

NOTE: The Richland Operations Office (RFO) is in the process of developing computer-based training (CBT) for the Fire Protection portion of the Technical Qualification Program. The material will include the content of Occupational Safety competency 1.3. In the meantime, and for your convenience, the Oak Ridge Operations Office (ORO) developed the following study material in order to offer the Occupational Safety professional a resource while the CBT is in development. ORO was responsible for the development of study material for most of the Occupational Safety functional standard. The material offered here will be replaced with the CBT when it is approved and made available.

Occupational Safety Competency 1.3

Competency 1.3 Occupational safety personnel shall demonstrate a working level knowledge of fire hazards and the principles and methods of fire prevention and protection.

1. Supporting Knowledge and Skills

- a. Discuss the chemistry of fire (i.e., describe the three required elements), and the role of this chemistry in fire prevention and protection efforts.
- b. Describe the workplace and facility inspection procedures necessary to identify fire hazards and assess the status of compliance with applicable regulations.
- c. Describe fire protection considerations that must be addressed in the review of proposed or existing processes and operations and, identify appropriate control measures.
- d. Discuss the need to develop, maintain, and implement work procedures that focus on the prevention of fires and explosions, such as hot work permits, fire watches, and the proper handling and storage of flammable materials.
- e. Discuss and assess the applicability of requirements related to fire detection systems.
- f. Discuss and assess the applicability of requirements related to portable and fixed fire suppression equipment.
- g. Discuss and assess the application of requirements related to basic design principles set forth in the National Fire Protection Association (NFPA) 101, Life Safety Code.
- h. Discuss the role and purpose of fire protection design considerations including fire proof and fire resistant structures, fire walls, and fire curtains.
- i. Discuss the health and safety hazards associated with currently employed fire suppressant systems.

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2. Self-Study Activities (Corresponding to the Intent of the Above Competency)

Below are two web sites containing many of the references you may need.

Web Sites		
Organization	Site Location	Notes
Department of Energy	http://wastenot.inel.gov/cted/stdguido.html	DOE Standards, Guides, and Orders
U.S. House of Representatives	http://law.house.gov/cfr.htm	Searchable Code of Federal Regulations

Scan DOE-HNDBK-1081-94, *DOE Handbook: Primer on Spontaneous Heating and Pyrophoricity*.

EXERCISE 1.3-A Discuss the chemistry of fire (i.e., describe the three required elements).

EXERCISE 1.3-B Discuss the role of the chemistry of fire in fire prevention and protection efforts.

Scan DOE O 5480.7A, *Fire Protection*, Section 9, DOE Fire Protection Program Requirements.

EXERCISE 1.3-C Describe the workplace and facility inspection procedures necessary to identify fire hazards and assess the status of compliance with applicable regulations.

EXERCISE 1.3-D Describe fire protection considerations that must be addressed in the review of proposed or existing processes and operations, and identify appropriate control measures.

EXERCISE 1.3-E Discuss the need to develop, maintain, and implement work procedures such as hot-work permits, fire watches, and the proper handling and storage of flammable materials.

EXERCISE 1.3-F Discuss the applicability of requirements related to fire detection systems.

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Scan 29 CFR 1910.157, *Occupational Safety and Health Standards*.

EXERCISE 1.3-G Discuss requirements related to portable and fixed fire suppression equipment.

Scan National Fire Protection Association (NFPA) 101, *Life Safety Code*, Table of Contents.

EXERCISE 1.3-H Discuss the requirements related to basic design principles set forth in the National Fire Protection Association (NFPA) 101, *Life Safety Code*.

Scan DOE O 6430.1A, *General Design Criteria*.

EXERCISE 1.3-I Discuss fire protection design considerations including fire proof and fire resistant structures, fire walls, and fire curtains.

Scan 29 CFR 1926.156, "Total Flooding Systems With Potential Health and Safety Hazards to Employees."

Scan *Occupational Safety Management and Engineering*, Hammer, 1989, Prentice-Hall, Inc., Fourth Edition, Chapter 21, "Fires and Fire Suppression."

EXERCISE 1.3-J Discuss the health and safety hazards associated with currently employed fire suppressant systems.

3. Summary

The purpose and goal of OSHA is to assure safe and healthful workplaces for all employees. Both 29 CFR 1910 and 1926 are used to ensure the health and safety of employees in the DOE workplace.

The objectives of the DOE Orders are as follows:

- Minimize the potential for the occurrence of a fire.
- Ensure that fire does not cause an on-site or off-site release of radiological and other hazardous material that will threaten the health and safety of the environment.
- Establish requirements that will provide an acceptable degree of life safety to DOE and contractor personnel and ensure there are no undue hazards to the public from fire and its effects in DOE facilities.
- Ensure that process control and safety systems are not damaged by fire or related perils.

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- Ensure that vital DOE programs will not suffer unacceptable delays as a result of fire and its effects.
- Ensure that property damage from fire and related perils does not exceed an acceptable level.

To this end, the OSHA Standards, the National Fire Protection Association codes, as well as various DOE Orders are applied in Fire Protection.

4. Exercise Solutions

EXERCISE 1.3-A Discuss the chemistry of fire (i.e., describe the three required elements).

ANSWER 1.3-A Generally, there are three items necessary to support combustion:

1. Oxidizing agent
2. Fuel
3. Heat source

These are commonly called the Fire Triangle. The Fire Triangle shows that for combustion to occur, fuel, an oxidizing agent, and a heat source must all be present in the same place at the same time. If any one of the triangle's legs are removed, the fire will be extinguished.

EXERCISE 1.3-B Discuss the role of the chemistry of fire in fire prevention and protection efforts.

ANSWER 1.3-B The Fire Triangle shows that for combustion to occur, fuel, an oxidizing agent, and a heat source must all be present in the same place at the same time. If any one of the triangle's legs are removed, the fire will be extinguished.

EXERCISE 1.3-C Describe the workplace and facility inspection procedures necessary to identify fire hazards and assess the status of compliance with applicable regulations.

ANSWER 1.3-C Section 9 of DOE O 5480.7A, *Fire Protection*, lists the assessment and inspection requirements for the Fire Protection Program.

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EXERCISE 1.3-D Describe fire protection considerations that must be addressed in the review of proposed or existing processes and operations, and identify appropriate control measures.

ANSWER 1.3-D According to DOE O 5480.7A, Section 9, *DOE Fire Protection Program Requirements*:

“A DOE facility shall be characterized by a level of fire protection sufficient to fulfill the requirements for the best protected class of industrial risks (Highly Protected Risk/Improved Risk). This program is characterized by the inclusion of a continuing, sincere interest on the part of management and employees in minimizing losses from fire and related perils and the inclusion of preventive features necessary to ensure the satisfaction of objectives related to safety.”

EXERCISE 1.3-E Discuss the need to develop, maintain, and implement work procedures such as hot-work permits, fire watches, and the proper handling and storage of flammable materials.

ANSWER 1.3-E In accordance with DOE O 5480.7A, Section 9, *DOE Fire Protection Program Requirements*, c. Administrative Features of the Program, “Facilities shall have procedures governing the use and storage of combustible, flammable, radioactive and hazardous materials so as to minimize the risk from fire. Such procedures shall also exist for activities, such as smoking limitations, isolation of hot work, and other fire prevention measures, which contribute to the decrease in fire risk.

EXERCISE 1.3-F Discuss the applicability of requirements related to Fire Detection Systems.

ANSWER 1.3-F Fire Detection Systems are “any system designed to detect, extinguish, and limit the extent of fire damage or enhance life safety.” Redundant systems include any two of the following:

- (1) Automatic suppression systems, such as fire sprinklers, foam, gaseous, explosion suppression, or other specialized extinguishing systems plus appropriate alarms.

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- (2) Automatic fire detection, occupant warning, manual fire alarm, and fire alarm reporting systems combined with properly equipped and adequately trained fire departments or brigades.
- (3) Fire barrier systems or combinations of physical separation and barriers for outdoor locations.
- (4) Other systems, such as alternate process control systems.

EXERCISE 1.3-G Discuss requirements related to portable and fixed-fire suppression equipment.

ANSWER 1.3-G For portable extinguishers, refer to 29 CFR 1910.157(c)(5)(d) *Selection and Distribution*. (1) Portable fire extinguishers shall be provided for employee use and selected and distributed based on the classes of anticipated workplace fires and on the size and degree of hazard that would affect their use.

For fixed-extinguisher systems, refer to 29 CFR 1910.160, *Fixed Extinguishing Systems, General*. (1) Scope and Application. This section contains the general requirements that are applicable to all fixed-extinguishing systems to meet OSHA standards.

EXERCISE 1.3-H Discuss the requirements related to basic design principles set forth in the National Fire Protection Association (NFPA) 101, *Life Safety Code*.

ANSWER 1.3-H The *Life Safety Code* establishes minimum requirements that will provide a reasonable degree of safety from fire in both new and existing buildings and structures.

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EXERCISE 1.3-I Discuss the role of fire protection design considerations including fire-proof and fire-resistant structures, fire walls, and fire curtains.

ANSWER 1.3-I Reference Division 1, General Requirements, 0110-6.2 Fire Protection Design Analysis: A special fire protection design analysis shall be made of each facility vital to DOE mission accomplishment. The analysis shall use time parameters established in accordance with DOE 5480.7. The analysis shall identify the special fire prevention and protection features and controls deemed by the cognizant DOE fire protection authority to achieve a level of fire protection for vital facilities and programs that meets or exceeds the "improved risk" level.

EXERCISE 1.3-J Discuss the health and safety hazards associated with currently employed fire suppressant systems.

ANSWER 1.3-J Reference 29 CFR 1926.156, "Total flooding systems with potential health and safety hazards to employees." (1) The employer shall provide an emergency action plan. . .(3) On all total flooding systems the employer shall provide a pre-discharge employee alarm. . .(4) The employer shall provide automatic actuation of total flooding systems by means of an approved fire detection device installed and interconnected with a pre-discharge employee alarm system to give employees time to safely exit from the discharge area prior to system activation.

Total flooding systems usually employ either carbon dioxide or Halon 1211 or 1301 (halogenated hydrocarbon). CO² has the hazard of asphyxiation and these systems must be used in conjunction with an alarm system to warn employees. The Halon systems are safe to humans in concentrations up to 10 percent by volume of air for exposures up to 20 minutes. Foam systems, too, have the possibility of asphyxiation in closed areas.

References: DOE-HNDBK-1081-94, *DOE Handbook: Primer on Spontaneous Heating and Pyrophoricity*.
DOE O 5480.7A, *Fire Protection*.
DOE O 6430.1A, *General Design Criteria*.
29 CFR 1910, *Occupational Safety and Health Standards*.
29 CFR 1926, *Safety and Health Regulations for Construction*.
National Fire Protection Association (NFPA) 101, *Life Safety Code*.
Occupational Safety Management and Engineering, Hammer, 1989, Prentice-Hall, Inc., Fourth Edition.