NATIONAL ACCELERATOR LABORATORY

ENVIRONMENT, SAFETY & HEALTH DIVISION

Chapter 51: Control of Hazardous Energy

Alternative Hazard Control Methods

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1 Purpose

The purpose of these requirements is to prevent worker exposure to *hazardous energy* (such as from unexpected energization, startup, or release of stored energy) during service and maintenance of machines, equipment, or systems.

They cover allowed alternatives to the methods of *control of hazardous energy (CoHE)* protection described in the rest of Chapter 51, "Control of Hazardous Energy", and the criteria for their use.

They apply to workers and supervisors; equipment designers, custodians, and owners; CoHE assessors; construction and service managers and points of contact; the CoHE program manager, and related ESH program managers.

1.1 Background

The 2024 revision of ANSI/ASSP Z244.1, "The Control of Hazardous Energy – Lockout, Tagout, and Alternative Methods", revised, expanded, and clarified many of the requirements for control of hazardous energy. Included in the changes is Chapter 9, "Alternative Methods of Hazardous Energy Control". In particular, the standard allows for the use of safety systems, including programmable logic controllers (PLCs), interlocks, and safety controls, in the control of hazards, providing certain criteria are met.

2 Risk Assessment and Controls

Before the application of an alternative hazard method an approved risk assessment of the hazard and proposed tailored controls is required. The risk assessment must

- Evaluate the hazards and define applicable controls
- Identify controls must be specified which ongoing operations and credible upsets are listed, the probability and consequences are predicted, and a resulting risk[1] is identified
- Grade or evaluate the risks
- Be recorded as a controlled document
- Reviewed and approved by the CoHE program manager

1 See General Policy and Responsibilities: Hazard Control Selection and Management Requirements

The control methods in the approved risk assessment may, as applicable, be used to supplement or replace those described in this chapter. Refer to ANSI/ASSP Z244.1 for specific guidance on compliant methods.

Contact the CoHE program manager for more information.

Except for those controls explicitly evaluated and approved in the assessment, the requirements of this chapter, including training, qualifications, documentation, and etc., apply.

2.1 Use of Engineered Safety Systems

Where hazards are controlled by approved safety systems, under strict configuration control and subject to routine, rigorous testing, hazard control features and keys may be called out and used as an element of a complex CoHE LOTO energy isolation plan to control hazards or as elements of an energy isolation plan.

Where appropriate and when used as designed, an engineered safety system can provide comprehensive protection against hazards in a manner that eliminates the need for workers to apply CoHE LOTO locks and tags.

The use of such a safety system, which may include the use of PLCs or other programmable elements, must satisfy the requirements of ANSI/ASSP Z244.1, Chapter 9.

Note	The use of engineered controls may provide lower risk to the worker than the application of CoHE LOTO, as it can eliminate or reduce the probability of procedural errors or errors in the application of hazard controls.

The following systems and control points are recognized as meeting ANSI/ASSP Z244.1 and SLAC requirements:

- Personnel protection system (PPS) and hutch protection system (HPS) access control keys (for example, PPS odd sector keybank key)
- PPS and HPS system stopper control keys
- PPS and HPS system for the control of non-ionizing radiation (RF) and ionizing radiation inside of a PPS/HPS zone
- Master keys for laser safety systems (LSS) (see Laser Safety Systems Technical Basis Document)

The use of these control points is restricted to the applicability of the associated safety system, and only valid within the periodic testing period of the system[2].

Contact the CoHE program manager for qualification of additional engineered safety systems. The program manager will work with other subject matter experts as appropriate to evaluate proposed alternative controls.

2 Systems undergoing testing may take credit for the operation of subcomponents, such as stopper control keys, that had been tested as part of an ongoing initial acceptance test (IAT) or safety assurance test (SAT) testing protocol.

Examples

- When working in a Class 4 laser room, the laser safety system can protect workers from unanticipated laser light exposure by placing the laser in a Class 1 operation mode. The worker does not need to join a CoHE LOTO lockout for hazard control.
- To control laser hazards in a Class 4 laser room, the laser system master key can be placed in a CoHE LOTO lockbox as part of a complex lockout.
- To control electron beam hazards while certifying the PPS access control in the beam switchyard (BSY) the PPS Odd Sector keybank key can be placed in a CoHE LOTO lockbox as part of a complex lockout.
- When modifying or certifying a PPS system, the applicable beam stopper's control keys can be placed in a CoHE LOTO lockbox as part of a complex lockout.

2.2 Use of Grounding Sticks / Hooks

Grounding sticks, also known as grounding hooks, may be left hanging on a high-voltage capacitor bank as part of an equipment lockout procedure (ELP) or energy isolation plan (EIP) for protection against self-recharging due to dielectric absorption. When used in this capacity, the use of red CoHE LOTO locks and tags are not required on the grounding stick.

2.3 Use of Administrative Control Measures

In situations where a documented and reviewed hazard analysis shows that an imminent hazard does not exist, administrative locks may be used as a risk reduction measure.

Note A useful example of the use of administrative locks was their application during the 2026 long downtime of the LCLS-II cryogenic accelerator. During this period helium was stored in external gas storage tanks and isolated from the accelerator undergoing maintenance and installation. The helium tank valves were administratively locked closed to prevent inadvertent release and to conserve helium.

The hazard analysis for this storage during accelerator maintenance and opening of distribution lines determined that the opening of the controlled valve would not create an imminent oxygen-deficiency life safety hazard in the accelerator tunnel area; therefore, the lock served operational control, not personnel protection, and that a CoHE LOTO was not required. When workers in the cryoplant needed to work on the helium piping, valves, or connected equipment in a way that could expose them to stored pressure, release or other hazardous energy, the normal CoHE LOTO process was deployed, which included the application of red CoHE LOTO locks on the administratively locked isolation valves.

3 Forms

The following forms and systems are required by these requirements:

- None

4 Recordkeeping

The following recordkeeping requirements apply for these requirements:

- Risk assessment of the hazard and proposed tailored controls recorded as a controlled document

5 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)

- Chapter 51, "Control of Hazardous Energy"
  - Control of Hazardous Energy: General Requirements (SLAC-I-730-0A10S-004)
  - Control of Hazardous Energy Program Site (SharePoint)
- Chapter 1, "General Policy and Responsibilities"
  - General Policy and Responsibilities: Hazard Control Selection and Management Requirements (SLAC-I-720-0A24S-001)
- Chapter 10, "Laser Safety"
  - Laser Safety Systems Technical Basis Document (SLAC-I-730-0A05Z-001)

Other Documents

- American National Standards Institute (ANSI)/American Society of Safety Professionals (ASSP) Z244.1, "The Control of Hazardous Energy – Lockout, Tagout, and Alternative Methods" (ANSI/ASSP Z244.1)