Health and Safety Programs

Hazardous Energy Control Programs

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What is hazardous energy?

Hazardous energy is defined: "any electrical, mechanical, hydraulic, pneumatic, chemical, nuclear, thermal, gravitational, or other energy that can harm personnel" (CSA Z460-20 "Control of Hazardous Energy - Lockout and Other Methods"). Some energy sources are obvious, such as electricity, heat in a furnace, or something that might fall. Others may be hidden hazards such as air pressure in a system or a tightly wound spring.

In this document, the term energy refers to anything that can provide power to a system to allow it to perform work. The term system refers to machinery, equipment, and/or processes.

What are the types of energy?

Electrical energy is the most common form of energy used in workplaces. It can be available live through power lines or it can also be stored, for example, in batteries or capacitors. Electricity can harm people in one of three ways:

1. By electrical shock.
2. By secondary injury.
3. By exposure to an electrical arc.

See the Electrical Safety - Basic Information OSH Answers document for more details.

Hydraulic potential energy is the energy stored within a pressurized liquid. When under pressure, the fluid can be used to move heavy objects, machinery, or equipment. Examples include: automotive car lifts, injection moulding machines, power presses, and the braking system in cars. When hydraulic energy is released in an uncontrolled manner, individuals may be crushed or struck by moving machinery, equipment or other items. Other injuries include risk of exposure to hydraulic oil or other pressurized liquid which may cut the skin.

Pneumatic potential energy is the energy stored within pressurized air. Pneumatic systems are generally powered by compressed air to power equipment. Examples include spraying devices, power washers, rock drills, and riveters. When pneumatic energy is released in an uncontrolled manner, individuals may be crushed or struck by machinery, equipment, or other items such as hoses.

Chemical energy is the energy released when a substance undergoes a chemical reaction. The energy is normally released as heat, but could be released in other forms, such as pressure. A common result of a hazardous chemical reaction is fire or explosion.

Thermal energy is energy from an explosion, flame, objects with high or low temperatures or radiation from heat sources. Common injuries include burns, scales, dehydration, frostbite, etc.

Radiation energy is energy related to ionizing, low-frequency electromagnetic, optical, or radio-frequency electromagnetic radiation. Effects depend on radiation levels and length of exposure and may include skin burns, acute radiation syndrome, cardiovascular disease, and changes to genetic material, which may lead to cancer.

Gravitational potential energy is the energy related to the mass of an object and its distance from the earth (or ground). The heavier an object is, and the further it is from the ground, the greater its gravitational potential energy. For example, a 1 kilogram weight held 2 metres above the ground will have greater gravitational potential energy then a 1 kilogram weight held 1 metre above the ground.

Mechanical energy is the energy contained in an item under tension. For instance, a spring that is compressed or coiled will have stored energy which will be released in the form of movement when the spring expands. The release of mechanical energy may result in an individual being crushed or struck by the object.

It is important to understand that all of these energy types can be considered as either the primary energy source, or as residual or stored energy (energy that can reside or remain in the system). Primary energy source is the supply of power that is used to perform work. Residual or stored energy is energy within the system that is not being used, but when released it can cause work to be done.

For example, when you close a valve on a pneumatic (air) or hydraulic (liquid) powered system, you have isolated the system from its primary energy source. However, there is still residual energy stored in any air or liquid that remains in the system. In this example, removing the residual energy would include bleeding out the liquid, or venting out the air. Until this residual energy is removed, the system is not de-energized, and an injury may occur due to the unexpected and unintended release of hazardous energy if someone were to begin work.

In addition, the residual or stored energy may not be the same as the primary energy source and there may be more than one type of energy within a system that must be controlled. For example, an overhead roll-up door may have mechanical energy (roll-up mechanism) and gravitational potential energy. Should the roll-up mechanism fail, the energy would be released from the mechanism (such as a spring) and the roll-up door may also fall to the ground due to gravity. To control this potential energy, workplaces may use a manual blocking device for all roll-up or garage-style doors.

Not properly assessing and dissipating stored energy can result in injuries or incidents. Control of hazardous energy includes isolating the system from its primary power source **and** residual energy.

Are lockout and hazardous energy control the same thing?

The terms lockout and hazardous energy control are sometimes used interchangeably, but they are NOT the same thing. Hazardous energy control is a broad term describing the use of procedures, techniques, designs and methods to protect personnel from injury due to the inadvertent release of hazardous energy. Lockout is the placement of a lock and tag on an energy-isolating device in accordance with an established procedure. It indicates that the energy-isolating device is not to be operated until removal of the lock or tag. Therefore, lockout is one way in which hazardous energy control can be achieved.

See the Lockout/Tag out OSH Answers document for more information.

What is the purpose of a hazardous energy control program?

In most cases, equipment or systems will have safety devices built in. These safety devices include barrier guards and safeguarding devices to help protect workers during normal operations. However, during maintenance or repairs, these devices may have to be removed or by-passed. In these situations, a hazardous energy control program is needed.

A hazardous energy control program is used to maintain worker safety by preventing:

- Unintended release of stored energy.
- Unintended start-up.

- Unintended motion.
- Contact with a hazard when guards are removed or safety devices have been by-passed or removed.

What methods, other than lockout, exist to control hazardous energy?

The method of hazardous energy control will depend on whether the task can be performed when the equipment is de-energized or not. If a full zero-energy state is possible, then a lockout program should be developed. Lockout is generally viewed as the most reliable way to protect an individual from hazardous energy because the system is brought to a zero-energy state. When a system is in a zero-energy state, the hazard has been eliminated; thus, no hazardous energy exists.

In some cases, using lockout is not practical and other controls must be implemented to effectively reduce the risk of the hazard. Other methods include restraint systems, such as using blocks, chocks, pins, bars, chains, or cribbing. In some cases, isolation may be used such an inflatable bladder, or blanks and blinds to isolate workers performing tasks in or on a pipe.

Always conduct a risk assessment of each task to identify all hazards and methods to be used as controls. Once the risk assessment for other control methods is completed, the other control methods can be selected and implemented. However, if an adequate level of risk cannot be achieved, then lockout will be the main method of control. Creating a zero-energy state and following a lockout program is the preferred method.

What are the elements involved in a Hazardous Energy Control Program?

Hazardous energy control programs involve the following elements:

1. Identify sources of hazardous energy in the workplace
2. Perform a hazard and risk assessment for the sources of hazardous energy
3. Implement energy controls and procedures
4. Provide training
5. Inspect and audit program and controls

1. Identify Sources of Hazardous Energy

Determine all types of hazardous energy within your workplace that should be covered by the program.

Next, gather documentation from the manufacturer or designer of each system about:

- Where energy isolating devices are located and procedures for their use.
- Step-by-step procedures for servicing or maintaining the system.
- How to safely address malfunctions, jams, misfeeds, or other planned and unplanned interruptions in operations.
- How to install, move, and remove any or all parts of the system safely.

This information will allow you to understand how the system was intended to be used, and will provide you with recommendations on how the tasks can be performed safely.

2. Perform a Hazard and Risk Assessment

A hazard analysis is performed by examining all the intended uses of the system from the perspective of both the manufacturer and the user. List all tasks and steps required to accomplish the task. This analysis should also include any hazards related to any possible misuse of the system. When performing the task identification, at a minimum, consider the following categories:

- Machine/process set-up.
- Teaching and programming of machinery.
- Testing and start-up.
- All modes of operation.
- Product feeding into machine/process.
- Product takeoff from machine/process.
- Process/tool changeover.
- Normal stoppages and restart.
- Unscheduled stoppages (control failure or jam) and restart.
- Emergency stoppages and restart.
- Unexpected start-up.
- Fault-finding and troubleshooting.
- Cleaning and housekeeping.
- Planned maintenance and repair.
- Unplanned maintenance and repair.

Based upon the information gathered, evaluate the likelihood and exposure of each hazard. The risk assessment should outline the possible hazards, and the associated risk of each hazard.

A recommended process for identifying hazards and their associated risk is outlined in both the CSA Z460-20 "Control of Hazardous Energy - Lockout and Other Methods" and the ISO 12100:2010 (R2015) "Safety of Machinery - General Principles for Design - Risk Assessment and Risk Reduction" standards.

The hazard and risk assessment will outline all situations where a worker could be exposed to hazards. This assessment includes answering the “what if’s” questions. For example, what if a barrier or guard was removed or by-passed? Or, what if a hydraulic hose releases pressurized fluid when it is removed during maintenance? By considering scenarios of what could happen, controls can be implemented for all possible situations. .

3. Implement Controls and Procedures

The controls required will follow what hazards and risks were identified during the risk assessment. The risk assessment will also assist in prioritizing controls. Controls must be implemented using the hierarchy of controls. When the hazard cannot be eliminated, safeguards or other engineering controls can be installed.

Administrative controls include altering the way the work is completed or introducing safe work procedures.

4. Provide Training

Employers must communicate the hazardous energy control program with workers and provide education and training on their roles and responsibilities within the program. The training should cover all types of hazardous energy they may encounter throughout their work and how it can be controlled.
All training should be documented and recorded.

5. Periodic Inspections and Audits

Follow-up is important to determine if the program is effective. Employers, supervisors, and health and safety committee members should include hazardous energy control on their inspection checklists.
Formal audits may be helpful to ensure there are no gaps in the program and that all workers are trained on the control program.
The program should be reviewed regularly, or more frequently if new equipment or machinery is introduced and if there is a change in process, standards, or legislation.

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