of PPE in addition to compliance with other safety protocols is an effective method of protection from workplace hazards. The type of PPE worn by a worker depends on the type of job tasks that will be performed.

All employees should be trained on the proper use of PPE to ensure correct and compliant utilization as well as the proper care, maintenance, useful life and disposal of the PPE, in accordance with 1910.132(f)(1)(v).

Focus on ...

PPE commonly used in energy and utilities jobs:

Safety glasses/face shields
Hard hats
Safety footwear
Insulating gloves
Insulating sleeve covers
Flame-resistant clothing
Fall protection equipment
Respirators
Cut-resistant chaps

Tool, Material, and Equipment Safety

In addition to PPE, energy and utilities workers often use insulating protective equipment (IPE). IPE includes items such as:

- Line hoses
- Rubber hoods
- Rubber blankets
- Insulating live-line tools

Tool, Material, and Equipment Safety Rules

- To ensure safe use of tools and machinery, good inspection and maintenance procedures should be implemented and maintained.
- All tools, whether company or personal, must be in good working condition.
- Never use defective tools.
- Guards and other protective devices should be fully operational. Equipment with faulty or altered guards should not be used.
- Loose or frayed clothing, dangling ties, and finger rings must not be worn around moving machinery or other places where they can get caught.
- Machinery should not be repaired or adjusted while in operation.

PPE, tool, material, and equipment safety will be discussed in more detail in the following unit.

Ergonomics

Musculoskeletal injuries are considered a frequent and persistent type of workplace injury. All work tasks should be well planned and supervised to prevent injuries when working with equipment, handling heavy materials, or performing repetitive or other physically demanding tasks.

If improperly selected and used, tools and machinery can cause musculoskeletal injuries. Employees should be trained in and utilize good ergonomics and body mechanics, such as safe lifting procedures, to prevent musculoskeletal disorders and cumulative stress trauma.

☼ ACTIVITY: Imaginative Ergonomics

Team up with another student to come up with an ergonomic concept, new tool, product, or procedure that will help energy and utilities workers on the job.

Teams should prepare a PowerPoint presentation that explains their idea, how they plan to sell it, and who they think would buy it.

OSHA Permit Required Confined Spaces Regulations

Energy and utilities workers are sometimes required to perform work duties in confined spaces. Confined spaces may refer to manholes or vaults that contain electrical utility equipment. Protocols that must be followed when working in confined spaces depend on the work to be conducted in the confined space and the hazards within the confined space.

Employee Qualifications and Proficiency

Workers entering confined space should be trained and qualified to enter and perform work within the confined space.

Aboveground Attendant

When work is being done in a confined space, an attendant trained in first aid, **CPR**, and rescue procedures is required to be above/outside the space and maintain communication with the worker(s) in the space. It is vitally important to note: in accordance with 1910.146(i)(4), the attendant "Remains outside the permit space during entry operations until relieved by another attendant." This is to prevent the attendant from becoming a casualty without available assistance.

Entry and Exit

Before entering an enclosed space, it must first be checked for indications of potential problems. A guardrail or barrier must be set up around the opening to prevent objects from entering the space. Rescue equipment (or a rescue service) must also be available and ready for use if needed.

"Before an employee enters the space, the internal atmosphere shall be tested, with a calibrated direct-reading instrument, for oxygen content, for flammable gases and vapors, and for potential toxic air contaminants, in that order." Per 1910.146(c)(5)(ii)(C). Workers may not enter any enclosed space that contains a hazardous atmosphere.

Flame Use and Lowering Equipment

Attendants must be sure that workers in an enclosed space or manhole are clear of the opening before lowering any equipment into the space.

If a flame is to be used in an enclosed space, an additional test for flammables must be conducted.

Outside Rescue Services

OSHA requires employers to "provide equipment to ensure the prompt and safe rescue of employees" from confined spaces. Prompt rescue is defined as service that is available immediately or in a time period appropriate for the hazards. Employers must ensure that selected rescue services are competent and compliant with all OSHA regulations.

Fall Protection

For employees working on structures such as poles, towers, or other equipment that supports overhead generation, transmission, and distribution lines and equipment, OSHA requires fall protection precautions. Fall protection safeguards such as personal fall arrest equipment, work positioning equipment, or travel restricting equipment must be used by employees working at locations elevated more than four feet above the ground.

Personal fall arrest equipment (PFAS) usually consists of a body harness with a shock-absorbing lanyard. Unqualified climbers must wear fall arrest equipment at all times while climbing and working at elevated locations. Work positioning equipment usually consists of a body belt and pole strap.

Some specialty line workers who have been trained and have demonstrated **proficiency** in climbing are considered "qualified climbers" and do not need to use fall protection equipment when ascending, descending, or changing positions on poles or towers. However, if adverse conditions are present that could cause a worker to lose his or her grip or footing, a fall arrest system must be used.

Employees working from aerial lift devices such as a basket or bucket truck must wear a harness and lanyard that is attached to the boom or basket.

Appropriate design, maintenance, and inspection of fall protection equipment are essential for safety performance. Fall protection equipment should be inspected before each use to identify defects and prevent malfunction.

Hazardous Communication, Hazardous Chemicals, and Safety Data Sheets

In the past, there was no guarantee that you would be told of the chemical and physical hazards you might encounter while doing your job. That is why the OSHA standards pertaining to workplace hazardous chemicals and hazardous operations are so important.

OSHA provides today's workers with the "right to know." Employers must establish a written, comprehensive hazard communication program that includes requirements for container labeling, safety data sheets, and appropriate training opportunities.

The Hazard Communication Standard (HCS) is the most frequently cited of all OSHA standards. This program is intended for workplaces that do not manufacture, import, or distribute hazardous chemicals; these industries have their own specific standards.

The HCS establishes uniform requirements to make sure the hazards of all chemicals imported into or produced or used in U.S. workplaces are evaluated, and that this hazard information is transmitted to affected employers and exposed employees.

The HCS is different from other OSHA health rules because it covers all hazardous chemicals. The rule also incorporates a "downstream flow of information," which means that producers of chemicals have the primary responsibility for generating and disseminating information, whereas users of chemicals must obtain the information and transmit it to their employees.

OSHA's HCS applies to general industry, shipyard, marine terminals, longshoring, and construction employment and covers chemical manufacturers, importers, employers, and employees exposed to chemical hazards.

As of 2012, according to OSHA, "The Hazard Communication Standard (HCS) is now aligned with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). This update to the HCS will provide a common and coherent approach to classifying chemicals and communicating hazard information on labels and safety data sheets. This update will also help reduce trade barriers and result in productivity improvements for American businesses that regularly handle, store, and use hazardous chemicals while providing cost savings for American businesses that periodically update safety data sheets and labels for chemicals covered under the hazard communication standard."

Employer Responsibilities

- Identify and list hazardous chemicals in the workplaces.
- Obtain safety data sheets (SDS) and labels for each hazardous chemical, if not provided by the manufacturer, importer, or distributor.
- Implement a written HCS program, including labels, SDS, and employee training.
- Inform employees of protective measures available to prevent adverse effects from occurring.
- Communicate hazard information to employees through labels, SDS, and formal training programs.

☼ ACTIVITY: HCS and SDS Guest Speaker

As a class, invite a Hazmat commander, the designated person selected to coordinate all activities in a hazardous situation, or someone similar to make a presentation on hazard communication.

Have the guest speaker list and describe the key components of the Hazardous Communication Standard (HCS) and safety data sheets (SDS).

Ask the speaker to explain health effects of common hazardous chemicals in the workplace.

Take notes and ask questions during the presentation.

☼ ACTIVITY: HCS and SDS Inspection

Break up into small student groups to form inspection teams. Each team should inspect an area of the school/building grounds to determine if SDS are available and up to date.
For example:

- Labs
- Carpentry shop
- Auto shop
- Janitorial supplies storage area

Teams should report their findings to the class.

Teams should also schedule a meeting with an administrator in charge to discuss any safety problems they find.

The Control of Hazardous Energy

General Requirements

Hazardous energy control programs are created to protect employees from the risks of powerful electrical energy associated with work performed on systems utilized in the energy and utilities industries. Hazardous energy control programs create protocols in which energy systems are temporarily disabled so work can be performed safely.

Hazardous energy control practices for electric power generation systems are commonly referred to as lockout/tag out (LOTO) procedures. Hazardous energy control practices for transmission and distribution systems are commonly referred to as **de-energization** and grounding practices.

Additional Energy Control Requirements:

Job Briefings—Job briefings must include a review of the sources and hazards of hazardous energy present, as well as the methods of control.

Minimum Approach Distance—Workers must maintain a safe distance from energized parts in accordance with OSHA's minimum approach distances requirements.

Central Control of Energy Isolating Devices—A qualifying system operator is permitted to place and remove lockout/tag out devices that are inaccessible to other employees because they are located in a central location under the exclusive control of the system operator.

Hazardous Energy Control Communication and Training

OSHA requires employers to notify and train employees who are affected by energy control program practices. Employers are required to provide training to ensure that energy control program practices are understood and correctly applied.

All employees whose work is affected by energy control procedures should be instructed in the purpose and use of applicable energy control procedures. Training should occur whenever there is a change in job assignment, machinery, or equipment that results in new energy control procedures.

Lockout/Tag Out Programs

Lockout/tag out procedures are created to prevent the unexpected energization or startup of machines or equipment that would result in the release of energy that could cause serious injury to employees.

Lockout/tag out procedures use devices that are applied to energy isolating devices that disable a system to prevent unexpected energization. Lockout/tag out procedures provide personal protection for employees by ensuring that each individual is uniquely accounted for and that each individual is the only person who can release their individual lockout or tag out device.

Lockout and tag out devices shall be standardized within the facility in at least one of the following criteria: Color; shape; or size; and additionally, in the case of tag out devices, print and format shall be standardized.

An energy isolating device is a mechanical device that physically prevents the transmission or release of energy. Energy isolating devices include circuit breakers, disconnect switches, and line valves or blocks. An energy isolating device is capable of being locked out if it has an attachment that a lock can be affixed to, or it has a locking mechanism built into it.

Lockout

A lockout device is a mechanical device that uses a lock to hold an energy isolating device in a safe position and prevent the energizing of a machine or equipment. The placement of a lockout device on an energy isolating device ensures that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Tag Out

A tag out device is a conspicuous warning device, such as a tag, which is securely attached to an energy isolating device. The placement of a tag out device on an energy isolating device provides a visual indication that the energy isolating device and the equipment being controlled may not be operated until the tag out device is removed.

Limitations of Tag Out Systems

In comparison to tag out procedures, OSHA states that lockout procedures are more effective at ensuring de-energization, and are therefore the preferred method of use.

Lockout procedures are the preferred method to use to ensure de-energization unless an employer can demonstrate that tag out procedures will provide equivalent protection.

Specific Tag out Limitations

- Tags are visual warning devices attached to energy isolating devices and do not provide the physical security that is provided by a lock.
- Tags must be securely attached to energy isolating devices so they cannot be inadvertently or accidentally detached during use.
- Lockout and tag out devices shall be standardized within the facility in at least one of the following criteria: Color; shape; or size; and additionally, in the case of tag out devices, print and format shall be standardized.
- Lockout devices shall be substantial enough to prevent removal without the use of excessive force or unusual techniques, such as with the use of bolt cutters or other metal cutting tools.
- Tag out device attachment means shall be of a non-reusable type, attachable by hand, self-locking, and non-releasable with a minimum unlocking strength of no less than 50 pounds and having the general design and basic characteristics of being at least equivalent to a one-piece, all-environment-tolerant nylon cable tie.

Lockout/Tag Out Procedures

Detailed procedures for lockout/tag out (LOTO) protocols vary among companies. All employees should follow company-provided energy control procedures to ensure safe and comprehensive LOTO applications. Following is a list of basic steps in common LOTO procedures.

Locking/Tagging

Before beginning service or maintenance, the following steps must be accomplished in sequence and according to the specific provisions of the employer's energy-control procedure:

- Prepare for shutdown;
- Shut down the machine;
- Disconnect or isolate the machine from the energy source(s);
- Apply the lockout or tag out device(s) to the energy-isolating device(s);
- Release, restrain, or otherwise render safe all potential hazardous stored or residual energy. If a possibility exists for reaccumulation of hazardous energy, regularly verify during the service and maintenance that such energy has not reaccumulated to hazardous levels; and

- Verify the isolation and de-energization of the machine.
- Complete “re-checking” of all formal LOTO application procedures

Unlocking/Untagging

When the servicing or maintenance is completed and the machine or equipment is ready to return to normal operating condition, the following steps shall be taken:

- Check the machine or equipment and the immediate area around the machine to ensure that nonessential items have been removed and that the machine or equipment components are operationally intact
- Check the work area to ensure that all employees have been safely positioned or removed from the area
- Verify that the controls are in neutral
- Remove the lockout devices and reenergize the machine or equipment
- Note: The removal of some forms of blocking may require reenergization of the machine before safe removal
- Notify affected employees that the servicing or maintenance is completed and the machine or equipment is ready for use

Shift or Personnel Changes

Employers must make sure that there is a continuity of lockout or tag out protection. This includes the orderly transfer of lockout or tag out device protection between outgoing and incoming shifts to control hazardous energy. When lockout or tag out devices remain on energy-isolation devices from a previous shift, the incoming shift members must verify for themselves that the machinery is effectively isolated and deenergized.

☼ ACTIVITY: Commitment to Responsibility for Personal Safety

Work in small groups to create a statement or pledge outlining your responsibility for personal safety. Statements should include such things as being prepared mentally and physically, avoiding drug use, wearing proper personal protective equipment, obeying safety rules, and so forth.

Groups should present their statements to the class.

As a class, create a comprehensive statement combining the best parts of each group’s work.

Protecting Others

Many of the procedures listed above under personal safety are also methods of protecting the safety of others. In the same way, following safety procedures to protect the safety of others is a personal safety measure too.

General Housekeeping

Housekeeping is an integral part of maintaining a safe workplace. All employees are responsible for keeping their work areas clean and free of hazards. Employees should maintain clean work areas while working, and they should clean up when work is completed.

Medical Services and First Aid

OSHA requires that first aid supplies are readily available and easily located. Contents of first aid kits should be inspected regularly to ensure the necessary items are available and no contents have expired. Emergency numbers and contact information should also be easily located.

Due to the hazardous potential of electric power work, workers who work with high voltage are subject to more stringent OSHA first aid requirements. One such requirement is the **Universal Precautions** for Bloodborne Pathogens. Universal Precautions is an approach to infection control. According to the concept of Universal Precautions, all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other bloodborne pathogens. It is necessary to provide personal protective equipment (PPE), such as gloves, gowns, eye protection, and masks. Employers must clean, repair, and replace this equipment as needed. Provision, maintenance, repair and replacement are at no cost to the worker. - Per 1910.1030.

Minimum of Two Workers in a Crew

In certain circumstances, crews of at least two people are required so that one can provide first aid or CPR to the other person if needed. Situations in which this applies:

- In most situations where a worker is exposed to contact with lines or equipment energized at more than 600 volts
- In manholes and some vaults that are underground: a second person trained in CPR and first aid must be immediately available aboveground when a worker is working underground.
- Involving certain tasks performed by tree crews, including trimming trees or roping branches near energized lines

Four-Minute Rescue Requirement for Fixed Work Locations

Many energy and utilities workers work in groups or crews, but at some fixed work locations such as power plants and substations, many employees work alone. In these instances, OSHA requires that an adequate number of employees trained in CPR and first aid are located in a proximity of four minutes or less to solitary workers.

☼ ACTIVITY: First Aid and CPR Demonstration and Training

Invite a local Red Cross instructor to give a first aid and CPR demonstration to the class.

Prepare questions to ask about first-aid procedures with regard to energy and electricity injuries and emergencies.

Protecting the Community and the Environment

The general public is increasingly aware of the possibility of negative impacts on the environment caused by industrial means. Federal, state, and local governments have created numerous environmental regulations to minimize environmental impacts and pollution.

☼ ACTIVITY: Environmental Protection Agencies

As a class, invite a representative from an environmental protection agency to discuss environmental regulations as they relate to the energy and utilities industry.

Be sure to take notes and ask questions.

In addition to federal, state, and local regulations that are imposed upon energy and utilities companies, most companies create and enforce additional environmental policies that are designed to protect the environment as well as the health and safety of employees, customers, and the general public.

Typical Energy and Utilities Company Environmental Policy Elements

Compliance

Operate in accordance with all applicable environmental, health, and safety laws and regulations, as well as other relevant standards to which an individual business may voluntarily subscribe.

Risk Reduction

Utilize facility designs and operation protocols that minimize risk to employees and communities.

Improved Performance

Conduct periodic environmental, health, and safety evaluations and continuously improve associated operations and management systems.

Corrective Action

Promptly correct conditions caused by operations considered of concern to human health and safety or the environment and remedy any harm caused.

Pollution Prevention

Minimize waste, promote materials recycling and reuse, and dispose of remaining wastes using safe and responsible methods.

Resource Conservation

Take into account the conservation of natural resources, improvements in energy efficiency, and the use of sustainable energy resources during project planning.

Employee Awareness

Inform, train, and motivate employees to carry out their responsibilities in a safe and environmentally responsible manner.

Public Awareness

Make company policies available to the public and inform customers, neighbors, and appropriate governmental officials of any significant environmental, health, or safety aspects of operations in a timely manner.

☼ ACTIVITY: ECAT Interview

Contact an environmental and chemical analysis technician (ECAT) at your local power plant for a telephone interview or a visit to the class.

Make a list of natural resources the ECAT monitors and protects.

Make a list of duties the ECAT performs on a daily and weekly basis.

Find out what type of training or education the ECAT received before being hired for the job.

☼ CAREER PROFILE: ECAT

Gary R. and Tina M. are environmental and chemical analysis technicians (ECAT) who work for a power plant. Gary's primary responsibility is for air quality; Tina's is for water quality.

The main by-product of the power plant operation they work for is ash—bottom ash (heavy enough to fall to the bottom of the stack) and fly ash (light enough to float out into the atmosphere). Fly ash emissions must be kept within certain limits established by the Environmental Protection Agency (EPA) and the state air quality control agency.

Gary's job is to check the air quality equipment and monitoring instruments. If fly ash emissions go over or even near the EPA limit, Gary tracks down the problem and corrects it. Gary is a fisherman and outdoorsman who takes great pride in his work. "This area is my home," he says. "It's important to me to protect the quality of the environment."

Tina oversees water quality for the plant. She supervises the disposal of bottom ash into large ponds that are lined with clay to prevent the ash from contaminating the ground water or the land around it. She also monitors the water that is released from the cooling water system back into the lake. This *effluent,* as it is called, is kept in holding ponds until its temperature drops close to that of the lake. Both Tina and Gary spend a lot of time preparing routine reports for the EPA and the state.

Like Gary, Tina discovers and corrects problems when they occur. "But the name of the game for us," says Tina, "is prevention. We don't wait for problems. We anticipate them and stop them from happening."

Emergency Planning and Community Right-to-Know

All citizens should feel a responsibility for emergency preparedness. In addition to local, state, and federal government agencies, law enforcement and other first-responders, health professionals and hospitals, schools, private industry, and public-interest organizations are all responsible for emergency planning and response, public health, and environmental protection.

Emergency Planning and Community Right-to-Know Act

The Emergency Planning and Community Right-to-Know Act (EPCRA) was enacted in 1986. EPCRA established standards for community emergency planning and preparedness, emergency notification and chemical release reporting, and Community Right-to-Know reporting. In 1997, the EPA expanded the list of industry groups subject to reporting requirements under EPCRA to include certain electric utility operations.

EPCRA was enacted to encourage and support federal, state, and local preparation and planning for emergencies caused by the release of hazardous chemicals. EPCRA also provides for increased public knowledge and access to information on hazardous chemicals being used in their communities.

Community Emergency Planning Requirements

- Identification of facilities that use extremely hazardous substances
- Identification of transportation routes of extremely hazardous substances
- Emergency response procedures
- Emergency notification procedures
- Designation of emergency coordinators
- Methods to determine probable affected area and population
- Evacuation plans
- Description of local emergency equipment, facilities, and personnel
- Training program for emergency responders
- Emergency response plan practice programs/schedules

Focus on …

FEMA advises that emergency preparedness is developed through the following:

- Planning
- Organizing
- Coordinating
- Collaborating
- Training
- Equipping
- Practicing
- Evaluating
- Adjusting

Protecting the Infrastructure of the Energy and Utilities Industry

The U.S. Department of Homeland Security collaborates with other organizations to promote the preparedness and protection of the infrastructure of the energy sector.

The U.S. Department of Energy, the Federal Energy Regulatory Commission (FERC), the North American Electric Reliability Council (NERC), the National Association of Regulatory Utility Commissioners (NARUC), and the National Association of State Energy Officials (NASEO) work together to share best practices that address energy infrastructure issues.

In 2006, the DHS announced the National Infrastructure Protection Plan (NIPP) to define critical infrastructure protection responsibilities. The NIPP provides for collaboration between federal, state, and local governments as well as entities in the private sector to assist the Department of Energy in its infrastructure protection initiatives.

Focus on …

"The U.S. energy infrastructure fuels the economy of the 21st century. Without a stable energy supply, health and welfare is threatened and the U.S. economy cannot function."

– U.S. Department of Homeland Security

There is a multitude of risks that could affect the stability of the energy infrastructure. DHS defines four major areas of focus for the energy sector:

- Information sharing and communication
- Physical and cyber security
- Coordination and planning
- Public confidence

Cyber Security

As the energy and utilities industry has increasingly utilized computer-based technology in its operations, the possibility of cyber security attacks has also increased. DHS has recently focused its attention on the need for increased cyber security measures to protect the infrastructure of the energy sector.

DHS has established four main goals for the energy sector to address cyber security issues:

- Measure and assess security posture.
- Develop and integrate protective measures.
- Detect intrusion and implement response strategies.
- Sustain security improvements.

The North American Electric Reliability Council (NERC) also promotes standards that protect and regulate cyber security for the energy sector. NERC standards that involve infrastructure protection issues include:

- Critical cyber assets
- Security management controls
- Personnel and training
- Electronic security
- Physical security
- Systems security management
- Incident reporting and response planning
- Recovery plans

All stakeholders must work together to improve planning and preparedness protocols to better detect, prevent, and respond to cyber security incidents.

Industry-Specific Issues—Nuclear Security

To ensure safe operation of nuclear facilities, the U.S. Department of Energy (DOE) establishes standards for enforcing security at licensed sites. Sites must be prepared to detect, assess, and neutralize threats by establishing, maintaining, and implementing safeguards in the following areas:

- Nuclear physical security
- Nuclear cyber security
- Nuclear personnel security

Nuclear Physical Security

The protection of physical property at nuclear facilities includes:

- Physical protection of plants and materials (including during transit)
- Material control, accounting, inventory, and records requirements
- Facility security clearance

Physical security programs include:

- Delineated physical protection areas: exclusion area, protected area, vital area, and material access area barriers and controls
- Intrusion detection and response
- Assessment of detection alarms to distinguish between false or nuisance alarms and actual intrusions and to initiate response

Nuclear Cyber Security

U.S. Nuclear Regulatory Commission (NRC) licensees must establish, implement, and maintain a cyber security program that safeguards critical national security information and restricted data.

The NRC requires high assurance that computer and communication systems are adequately protected against cyber security threats.

The NRC specifically requires protection of digital computer and communication systems associated with the following:

- Safety-related functions
- Security functions
- Emergency preparedness functions

Nuclear Personnel Security

Personnel security at nuclear facilities includes:

- Criteria and procedures for determining eligibility for access to or control over special nuclear materials
- Access authorization for licensee personnel
- Evaluation of fitness for duty

In addition to OSHA workplace safety standards, the U.S. Department of Energy also imposes special requirements for protecting individuals from hazards associated with working with nuclear materials. Examples of nuclear safety protection standards cover quality assurance and safety requirements such as:

- Standards for internal and external exposure
- Monitoring of individuals and areas
- Entry control programs
- Posting and labeling
- Records
- Reports to individuals
- Radiation safety training
- Design and control
- Radioactive contamination control
- Sealed radioactive source control
- Emergency exposure situations

Industry-Specific Issues—Natural Gas Security

Natural gas is reliable and safe as long as it is used properly and the related equipment is properly maintained. When taken from the ground, natural gas is odorless. A harmless but pungent odorizer called mercaptan is added as a safety precaution. The odorant is so powerful you can smell even the smallest quantity of gas in the event of a leak.

Recognizing a Natural Gas Leak

How to recognize a potentially dangerous natural gas leak:

- **Smell**: Natural gas has no odor in its natural state, but the added odorant has a strong sulfur-like smell to indicate the existence of a leak.
- **Listen**: Depending on its size and pressure, a natural gas leak may produce a quiet hissing or blowing sound.
- **Look**: A leak also may cause dust, dirt, or debris to blow away from the source. A leak may also cause bubbling in water. Dead or discolored vegetation in an otherwise green area may also be an indication of a leak.

Responding to a Natural Gas Leak

When a distinctive gas odor is persistent or widespread, it could be a sign of a gas leak. Upon detecting such a situation, move a safe distance away from the source of the leak and call for help.

Since an electric spark can ignite leaking gas and cause an explosion, remember to follow these tips:

- Call the responsible energy company or 911 in an emergency.
- Do not turn electrical switches on or off.
- Avoid using any electric appliances or equipment.
- Do not turn motor vehicles on or off.
- Avoid open flames or other ignition sources.
- Stay away until the energy company or emergency responders have indicated that it is safe to return to the area.

Equipment Safety

Gas valves and other gas storage and distribution equipment are engineered with safe operation and equipment value conservation in mind. Service shut-off valves are located at multiple locations along a system and are used to shut off gas if needed in the event of an emergency.

Prevent potentially dangerous natural gas conditions by calling before you dig to avoid digging into or nicking a buried gas line. As a consumer, it is also a wise and effective safety measure to properly maintain and hire a qualified contractor to routinely inspect gas appliances to prevent carbon monoxide poisoning.

Pipeline Safety and Security

The Office of Pipeline Safety ensures safety in the design, construction, operation, maintenance, and emergency response planning of the nation's pipelines. In accordance with the Federal Pipeline Safety Act of 2002, companies must develop and implement a transmission integrity management plan (IMP) that addresses the monitoring and maintenance of transmission pipelines for community safety.

☼ CAREER PROFILE: Pipeline Technician

As a pipeline technician, Oscar G. is responsible for the operation, maintenance, and repair of pipelines, terminals, and associated equipment, including pipeline valve sites, mains, metering units, and pump stations for his company.

Pipeline technicians maintain, test, troubleshoot, and repair pipeline equipment, associated computer programming, and electronic control systems used in pipeline systems.

Oscar monitors control systems for indications of system errors or failures including leak detection or pressure fluctuations. He also uses computer applications and specialized programs to test pipeline system functions and maintain accurate records.

Pipeline technicians conduct site-based activities that evaluate pipeline product measurement and quality. Oscar says, "The favorite part of my job is doing hands-on pipeline maintenance." Pipeline technicians perform corrective maintenance as well as damage prevention activities on pipeline systems.

Pipeline technicians use customer service skills in communicating with the public about safety issues. Oscar says, "An important part of my job is to help educate the public about pipeline safety, such as telling them about the *Call Before You Dig* program, and how to identify gas line markers."

Gas Pipeline Markers

Pipeline markers are found in the pipeline right of way to identify that a pipeline is buried in the vicinity of the markers. Pipeline markers are not necessarily placed directly above the buried pipeline but typically follow the pipeline's general location and route. Pipeline markers identify what product is being carried in the pipeline (natural gas, for example), the name of the pipeline operator, an emergency contact number, and the area's one-call center ("call before you dig") number or 811 nationally.

High Consequence Areas

Federal regulations require some areas near pipelines to be designated as high consequence areas (HCA). An HCA is an area or building near a gas transmission pipeline where more than 20 people gather, work, or live. HCAs include schools, churches, apartment buildings, and business establishments.

While major pipeline incidents are rare, pipelines are frequently damaged by excavation and other construction activities. When a pipeline near an HCA is damaged, the area will be evacuated for safety reasons until the pipeline is repaired and it is safe to return.

Citizens should be alert to and take notice of pipeline markers placed throughout their communities. Knowing in advance the proximity of local pipelines and how to safely respond to pipeline incidents can help ensure community safety.

Unit A Glossary

bloodborne pathogens—infectious microorganisms in human blood that can cause disease in humans. These pathogens include, but are not limited to, hepatitis B (HBV), hepatitis C (HCV), and human immunodeficiency virus (HIV). Needlesticks and other sharps-related injuries may expose workers to bloodborne pathogens. Workers in many occupations, including first responders, housekeeping personnel in some industries, and nurses and other healthcare personnel, all may be at risk for exposure to bloodborne pathogens

Clean Power Plants—a national standard established to reduce mercury and other toxic air pollution from coal- and oil-fired power plants

confined space—a space that is not designed for continuous, sustained occupancy that has limited openings for entry, exit, or ventilation; confined spaces may pose a hazard due to gas, vapor, dust, or fume levels because of the enclosed nature of the space, its location, contents, or the work activity being done

CPR—cardiopulmonary resuscitation, an emergency procedure that involves giving artificial breathing and heart massage to someone who is not breathing or does not have a pulse (requires special training)

current—movement of electrical charge

de-energization—shutting off the energy sources to circuits and equipment

emergency response plan—detailed procedures for responding to an emergency for the purpose of maintaining order and minimizing the effects of the emergency

energized (alive, live, "hot")—electrically connected to a source of potential difference, or electrically charged; a voltage present that can cause a current, creating a possibility of getting shocked

enforcement—the application of sanctions against a company, by an authoritative regulatory group, for the purpose of penalizing and correcting noncompliance with required standards or conditions

ergonomics—the study and planning of the interaction between people and the work environment to reduce the potential for injury; usually focuses on the interaction between workers and the equipment they use

first aid—the immediate care given to a person who is injured or who suddenly becomes ill, to minimize injury

ground fault circuit interrupter (GFCI)—a protective device that detects current leakage from a circuit to ground and shuts the current off to prevent electrical shock

grounding—physical electrical connection of one or more conductive objects to the earth through the use of metal grounding rods or other devices as protection against electrical shock

hazard—the potential of any machine, equipment, process, material, or physical factor to have harmful effects on people, property, or the environment

hazardous energy—a voltage at which there is sufficient energy to cause injury

health—defined by the World Health Organization as more than just the absence of disease; a state of physical, mental, and social well-being

housekeeping—general cleanliness and neatness, including disposal of wastes, clean-up of spills, and maintaining clean work areas

investigation—the process of systematically gathering and analyzing information about an incident for the purposes of identifying causes and making recommendations to prevent future occurrences

job task analysis—the identification, examination, and evaluation of particular job tasks for the purpose of controlling workplace health and safety hazards

lockout—applying a physical lock to the energy sources of circuits and equipment after they have been shut off and de-energized to prevent accidental energization

safety data sheet (SDS)—a form that contains detailed information about possible health and safety hazards of a specific material and suggestions for proper storage, use, and handling

musculoskeletal injuries—injuries to the system of muscles, tendons, ligaments, joints, bones, and related structures of the human body

Nuclear Regulatory Commission—an independent agency created by Congress in 1974 to ensure the safe use of radioactive materials for beneficial civilian purposes while protecting people and the environment

occupational injuries—injuries, conditions, or sicknesses from exposure to workplace hazards

occupational safety—the maintenance of a work environment that is relatively free from actual or potential hazards that can injure employees

Occupational Safety and Health Administration (OSHA)—the federal agency within the U.S. Department of Labor that establishes and enforces occupational health and safety regulations

Occupational Safety and Health Review Commission (OSHRC)—an independent federal agency, providing administrative trial and appellate review, created to decide contests of citations or penalties resulting from OSHA inspections of American work places

personal protective equipment (PPE)—clothing or devices worn to help protect a person from direct exposure to a hazardous material or situation; examples include protective clothing, respiratory protection, and eye protection

proficiency—skills and knowledge of employees trained and qualified to perform the skills necessary to work safely, effectively, and efficiently

resistance—a material's ability to decrease, oppose, or stop electrical current

safety policy—a statement of intent and pledge for action and commitment to a safe workplace; a policy should present clear objectives to provide direction for a health and safety program

safety program—an established program of activities, procedures, standards, and guidelines designed to create and maintain a safe and healthy workplace

tag out—securing a prominent warning device, such as a tag, to energy isolating devices that indicate that the energy isolating device(s), and the equipment and circuits being controlled, cannot be energized until the tag out device is removed by the person who installed it

Universal Precautions—an approach to infection control. According to the concept of Universal Precautions, all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other bloodborne pathogens. It is necessary to provide personal protective equipment (PPE), such as gloves, gowns, eye protection, and masks.

work practices—procedures for completing specific work tasks to ensure that a worker's exposure to hazardous situations, substances, or physical agents is removed or controlled by the manner in which the work is done

workplace inspection—a regular and careful check of a workplace to identify health and safety hazards for the purpose of recommending corrective actions

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Unit B: Preparing for Hazards in the Workplace

UNIT B: PREPARING FOR HAZARDS IN THE WORKPLACE

Analyzing Tasks for Potential Safety Issues

As mentioned earlier in Unit A, safe work practices and procedures are created with the intention of preventing hazardous situations and accidents. While established general procedures have been written to cover a wide array of workplace situations, it is impractical to assume that every possible workplace situation can be addressed. Therefore, it is important for employees to be diligent about understanding and recognizing possible hazards, evaluating those hazards, and controlling the hazards.

As mentioned earlier, there are some hazards that are unique to the energy and utilities industry sector. Special precautions and work protocols must be followed because of the risks associated with working around electricity. The next few sections will describe elements of common safety procedures used in the energy and utilities industry.

Employees who fail to recognize, evaluate, and control hazards put their lives and the lives of others at risk of being injured or killed by electricity itself, electrical fires, or falls.

Critical Thinking

How can you be injured at the worksite?

What types of accidents can occur in the energy and utilities industry?

What types of precautions can be taken to protect workers?

☼ ACTIVITY: Occupational Injuries and Prevention Interview

Interview someone who is employed in the energy and utilities industry about the most common types of injuries or pain that are work-related in their field or specialty area.

Be sure to ask about specific occupational information such as:

- Description of occupation
- Specific regulations and guidelines regarding workplace practices
- Common injuries
- Prevention methods
- Personal Protective Equipment (PPE) used

Electric Shock

Energy and utilities workers must pay special attention to electrical hazards because they work on or with various equipment and systems that carry electric voltage. Coming in contact with an electrical voltage can cause current to flow through the body, resulting in electrical shock, burns, or even serious injury or death.

Whenever work is done on electrical circuits or electrified systems, there is a risk from electrical hazards, particularly electrical shock.

☼ ACTIVITY: Basic Electrical Safety

In student groups, develop a checklist of common electrical hazards.

All groups should then collaborate as a class in the creation of one master checklist.

Find a test site to apply the checklist to, and conduct a full inspection with the checklist. Edit and adapt the checklist as needed.

Examples of energy and utilities industry electric shock hazards include:

- Inadequate wiring
- Exposed electrical components
- Overhead power lines
- Defective insulation
- Improper grounding
- Electrical overload
- Wet conditions
- Faulty tools or equipment
- Improper use of PPE

☼ ACTIVITY: Preventing Electrical Accidents

Energy and utilities industry workers must be familiar with electrical safety procedures for working on and around new and existing energized (hot) circuits. They must be familiar with electrical safety procedures for using specialized safety tools to prevent injury from electrical shock.

Select one of the following various pieces of protective equipment to research:

- Rubber protective equipment, including gloves and blankets
- Protective apparel
- Personal clothing
- Hot sticks
- Fuse pullers
- Shorting probes
- **Eye and face protection**
- Ground fault circuit interrupters (GFCI)

Prepare an informational brochure, poster, or PowerPoint presentation explaining the proper use of the selected protective equipment.

Fire Hazards

Electrical Fires

Electricity is one of the most common causes of fires and **thermal burns** in workplaces. Defective or misused electrical equipment is a major cause of electrical fires. Arcing/sparking, overheating, friction, static electricity, electrical current leakage/faults, and other electrical hazards can cause fire and explosions.

The first line of defense against fire hazards is prevention. Compliance with safe work procedures; regular inspections of work areas, tools, and equipment; and knowledge and understanding of potential fire hazards can help prevent fires.

There are different classes of fires commonly referred to as classes A, B, C, and K. The letters are explained below:

A **Ordinary Combustibles** (paper, wood, cloth, rubber, most plastics)

B **Flammable Liquids** (oils, gasoline, grease solvents, lacquers)

C **Energized Equipment/Electrical Fires** (electrical sources still supplied with power)

K **Cooking Oils** (vegetable or animal oils and fats)

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Because there are different classes of fires, there are also different classes of fire extinguishers. Fire extinguishers are marked with letters and symbols that indicate the classes of fires they can extinguish. It is critically important to understand the classes of extinguishers and their appropriate uses. In a fire emergency, if you select the wrong class of extinguisher, the fire could actually become worse.

All employees should be familiar with and periodically trained in the operation and use of fire extinguishers. Employees should understand the importance of using only approved fire extinguishers to fight fires near exposed, energized parts. If it becomes necessary to use any solution or liquid that might act as a conductor, all neighboring electrical equipment must first be de-energized.

Employees should ensure that extinguishers are not damaged, out of date, discharged, or partially discharged. Materials or equipment should not be stored in a manner that would block pathways to fire extinguishers or fire equipment or otherwise hinder the operation of fire protection systems.

It is important to note that fire extinguishers are designed to attempt to extinguish **incipient stage fires** or small fires. If a fire cannot be immediately and easily extinguished with a fire extinguisher, all employees should evacuate the area.

☼ ACTIVITY: Types of Fires and How to Extinguish Them

What causes a fire? Are all fires the same? What is the "fire triangle"? In student groups, research the answers to these questions.

Using the library, Internet, or other resources, find the following information:

- The different classes/types of fires.
- The different classes of fire extinguishers.
- The classes of fires that might occur at home, at school, and in the energy and utilities workplace.

Fire Extinguisher Use Guidelines

Employees who are in working environments with a high probability of anticipated fire extinguisher use should be trained on the hazards of fires and how to properly operate a fire extinguisher in the event of an emergency.

Every company has its own guidelines and regulations regarding fire extinguisher use. Some companies instruct employees who are not trained or designated to fight fires to immediately evacuate the area at the first sign of fire or fire alarm activation and are prohibited from using a fire extinguisher.

Steps for Safe Use

- As mentioned earlier, a fire extinguisher should be used to fight a fire only if the fire is incipient or small and the user has been trained in fire extinguisher use.
- The appropriate fire extinguisher should be selected depending on the type of fire.
- The fire extinguisher nozzle should be aimed at the base of the fire.
- The handle of the fire extinguisher should be squeezed as the extinguisher nozzle is aimed at the base of the fire and moved side to side in a sweeping motion.
- Once the fire appears to be completely out, back away and exit the area.
- Ensure you have an unobstructed escape route to your back.
- If the fire becomes larger or the extinguisher is fully discharged and the fire is not completely out, exit the area immediately.

  Remember the acronym "PASS" for safe fire extinguisher use.
  P - Pull the Pin
  A - Aim at the base of the fire
  S - Squeeze the handle
  S - Sweep from side to side

Identifying Fall Hazards

Identifying fall hazards and deciding how best to protect workers is the first step in reducing or eliminating injuries caused by falls. As mentioned in Unit A, employees who work on structures such as poles, towers, or other elevated equipment that support overhead generation, transmission, and distribution lines and equipment are required by **OSHA** to follow fall protection precautionary measures. In addition to compliance with safe work practices and training, fall protection safeguards such as a **personal fall arrest system**, work positioning equipment, or travel restricting equipment must be used by employees working at locations elevated more than four feet above the ground.

Whether conducting a **hazard assessment** or developing a comprehensive fall protection plan, thinking about fall hazards before the work begins will help to manage fall hazards and focus attention on

prevention efforts. If personal fall protection systems are used, particular attention should be given to identifying attachment points and to ensuring that employees know how to properly **don** and inspect the equipment.

Personal Protective Equipment

All work tasks involve certain hazards, but when working around electricity, the hazard can become life-threatening. For example, a mistake made during a switching operation can result in serious injury or even death because of the high voltages and the large amounts of current involved. However, there are times when equipment must be taken out of service to be worked on safely and thus switching is a necessity. The operator must have the best protective equipment available and must be trained thoroughly in the use of this equipment. Under these circumstances, even if a mistake is made, the operator will be much more likely to avoid serious injury.

There are two types of electrical hazards—current passing through the person's body and dangerous exposure to the intense heat of the electrical arc that forms when an error occurs. Special protective clothing and equipment are provided to minimize the risk of both hazards. Plant management provides specific rules regarding the use of this equipment. It is the responsibility of the operator to use these safeguards properly while working around electrical hazards. It is the responsibility of the plant manager to see that safety equipment is used in the proper manner when switching is performed.

The use of properly selected **Personal Protective Equipment (PPE)** by workers trained in the proper fit and use, in tandem with other control methods, is a time-proven and cost-effective method of protecting workers from hazards in the workplace. The purpose of PPE is to provide an effective line of defense against health and safety hazards on and off the job.

General Personal Protective Equipment Guidelines

- Employees should wear and use only company-approved personal protective equipment.
- Before starting work, devices or tools should be carefully examined by employees who will use them to make certain they are in good working condition.
- It is the responsibility of employees to ensure all PPE is properly maintained, kept in a sanitary condition, and worn as prescribed by company policy. PPE should not be modified in any manner.
- Defective or damaged PPE should never be used and should be removed from service immediately.

The following pages will outline specific personal protective equipment to protect energy workers from dangers they are likely to encounter on the job. For each category, a description of the device(s), standards related to their use, usage information, fit and sizing, and information on how to maintain the equipment is provided.

Hard Hat

Description

A hard hat is worn when a potential for head injury from impact and penetration from falling objects or an electric shock or arc hazard exists. Hard hats must have a hard outer shell and a shock-absorbing lining that incorporates a headband and straps that suspend the shell from 1 to 1 1/4 inches (2.54 cm to 3.18 cm) away from the head. This type of design provides shock absorption during an impact and ventilation during normal wear.

Hard Hat Type II Class E

Standards

The current **ANSI** standard is ANSI Z89.1-2009

- **Type I** Protection from blows to top of head
- **Type II** Protection from blows to top/sides of head
- **Class E** (electrical) tested to withstand 20,000 volts
  Helmets are intended to reduce the danger of exposure to high voltage conductors. Test samples are proof-tested at 20,000 volts (phase to ground). However, this voltage is not intended as an indication of the voltage at which the helmet protects the wearer.
- **Class G** (general) tested at 2,200 volts
  Helmets are intended to reduce the danger of contact exposure to low voltage conductors. Test samples are proof-tested at 2,200 volts (phase to ground). However, this voltage is not intended as an indication of the voltage at which the helmet protects the wearer.
- **Class C** (conductive) provides no electrical protection

  Hard hats should not be confused with another class of protective headgear on the market called a “bump hat,” designed for use in areas with low head clearance. They are recommended for areas where protection is needed from head bumps and lacerations. These are not designed to protect against falling or flying objects and are not ANSI approved.

Additional ANSI hard hat compliance standards: hats must include date of manufacture along with the manufacturer's name, sizing instructions, guidelines for care and service, and the ANSI legend and class description. It is important to note that hard hats are not guaranteed to be entirely impact resistant. They are designed to *reduce* the risk of head injury.

Fit and Sizing

Head protection that is either too large or too small is inappropriate for use, even if it meets all other requirements. Protective headgear must fit appropriately on the body and for the head size of each individual. Most protective headgear comes in a variety of sizes with adjustable headbands to ensure a proper fit (many adjust in 1/8-inch increments). A proper fit should allow sufficient clearance between the shell and the suspension system for ventilation and distribution of an impact. The hat should not bind, slip, fall off, or irritate the skin.

Accessories

Hard hat with face shield

Some protective headgear allows for the use of various accessories to help employees deal with changing environmental conditions, such as slots for earmuffs, safety glasses, face shields, and mounted lights. Optional brims may provide additional protection from the sun and some hats have channels that guide rainwater away from the face. Protective headgear accessories must not compromise the safety elements of the equipment. For example, adding some **hearing protection** devices may reduce the Class rating from an E to a G or C rating if they are not dielectric.

Usage

Employers must ensure that their employees wear head protection if any of the following apply:

- Objects might fall from above and strike them on the head.
- They might bump their heads against fixed objects, such as exposed pipes or beams.
- There is a possibility of accidental head contact with electrical hazards.

Some examples of occupations in which employees should be required to wear head protection include construction workers, carpenters, electricians, linemen, plumbers and pipefitters, timber and log cutters, and welders, among many others. Whenever there is a danger of objects falling from above, such as working below others who are using tools or working under a conveyor belt, head protection must be worn. Hard hats must be worn with the bill forward to protect employees properly.

Maintenance

Periodic cleaning and inspection will extend the useful life of protective headgear. A daily inspection of the hard hat shell, suspension system, and other accessories for holes, cracks, tears, or other damage that might compromise the protective value of the hat is essential. Paints, paint thinners, and some cleaning agents can weaken the shells of hard hats and may eliminate electrical resistance. Consult the helmet manufacturer for information on the effects of paint and cleaning materials on their hard hats. Never drill holes, paint, or apply labels to protective headgear as this may reduce the integrity of the protection. Do not store protective headgear in direct sunlight, such as on the rear window shelf of a car, since sunlight and extreme heat can damage them.

Hard hats with any of the following defects should be removed from service and replaced:

- Perforation, cracking, or deformity of the brim or shell
- Indication of exposure of the brim or shell to heat, chemicals, or ultraviolet light and other radiation (in addition to a loss of surface gloss, such signs include chalking or flaking)

Always replace a hard hat if it sustains an impact, even if damage is not noticeable. Suspension systems are offered as replacement parts and should be replaced when damaged or when excessive wear is noticed. It is not necessary to replace the entire hard hat when deterioration or tears of the suspension systems are noticed.

Eye and Face Protection

There are three types of protection from eye and face injuries: safety glasses (sometimes referred to as spectacles), safety goggles, and face shields. Personal protective equipment (PPE) for the eyes and face is designed to prevent or lessen the severity of injuries to workers. The employer must assess the workplace and determine if hazards that necessitate the use of eye and face protection are present or are likely to be present before assigning PPE to workers.

A hazard assessment should determine the risk of exposure to eye and face hazards, including those that may be encountered in an emergency. Employers should be aware of the possibility of multiple and simultaneous hazard exposures and be prepared to protect against the highest level of each hazard.

There are five broad categories of hazards to the eyes and face. The table below will help to assess these risks. As we discuss each type of protective eyewear in the following sections, we will refer to the five risk categories to identify the hazards protected against by each type of protective eyewear.

Hazard Assessment		
Hazard Type	**Examples of Hazard**	**Common Related Tasks**
Impact	Flying objects such as large chips, fragments, particles, sand, and dirt.	Chipping, grinding, machining, masonry work, wood working, sawing, drilling, chiseling, powered fastening, riveting, and sanding.
Heat	Anything emitting extreme heat.	Furnace operations, pouring, casting, hot dipping, and welding.
Chemicals	Splash, fumes, vapors, and irritating mists.	Acid and chemical handling, degreasing, plating, and working with blood.
Dust	Harmful dust.	Woodworking, buffing, and general dusty conditions.
Optical Radiation	Radiant energy, glare, and intense light.	Welding, torch-cutting, brazing, soldering, and laser work.

Source: OSHA Eye and Face Protection eTool: http://www.osha.gov/SLTC/etools/eyeandface/ppe/selection.html

It should be noted that the OSHA standard requiring eye and face protection, CFR 1910.133, requires that equipment be constructed in accordance with one of the above consensus standards referring to ANSI Z87.1-1989 and ANSI Z87.1-2003. These standards discuss regulations for glasses, goggles, and face shields independently. A new ANSI standard, ANSI Z87.1-2010, has been released that is organized by type of hazard. Changes were also made in the way protection levels are indicated on the device. You should be aware that these differences exist so you will know if you are being protected.

Safety Glasses (Spectacles)

Description

Safety glasses are intended to shield the wearer's eyes from eye hazards from flying fragments, objects, large chips and particles, and glare. Safety glasses are required to have side shields when there is a hazard from flying objects. Dielectric (nonconducting) safety glasses must be worn while working on live exposed electrical parts.

To encourage workers to use safety glasses more consistently, manufacturers have worked hard to improve their appearance, offering more modern designs with sleeker looks.

Older styles source: OSHA

Newer styles source: SafetyGlassesUSA.com

Standards

Eye and face PPE shall be distinctly marked to facilitate identification of the manufacturer. [OSHA CFR 1910.133(a)(4)]

The following minimum requirements must be met by all protective devices. Protectors shall:

- Provide adequate protection against the particular hazards for which they are designed
- Be of safe design and construction for the work to be performed
- Be reasonably comfortable when worn under the designated conditions
- Fit snugly and not unduly interfere with the movements of the wearer
- Be durable
- Be capable of being disinfected
- Be easily cleanable
- Be distinctly marked to facilitate identification of the manufacturer

As mentioned earlier, glasses meeting the ANSI Z87.1-1989, ANSI Z87.1-2003, and ANSI Z87.1-2010 standard will satisfy the OSHA CFR 1910.133 standard. Therefore, safety glasses may bear a variety of different markings that you should be aware of.

- Impact protector (must meet High Mass Impact, High Velocity Impact, and Penetration tests) shall be marked Z87+.
- Non-Impact Protector (must meet all requirements, except impact requirements) shall be marked Z87.
- Lens: Manufacturer's mark, and, if applicable, "S" for lenses with less than 85% visible light transmission.
- Frame components: All major components shall bear Manufacturer's mark and shall be marked Z87.
- Optional tests and markings: There are optional tests for Welding lenses, UV lenses, IR lenses, and VLT filters. If these properties are claimed, they have to be marked on the lens.
- Welding: W-followed by shade number
- UV filter: U and scale number
- Visible light filter: L and scale number
- IR filter: R and scale number

Fit and Sizing

In the fitting of PPE, consideration should be given to comfort and fit. Poorly fitting eye and face protection will not offer the necessary protection. They should fit snugly and not unduly interfere with the movements of the wearer.

- Fitting of goggles and safety spectacles should be done by someone skilled in the procedure.
- Prescription safety spectacles should be fitted only by qualified optical personnel.
- Devices with adjustable features should be fitted on an individual basis to provide a comfortable fit that maintains the device in the proper position.

Usage

The majority of impact injuries result from flying or falling objects, or sparks striking the eye. Most of these objects are smaller than a pin head and can cause serious injury such as punctures, abrasions, and contusions.

While working in a hazardous area where the worker is exposed to flying objects, fragments, and particles, primary protective devices such as safety spectacles with side shields or goggles must be worn. Nonconductive eyewear will be worn while working on live, exposed electrical parts. Secondary protective devices such as face shields are required in conjunction with primary protective devices during severe exposure to impact hazards. Safety glasses alone do not give adequate protection when working with chemicals.

Generally, every job involved in the generation, transmission, and distribution of power requires the use of safety glasses. Many of those require the high impact type.

A few other occupations requiring high impact protection in eyewear include:

- Construction and Maintenance Workers
- Plumbers and Pipefitters
- Chain Saw Operators
- Millwrights
- Lineworkers

Heat injuries may occur to the eye and face when workers are exposed to high temperatures, splashes of molten metal, or hot sparks. Protect your eyes from heat when workplace operations involve pouring, casting, hot dipping, furnace operations, and other similar activities. Burns to eye and face tissue are the main concern when working with heat hazards.

SafetyGlassesUSA.com

Working with heat hazards requires eye protection such as goggles or safety spectacles with special-purpose lenses and side shields. However, many heat hazard exposures require the use of a face shield in addition to safety spectacles or goggles. When selecting PPE, consider the source and intensity of the heat and the type of splashes that may occur in the workplace.

Employers and safety officers should consult OSHA to help determine which type of safety eyewear is most appropriate for different jobs.

Maintenance

Eyewear will be examined for scratches, pitting, and frame damage, all of which damage and weaken the impact and shatter resistance of the eyewear. Worn or damaged equipment should be replaced immediately.

- PPE must be used and maintained in a sanitary and reliable condition.
- The use of equipment with structural or optical defects is prohibited.
- Pitted lenses, like dirty lenses, can be a source of reduced vision. They should be replaced. Deeply scratched or excessively pitted lenses are apt to break.
- Slack, worn-out, sweat-soaked, or twisted headbands do not hold the eye protection in proper position. Visual inspection can determine when the headband elasticity is reduced to a point below proper function.

Cleaning

- Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleansing may be necessary.
- Eye and face protection equipment that has been previously used should be disinfected before being issued to another employee.
- When employees are assigned protective equipment for extended periods, the equipment should be cleaned and disinfected regularly.
- Several methods for disinfecting eye-protective equipment are acceptable. The most effective method is to disassemble the goggles or spectacles and thoroughly clean all parts with soap and warm water.
- Carefully rinse all traces of soap and replace defective parts with new ones.
- Swab thoroughly and immerse all parts for 10 minutes in a solution of germicidal deodorant fungicide.
- Remove parts from solution and suspend in a clean place for air drying at room temperature or with heated air.
- Do not rinse after removing parts from the solution because this will remove the germicidal residue that retains its effectiveness after drying.

Storage

- Goggles should be kept in a case when not in use. Spectacles, in particular, should be given the same care as one's own glasses, since the frame, nose pads, and temples can be damaged by rough usage.
- Items should be placed in a clean, dust-proof container, such as a box, bag, or plastic envelope, to protect them until reissue.

These are dielectric with no metal parts, recommended for linemen.

Safety Goggles

Description

Safety goggles are tight-fitting eye protection that completely cover the eyes, eye sockets, and the facial area immediately surrounding the eyes and provide protection from impact, dust, and splashes. Some goggles will fit over corrective lenses. Safety goggles are intended to shield the wearer's eyes from impact hazards, heat hazards, chemical hazards, dust, and with special lenses even optical radiation. Goggles come in ventilated (both direct and indirect) and nonventilated versions. Ventilated goggles tend to be cooler and to resist fogging.

Courtesy of *Klein Tools, Inc.*

Goggles with tinted lenses can protect eyes during acetylene burning, cutting, or welding but are not recommended for arc welding. A specialty goggle is the laser safety goggle. These specialty goggles protect against intense concentrations of light produced by lasers. The type of laser safety goggles an employer chooses will depend upon the equipment and operating conditions in the workplace.

Standards

The standards for safety glasses also cover safety goggles. These include OSHA CFR 1910.133 and ANSI Z87.1-1989, ANSI Z87.1-2003, and ANSI Z87.1-2010.

Fit and Sizing

Safety goggle frames must be properly fitted to the worker's face to form a protective seal around the eyes. Poorly fitted goggles will not offer the necessary protection. If wearing eyecup safety goggles, make sure they cover the eye sockets completely.

Some goggles are made to fit over the user's own prescription glasses. Be sure the goggle is sufficiently sized to fit over the glasses and still fit to the face to protect the eyes.

Usage

A variety of safety goggles exists to meet different eye protection needs. A lab goggle intended to protect your eyes from chemical splashes and dust, for example, probably won't have the impact resistance of a goggle intended to be used by an arborist clearing trees and branches from utility lines and using a chipper to reduce them to mulch.

Because of the wide variety of goggles available, you must carefully analyze your work environment to determine the protection needed and then choose your goggles to protect your eyes from those risks. If the risks vary from task to task, you may need to have multiple goggles so that you can change them out to fit the task you are working on at the time.

Employers may supply each worker with appropriate goggles for their job, or they may have goggles that are shared among workers performing a given task.

Maintenance

(Care and cleaning of safety goggles is essentially the same as for safety glasses.)

Eyewear will be examined for scratches, pitting, and frame damage. Scratches, pitting, and frame damage weaken the impact and shatter resistance of the eyewear. Worn or damaged equipment should be replaced immediately.

- PPE must be used and maintained in a sanitary and reliable condition.
- The use of equipment with structural or optical defects is prohibited.
- Pitted lenses, like dirty lenses, can be a source of reduced vision. They should be replaced. Deeply scratched or excessively pitted lenses are apt to break.
- Slack, worn-out, sweat-soaked, or twisted headbands do not hold the eye protection in proper position. Visual inspection can determine when the headband elasticity is reduced to a point below proper function.

Cleaning

Careful cleaning with appropriate materials is important to maintain goggles. Improper techniques can cause scratching of the lens, removal of optical coatings that help to protect the eyes, and even deterioration of the goggle material. When goggles are shared by employees, it is important to thoroughly clean them for each user. If the cleanliness of the goggle impairs vision, goggles should be cleaned.

- Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleansing may be necessary.
- Eye and face protection equipment that has been previously used should be disinfected before being issued to another employee.
- When employees are assigned protective equipment for extended periods, the equipment should be cleaned and disinfected regularly.
- Several methods for disinfecting eye-protective equipment are acceptable. The most effective method is to disassemble the goggles and thoroughly clean all parts with soap and warm water.
- Carefully rinse all traces of soap, and replace defective parts with new ones.
- Swab thoroughly or completely and immerse all parts for 10 minutes in a solution of germicidal deodorant fungicide.
- Remove parts from solution and suspend in a clean place for air drying at room temperature or with heated air.
- Do not rinse after removing parts from the solution because this will remove the germicidal residue that retains its effectiveness after drying.

Storage

- Goggles should be kept in a case when not in use.
- Items should be placed in a clean, dust-proof container, such as a box, bag, or plastic envelope, to protect them until reissue.

Face Shields

Description

Face shields are intended to protect the entire face or portions of it from impact hazards such as flying fragments, objects, large chips, and particles. When worn alone, face shields do not protect employees from impact hazards, but should be used in combination with safety glasses or goggles.

Courtesy of *Klein Tools, Inc.*

Face shields consist of two parts, the head gear and the window shield. Headgear supports the window shield and secures the device to the head.

Face shield windows extend from the level of the brow to below the chin and across the entire width of the face. Some will wrap around to protect the side of the head and ears as well. The window material may be plastic to provide against light impact and may be clear or filtered. Wire-screen windows protect against some moderate impact but are not recommended for use involving chemical or liquid hazards. Wire screens also help to shield the face from a variety of heat hazards.

Some face shields are designed to mount to a hard hat under the visor of the hat.

Welders need greater protection from heat and optical radiation so they will wear welding helmets. Welding helmets protect the eyes and face from flying sparks, metal spatter, and slag chips produced during welding, brazing, soldering, and cutting. For complete protection of the eyes, safety glasses or goggles may be worn beneath the welding helmet or face shield.

The welding helmet is constructed of heat resistant material such as vulcanized fiber or fiberglass and fitted with a filtered lens to protect the worker's eyes from burns caused by infrared and or other intense radiant energy. The filter lenses are tinted to coincide with specific radiant energy exposure. The table below in standards describes the lenses to use for each level of protection.

Standards

OSHA standards call for lens shades by operation as shown in the following table:

Filter Lenses for Protection Against Radiant Energy

Operations	Electrode Size 1/32 in.	Arc Current	Minimum (*) Protective Shade
Shielded metal arc welding	Less than 3 3-5 5-8 More than 8	Less than 60 60-160 160-250 250-550	7 8 10 11
Gas metal arc welding and flux cored arc welding		Less than 60 60-160 160-250 250-500	7 10 10 10
Gas Tungsten arc welding		Less than 50 50-150 150-500	8 8 10
Air carbon arc cutting	(light) (heavy)	Less than 500 500-1,000	10 11
Plasma arc welding		Less than 20 20-100 100-400 400-800	6 8 10 11
Plasma arc cutting	(light) (**) (medium) (**) (heavy) (**)	Less than 300 300-400 400-800	8 9 10
Torch brazing Torch soldering Carbon arc welding			3 2 14
Operations	**Plate thickness-inches**	**Plate thickness-mm**	**Minimum (*) Protective Shade**
Gas welding: Light Medium Heavy	 Under 1/8 1/8 to 1/2 Over 1/2	 Under 3.2 3.2 to 12.7 Over 12.7	 4 5 6
Oxygen cutting: Light Medium Heavy	 Under 1 1 to 6 Over 6	 Under 25 25 to 150 Over 150	 3 4 5

Footnote(*) As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade that gives sufficient view of the weld zone without going below the minimum. In oxyfuel gas welding or cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the (spectrum) operation.

Footnote(**) These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the work piece.

Fit and Sizing

Face shields and helmets come in various sizes. It is important to use one that fits you and protects your face and eyes. Headgear often has straps to allow the user to manipulate the size of the headgear to ensure a proper fit. You should always take the time to adjust the face shield so it fits securely and will not fall off when you carry out your tasks.

Usage

Face shields should be worn while working with a pneumatic or electrical tool, which may produce dust, chips, or airborne objects. Tools such as a jackhammer, chipping gun, grinder, or beveling machine require the use of face shields. Face shields should be worn when performing energized pressure washing in substations or current, performing battery maintenance, during abrasive blasting operations, operating abrasive equipment, or as required by the manufacturer. For complete protection, safety goggles should be worn beneath the face shield.

Face shields come in a variety of styles with windows and headgear made from different transparent materials in different shades and thicknesses to correspond with specific tasks. It is important to select the proper shield for the job.

Maintenance

Face shields require maintenance and cleaning similar to safety glasses and safety goggles.

Gloves

If a workplace hazard assessment reveals that employees face potential injury to hands and arms that cannot be eliminated through engineering and work practice controls, employers must ensure that employees wear appropriate protection. Potential hazards include skin absorption of harmful substances, chemical or thermal burns, electrical dangers, bruises, abrasions, cuts, punctures, fractures, and amputations. Protective equipment includes gloves, finger guards, and arm coverings or elbow-length gloves.

Employers should explore all possible engineering and work practice controls to eliminate hazards and use PPE to provide additional protection against hazards that cannot be completely eliminated through other means. For example, machine guards may eliminate a hazard. Installing a barrier to prevent workers from placing their hands at the point of contact between a table saw blade and the item being cut is another method.

Description

There are many types of gloves available today to protect against a wide variety of hazards. The nature of the hazard and the operation involved will affect the selection of gloves. The variety of potential occupational hand injuries makes selecting the right pair of gloves challenging. It is essential that employees use gloves specifically designed for

the hazards and tasks found in their workplace because gloves designed for one function may not protect against a different function even though they may appear to be an appropriate protective device.

The following are examples of some factors that may influence the selection of protective gloves for a workplace:

- Type of chemicals handled
- Nature of contact (total immersion, splash)
- Duration of contact
- Area requiring protection (hand only, forearm, arm)
- Grip requirements (dry, wet, oily)
- Thermal protection
- Size and comfort
- Abrasion/resistance requirements

Gloves made from a wide variety of materials are designed for many types of workplace hazards. In general, gloves fall into four groups:

- Gloves made of leather, canvas or metal mesh
- Fabric and coated fabric gloves
- Chemical- and liquid-resistant gloves
- Insulating rubber gloves

Leather, Canvas, or Metal Mesh Gloves

Sturdy gloves made from metal mesh, leather, or canvas provide protection against cuts and burns. Leather or canvas gloves also protect against sustained heat.

- **Leather gloves** protect against sparks, moderate heat, blows, chips, and rough objects.
- **Aluminized gloves** provide reflective and insulating protection against heat and require an insert made of synthetic materials to protect against heat and cold.
- **Aramid fiber gloves** protect against heat and cold, are cut- and abrasive-resistant, and wear well.
- **Synthetic gloves** of various materials offer protection against heat and cold, are cut- and abrasive-resistant, and may withstand some diluted acids. These materials do not stand up against alkalis and solvents.

Fabric and Coated Fabric Gloves

Fabric and coated fabric gloves are made of cotton or other fabric to provide varying degrees of protection.

- **Fabric gloves** protect against dirt, slivers, chafing, and abrasions. They do not provide sufficient protection for use with rough, sharp, or heavy materials. Adding a plastic coating will strengthen some fabric gloves.
- **Coated fabric gloves** are normally made from cotton flannel with napping on one side. By coating the unnapped side with plastic, fabric gloves are transformed into general-purpose **hand protection** offering slip-resistant qualities. These gloves are used for tasks ranging from handling bricks and wire to chemical laboratory containers. When selecting gloves to protect against chemical exposure hazards, always check with the manufacturer or review the manufacturer's product literature to determine the gloves' effectiveness against specific workplace chemicals and conditions.

Chemical- and Liquid-Resistant Gloves

Chemical-resistant gloves are made with different kinds of rubber: natural, butyl, neoprene, nitrile, and fluorocarbon (viton); or various kinds of plastic: polyvinyl chloride (PVC), polyvinyl alcohol, and polyethylene. These materials can be blended or laminated for better performance. As a general rule, the thicker the glove material, the greater the chemical resistance, but thick gloves may impair grip and dexterity, having a negative impact on safety.

Some examples of chemical-resistant gloves include:

- **Butyl gloves**, which are made of a synthetic rubber and protect against a wide variety of chemicals, such as peroxide, rocket fuels, highly corrosive acids (nitric acid, sulfuric acid, hydrofluoric acid, and red-fuming nitric acid), strong bases, alcohols, aldehydes, ketones, esters, and nitrocompounds. Butyl gloves also resist oxidation, ozone corrosion, and abrasion, and remain flexible at low temperatures. Butyl rubber does not perform well with aliphatic and aromatic hydrocarbons and halogenated solvents.
- **Natural (latex) rubber gloves**, which are comfortable to wear, which makes them a popular general-purpose glove. They feature outstanding tensile strength, elasticity, and temperature resistance. In addition to resisting abrasions caused by grinding and polishing, these gloves protect workers' hands from most water solutions of acids, alkalis, salts, and ketones. Latex gloves have caused allergic reactions in some individuals and may not be appropriate for all employees. Hypoallergenic gloves, glove liners, and powderless gloves are possible alternatives for workers who are allergic to latex gloves.

- **Neoprene gloves**, which are made of synthetic rubber and offer good pliability, finger dexterity, high density, and tear resistance. They protect against hydraulic fluids, gasoline, alcohols, organic acids, and alkalis. They generally have chemical and wear resistance properties superior to those made of natural rubber.
- **Nitrile gloves**, which are made of a copolymer and provide protection from chlorinated solvents such as trichloroethylene and perchloroethylene. Although intended for jobs requiring dexterity and sensitivity, nitrile gloves stand up to heavy use even after prolonged exposure to substances that cause other gloves to deteriorate. They offer protection when working with oils, greases, acids, caustics, and alcohols but are generally not recommended for use with strong oxidizing agents, aromatic solvents, ketones, and acetates.

Electrical Protective Gloves

Electrical protective gloves are among the most important articles of personal protection for electrical workers. To be effective, the gloves must have a high electrical resistance and be strong and durable. The gloves must be flexible as well so workers can maintain their manual dexterity. Because they are not resistant to high heat or wear, they must be worn with a leather protective glove to protect the glove.

Standards

Rubber insulating gloves should meet and/or exceed the requirements of current American Society for Testing and Materials (ASTM) D120 specifications. Gloves should also be electrically tested following ASTM D120/IEC903 specifications.

Electrical protective gloves are categorized by the level of voltage protection they provide and whether or not they are resistant to ozone. Voltage protection is broken down into the following classes:

- Class 0: Maximum use voltage of 1,000 volts AC/proof tested to 5,000 volts AC
- Class 1: Maximum use voltage of 7,500 volts AC/proof tested to 10,000 volts AC
- Class 2: Maximum use voltage of 17,000 volts AC/proof tested to 20,000 volts AC

Science Connections

The Physics of Protection

The following is an illustration of the need for rubber gloves when working around electrical switchgear on a humid day. Line voltage in the area is 22,000 volts. The nominal resistance of rubber gloves is about 10^{19} ohms; the resistance of a perspiring switchman is about 1,000 ohms. If the switchman accidentally touched a live conductor without his gloves, the current through his body would be:

$$I = \frac{E}{R} = \frac{22,000V}{1000\Omega} = 22amps$$

With rubber gloves

$$I = \frac{22,000V}{10^{19}\Omega} = 2.2\text{X}10^{-16}\,milliamps$$

The lethal range for current through a person's body is over 50 milliamps. Therefore, in the first case, the workman would be dead; in the second case, the workman would be unharmed.

- Class 3: Maximum use voltage of 26,500 volts AC/proof tested to 30,000 volts AC
- Class 4: Maximum use voltage of 36,000 volts AC/proof tested to 40,000 volts AC

Fit and Sizing

Proper fit is critical because it leads to improved productivity. Finger length or the overall length of the glove should not be too long to avoid getting caught in moving equipment. In terms of overall sizing, the hand circumference should not be too small, because this reduces the user's range of motion, or too big so that the gloves are too loose.

Accessories

Liner Gloves – Are used to reduce the discomfort of wearing rubber insulating gloves in all seasons, for year-round use. Liners provide warmth in cold weather, while they absorb perspiration in the warm months. These can have a straight cuff or knit wrist.

Glove Dust/Powder – Absorb moisture and perspiration to increase comfort and decrease "sticky" gloves.

Glove Bag – Are used to store and protect insulating gloves and protectors. They can be made of canvas or other sturdy material.

Usage

Whenever the potential for skin absorption of harmful substances, chemical or thermal burns, electrical dangers, bruises, abrasions, cuts, punctures, fractures, and amputations exist, workers should be provided with protective gloves. The hazards of each task should be evaluated to determine the exact risks involved so that the proper glove for the job can be chosen.

Whenever rubber insulating gloves are used, leather protective gloves should be worn over them to provide the mechanical protection needed against cuts, abrasions, and punctures. Look for those that are steam pressed on curved hand forms to ensure proper fit over rubber gloves.

Chemical resistant gloves must be chosen dependent on the chemicals to be handled and their properties. The following table shows the level of protection various types of gloves provide for specific chemicals. You do not need to memorize the table, just know that they exist and should be consulted when choosing your gloves. The glove manufacturer should be consulted if there is any question.

The following table from the U.S. Department of Energy (Occupational Safety and Health Technical Reference Manual) rates various gloves as being protective against specific chemicals and will help you select the most appropriate gloves to protect your employees. The ratings are abbreviated as follows: VG: Very Good; G: Good; F: Fair; P: Poor (not recommended). Chemicals marked with an asterisk (*) are for limited service.

Chemical Resistance Selection Chart for Protective Gloves

Chemical	Neoprene	Latex/Rubber	Butyl	Nitrile
Acetaldehyde*	VG	G	VG	G
Acetic acid	VG	VG	VG	VG
Acetone*	G	VG	VG	P
Ammonium hydroxide	VG	VG	VG	VG
Amyl acetate*	F	P	F	P
Aniline	G	F	F	P
Benzaldehyde*	F	F	G	G
Benzene*	P	P	P	F
Toluene*	F	P	P	F
Toluene diisocyanate (TDI)	F	G	G	F
Trichloroethylene*	F	F	P	G
Triethanolamine (85%)	VG	G	G	VG
Tung oil	VG	P	F	VG
Turpentine	G	F	F	VG
Xylene*	P	P	P	F

Note: When selecting chemical-resistant gloves, be sure to consult the manufacturer's recommendations, especially if the gloved hand(s) will be immersed in the chemical.

Maintenance

All protective apparel and equipment should be kept as clean and sanitary as possible. Frequent washing and cleaning is a necessity. When not in use, the equipment should be kept in protected storage locations. The apparel should be inspected carefully each time it is to be used, particularly the rubber gloves, which should be inspected both visually and air tested before each use.

Any gloves with impaired protective ability should be discarded and replaced. Reuse of chemical-resistant gloves should be evaluated carefully, taking into consideration the absorptive qualities of the gloves. A decision to reuse chemically-exposed gloves should take into consideration the toxicity of the chemicals involved and factors such as duration of exposure, storage, and temperature.

Testing Rubber Insulating Gloves

Rubber insulating gloves must be electrically tested in the lab within 12 months of the first issue and every 3 months after that. Before each wearing, the user must visually inspect the rubber gloves, stretch a small area of the glove for a time, and look for defects such as:

- Embedded foreign material
- Deep scratches
- Pinholes and punctures
- Snags or cuts

In addition, check for signs of deterioration caused by oil products, insulation compounds, or other substances. If the gloves are dirty, wash them with soap and water before inspecting them and then inspect the gloves thoroughly.

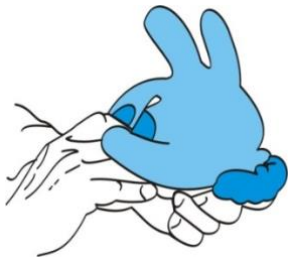
Be sure to turn the gloves inside out and inspect the inside thoroughly for signs of wear.

After visually inspecting each glove, apply an air test as follows to check for other defects.

Hold the glove with the thumb and forefingers as illustrated at right.

Twirl the glove around quickly to fill it with air as illustrated at left.

Trap the air by squeezing the gauntlet with one hand (see figure at right). Use the other hand to squeeze the palm, fingers, and thumb of the glove and look for weaknesses and defects. Hold the glove near your face to detect air leakage and then listen for escaping air when you hold the glove close to your ear.



Gloves that are found to be defective in any way should not be used. Mark them or cut them in some way to ensure no one else will accidently find and use them.

Fall Protection

In this section, we will deal only with PPE designed for fall protection and not deal with guard rails, safety nets, and items that are part of the worksite environment.

Description

Fall protection equipment includes fall arrest, work positioning, and travel restricting equipment worn by workers when working from heights.

Personal fall arrest system is intended to catch the user in the event of a fall. Personal fall arrest system presents dangers in and of itself. While the fall distance will be minimized, the body can suffer freefall injuries. Also, if the worker is not "rescued" within a rather short time frame, they can suffer circulatory problems, stroke, or heart attack from suspension trauma.

Work positioning equipment includes equipment such as rappelling equipment that allows workers to be suspended from ropes to gain access to their place of work. Generally, when a job demands this type of suspension, two sets of ropes are used**–t**he suspension lines and a separate safety line for fall arrest.

Travel restricting or fall restricting equipment is intended to prevent falls by anchoring a worker in a position to keep him away from the edge of a work surface to prevent accidental falls.

Fall protection equipment actually consist of harnesses, anchorages, and connecting components.

The body **harness** consists of the straps and padding that are worn by the employee in a way that will distribute the fall arrest forces over at minimum the person's thighs, pelvis, waist, chest, and shoulders. The harness may have multiple attachment points in different positions, each for a different purpose, such as fall arrest, work positioning, and travel restriction.

The **anchorages** are the point or points at which the user's PPE is connected to the structure, or point that is to take the force of a fall. These points normally should support a minimum dead weight of 5,400 pounds. There are several different types of anchor devices. Some are permanently fixed single point anchors such as eyebolts or anchor posts, temporary anchor devices such as girder slings, horizontal anchor lines, and horizontal anchor rails.

The connecting component is typically in the form of a lanyard of sufficient length to allow required freedom of movement and connectors to allow the lanyard to be attached and detached as necessary. The connecting components also include shock absorbing devices to control the deceleration of a fall to dissipate a substantial amount of the energy during a fall event.

Standards

OSHA 1926.104 deals with the standards for usage of personal protective and lifesaving equipment including the materials that can be used and their physical properties. ANSI Z359 is the Fall Protection Code. It is important to remember that the ANSI standards are voluntary unless referenced in federal regulations.

Fit and Sizing

Fit is essential in preventing injuries from the equipment and to ensure that the forces on the body will be distributed to the points best able to absorb the shock.

Usage

Fall protection equipment such as fall arrest, work positioning, and travel restricting equipment must be worn by workers working from heights greater than 6 feet for qualified climbers and 4 feet for all others. The proper choice of equipment depends on specific job-site facts and application limitations. A competent person, as defined by OSHA, must make these equipment decisions.

Maintenance

To maintain proper service life and safe performance, all fall protection system components must be inspected regularly.

For harnesses, you should inspect all webbing by gently rolling it to look for frayed edges, broken fibers, pulled stitches, cuts, burns, and chemical damage. D-rings should be checked for distortion, cracks, breaks, and rough or sharp edges. There should be no unusual wear, frayed or cut fibers, or broken stitches in the D-ring or buckle attachments. All buckles should be free of distortion, straight, and, for quick-connect buckles, make sure the tab release mechanism is free of debris and engages properly. Harnesses also include fall arrest indicators. If there is any sign that the harness has been activated, remove the harness from service.

Lanyards should be inspected from one end to the other by slowly rotating the lanyard so that the entire circumference is checked. Fiber rope or web lanyards should be observed for fuzzy, worn, broken, snagged, cut, cracked, size distortion, or charring of the surfaces. Look for signs of activation. Remove from service if any of the above are present. Shock absorber packs or shock absorbing lanyards should be closely examined for signs of deployment. Wire rope lanyards should be inspected for broken strands, cuts, or frays. You should wear gloves to avoid injury when inspecting wire lanyards. Also check the hardware to ensure snaps latch and lock properly.

Braking mechanisms should be checked. If the brake slips or fails to engage, do not use it.

Cleaning

For all nylon or polyester surfaces, remove all surface dirt with a damp sponge. Then dip the sponge in a mild solution of water and commercial soap and detergent and work up a thick lather with vigorous back and forth motions. Wipe with a clean cloth. Hang the harness to freely dry in a clean environment away from excess heat or direct sunlight. Some manufacturers suggest you store body harnesses in a hanging position from the back attachment point to keep it from creasing and to make it easier to put on the next time it is used.

Safety Vests

Description

Safety vests are garments worn over work clothes that incorporate the use of brightly colored fluorescent background material to increase visibility. These colors usually include fluorescent yellow-green, fluorescent orange-red, and fluorescent red. In addition to using a high visibility color, the use of retroreflective material is also utilized to make the garment especially noticeable.

Standards

ANSI standards (ANSI/ISEA 107-2015) establish the standards, design, and specifications for reflective materials and the minimal amounts, placement, background material, testing methods, and care labeling for safety vests in an effort to make workers more visible.

Standards for three classes of safety garments now exist.

a. **Class I** is intended for use in areas where vehicle traffic does not exceed 25 mph. This class includes both vest and t-shirt styles.


Class I

b. **Class II** is intended for use in areas where workers require greater visibility. This class is intended for traffic areas that involve speeds exceeding 25 mph.

Class II

c. **Class III** provides the highest level of visibility, especially in high-risk areas and where speeds exceed 50 mph. These garments extend coverage to include the arms and legs as well as the torso. This class often includes coveralls, jackets, pants, or rain gear.

Class III

Image supplied by SafetyGlassesUSA.com

Fit and Sizing

Safety vests are available in a variety of sizes and styles to accommodate both large- and small-frame individuals. Garments should allow free movement but not to the point of hampering mobility or failing to stay in place during their use.

Usage

Safety vests should be used in any situations or areas where subdued, reduced lighting and high traffic require increased visibility. Each company should set their own standards where reflective garments should be required. There should always be sufficient numbers to provide any worker the option of wearing a reflective safety garment even when not required.

Maintenance

Manufacturers of reflective safety articles usually include care instructions with their product. Many companies have limits placed on the number of cleaning cycles that can be performed before the effectiveness of the garment is reduced. They may also include instructions for use as well.

Safety Footwear

Description

Protective footwear is worn at the workplace for a variety of reasons. There are many hazards that require special protection for the feet and legs. Hazardous chemicals, hot metals, falling objects, slippery surfaces, sharp objects, and electrical hazards are just a few of the dangers present. There is a wide variety of footwear to fit the special workplace situations and some that are multipurpose. Some protective devices are added to existing work shoes and some involve replacing the entire shoe with a safety shoe. Those shoes specifically designed for use with electricity are often referred to as dielectric insulated footwear.

Standards

Safety footwear must meet ANSI minimum compression and impact performance standards in ANSI Z41-1991 (American National Standard for Personal Protection-Protective Footwear) or equivalent protection. All ANSI-approved footwear has a protective toe and offers impact and compression protection.

Specific safety shoes exist for workers involved in working with electricity. Electric hazard safety shoes prevent feet from completing an electrical circuit. These shoes do have their safety factor compromised if they become wet, have worn-through soles or metal objects embedded in the soles, or contact conductive grounded items. Nonconductive footwear should not be worn in an explosive or hazardous location.

Fit and Sizing

Proper fit and sizing are very important aspects of wearing protective footwear. Improperly fitting shoes can cause a variety of foot ailments. Calluses, blisters, discomfort, foot pain, back pain, and fatigue can plague workers with improperly fitting shoes. All of these conditions can affect the attentiveness of a worker and can in turn create additional workplace mishaps. The worker should first wear the shoes at home for a time to establish proper fit and to afford early detection of any problems before

wearing them to the workplace. The shoes/boots should have ample toe room, especially when accommodating thicker socks or arch supports. They should be fully laced up to ensure a stable, comfortable shoe.

Accessories

Considering workers' specific workplace conditions, some of the protection choices include leggings to protect the lower legs and feet. Toe guards are available to fit over the toe of existing shoes to protect the toes from heavy objects. Dielectric overshoes are available for workers working in hazardous electrical conditions.

Usage

Workers involved in any environment where the feet and legs are susceptible to injury by workplace hazards should wear protective footwear. Choose the type of shoe that is most appropriate for the possible hazards at the workplace.

Maintenance

All safety footwear should be inspected before each use. Shoes should be inspected for cracks and wear and tear. Materials can separate and laces and buckles can break. Inspect the soles closely for embedded metal or other compromising materials that could create a tripping or electrical hazard. Workers should follow the manufacturers' recommendations for care, cleaning, and maintenance of their safety footwear.

Flame-Resistant (FR) Clothing

Description

Flame-resistant clothing made from 100% cotton or wool may be acceptable if its weight is appropriate for the flame and electric arc conditions to which a worker could be exposed. As heat levels increase, these materials will not melt, but they can ignite and continue to burn. The amount of heat required to ignite these materials is dependent upon a number of factors, including the weight, texture, weave, and color of the material. This type of clothing does not comply with the "269" standard if it can ignite (and continue to burn) under the electric arc and flame exposure conditions found at the workplace. If they do not choose FR clothing, employers need to make a determination of whether or not the clothing worn by the worker is acceptable under the conditions to which he or she could be exposed. FR clothing is acceptable with respect to the OSHA apparel requirements.

Flame-resistant clothing and protective clothing in general can be purchased as separates, pants and shirts, or as one-piece coveralls. Even partial protection, such as aprons, sleeves, chaps, and so forth, is available to cover specific areas of the body in danger in specific situations.

Body Protection

Employees who face possible bodily injury of any kind that cannot be eliminated through engineering, work practice, or administrative controls must wear appropriate body protection while performing their jobs. In addition to cuts and radiation, the following are examples of workplace hazards that could cause bodily injury:

- Temperature extremes
- Hot splashes from molten metals and other hot liquids
- Potential impacts from tools, machinery, and materials
- Hazardous chemicals

There are many varieties of protective clothing available for specific hazards. Employers are required to ensure that their employees wear personal protective equipment only for the parts of the body exposed to possible injury. Examples of body protection include laboratory coats, coveralls, vests, jackets, aprons, surgical gowns, and full body suits.

If a hazard assessment indicates a need for full body protection against toxic substances or harmful physical agents, the clothing should be carefully inspected before each use, it must fit each worker properly, and it must function properly and for the purpose for which it is intended.

Protective clothing comes in a variety of materials, each effective against particular hazards, such as:

- **Paper-like fiber** used for disposable suits provides protection against dust and splashes.
- **Treated wool and cotton** adapts well to changing temperatures, is comfortable and fire-resistant, and protects against dust, abrasions, and rough and irritating surfaces.
- **Duck** is a closely woven cotton fabric that protects against cuts and bruises when handling heavy, sharp, or rough materials.
- **Leather** is often used to protect against dry heat and flames.
- **Rubber, rubberized fabrics, neoprene, and plastics** protect against certain chemicals and physical hazards. When chemical or physical hazards are present, check with the clothing manufacturer to ensure that the material selected will provide protection against the specific hazard.

Standards

Employees will wear company-approved flame retardant (FR) clothing whenever they are within 6 feet of exposed, energized parts capable of producing an arc hazard.

Employees working within reach of exposed energized equipment shall remove or make nonconductive (for example, covering a ring with insulating gloves) all exposed conductive articles such as keys and watch chains, bracelets, wristwatches, and so forth.

Fit and Sizing

Clothing must fit properly to allow for freedom of motion. It must not be too loose so that shirt tails or cuffs might get caught in equipment and pull the worker into danger. Most manufacturers supply a variety of sizes for both men and women to ensure proper fit.

Usage

Fire-resistant clothing is required for work in energized AC or DC distribution cabinets located within 6 feet of exposed parts energized at 50 volts or greater that will sustain an arc. Depending on other work tasks, clothing that protects against temperature extremes; hot splashes from molten metals and other hot liquids; potential impacts from tools, machinery, and materials; and hazardous chemicals may be required.

Maintenance

Clothes should be cleaned according to manufacturer's instructions. If wearing chemically treated clothes, certain cleaning materials or processes might remove the protective qualities of the clothes.

Respirators

Description

A respirator is a protective face piece, hood, or helmet that is designed to protect the wearer against a variety of harmful airborne agents. It is specifically selected and worn by medically qualified, trained, and fit-tested personnel who work in locations where they may be breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors; or if they may be working in oxygen deficient or IDLH (Immediately Dangerous to Life or Health) atmospheres. The respirator must adhere to the company's Respiratory Protection Compliance Guide.

Standards

The OSHA Respirator Protection Standard (29 CFR 1910.134 and 29 CFR 1926.103) applies to all occupational airborne exposures to contaminated air where the employee is:

1) Exposed to a hazardous level of an airborne contaminant; or
2) Required by the employer to wear respirators; or
3) Permitted to wear respirators.

Four major duties are imposed by each of these standards. These duties are:

1) Use engineering controls where feasible to control the hazard;
2) Provide an appropriate respirator;
3) Ensure the use of an appropriate respirator; and
4) Institute a **respiratory protection** program that complies with the rest of the standard.

Types of Respirators

There are two main types of respirators—air-purifying and atmosphere-supplying, as described below.

1. **Air-Purifying Respirators are of the following designs:**
   a. **Particulate**: These respirators capture particles in the air, such as dusts, mists, and fumes, but do not protect against gases or vapors. As the filter is used, this respirator becomes more efficient as the particles accumulate and plug spaces between the fibers. Once the filter is difficult to breathe through, it should be replaced.

   b. **Combination**: This respirator is effective against particles, gases, and vapors because it contains both particulate and gas/vapor filters. This respirator is commonly heavier in weight.

   c. **Gas and Vapor**: When there are hazardous gases and vapors in the air, this respirator is used. It utilizes cartridges or canisters to remove these contaminants. However, these do not protect against airborne particles. They are manufactured to protect against specific gases or vapors. Another factor is that this respirator only provides protection as long as the filter's absorbing capacity is not exceeded. Service life is dependent on many factors and can be estimated in various ways.

2. **Atmosphere-Supplying Respirators are also divided into three groups.**

a. **Air Supplied:** This respirator makes use of a hose to deliver clean, safe air from a stationary source of compressed air and can provide protection for long periods of time. These are usually fairly light in weight and can be used for extended periods of time. Their range is limited by the hose length and may fail due to hose damage.

b. **Combination**: These devices contain an auxiliary supply of air if the primary source fails. The auxiliary supply can be a small supply since it would only be utilized in escape situations. This respirator is commonly used in confined space entry situations.

c. **Self-Contained Breathing Apparatus**: This device consists of a wearable clean-air supply pack and does not restrict movement due to hose length. The closed-circuit type can provide air up to 4 hours. The open-circuit type can provide air for only 30 to 60 minutes.

Fit and Sizing

All respirators that rely on a mask-to-face seal need to be annually checked with either qualitative or quantitative methods to determine whether the mask provides an acceptable fit to a wearer. The qualitative fit test procedures rely on a subjective sensation (taste, irritation, smell) of the respirator wearer to a particular test agent while the quantitative test uses measuring instruments to measure face seal leakage. The relative workplace exposure level determines what constitutes an acceptable fit and which fit test procedure is required. For negative pressure air purifying respirators, users may rely on either a qualitative or a quantitative fit test procedure for exposure levels less than 10 times the occupational exposure limit. Exposure levels greater than 10 times the occupational exposure limit must utilize a quantitative fit test procedure for these respirators. Fit testing of tight-fitting atmosphere-supplying respirators and tight-fitting powered air-purifying respirators shall be accomplished by performing quantitative or qualitative fit testing in the negative pressure mode.

Usage

Employees shall be provided with and use respirators if they are exposed to unacceptable levels of hazardous atmospheric contaminants. Before they are allowed to wear and use respirators, employees shall be medically certified annually, properly fitted, and trained in all respirators they will use in the workplace. Before an employee can use any respirator with a tight-fitting face piece, he/she must be fit tested annually with the same make, model, style, and size of respirator that will be used. Employees who use respirators shall become familiar with the company's Respiratory Protection Program.

Employees shall not wear and use respirators if they have:

- Facial hair that comes between the sealing surface of the face piece and the face, or that interferes with valve function
- Any condition that interferes with the face-to-face piece seal or valve function
- Goggles, eyeglasses, or other personal protective equipment that is worn in such a manner that interferes with the seal of the face piece to the face. Employees with a medical need will be furnished prescription glass inserts.

Maintenance

The employer must provide for the cleaning, disinfecting, storage, inspection, and repair of respirators used by employees according to the procedures in 29 CFR 1910.134.

Always inspect all respirators before putting them to use and assure that the seal is in good condition and seals properly.

Disposable respirators cannot be disinfected and must be discarded. They are usually assigned to each individual and must be discarded if they become soiled, physically damaged, or reach the end of their service life.

Reusable respirators with replaceable filters may be shared, but must be cleaned and disinfected after each use before being used by another person. The standard may be found in Appendix B-2 of 29 CFR 1910.134 or using the manufacturer's recommendations. All filters must be replaced whenever they are damaged, soiled, or cause difficulty breathing and discomfort.

Respirators must be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals. They must also be packed or stored to prevent deformation of the face piece and exhalation valve. The face pieces will become distorted and the straps will lose elasticity if hung by the strap.

Storing the respirator in a sealed plastic bag is not recommended. The respirator can become damp during use and the seal of the bag prevents drying and can create germ growth. They should always be allowed to dry before storage.

Employees need to store their assigned respirators in an appropriate manner to protect from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals. Respirators maintained for use in emergency situations shall be inspected at least monthly and after each use. Respirators that fail an inspection, or are otherwise found to be defective, shall be removed from service. Repairs or adjustments to respirators shall be made only by persons properly trained to perform such operations. All filters, cartridges, and canisters used in the workplace shall be:

- Labeled
- Color coded with the **NIOSH**-approval label
- Not used if the label is removed or is illegible

Hearing Protection

Description

Hearing protection is worn to reduce, control, or eliminate hazards associated with noise exposure. The protection comes in a variety of forms from disposable ear plugs to full ear muffs. In extreme noise situations, a worker can wear both ear plugs and ear muffs together.

Some types of hearing protection include:

- **Single-use earplugs** are made of waxed cotton, foam, silicone rubber, or fiberglass wool. They are self-forming and, when properly inserted, they work as well as most molded earplugs.
- **Pre-formed or molded earplugs** must be individually fitted by a professional and can be disposable or reusable. Reusable plugs should be cleaned after each use.
- **Earmuffs** require a perfect seal around the ear. Glasses, facial hair, long hair, or facial movements such as chewing may reduce the protective value of earmuffs.

The following table summarizes the differences between ear plugs and ear muffs.

Comparison of Hearing Protection	
Ear Plugs	**Ear Muffs**
Advantages: • small and easily carried • convenient to use with other personal protection equipment (can be worn with ear muffs) • more comfortable for long-term wear in hot, humid work areas • convenient for use in confined work areas	**Advantages:** • less attenuation variability among users • designed so that one size fits most head sizes • easily seen at a distance to assist in the monitoring of their use • not easily misplaced or lost • may be worn with minor ear infections
Disadvantages: • requires more time to fit • more difficult to insert and remove • require good hygiene practices • may irritate the ear canal • easily misplaced • more difficult to see and monitor usage	**Disadvantages:** • less portable and heavier • more inconvenient for use with other personal protective equipment • more uncomfortable in hot, humid work area • more inconvenient for use in confined work areas • may interfere with the wearing of safety or prescription glasses: wearing glasses results in breaking the seal between the ear muff and the skin and results in decreased hearing protection.

Standards

Employers must provide hearing protectors to all workers exposed to 8-hour TWA noise levels of 85 dB or above. This requirement ensures that employees have access to protectors before they experience any hearing loss.

Employees must wear hearing protectors:

- For any period exceeding 6 months from the time they are first exposed to 8-hour TWA noise levels of 85 dB or above, until they receive their baseline audiograms if these tests are delayed due to mobile test van scheduling
- If they have incurred standard threshold shifts that demonstrate they are susceptible to noise
- If they are exposed to noise over the permissible exposure limit of 90 dB over an 8-hour TWA.

Employers must provide employees with a selection of at least one variety of hearing plug and one variety of hearing muff. Employees should decide, with the help of a person trained to fit hearing protectors, which size and type protector is most suitable for the working environment.

The protector selected should be comfortable to wear and offer sufficient protection to prevent hearing loss. Hearing protectors must adequately reduce the noise level for each employee's work environment. Most employers use the Noise Reduction Rating (NRR) that represents the protector's ability to reduce noise under ideal laboratory conditions. The employer then adjusts the NRR to reflect noise reduction in the actual working environment. The employer must reevaluate the suitability of the employee's hearing protector whenever a change in working conditions may make it inadequate. If workplace noise levels increase, employers must give employees more effective protectors. The protector must reduce employee exposures to at least 90 dB and to 85 dB when an STS already has occurred in the worker's hearing. Employers must show employees how to use and care for their protectors and supervise them on the job to ensure that they continue to wear them correctly.

According to OSHA 1910.95, when employees are subjected to sound exceeding those listed in the following table, Permissible Noise Exposures, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of the table, personal protective equipment shall be provided and used to reduce sound levels within the levels of the following table.

PERMISSIBLE NOISE EXPOSURES (1)

Duration per day, in hours	Sound level in dB*
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

Footnote(*) When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: C(1)/T(1) + C(2)/T(2) = C(n)/T(n) exceeds unity, then the mixed exposure should be considered to exceed the limit value. C(n) indicates the total time of exposure at a specified noise level, and T(n) indicates the total time of exposure permitted at that level. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

Fit and Sizing

The effectiveness of hearing protection is reduced greatly if the hearing protectors do not fit properly or if they are worn only part time during periods of noise exposure. To maintain their effectiveness, they should not be modified. Remember, radio headsets are not substitutes for hearing protectors and should not be worn where hearing protectors are required to protect against exposure to noise.

Molded ear plugs must be fitted by a professional.

To insert ear plugs, the ear should be pulled outward and upward with the opposite hand to enlarge and straighten the ear canal, and insert the plug with clean hands. Ensure the hearing protector tightly seals within the ear canal or against the side of the head. Hair and clothing should not be in the way.

Usage

Ear protectors must be used *all the time* to get full benefit. Removing the hearing protection for even five minutes during a shift will greatly reduce their protection.

People should wear a hearing protector if the noise or sound level at the workplace exceeds 85 decibels (A-weighted) or dB(A). Hearing protectors reduce the noise exposure level and the risk of hearing loss.

If hearing protection is required, then a complete hearing conservation program should be instituted. A hearing conservation program includes noise assessment, hearing protector selection, employee training and education, audiometric testing, maintenance, inspection, record keeping, and program evaluation.

Maintenance

Hearing protection must be cared for properly. In addition, ear plugs must be kept clean and free from dirt and grime. You should wash your hands before inserting them. Below are some general guidelines:

- Follow the manufacturer's instructions.
- Check hearing protection regularly for wear and tear.
- Replace ear cushions or plugs that are no longer pliable.
- Replace a unit when head bands are so stretched that they do not keep ear cushions snugly against the head.
- Disassemble ear muffs to clean.
- Wash ear muffs with a mild liquid detergent in warm water, and then rinse in clear warm water. Ensure that sound-attenuating material inside the ear cushions does not get wet.
- Use a soft brush to remove skin oil and dirt that can harden ear cushions.

- Squeeze excess moisture from the plugs or cushions, and then place them on a clean surface to air dry. (Check the manufacturer's recommendations first to find out if the ear plugs are washable.)

☼ ACTIVITY: Testing, Wearing, Cleaning, and Storing PPE

In student groups, use the library or Internet to research a specific piece of PPE that is commonly used in the energy and utilities industry. Groups will be responsible for creating a formal presentation to the class about their selected piece of PPE.

Examples of personal protective equipment used in the energy and utilities industry:

- Respirators
- Goggles
- Gloves
- Hard hats
- Steel-toed shoes
- Hearing protection (ear plugs, muffs)

Your presentation should include essential information such as:

- Description of equipment
- Picture/demo of equipment being worn properly
- General usage guidelines
- Proper care and storage of equipment
- Specific regulations and guidelines related to the PPE

Following Guidelines for Equipment Use

Hundreds of types of tools and equipment are used on a daily basis by thousands of energy and utilities industry workers. Even though the use of tools and equipment is an everyday occurrence, workers must remember that deviation from appropriate and safe-use protocols can cause serious injury or death.

In the energy and utilities industry, employees must recognize hazards associated with the different tools and equipment they use and be knowledgeable about proper use and safety precautions necessary to prevent hazards.

Safe work practices and procedures created by tool and equipment manufacturers and energy and utility companies are compiled into manuals or utilized to provide safety training to promote employee protection and prevent accidents.

Compliance with safety procedures set forth in manuals and safety trainings ensures the health and safety of employees, employers, and the community.

The established methods and protective devices referred to in manuals and company safety trainings are the result of research and experience.

General Safe Practices for Tool and Equipment Use

- Use only tools and equipment made and certified by reputable manufacturers.
- Always use the right tool or machine for the job.
- Never use a tool or equipment that you are unfamiliar with.
- Inspect tools and equipment before each use.
- Take necessary precautions to prevent dropping tools or equipment.
- Do not wear jewelry such as rings or necklaces when working with tools or equipment.
- Know the hazards of the tool or equipment you are using.
- Use only tools and equipment in the manner in which they were designed to be used.

Critical Thinking

Why do you think energy and utility workers shouldn't wear jewelry like rings or necklaces when working with tools or equipment?

What other general safe practices can you think of that should be followed when using tools and equipment?

Following Manuals

All employees are responsible for reading, understanding, and following the guidelines and procedures set forth in tool and equipment manuals.

Manuals delineate safe and proper tool/equipment usage by providing explicit directions and instructions. Employees should understand and appreciate the importance of reading manuals thoroughly before attempting to use new or unfamiliar tools and equipment.

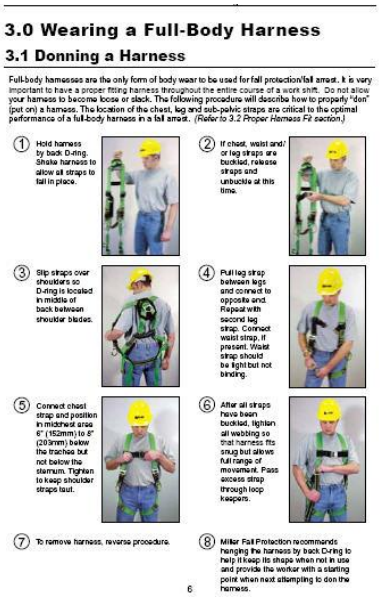
☼ ACTIVITY: Manuals and Tools and Equipment Safety

What experiences do you have working with various tools or equipment? How often do you read or consult the user's manual on safe use of a tool or piece of equipment?

Select a specific tool or piece of equipment and review its user manual. Describe any prevention, safety, and precaution methods stated in the manual such as:

- Description of equipment containing detailed pictures, drawings, or photographs
- Description of intended function
- What to check in a safety inspection
- Basic care and maintenance tips
- Directions for proper use
- What personal protective equipment, if any, should be worn when working with the tool or piece of equipment
- Proper use of any guards

What additional safety information is provided in the manual that was not listed above? What safety information was missing from the safety manual? What changes could be applied to make the safety manual easier to read and understand?



3.0 Wearing a Full-Body Harness

3.1 Donning a Harness

Full-body harnesses are the only form of body wear to be used for fall protection/fall arrest. It is very important to have a proper fitting harness throughout the entire course of a work shift. Do not allow your harness to become loose or slack. The following procedure will describe how to properly "don" (put on) a harness. The location of the chest, leg and sub-pelvic straps are critical to the optimal performance of a full-body harness in a fall arrest. *(Refer to 3.2 Proper Harness Fit section.)*

1. Hold harness by back D-ring. Shake harness to allow all straps to fall in place.
2. If chest, waist and/or leg straps are buckled, release straps and unbuckle at this time.
3. Slip straps over shoulders so D-ring is located in middle of back between shoulder blades.
4. Pull leg strap between legs and connect to opposite end. Repeat with second leg strap. Connect waist strap, if present. Waist strap should be tight but not binding.
5. Connect chest strap and position in midchest area 6" (152mm) to 8" (203mm) below the trachea but not below the sternum. Tighten to keep shoulder straps taut.
6. After all straps have been buckled, tighten all webbing so that harness fits snug but allows full range of movement. Pass excess strap through loop keepers.
7. To remove harness, reverse procedure.
8. Miller Fall Protection recommends hanging the harness by back D-ring to help it keep its shape when not in use and provide the worker with a starting point when next attempting to don the harness.

6

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KEY SAFETY SYMBOLS AND WARNINGS

These important safety symbols are used throughout this manual and may also appear on your chain saw. They are provided to make you aware of potential hazards, and the precautions you must take to protect yourself from injury. You must read and understand the explanations, and obey the instructions. These symbols appear on safety labels as a reminder to follow these important precautions whenever you are transporting, fueling, operating, servicing, or handling your saw.

CIRCLE/SLASH SYMBOL
This symbol means the specific action shown is prohibited. Ignoring these prohibitions can result in serious or fatal injury.

SAFETY ALERT SYMBOL
The safety alert symbol is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid serious or fatal injury.

DANGER!
The safety alert symbol appearing with the word "DANGER!" calls attention to an act or condition which WILL lead to serious personal injury if not avoided.

WARNING!
The safety alert symbol appearing with the word "WARNING!" calls attention to an act or condition which COULD lead to serious personal injury if not avoided.

CAUTION!
The safety alert symbol appearing with the word "CAUTION!" calls attention to an act or condition which may lead to minor or moderate personal injury if not avoided.

CAUTION!
The word "CAUTION!" used without a safety alert symbol calls attention to an act or condition which can lead to property damage if not avoided.

READ INSTRUCTION MANUAL
Read instruction manual carefully and follow rules for safe operation. Failure to do so could result in serious or fatal injury.

WEAR HEAD, EYE, AND HEARING PROTECTION
Wear Eye (ANSI Z.87.1), Ear, and Head Protection that meet ANSI requirements

WEAR PROTECTIVE CLOTHING
Wear cut-resistant protective foot-wear and leg protection. Chain-saw leg chaps, or pants with ballistic or cut-resistant fabric may help reduce the risk of injury due to chain contact.

HOT SURFACE SYMBOL
Contact with hot surfaces can cause serious burns.

CHAIN BRAKE SYMBOL
Arrows show how to engage or disengage chain brake. Push chain brake lever (front hand guard) all the way forward to engage, pull back to disengage.

STOP SYMBOL
Indicates the Stop position for the engine ignition switch (Stop Switch).

IGNITION SWITCH ON/OFF POSITIONS
Indicates the ignition ON/OFF positions for the engine ignition switch (Stop Switch).

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ECHO®

CHAIN SAW SAFETY MANUAL

DANGER!

Misuse may result in serious or fatal injuries. You must read, understand, and follow these safety instructions and the instructions in your Chain Saw Instruction Manual before operating a Chain Saw.

DANGER!

Chainsaw kickback can cause serious or fatal injuries. Read and follow the instructions to avoid kickback. ECHO supplies an anti-kick back guard called a Kick Guard ® with every new chain saw. Read the Kick Guard® instructions to determine which cutting applications and conditions require the installation of the kick guard. Always use the Kick Guard® where possible.

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Following Safety Training Procedures

There are many methods and types of safety training. Most safety training, regardless of what form it is provided in, provides important procedural instructions such as how to complete a particular job task or procedure.

Safety meetings, tool-box talks, or "tailboards" are designed to provide instructional information to all employees regarding safety and health issues, typically regarding the use of tools and equipment or other safe work practices. When given properly, tool-box talks are an effective way to communicate existing or potential hazards to workers before any work begins. Compliance with safety training in all aspects of work functions including tool and equipment use helps to ensure a safe and hazard-free workplace.

☼ ACTIVITY: Training Procedures and Tool Safety

As a class, make a list of common tools used in the energy and utilities industry.

In pairs, select one or more tools to research and create a tool safety tailboard.

Each safety tailboard should include:

- Picture, drawing, or photograph of the tool
- Description of the function of the tool
- What to check in a safety inspection of the tool
- How to use the tool properly
- Basic care and maintenance tips
- What personal protective equipment, if any, should be worn when working with the tool

Prepare and deliver a presentation to the class of the safety tailboard(s) created.

NOTE: References should include texts, Internet sources, and documents or manuals provided by the manufacturer of the selected tool(s). References should be documented at the bottom of the safety sheets.

For ideas on what other content could be included in the safety tailboard, review the example provided for pavement breaker safety.

Unit B Glossary

ANSI—the American National Standards Institute is a private, nonprofit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States

don—to put on PPE

eye and face protection—equipment designed to provide protection to the face and eyes during exposure to such hazards as flying particles, molten metal or sparks, liquid chemicals, acids or caustic liquids, or potentially injurious light radiation such as from lasers or welding

hand protection—equipment designed to provide protection to the hands during exposure to potential hazards such as sharp objects, abrasive surfaces, temperature extremes, and chemical contact; hand protection is selected based on the hazard and performance characteristics of the gloves

hazard assessment—the process utilized to identify hazards in the workplace and to select the appropriate personal protective equipment to guard people against potential hazards

head protection—equipment designed to provide protection to the head during exposure to potential hazards such as falling objects, striking against low hanging objects, or electrical hazards

hearing protection—equipment designed to provide protection to an individual's hearing during exposure to high noise levels

incipient stage fires—fires which are in the initial or beginning stage and which can controlled or extinguished by portable fire extinguishers, class II standpipe, or small hose systems without the need for protective clothing or breathing apparatus

NIOSH—the National Institute of Occupational Safety and Health is the federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness

OSHA—the Occupational Safety and Health Administration is an agency of the United States Department of Labor whose mission is to prevent work-related injuries, illnesses, and deaths by issuing and enforcing standards for workplace safety and health

personal fall arrest system—a system used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors, a body belt or body harness, and may include a lanyard, deceleration device, lifeline, or suitable combinations of these. As of January 1, 1998, the use of a body belt for fall arrest is prohibited

personal protective equipment (PPE)—includes all equipment designed to provide protection to the wearer from potential hazards to the eyes, face, hands, head, feet, ears, and extremities

respiratory protection—equipment designed to provide protection to the wearer from potential inhalation hazards such as vapors, mists, particulates, and gases

thermal burn—tissue injury, usually of the skin, caused by exposure to extreme heat

Unit B References

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Unit B Photo Credits

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Unit C: Hazards and Response

UNIT C: HAZARDS AND RESPONSE

Safety Starts with You!

Keeping yourself and your coworkers safe requires all of your team to be alert and aware of what's going on around you. Constantly monitoring your surroundings is actually quite simple. Begin with basic **housekeeping**. In the context of the power industry job site, this means using the proper methods for disposing of waste, handling tools, storing materials, and cleaning up spills. Catching problems now—whether at the plant, in a storage area, or at a remote worksite—will prevent accidents and injury. At the beginning of the day, at the end of the day, and all the time in between, you are responsible for monitoring your surroundings and correcting or reporting unsafe conditions as directed by your employer's safety policies. Standards developed by **OSHA** require that the following conditions be maintained through regular housekeeping:

- The workspace is clean, orderly, and sanitary.
- Floors are clean and dry.
- Halls and passageways are unobstructed.
- Work areas and walkways have adequate lighting.
- Materials are stored safely to prevent tripping and other injuries, fire, or explosions, and to avoid attracting mice or insects.
- Electric cords are in good condition and out of pathways.
- A portable fire extinguisher is available.
- Chemicals are labeled and stored in the manner prescribed by their **safety data sheets**.
- Signs are used to mark **hazards**.

☼ ACTIVITY: SPOT THE HAZARD 1

There are at least five safety hazards in your classroom. Can you name them all? Use the Workplace Housekeeping checklist provided by your instructor as a guide.

☼ CAREER PROFILE: INDUSTRIAL HEALTH AND SAFETY ENGINEER

Tomas B. finds his job both challenging and rewarding. "I have to really stay on top of new government regulations and the latest technologies. The bottom line is that I'm responsible for employee safety but also for keeping our plant in compliance with standards." Every day, he performs inspections of the plant's facility, machinery, and safety equipment. "My job is to reduce our employees' exposure to any kind of hazard—electrical, chemical, or any other physical dangers here at work." When the plant installs new equipment, Tomas is there to oversee the process and ensure safety requirements are met. He regularly reviews accident investigation reports and interviews supervisors and employees about workplace incidents, a task requiring considerable interpersonal communication skills. "I use my engineering background and my ability to be a good listener to solve problems and prevent injuries."

An uncluttered work area free from loose electrical components, extra test leads, wire, and spilled liquids reduces the possibility of shock. (You read about general electrical safety in earlier sections of this module.) Exposed metal and wet surfaces are good **conductors**. Avoid working with electricity on surfaces where water or metal are present. Do not work with electrical equipment if the floor is damp or wet. Keep in mind that the human body also can be a conductor of electricity. When a person touches a point where electricity is present, current attempts to flow through the body to the ground and the person receives a shock. **Grounding** refers to electricity's preference for flowing from high voltage to lower voltage. An easy way to remember this is to imagine water flowing from a high place to a lower place. To "ground" a tool or electrical system means to create a low-resistance path that connects to the earth. This prevents a buildup of voltage that could cause an accident. A common grounding item with which you are familiar is the three-prong plug.

Critical Thinking

Conductivity

Is the human body a good conductor?

Why don't birds sitting on a power line get electrocuted?

An **insulated** human body is not a good conductor of electricity. Most metals are good conductors, which is why they are used in electrical wiring. Most solids such as wood, glass, and rubber are good insulators, meaning the electrons are tightly bound to atoms or molecules and cannot move easily. Insulated equipment-grounding conductors are usually color-coded either solid green or green with yellow stripes. Insulation covering grounded conductors is white or grey.

"Hot" or "live" wires (ungrounded conductors) are often black or red but may be any color other than green, grey, or white. As noted earlier in this module, electrical utility workers in the field often wear protective gear such as heavy rubber gloves or rubber aprons. OSHA regulations require protective equipment to be maintained in a safe, reliable condition and periodically inspected or tested. In the workplace, standing on an insulating floor mat prevents current from flowing through the body to the ground. Using an insulated mat on top of the work station and wearing rubber-soled shoes are two additional precautionary measures.

Did you know?

Insulators Are Not Infallible

Insulating materials are used to stop the flow of current and prevent shock, fires, and short circuits. To be effective, insulators must be appropriate for the voltage and many other factors, including temperature and exposure to moisture or **corrosive** fumes that could cause them to fail.

Other modes of protecting against shock are used in conjunction with wearing personal protective equipment: system and equipment grounds and circuit protection devices. A **system (or service) ground** protects machines, tools, wires, and insulation from damage. An **equipment ground** protects the equipment operator by providing an alternate path for the current to pass through from the tool or machine to the ground. When too much current flows through a circuit, fuses melt and **circuit breakers** open the circuit—preventing further flow of electricity. This prevents wires and other components from overheating. **Ground fault circuit interrupters** are used in wet and high-risk situations. They

prevent electrocution by automatically shutting off electric power in as little as 1/40 of a second.

Before being worked on, live parts must be **de-energized** unless they operate at less than 50 volts and as long as there will be no increased exposure to electrical burns or to explosion due to **electric arcs**. An electric arc occurs when electric current jumps the gaps between two electrodes or in a circuit. The resulting arc of electrons—like lightning—is very bright, hot, and dangerous. In some cases, however, workers must test parts while they are live or it is not feasible to de-energize live parts because doing so would interrupt life support equipment, deactivate emergency alarm systems, shut down hazardous location ventilation equipment, or turn off the lights in an area. Specialized safety measures must be observed in these cases.

Focus on … 

Staying Alive

Consider all power lines energized (live) unless you have followed procedures to determine they are not.

You can be shocked or injured without actually making physical contact with a high voltage power line.

OSHA has identified the **minimum approach distance** for utility workers who are trained and certified as being able to identify the voltages of power lines and equipment they are working on and knowledgeable about the precautions that must be taken to avoid hazards. The minimum approach distance is the closest that an employee is permitted to get to an energized or grounded object. Unqualified personnel are required to stay at least 10 feet away from lines carrying up to 50 kilovolts and an additional 4 inches for every 10 kilovolts over that. Because numbers ending in 5 are easy to remember, here's a chart to help you calculate the minimum approach distance for an unqualified person.

Line Voltage	Distance
Up to 50,000 volts (50 kv)	10 feet
50kv to 200kv	15 feet
200kv to 350kv	20 feet
350kv to 500kv	25 feet
500kv to 750kv	35 feet
750kv to 1,000 kv	45 feet

☼ ACTIVITY: SPOT THE HAZARD 2

What is this technician doing that is unsafe? What are the likely consequences?

Draw arrows to indicate the direction the current is flowing.

What would happen to the flow of current if he put his left hand on the metal table?

How would you remedy the situation so that a similar incident does not happen again?

Nonelectrical Hazards on the Job

Hazardous Substances

Not surprisingly, large industrial operations use all sorts of chemicals—hazardous, nonhazardous, and some only hazardous in reaction with other substances. As an employee, you have the right to know what hazardous chemicals are being used in your workplace. But once you know, what next? Refer to the **safety data sheet (SDS)** provided by the manufacturer for that substance. An SDS contains information on the toxicity, use, storage, handling, and emergency procedures related to any products the government feels need to be controlled. Controlled products include compressed gases, flammable and combustible liquids, oxidizing materials, poisonous or infectious material, corrosive material, and dangerously **reactive** material. Suppliers who sell controlled products must provide an SDS to their customers. By law, these letters must be updated every 3 years.

The SDS is a critical safety tool. It describes the possible hazards involved with the product, how to use it safely, and what to expect when the safety recommendations are not followed. Its purpose is to safeguard workers and reduce injuries, illnesses, deaths, and fires caused by the use of hazardous materials. In addition, an SDS explains what to do when accidents occur and how to recognize symptoms of overexposure. The toxicology section outlines the short-term and long-term toxic effects on health. **Acute toxicity** is a one-time exposure to relatively large amounts of a chemical that can cause you to pass out. **Chronic toxicity** comes from repeated exposure, over a long period of time. Chemicals can enter the

body and gradually produce poisoning. This kind of poisoning occurs because the exposure is repeated daily over many years.

HMIS/HMIG Letter	PPE
A	Safety Glasses
B	Safety Glasses & Gloves
C	Safety Glasses, Gloves & Apron
D	Face Shield, Gloves & Apron
E	Safety Glasses, Gloves & Dust Respirator
F	Safety Glasses, Gloves, Apron & Dust Respirator
G	Safety Glasses, Gloves & Vapor Respirator
H	Splash Glasses, Gloves & Dust and Vapor Respirator
I	Safety Glasses, Gloves & Dust and Vapor Respirator
J	Splash Glasses, Gloves, Apron & Dust and Vapor Respirator
K	Air-line Hood or Mask, Gloves, Full Suit & Boots
X	Special Instructions

The SDS also provides essential information for the transportation of the majority of all goods around the world. Based on the information corresponding to the SDS, the National Fire Protection Association (NFPA) assigns a four-diamond label that is numbered and color-coded and posted on trucks hauling materials that are controlled. Numbers in the three colored sections range from 0 (least severe hazard) to 4 (most severe hazard). The fourth (white) section is left blank and is used only to denote special firefighting measures. In an emergency, the diamond code gives response teams a quick visual way to assess the potential health hazards, fire hazards, reactivity, and other specific hazards (radioactivity, corrosiveness) of the product in the storage tank and to act accordingly. The American Coatings Association developed another means of labeling hazardous substances known as the Hazardous Materials Identification System or Guide (HMIS/HMIG). This system uses stacked bars instead of diamonds in its configuration, but both systems use the same numbering system and color-coded fields to indicate the flammability (red), health (blue), and reactivity (yellow) hazards associated with the material. In the HMIS/HMIG, the white field is used to indicate required personal protective equipment (rather than special handling, as in the NFPA system).

☼ ACTIVITY: INTERPRETING AN SDS FOR A PRODUCT

Your instructor will provide you with:

Safety Data Sheet for WD-40
SDS Worksheet

Complete the worksheet based on your interpretation of the SDS for the product. *Note*: The SDS contains a lot of complex information. You may want to underline or highlight relevant information on the SDS as you locate it.

Fire Prevention

Another absolutely critical component of power plant facility and employee safety is fire prevention. Fires can occur at any power plant, regardless of the type of fuel or energy source it is using. As part of your employee orientation, you should be instructed about:

- The location of the fire extinguishers
- The location of the fire alarms
- Rules regarding smoking on the premises
- Fire exit routes
- Disposal of flammable waste
- Minimization of static hazards

You will need to find out what you are expected to do in a fire and what must be left to a specially trained fire brigade. Under OSHA standard 1910.156, a utility company can establish and train groups of employees designated as the in-plant fire brigades. They must be in excellent health, thoroughly trained by qualified instructors, and provided with complete protective gear for firefighting.

Be aware that fires may begin in any area of plant operation. An underground or above-ground transformer may explode from a short circuit or electrical arc. Coal dust may accumulate and be touched off by a spark of static from a conveyor or other piece of machinery. Similarly, a spark may set leaking natural gas or chemical vapors on fire. A careless employee may toss away a cigarette butt and accidentally cause a fire in a waste bin.

Fortunately, advanced fire detection and suppression technologies exist. If you glance up at the ceiling, you will likely see a sprinkler system that will deploy automatically under certain conditions. Some measures the company has taken to improve safety may be less noticeable, such as the installation of explosion-proof fixtures in hazardous locations. In a coal-fired plant, fire prevention involves washing down storage areas and monitoring holding bins for signs of spontaneous combustion using carbon dioxide monitors, infrared scanning, and temperature scanning.

Critical Thinking

Case Study: What Sparked This Fire?

On October 2, 2007, a chemical fire inside a confined space at Xcel Energy's hydroelectric plant in a remote location 45 miles from Denver killed five and injured three painting contractors. They were recoating the sluice tunnel with an epoxy product when a flash fire occurred. Flammable solvent being used to clean the equipment ignited. The fire quickly grew as it ignited additional buckets of solvent and combustible epoxy, trapping and preventing five of the eleven workers from exiting the only way out. Fourteen emergency teams responded to the incident. The trapped workers communicated via handheld radios with emergency responders for 45 minutes before succumbing to smoke inhalation.

—U.S. CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD

Natural gas-fired plants have shut-off valves installed strategically along the gas lines so that the supply can be cut if a fire erupts. Many power substations use electronic monitoring systems—**supervisory control and data acquisition (SCADA)** systems—which provide real-time data about the system's status to plant engineers. This can be augmented with video surveillance that will confirm a SCADA fire sensor alarm with visual verification of smoke or flame.

Traffic Safety

Good road safety practices are designed to protect the driver, the work crew, the public—pedestrians and other drivers—and the power company's equipment and materials. Prior to being entrusted with a position that includes driving, applicants will be asked to provide the human resources department with a copy of their driver's license. (In some cases, a commercial driver's license may be required.) Note that the company also has the right to conduct a background check that includes driving record, medical history, and results of drug tests.

While driving a company truck, all of the standard safe driving procedures still apply:

- Wearing seat belts
- Using turn signals
- Obeying speed limits
- Avoiding distractions
- Observing traffic signs and signals

Critical Thinking

Case Study: What Went Wrong?

On July 25, 2000, a 33-year-old male journeyman lineman died, and a coworker was injured, after they were struck by a car that drove through a utility construction work zone that was beside the road. They were installing a new power pole near an intersection of two county roads. After traveling past the flagger, the intruding car crossed the opposing traffic lane and headed straight into the work zone. The injured worker was struck and thrown 15 feet onto the grass in the work area. The worker who died was thrown over the top of the vehicle, striking his head on the pavement. A witness, who was stopped at one of the flagger stations, immediately called 911. Both victims were treated on site and transported to a local emergency room. The fatal victim was airlifted to a trauma center and died of his injuries 10 days later.

—WASHINGTON STATE FATALITY ASSESSMENT AND CONTROL EVALUATION INVESTIGATION PROGRAM

An additional part of the crew's daily routine will be inspecting the vehicle before departure and upon returning to ensure that all equipment is in good working condition. A quick written checklist will include brakes, steering, lights, mirrors, reflectors, tires, horn, and windshield wipers. A job supervisor may also conduct a safety "tailboard" or "toolbox" briefing alerting workers about potential hazards they may encounter.

At the worksite, the vehicle operator will need to place orange hazard cones around the vehicle. Depending on the location of the job, the amount and speed of traffic, and visibility due to weather conditions, workers wearing reflective gear may signal and control traffic.

Using an aerial lift—a "bucket" that lifts workers up from the vehicle to reach power lines—requires additional precautions. The truck should not be moved with the bucket in the raised position. Workers in the bucket must wear a harness to protect them from falls and insulated gloves if they are working on live power lines. They must remain in the bucket with both feet touching the bottom of the bucket. National standards for bucket vehicles require that the operator on the ground be able to control the bucket's movement in an emergency.

Preparing for the Worst

Line workers often get called in the middle of the night to respond to catastrophic events. They are called to restore electrical service to customers under all sorts of conditions.

Sometimes it is in response to a small but potentially fatal accident in which a car has crashed into a utility pole as the driver swerved to miss a deer in the road. Other times, worsening weather conditions or

Focus on …

Work Zone Traffic Safety

Project managers determine traffic control plans within worksites.

Approved traffic control devices, including cones, barrels, barricades, and various other barriers, can help limit motorist intrusions into work zones.

Drivers should be warned with signs that there will be flaggers ahead. Flaggers should use STOP/SLOW paddles, paddles with lights, or flags, and must be certified in the use of authorized signaling methods. They must wear high-visibility fluorescent clothing made of reflective material. This makes employees visible for at least 1,000 feet in any direction.

—OSHA

Critical Thinking

Case Study: Investigate This!

At 1:48 a.m., a Ford F-150 crashed into a utility pole, snapping power lines and leaving several hanging. A police officer on nightly patrol came upon the crash and radioed for help. Twelve responders from the fire department, sheriff's department, and the emergency medical services came to the scene before the utility vehicle arrived. An emergency medical technician bringing medical supplies to the accident victims in the truck walked through two lines hanging about 4-5 feet above the damp ground. He slipped and fell on the lines and was electrocuted.

As the accident investigator, what questions would you ask to determine why this happened and how it could have been avoided?

natural disasters bring down power lines and cause transformers to explode. In the best-case scenario, police, fire and rescue, and utility employees work together on the scene. Police officers block traffic from entering the danger zone; line workers de-energize downed lines; and firefighters and emergency medical technicians rescue, treat, and transport accident victims. Communication and cooperation mean the difference between life and death.

If a rain squall occurs during routine work, line workers may wait for it to stop or reschedule the job. During emergency conditions, however, they must work in variable weather conditions—heavy rain, wind, ice, snow, and extreme heat—which affect the transmission and distribution system and cause power outages. They will, however, wait for the risk of lightning to pass. Priority for restoration of service is usually given to customers who rely on life support equipment or have an impact on public health and safety.

Fortunately, today's advanced weather forecasting technologies allow utility managers to anticipate the need for additional crews. For example, data from lightning strike indicators and wind speed measuring devices can be integrated with data from geographic information systems (GIS) to pinpoint where storms may have damaged equipment in the field.

Long-term emergency situations, such as the aftermath of a devastating hurricane or terrorist attack, may call for long hours and difficult working conditions. When events like these occur, however, utility workers react with dedication. As a result of the World Trade Center attacks, two major substations were damaged, but Con Edison reconnected power within a week by redirecting lines to other nearby substations, repairing one substation, and using emergency generators.

Did you know?

Franklin's Lightning Bells

In addition to inventing the lightning rod, Benjamin Franklin developed lightning bells—an early warning system alerting him when lightning was in the area. His intent was to draw electricity from storms down into his home so that he could perform experiments. Don't try this at home!

☼ ACTIVITY: CREATE A SAFETY RAP OR SONG

Create a safety rap that will help your coworkers remember how to remain safe. Each group will be assigned a different set of hazards to address: electrical, hazardous substances, fire, traffic, or weather.

Dominion Power has created and videotaped its Safety Rap, which you can watch for inspiration. http://www.youtube.com/watch?v=7viGDALSoJE

Be prepared to present your rap to the class—either through a performance or in a video that you create.

First Aid

(***Important Note**:* This information is not a substitute for face-to-face training in first aid obtainable from the American Red Cross. Visit their website http://www.redcross.org/where to find your local chapter. This training is also available through the American Heart Association, state and national safety councils, or a local provider.)

Generally, when utility workers respond to the scene of an accident, they will have been called by first responders such as the police or fire department. Their job is to de-energize lines so that emergency medical personnel can provide treatment to victims. Accidents and health emergencies do happen on the job, however, and workers need to know basic first aid and when to call 911 for additional help. OSHA does not require employers to keep records of work-related injuries that require only first aid, just those that cause work-related injuries and illnesses that result in death, loss of consciousness, days away from work, restricted job activity, or medical treatment beyond first aid. Individual power companies will inform new employees of reporting procedures as part of their job orientation. They also may require first aid certification and will provide the training on-site.

Recognize the Symptoms

- **Cuts**
  Cuts are easy to identify, as there will be bleeding. This is not an emergency unless the cut is very deep and bleeding heavily.

- **Insect stings**
  Meter readers are likely to encounter stinging insects. A sting generally raises a red welt at the site. Workers who are severely allergic, however, may experience **anaphylaxis**, a condition in which their throats swell and they have difficulty breathing. A sting is not an emergency; anaphylaxis is an emergency and requires immediate attention to prevent death.

- **Dog bites**
  Meter readers may also encounter dogs that bite. An aggressive animal will usually break the skin and may tear it or leave puncture marks. Utility workers need training in how to avoid being bitten.

- **Broken bones**
  Broken bones are more difficult to identify unless the victim has a compound fracture in which the bone is protruding through the skin. The victim may also have felt the bone snap. An X-ray is required to confirm the break. A broken bone requires medical attention, preferably quickly, but is not a life-and-death emergency unless the victim goes into **shock**.

- **Spinal injury**
  A victim with an injured spine may experience numbness, pain, or no immediate symptoms. Assume that a person who has been in a car crash or has fallen more than 15 feet has a head, neck, or spine injury and that the situation requires emergency care by professionals.

- **Thermal burns**
  Thermal burns (from heat or fire) are categorized by their severity as first-, second-, or third-degree burns. A first-degree burn is superficial, injuring the outermost layer of skin and causing redness and pain—like sunburn or scalding. A first-degree burn is usually not an emergency. A second-degree burn causes blisters as well as redness and may cause pain unless nerve endings have been destroyed. If the second-degree burn covers a large area of the body, it should be considered an emergency. A third-degree burn goes through all three layers of skin. The skin appears white or charred and the victim may not feel pain or any sensation because the nerve endings have been burned away. Third-degree burns are an emergency requiring immediate medical attention.

- **Electrical burns**
  Exposure to electric current may cause electrical burns that have the same characteristics as thermal burns and the same emergency responses apply.

- **Chemical burns**
  Chemical burns are caused by skin exposure to corrosive chemicals (strong acids or bases) that can eat away metal. Blisters may form.

- **Electric shock**
  In cases of electric shock, the voltage and length of exposure determine the effects. Exposure to a small amount of current creates only a tingling sensation. Exposure to a larger amount may cause muscle contractions and heart arrhythmias or may throw the victim quite some distance from the source, causing injuries similar to those incurred in a fall. These serious conditions are considered an emergency and require immediate medical attention.

- **Shock**
  Shock refers not to an electrical current running through the body but to a physical response that occurs in response to an accident causing internal or external bleeding or to blunt force trauma, burns, or snake bite. Symptoms include pale skin, rapid pulse, increased breathing rate, weakness, nausea, cold hands, and clammy skin. Shock can result in death; immediate emergency treatment is required.

- **Heart attack**
  Symptoms of a heart attack usually start with mild discomfort or chest pain—often mistaken for indigestion—and grow more painful. In addition to feeling heavy pressure or squeezing underneath the breastbone, victims may experience shortness of breath; nausea and vomiting; sweating; and general upper body, shoulder, or jaw pain. Treat all severe chest pain as though it is a heart attack; immediate emergency medical attention is required.

- **Stroke**
  Signs of stroke include numbness or paralysis particularly on one side of the body, speech disturbance, loss of balance, confusion, vision trouble, and severe headache. A quick check for stroke involves asking the victim to raise both arms, smile, and repeat a simple sentence. Inability to do any of these may indicate a stroke in progress; immediate emergency medical attention is required.

- **Unconsciousness**
  An unconscious person will be lying still, be unresponsive, and may or may not be breathing. This may be the result of an injury, drug or alcohol use, or an illness such as diabetes. Unless this is a simple case of fainting in which the victim regains consciousness quickly, the situation is a medical emergency and treatment is required immediately.

Treat the Injuries Appropriately

Employers have policies in place regarding first aid, treatment, and reporting of injuries. Keep in mind that many times no treatment—except by a medical professional—is the best immediate treatment. Part of your decision-making about how to treat accident victims will depend on whether you are in the plant and have access to in-house emergency medical care or out at a job site where you may need to call 911.

First and foremost, follow safety procedures to avoid injuring yourself in a similar manner. Keep your tetanus shot up-to-date. Wear gloves if you are treating an injured person who is bleeding. If you are administering rescue breathing (artificial respiration), use a plastic mouth guard if possible. Except for minor cuts, insect sting welts, dog bites, superficial burns, and minor shocks, the injuries listed below merit emergency treatment. **Workers on the scene should call 911, monitor the victim's breathing and pulse, and follow procedures to prevent shock.**

- **Cuts**
  Superficial cuts and scratches that are not deep and are not bleeding profusely can be treated by washing with soap and water or wiping with an alcohol swab and then applying antibiotic ointment and a bandage. Apply pressure with clean gauze to a cut that is bleeding and elevate the body part until the bleeding stops. If bleeding will not stop, transport the victim to the hospital or call 911.

- **Insect stings**
  The welts from insect stings can be treated with antihistamine cream. Anaphylaxis requires immediate treatment with epinephrine to prevent death. Workers with known allergies will need to carry an EpiPen® with them. Immediately following a sting by the allergy-causing insect, the worker will self-inject using the EpiPen® and also call 911. If an EpiPen® is not available, call 911.

- **Dog bites**
  Small scrapes can be treated by washing with soap and water. Tears or punctures may require antibiotics to prevent infection. The workers should wash off the wound, apply pressure and a bandage and make an appointment to see a doctor quickly. If the wound will not stop bleeding, it may require stitches.

- **Broken bones**
  Do not move a victim with a broken leg; do not straighten the leg; call 911. While waiting for emergency medical professionals to arrive, make sure the victim is still breathing and look to see whether there are additional injuries. Ice may be applied to reduce swelling but do not apply directly to the skin. A broken arm may be splinted to be immobile, unless it is a compound fracture (bone showing through), if an ambulance is not available to transport the victim to the hospital.

- **Spinal injury**
  Assume that anyone who has been in a car crash or has fallen from a pole, bucket, or other elevated place has an injured back, neck, or head. If the victim is unconscious, do not attempt to awaken him by shaking him by the shoulders. Do not move or reposition the victim. Keep the victim's head immobile by placing a rolled-up jacket or towel on either side. Monitor his breathing and keep his airway clear. Call 911 and monitor for signs of shock. If the victim shows no signs of circulation (breathing, coughing, or movement), begin cardiopulmonary resuscitation (CPR) chest compressions if you are trained to do so, but do not tilt the head back to open the airway.

- **Thermal burns**
  First-degree burns and small second-degree burns can be held under cool water—not ice water—to stop the burn. Do not apply butter or greasy ointment or a bandage. The burns should be kept clean and dry until they heal on their own. A large second-degree burn will probably require treatment by a doctor to prescribe antibiotics to prevent infection. For a third-degree burn, call 911 and monitor the victim for signs of shock.

- **Electrical burns**
  Before treatment for electrical burns on the job site can begin, the utility worker must first turn off the current or de-energize the line and remove the source of the power from the victim. (An alternative would be to use an insulated object to move the victim off the live wire.) Until this is done, the victim cannot be treated safely because the rescuers risk electric burns, shocks, or electrocution themselves. Call 911 and arrange for emergency treatment and transportation to a hospital. If the victim stops breathing,

begin artificial respiration and continue until breathing starts or the paramedics arrive and advise otherwise. If the victim has no pulse, begin chest compressions and continue until the pulse can be felt or the ambulance arrives.

- **Chemical burns**
  Remove clothing that is soaked with the spilled chemical. In most cases, flushing the area of the burn continuously with gently running tap water will dilute the chemical and prevent further skin damage. If the skin has come in contact with metallic lithium, potassium, sodium, or magnesium or with white phosphorus or phenol, water is not the treatment to use. (It pays to be familiar with the common hazardous chemicals found in your workplace.) If the burn is small and superficial, transport the victim to a doctor. If the burn is large and exposure has been extensive, call 911.

- **Electric shock**
  A minor shock usually results in no injury and requires no treatment. A minor shock can, however, cause a victim to be startled and jump or fall and require treatment for these secondary injuries. A minor shock can also cause a muscle contraction that causes the victim to hold on tighter to the source of the shock, resulting in greater injuries. Before the victim's condition can be assessed and the victim treated, the circuit must be opened by flipping the power switch, unplugging the appliance, throwing the circuit breaker, or, in the case of high voltage, de-energizing the power lines by utility workers. Until this is done, the victim cannot be treated safely. Major shocks or those with secondary injuries require emergency treatment. Call 911 and monitor the victim's breathing and pulse and follow procedures for preventing shock.

- **Shock**
  It is better to prevent shock than to try to treat it. Do not reposition the body if there are broken bones, spinal injuries, or head injuries. Injuries that are serious enough to throw a victim's body into a state of shock merit calling 911. Physical shock can be prevented by elevating the victim's feet slightly, ensuring that the victim is neither too hot nor too cold, and offering reassurance that emergency medical personnel are on their way. The acronym W.A.R.T. may help you remember what to do to prevent shock.

  W: warmth; keep the victim off the damp ground, cover with a blanket as needed

  A: remember your ABC's; check the victim's airway (unobstructed), breathing, and circulation (pulse)

  R: reassure and rest: speak calmly to the victim; keep the victim from feeling anxious; keep the victim relatively still

  T: treat the injury

- **Heart attack**
  Call 911 and arrange for emergency transportation of the victim to hospital. If the victim becomes unconscious, watch the victim's chest to see if he or she is breathing. Check the victim's pulse. If the victim is not breathing but has a pulse, begin artificial respiration. If there is no breathing and no pulse, the victim is in cardiac arrest. Begin chest compressions and continue until emergency medical personnel arrive.

- **Stroke**
  Call 911 and arrange for emergency transportation of the victim to a hospital.

- **Unconsciousness**
  Ask the victim a question and listen for a response. If there is no response, call 911. Watch the victim's chest to see if he or she is breathing. Check the victim's pulse. If the victim is not breathing but has a pulse, begin artificial respiration. If there is no breathing and no pulse, the victim is in cardiac arrest. Begin chest compressions and continue until emergency medical personnel arrive.

☼ ACTIVITY: SYMPTOMS AND FIRST AID TREATMENT REQUIRED

On the worksheet provided by your instructor, try to match the symptoms with the conditions they indicate and the conditions with the proper first aid response without looking back at your text. It's important that you know the basic warning signs so that you can recognize the underlying health issues. Even if your first response is just to call 911, the dispatcher on the other end of the line is going to need for you to describe the victim's symptoms and surroundings.

Glossary for Unit C

acute toxicity—quick physical reaction to a one-time chemical exposure

anaphylaxis—a potentially life-threatening severe allergic reaction in which the victim may experience shortness of breath, hives, and swelling of the throat

chronic toxicity—harmful effects from exposure to a toxic substance over time

circuit breaker—a safety feature; an automatic switch that shuts off power to a circuit (opens the circuit) when the system is overloaded

conductors—materials through which electrons and electricity flow easily

corrosive—a substance that reacts to irreversibly damage metal, building, human flesh; corrosives are said to "eat away" the material upon which they react

de-energize—shutting off the energy sources to circuits and equipment

electric arc—a bright flash that occurs when electric current jumps the gaps between two electrodes or in a circuit

equipment ground—the provision of a conductive connection between noncurrent-carrying metallic parts of equipment and the ground; keeps workers from being shocked or electrocuted

ground fault circuit interrupter—a protective device that detects current leakage from a circuit to ground and shuts the current off to prevent electrical shock

grounding—physical electrical connection of one or more conductive objects to the earth through the use of metal grounding rods or other devices as protection against electrical shock

hazards—the potential of any machine, equipment, process, material, or physical factor to have harmful effects on people, property, or the environment

housekeeping—good housekeeping: general cleanliness and neatness. It includes disposal of wastes, clean-up of spills, and maintaining clean work areas

insulated—describing something that is not a good conductor of electricity (adjective); insulator is the noun describing a material that does not conduct electricity well

minimum approach distance—the closest distance a utility worker is permitted to get to an energized or a grounded object

OSHA—the Occupational Safety and Health Administration, a federal agency within the U.S. Department of Labor that establishes and enforces occupational health and safety regulations

reactive—a substance that is able to react with another substance or undergo change under the right conditions; generally used to mean that the substance should be handled with caution because it could explode, catch fire, release toxic fumes, or cause corrosion

safety data sheets—documents that provide information about hazardous substances used in the workplace

shock—a medical emergency resulting from illness or injury; the victim's skin may be bluish or pale; blood pressure decreases; pulse may be weak; and breathing rapid

supervisory control and data acquisition (SCADA)—an interconnected computer system of automated monitoring devices that continuously feed operations data back to a central location where it can be used to adjust how the power system is functioning

system (or service) ground—system grounding that involves grounding circuit conductors that are current- carrying under normal operation; for example, grounding one conductor of an AC power system

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