SANFORD UNDERGROUND RESEARCH FACILITY

SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

Fire Prevention and Protection Standard

Table of Contents

Revision History

Rev	Date	Section	Paragraph	Summary of Change	Authorized by
04	5/27/2025	4 & 5	4.3.2,5.0,5.4	Corrected grammar/added content to section 5.0 & 5.4	CCR 1115
05	2/19/2026	3, 4, 5 & 6	4.6, 5.1, 5.4, 5.9, 5.11, 5.14 & 6.1-6.8	Updated document due to change to the document numbering of controlled documents due to the change from DocuShare system to SharePoint system	CCR 1224

1.0 Purpose

The purpose of this standard is to establish a level of fire prevention and protection to eliminate or minimize loss from fire and related hazards.

South Dakota Science and Technology Authority (SDSTA) references the following to fulfill this standard:

- 29 CFR 1910, Occupational Safety and Health Standards (OSHA), General Industry Standards
- 29 CFR 1926, OSHA, Construction
- International Building Code (IBC)
- International Fire Code (IFC)
- National Fire Protection Association (NFPA) National Fire Codes and Standards
- 30 CFR, Mine Safety Regulations (MSHA)

2.0 Scope

This standard is applicable to all personnel, regardless of affiliation, at Sanford Underground Research Facility (SURF).

3.0 Definitions

Class I Flammable Liquid – Liquids having flash points below 73.4° F (23° C) and having a boiling point at or below 95° F (35° C).

Combustible Materials – Gases that may ignite or burn at temperatures of +210C (700F) or lower. Fluids or semi-fluids with a flash point of ≤ +1000C (2120F).

Fire Protection Authority Having Jurisdiction (AHJ) – An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure. SDSTA AHJ's are defined in EL-4000-A-001 SDSTA Guideline for Authority Having Jurisdiction.

Fire Protection System – Actively or passively assist in controlling the amount of damage that can occur in a location and protect its occupants in the event of a fire.

Flammable Liquid – Any liquid having a flashpoint at or below 199.4 °F (93 °C).

Flammable Materials – Materials that are ignited or flame immediately when contacting with fire or high temperature in the air and continue to burn or slightly flame when leaving fire. Examples include plywood, fiberboard, wood, and certain types of insulation/backing.

Incipient Stage Fire – A fire which is in the initial or beginning stage and which can be controlled or extinguished by trained personnel using portable fire extinguishers or small hose systems and without the need for protective clothing or breathing apparatus.

International Codes – A coordinated, comprehensive set of building safety and fire prevention codes promulgated by the International Code Council, a recognized publisher of building and fire codes. The primary International Codes implemented by this program are the International Building Code and the International Fire Code.

Highly Protected Risk (HPR) – A facility characterized by a level of fire protection of the best protected class of industrial risks.

National Fire Protection Association (NFPA) – An organization dedicated to fire safety through creating consensus standards and codes captured in the set known as the National Fire Codes (NFC).

Non-Incipient Stage Fire – A fire that has progressed to a point where visibility has been compromised by smoke, or structuring firefighting is required.

Safety Can – An approved container, of not more than 5 gallons capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

4.0 Responsibilities

4.1. SURF Laboratory Director

- **4.1.1.** Ensures all direct reports are familiar with the contents of this standard.
- **4.1.2.** Assures adequate resources are available to carry out fire prevention and protection at SURF.

4.2. Director of Environment, Safety, and Health (ESH)

- **4.2.1.** Conducts periodic assessments to evaluate compliance of each SURF facility with the requirements and best practices specified in this standard.
- **4.2.2.** Reviews and approves design plans for new construction of or modification to existing fire protection system designs.
- **4.2.3.** Reviews and approves all experiment-specific fire protection system designs.
- **4.2.4.** Reviews and revises the standard for compliance with applicable regulations.

4.3. Director of Science

- **4.3.1.** Reviews and approves all experiment-specific fire protection system designs.
- **4.3.2.** Ensure users comply with this standard.

4.4. Emergency Response Team (ERT)

- **4.4.1.** Identify adequate resources needed for fire prevention and protection.
- **4.4.2.** Coordinate fire hydrant, fire hose, annual fire extinguisher, and annual fire suppression testing with a third party.
- **4.4.3.** Conduct monthly portable fire extinguisher and annual air horn inspections.
- **4.4.4.** Conduct fire extinguisher training for SDSTA personnel.

4.5. Surface Operations and Utilities Department

- **4.5.1.** Ensure tests of fire hydrants and fire hoses are performed annually by a third party or ERT.
- **4.5.2.** Ensure third party vegetation mitigation is completed.
- **4.5.3.** Maintain fire detection and suppression systems.

4.6. Director of Engineering

4.6.1. Ensures that fire prevention and protection systems are designed and installed in accordance with applicable codes and standards.
4.6.2. Coordinates with AHJ as appropriate.
4.6.3. Ensure that digital, addressable fire alarm systems are designed in accordance with regulatory agencies.
4.6.4. Reviews and approves design plans for new construction of or modification to existing fire protection system designs.
4.6.5. Reviews and approves all experiment-specific fire protection system designs.
4.6.6. Ensures all contractors comply with this standard.

4.7. All Independent Groups, Workers, and Users

4.7.1. Submit proposed fire prevention and protection designs to the SDSTA Engineering Department, ESH Department, and Science Department.
4.7.2. Maintain a fire safe environment.
4.7.3. Report deficiencies/activations in any fire prevention and protection systems.
4.7.4. Comply with the requirements of this standard.

5.0 Instructions

Fire prevention is addressed by separating fuels and ignition sources, separating incompatible substances, isolating reactive substances, and by properly handling, storing, and using flammable materials.

Fire loads underground shall be kept to a minimum by elimination, substitution, and/or reduction of combustible sources. Combustibles taken underground shall be removed as soon as possible (e.g., cardboard boxes, packing material, crates, pallets, chemicals, dunnage, etc.). Trash receptables shall be made of non-flammable and have lids.

The ESH-8000-A-001 SDSTA Spill Prevention Control and Countermeasures Plan describes SDSTA's petroleum product storage locations. The ESH-8000-M-011 Tier II Reporting Map illustrates hazardous chemical storage locations and quantities.

5.1. Fire

- Fire, open flame devices, and other sources of ignition are not permitted in areas where flammable or explosive materials are stored, or in the vicinity of operations which constitute a fire hazard. Such areas shall be conspicuously posted with signage to the effect of 'No Open Flames'.
- Smoking is strictly prohibited on SURF property.
- Open flame devices shall not be left unattended unless they are equipped with automatic temperature controls and cutoff devices.
- One of the most common causes of workplace fires is faulty electrical equipment. See ESH-9000-S-001 Electrical Safety Standard for electrical safety requirements.

5.2. Wildland Fire Risk Mitigation

- The SURF is in the Black Hills Forest Fire Protection District (BHFFPD). The BHFFPD is an area in west central South Dakota that was established by State Law 34-35-15 and was established to protect the forest from fire dangers by regulating burning activities.

- The Lawrence County Planning and Zoning requires any new developments within the county undergo a Firewise inspection and certification.
- SDSTA actively collaborates with local emergency response organizations, including the local fire departments, to build familiarization with the lab property and surrounding area.
- SDSTA staffs a 24/7 Emergency Response Team onsite who trains regularly. Most members of this team are also members of local volunteer fire departments offering extensive experience with fighting fires and mitigating fire potential.
- SDSTA maintains a contract for the elimination of noxious weeds and the control of other vegetation on the property.

5.3. Fixed and Mobile Equipment

- Equipment such as pumps, loaders, jumbos, locomotives, conveyors, etc. represent proximal fuels and ignition sources.
- Fuel, grease, hydraulic fluid, and lubricating oils may leak or be spilled into and accumulate on and/or in motor and transmission compartments. Engine heat, exhaust system heat, and electrical systems represent ignition sources.
- Mobile and fixed powered equipment must be maintained and kept clean.
- Preventive maintenance shall address fluid leak and mechanical/electrical ignition source issues.
- Mobile and fixed powered equipment shall be supplied with fire extinguishers or fire suppression systems.

5.4. Housekeeping

- Proper housekeeping, with provision for prompt removal and disposal of accumulations of combustible scrap and debris, shall be maintained in all areas of SURF.
- Metal containers with metal lids and proper labeling shall be used for collection of waste materials containing ordinary combustible, flammable, and combustible liquids.
- All underground waste receptacles must be non-flammable, covered, and emptied frequently. Disposal shall be in accordance with hazardous waste regulations. See ESH-8000-S-001 Waste Management Standard.
- Tall grass, brush, and weed growth shall be trimmed or suppressed within three feet of any structure and fuel tanks.

5.5. Storage, Flammable Liquids

- Flammable/combustible liquids shall not be stored indoors or underground except in approved cabinets. Detailed storage and use requirements are as follows:
    - No more than 25 gallons of flammable or combustible liquids may be stored in a room outside of an approved storage cabinet.
    - Small quantities of flammable liquids shall be stored in safety cans.
    - Flammable materials must be stored away from exits, stairways, safe passage for people, electrical equipment or heating equipment and shall be stored in a separate, well-ventilated storage area, away from potential sources of ignition.
    - Flammable cabinets shall be conspicuously labeled, “FLAMMABLE”.

- Not more than 60 gallons of flammable (flashpoint below 140 degrees F) or 120 gallons of combustible (flashpoint at or above 140 degrees F) may be stored in any one storage cabinet.
- Not more than three storage cabinets may be present in a single storage area.
- Quantities in excess of the above shall be stored in an inside storage room constructed to meet the specifications for the particular stored material (e.g., paint) as set forth in Standard Methods of Fire Test of building Construction and Materials, NFPA 251-1969.
- Gasoline shall not be stored underground in any quantity.

5.6. Diesel Storage Underground

- All diesel fuel must be stored in:
  - Diesel fuel tanks in permanent underground diesel fuel storage facilities;
  - Diesel fuel tanks on diesel fuel transportation units in permanent underground diesel fuel storage facilities or in temporary underground fuel storage areas; or
  - Safety cans.
- The total capacity of stationary diesel fuel tanks in permanent underground diesel fuel storage facilities must not exceed 1000 gallons.
- Permanent underground diesel fuel storage facilities and temporary underground diesel fuel storage areas must be:
  - At least 100 feet from shafts, slopes, shops, or explosives magazines.
  - At least 25 feet from trolley wires or power cables, or electric equipment not necessary for the operation of the storage facilities or areas.
  - In a location that is protected from damage by other mobile equipment.
- Permanent underground diesel fuel storage facilities must not be located within the primary escapeway.

5.7. Grounding

- Dispensing systems used to transfer Class I flammable liquids, and the containers involved shall be grounded and bonded.

5.8. Cleaning and Degreasing

- Gasoline and liquids with a flash point below 100° F shall not be used for cleaning and degreasing.

5.9. Hot Work

- Hot work in the form of weed burners, grinding, welding, oxyacetylene torch, and plasma cutting requires adherence to the specifications stipulated by the ESH-7000-S-008 Hot Work Standard.

5.10. Fire Protection Systems Design Review and Experiment Review

- New construction of or modification to existing fire protection system designs shall be reviewed and approved by SDSTA Engineering Department, Project Managers, and the Director of ESH.

- All experiment-specific fire protection system designs shall be reviewed and approved by the SDSTA Engineering Department, Project Managers, and the Director of ESH.
- All fire protection system designs shall be reviewed to ensure that:
  - An appropriate level of protection is being provided.
  - The applicable fire protection provisions of the International Building Code, the International Fire Prevention Code, National Fire Protection Association Standards (NFPA), and applicable best practices and Highly Protected Risk criteria are being met, the installation plan is satisfactory.
  - Acceptance tests are adequate to ensure proper operation of the fire protection.
- The organization responsible for the system installation, modification, or for the experiment design is responsible for documentation.

5.11. Emergency Response

- Follow ESH-6000-S-003 Emergency Management Standard in the event of an emergency.
- Incipient stage fires may be extinguished by trained personnel with portable fire extinguishers or fire hoses. Non-incipient stage fires necessitate complete building/underground evacuation.

5.12. Indirect Firefighting of the Underground

- The SDSTA ERT trains for indirect firefighting of the underground via means of:
  - Flooding
    - Deluge system in both shafts
    - Foam
    - Water
  - Ventilation control
  - Construction of temporary walls

5.13. Active Fire Protection Systems

- Portable Fire Extinguisher Requirements
  - Shall be mounted, located, and identified so that they are readily accessible.
  - The bottom of the extinguisher is to be at least four inches off the ground and the top not more than five feet from the ground unless it is heavier than 40lbs. In this case, the top of the extinguisher cannot be more than three and one-half feet above the floor.
  - When selecting portable fire extinguishers, the following is considered:
    - Size of the area to be protected.
    - Class or classes of potential fire.
    - Weight of the fire extinguishers.
  - Types of portable fire extinguishers correlate with the fire classes.
    - Class A fires involve solid hydrocarbon materials such as plastics, wood, paper or cloth.

- Class B fires involve burning hydrocarbon liquids, such as oil, paint or solvent.
- Class C fires involve energized electrical equipment.
- Class D fires involve burning metal.
- Class K fires involve burning cooking oils and grease.

- Service and Maintenance of Portable Fire Extinguishers
  - Portable fire extinguishers are serviced annually, and the results documented on a tag affixed to each extinguisher by a third-party.
  - Portable fire extinguishers are inspected monthly and recorded in an electronic database.
    - The inspection is documented inspection tag attached to the extinguisher and must verify the following:
      - The extinguisher is physically present and mounted or stored.
      - The extinguisher is fully charged (that is, the arrow, if a gauge is attached, is in the green zone).
      - The tamper seal is unbroken.
      - The extinguisher appears undamaged.
      - The extinguisher is accessible.
      - The annual inspection is current.

- Automatic Fire Suppression System Requirements
  - Keep heat sources away from sprinkler heads.
  - Allow at least 18 inches of clearance below sprinkler heads.
  - In areas where damage to sprinkler heads is likely, such as in rooms with low ceilings, protective guards should be installed over the sprinkler heads.
  - Do not hang material from sprinkler piping or sprinkler heads.
  - Do not paint sprinkler heads.
  - Allow at least three feet of clearance around sprinkler control valves.
  - Fire suppression systems are inspected and tested annually by a third party.
- Fire Hydrant Requirements
  - Fire hydrants are maintained for emergency use by SOU and annually tested by the ERT.
  - Non-emergency use of fire hydrants must be authorized by the Director of ESH and the City of Lead.
  - The SDSTA coordinates annual inspections and flow tests fire hydrants at SURF.
  - Blocking fire hydrants is prohibited.

- Fire Alarm System Requirements
    - Some buildings are equipped with fire alarms that automatically transmit an alarm to the local fire department and activate evacuation alarms.
    - Alarms may also be activated manually at fire alarm boxes. Emergency responders are dispatched in response to all fire alarms received from SURF.
    - Automatic fire alarm systems are inspected and tested annually by a third party.
    - Manual fire alarm systems, such as the air horns used at the Yates Administrative Building, are inspected annually.

5.14. Passive Fire Protection Systems at SURF

- Underground fire doors/walls.
- Surface fire and smoke doors and dampers.
- Removing fire protection systems requires compliance with the ESH-7000-S-009 Disablement or Impairment of Critical Safety Equipment Standard.

5.15. Training

- All personnel are trained in fire prevention and protection including use of fire extinguishers, fire classifications, and fire extinguisher types.
- Training is required upon employment and at least annually thereafter.

6.0 Documented Information/Related Documents

6.1. ESH-6000-S-003 Emergency Management Standard
6.2. ESH-7000-S-008 Hot Work Standard
6.3. ESH-7000-S-009 Disablement or Impairment of Critical Safety Equipment Standard
6.4. ESH-8000-S-001 Waste Management Standard
6.5. ESH-8000-A-001 SDSTA Spill Prevention Control and Countermeasures Plan
6.6. ESH-8000-M-011 Tier II Reporting Map
6.7. ESH-9000-S-001 Electrical Safety Standard
6.8. EL-4000-A-001 SDSTA Guideline for Authority Having Jurisdiction