Cryogenic System Standard

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Revision History

Rev	Date	Section	Paragraph	Summary of Change	Authorized by
01	7/26/2023	NA	NA	Initial Release	CCR 788

1.0 Purpose

South Dakota Science and Technology Authority (SDSTA) ensures that the use of cryogenic fluids is conducted to avoid burns and/or serious life-threatening injury due to the displacement of oxygen from spills, leaks, or releases. Refer to ESH-(11000-S)-73328 Oxygen Deficiency Hazard Standard.

2.0 Scope

This standard applies to all personnel at Sanford Underground Research Facility (SURF).

3.0 Definitions

Cryogenic Liquids – A material that has a boiling point of less than -130°F (-90°C) and are used in research to provide extremely low temperatures for frozen storage and experimentation.

Asphyxiation – The state or process of being deprived of oxygen.

Cryogenic Personnel – Those engaged in or responsible for the production, use, transport, or storage of cryogenic fluids and/or materials.

4.0 Responsibilities

4.1. SDSTA Executive Director

4.1.1. Ensures accountability of the requirements of this document with direct reports.
4.1.2. Authorizes resumption of work activities when required.

4.2. Science Department Director

4.2.1. Ensures that no cryogenic facilities or systems are introduced before the requirements of this standard are satisfied.
4.2.2. Implements administrative controls necessary to prevent the introduction of unauthorized cryogens into the facility.
4.2.3. Ensures that the Environment, Safety, and Health (ESH) Department is advised as early as possible of any proposal to introduce cryogenic systems into facility spaces not previously authorized.
4.2.4. Ensures that a cryogenic safety analysis and review is completed and that any requirements are implemented prior to the initial operation of the system.
4.2.5. Maintains safety documentation for each cryogenic system.

4.3. ESH Department

4.3.1. Arrange for new cryogenic systems to be reviewed by a Cryogenic Safety Subcommittee.
4.3.2. Inspects the cryogenic system pre- and post-start-up to ensure that all prescribed safeguards are in place to prevent inadvertent spills or releases.

4.4. Engineering Department

4.4.1. Oversees the design, installation, and maintenance of facility cryogenic equipment.

4.4.2. Performs ODH calculations and assessments for in-house SDSTA projects that utilize cryogens. The ODH technical assessment methodology with examples, references, and the report format is attached.

4.4.3. Develop/update cryogenic system safety training for SDSTA personnel.

4.5. Cryogenic Safety Committee

4.5.1. Shall serve in a consulting capacity on all cryogenic facilities or system matters. The committee shall:

- Provide consultative support to the Science Director, when requested.
- Develop an in-house expertise and capability for evaluating cryogenic systems. Propose appropriate modifications to this standard as necessary.
- Consist of an ESH Representative, an Engineering Representative, a Science Department representative, and others as needed.
- Perform a technical assessment of any externally generated ODH analysis and provide recommendations prior to beginning operations.
- Review the Cryogenic Safety Analysis.
- Consults and makes recommendations on ODH issues.
- Provides technical backup to resolution on incidents related to ODH issues

5.0 Instructions

5.1. As specified by the scope, cryogenic facilities, or systems within the scope of this standard shall be reviewed:

- Before initial system operation
- After a shutdown and warm-up to room temperature of longer than two months; or
- Anytime a change in system configuration has been made. A change in system configuration is not an engine swap or the pumping of a vacuum jacket. System configuration changes are more substantive such as adding a new (including temporary) line, off normal operations not described in procedures, or unusual maintenance operations not previously documented.

5.2. Safety Review

- The analysis and review (ESH-(1100-A)-207392 Cryogenic Safety Analysis) shall be directed to all aspects of the system which could present a hazard to personnel prior to onsite operation.
- The analysis shall demonstrate that the system can be brought into operation safely. It should also demonstrate that safe operation can be maintained.
- The analysis shall demonstrate that all cryogenic pressure vessels falling under the scope of ASME Boiler and Pressure Vessel Code Section VIII are met. In the case of vacuum insulated vessels, the inner vessel shall be considered a cryogenic pressure vessel and the outer vessel shall be considered a vacuum vessel.
- Piping systems shall be designed and manufactured per ASME B31.3, Pressurized Process Piping.

5.3. Training

- Training plays a key role in the safe and efficient operation of cryogenic systems. Training may take the form of safety orientations, safety qualification courses, or training by supervisors as prescribed by Sanford Laboratory's safety training requirements. Both formal and on-the-job training shall be documented.
    - Cryogenic personnel shall have sufficient education, training, and supervision to assure that they can safely perform their duties. Furthermore, personnel shall be instructed in cryogenic hazards peculiar to the facility at which they work. Assistance from a person knowledgeable of these hazards shall be available to any individual newly assigned to perform cryogenic work at a facility until the supervisor determines that the individual can perform his or her duties unassisted.
    - Cryogenic personnel should attend the SDSTA (or equivalent) safety courses on such topics as: "Oxygen Deficiency Hazards", "Cryogenic Safety", and "Pressurized Gas Safety." Other courses, as defined by the ESH Department, may also be appropriate. General training in cryogenic principles may also be beneficial, particularly to personnel involved in operations.

5.4. A technical appendix describing ODH procedures which shall be followed by those preparing a safety analysis is referenced below.

6.0 Documented Information/Related Document

6.1. ESH-(11000-S)-73328 Oxygen Deficiency Hazard (ODH) Standard
6.2. ESH-(11000-A)-207392 Cryogenic Safety Analysis
6.3. ASME B31.3, Pressurized Process Piping