MODULE 4.0: INSPECTION REQUIREMENTS FOR FIRE PROTECTION PROGRAMS

Introduction

Welcome to Module 4.0 of the Fire Protection for Fuel Cycle Facilities Directed Self-Study Course! This is the fourth of four modules in this self-study course. The purpose of this module is to identify the inspection requirements for a fire protection program at fuel cycle facilities. This self-study module is designed to assist you in accomplishing the learning objectives listed at the beginning of the module. There are nine learning objectives in this module. The module has self-check questions to help you assess your understanding of the concepts presented in the module.

Before You Begin

It is recommended that you have access to the following materials:

- Trainee Guide
- NRC Inspection Procedures 88054, "Fire Protection (Triennial)"
- NRC Inspection Procedures 88055, "Fire Protection (Annual)"
- NFPA 801, "Standard for Fire Protection for Facilities Handling Radioactive Materials"
- NFPA 220, "Types of Building Construction"
- NFPA 80A, "Protection of Buildings from Exterior Fire Exposures"
- NFPA 30, "Flammable and Combustible Liquids Code"
- NFPA 780, "Lightning Protection Code"
- NFPA 70, "National Electrical Code"
- NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance"
- NFPA 70E, "Standard for Electrical Safety in the workplace"
- NFPA 79, "Electrical Standard for Industrial Machinery"
- NFPA 75, "Standard for the Protection of Information Technology Equipment"
- NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems"
- NFPA 92A, "Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences"
- Underwriters Laboratories Standard UL-586, Test Performance of High Efficiency, Particulate, Air Filter Units, also designated ANSI B 132.1, High Efficiency Air Filtration Units.
- NFPA 54 (ANSI Z223), "National Fuel Gas Code"
- NFPA 31, "Standard for Installation of Oil-Burning Equipment"

- NFPA 482, "Standard for the Production, Processing, Handling, and Storage of Zirconium"
- NFPA 85, "Boiler and Combustion Systems Hazards Code"
- NFPA 37, "Standard for the installation and use of Stationary Combustion Engines and Gas Turbines"
- NFPA 50, "Standard for Bulk Oxygen Systems at Consumer Sites"
- NFPA 50B, "Standard for Liquefied Hydrogen Systems at Consumer Sites"
- NFPA 801, "Standard Fire Protection for Facilities Handling Radioactive Materials"
- NFPA 72, "National Fire Alarm and Signaling Code"
- NFPA 13, "Standard for the Installation of Sprinkler Systems"
- NFPA 12A, "Standard on Halon 1301 Fire Extinguishing Systems"
- NFPA 12B," Standard on Halon 1211 Fire Extinguishing Systems"
- NFPA 2001, "Standard on Clean Agent Fire Extinguishing Systems"
- NFPA 750, "Standard on Water Mist Fire Protection Systems"
- NFPA 11, "Standard for Low Expansion Foam and Combined Agent Systems"
- NFPA 11A, "Standard for Medium and High Expansion Foam Systems"
- NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection"
- NFPA 600, "Standard on Industrial Fire Brigades"
- NFPA 801, "Recommended Fire Protection Practice for Facilities Handling Radioactive Materials"
- NFPA 10, "Standard for Portable Fire Extinguishers"

Complete the following prerequisites:

- Module 3.0 Fire Hazards and Fire Protections at Fuel Cycle Facilities

How to Complete this Module

1. Review the learning objectives.
2. Read each section within the module in sequential order.
3. Complete the self-check questions and activities within this module.
4. Check off the tracking form as you complete each activity within the module.
5. Contact your administrator as prompted for a progress review meeting.
6. Contact your administrator as prompted for any additional materials and/or specific assignments.

7. Complete all assignments related to this module. If no other materials or assignments are given to you by your administrator, you have completed this module.
8. Ensure that you and your administrator have dated and initialed your progress on your tracking form.
9. Go to the next assigned module.

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LEARNING OBJECTIVES

4.1 Upon completion of this module, you will be able to identify the inspection requirements for a fire protection program at fuel cycle facilities. You will be able to:

4.1.1 Identify the primary components of a Fire Protection Program at a fuel cycle facility.

4.1.2 Identify the elements of a systematic Fire Hazard Analysis (FHA).

4.1.3 Identify important characteristics of passive engineered fire protection features.

4.1.4 Identify high risk process components.

4.1.5 Identify indicators that the fire protection systems are properly maintained.

4.1.6 Identify administrative and engineering controls to be considered during an inspection.

4.1.7 Identify primary factors of pre-fire planning.

4.1.8 Identify good industry practices for maintaining a fire safe facility.

4.1.9 Identify the responsibilities of management to provide fire protection training to facility personnel.

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MODULE 4.0: INSPECTION REQUIREMENTS FOR FIRE PROTECTION PROGRAMS

INTRODUCTION

Familiarity with the issues encompassed by the NRC Inspection Procedures 88054, Fire Protection (Triennial) and 88055, Fire Protection (Annual), is a necessity for NRC inspectors. This lesson provides a cursory look at those issues. A copy of the procedures is available in Appendix B.

Reasons for Conducting Fire Protection Inspections at Fuel Cycle Facilities

The Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974 provide the NRC with the licensing and regulatory authority on nuclear energy within the commercial sector. This authority includes facility licensing, setting up national standards and guidelines, and establishing requirements. These requirements include regulating licensees in the control of radioactive material releases from nuclear facilities.

Licensees are required to conduct surveys, including measurements of radiation or concentrations of radioactive materials, as necessary to demonstrate compliance with regulations.

Team assessments of operational safety at major fuel cycle facilities, which were conducted following the accidental release of uranium hexafluoride (UF_6) Sequoyah Fuels Corporation in January 1986, identified management controls as one of the most important issues needing attention by licensees.

The purpose of management controls is to provide confidence that measures taken to achieve safe, reliable facility operations remain effective and that operations remain safe.
This confidence can be obtained from a management controls program that:

- Provides methods for seeking out and identifying items and activities important to safety and recognizes their potential significant failures.
- Establishes procedures for tests and inspections, surveillance, and maintenance to provide protection against potential failures.
- Provides feedback to confirm and verify program achievement and evaluates and assesses program effectiveness.

Many of the inspection objectives present in today's procedures evolved from the basic concepts presented as management controls.

INSPECTION OBJECTIVES

Points to be considered during inspections are briefly addressed in this section. NRC staff conducting Fire Protection Program inspections should use as their guide the applicable NRC Inspection Procedure 88054, Fire Protection (Triennial) or 88055, Fire Protection (Annual).

The inspection objectives, as stated in Procedure 88054, Fire Protection (Triennial), are to evaluate the licensee or certificate holder's fire protection capability from a programmatic

design-based and risk-informed perspective to determine whether the following meet license or certificate requirements and are adequate to preclude or mitigate the consequences of a fire:

- Program for control of combustibles and ignition sources within the plant;
- Program to ensure adequate fire detection and suppression capability;
- Program to ensure that the material condition, design, and qualification testing of passive fire protection features is adequate;
- Program to ensure that compensatory measures will be in place for out-of-service, degraded or inoperable fire protection equipment, systems or features;
- Program to ensure that feasible and reliable emergency operating actions will be taken if required to mitigate the adverse affects of a fire; and
- Program to assure that maintenance and facility changes continue to meet applicable codes and standards and license or certificate basis.

The inspection objectives, as stated in Procedure 88055, Fire Protection (Annual), are to evaluate the operational status and material condition of the licensee or certificate holder's fire protection systems to determine whether the following are adequate:

- Effectiveness of controls for combustibles and ignition sources within the plant;
- Operability of fire detection and suppression equipment and systems;
- The material condition of passive fire protection features; and
- Effectiveness of compensatory measures in place for out-of-service, degraded or inoperable fire protection equipment, systems or features.

Learning Objectives

When you finish this section, you will be able to:

4.1.1 Identify the primary components of a Fire Protection Program at a fuel cycle facility.

4.1.2 Identify the elements of a systematic Fire Hazard Analysis (FHA).

FIRE PROTECTION PROGRAM

Regular fire prevention inspections interspersed with comprehensive fire protection engineering evaluations will facilitate the timely identification and mitigation of fire hazards.

Fire prevention inspections should be performed in accordance with established frequencies and scope. Noted deficiencies should either be corrected immediately or a written notice issued to the facility manager to identify required remedial action. Such notices should be tracked until corrective action has been completed.

Components of a Fire Protection Program

According to Inspection Procedures 88054 and 88055, a facility Fire Protection Program should be documented and should, as a minimum, consist of the following elements:

- Fire Hazards Analysis (FHA)
- Passive fire protection features with adequate material condition, design, and qualification testing
- Process safety considerations
- Fire detection and suppression capability
- System for pre-fire planning, adequate compensatory measures, and follow-up for correction of deficiencies identified by the FHA, periodic audits, or inspection reports
- Control of transient combustibles and ignition sources
- Fire brigade equipment, training, and off-site response

The documented Fire Protection Program needs to be periodically reviewed and updated to reflect changing site circumstances and new requirements.

FIRE HAZARDS ANALYSIS (FHA)

The purpose of this section is to provide guidance on the development of Fire Hazard Analyses (FHAs). FHAs are required for new facilities and existing fuel cycle facilities were required to prepare some sort of an FHA during their required integrated safety analysis. NFPA 801, Standard for Fire Protection for Facilities Handling Radioactive Materials, provides guidance on considerations when preparing FHAs, however, other nationally recognized codes and standards may be used as guidance when appropriate.

The guidance provided in this section is general in nature and represents a minimally acceptable level of effort. It is intended to be utilized by qualified fire protection engineers.

FHAs and periodic inspections are necessary to provide a comprehensive and technically valid assessment of the fire risks to a facility as well as an indication of existing deficiencies that would degrade fire safety below acceptable levels. When significant modification of a facility or inventory of combustibles occurs, the development of a new FHA would be necessary. A graded FHA provides the technical basis for designing effective fire protection measures and can also be utilized as justification for implementing cost-effective solutions to fire protection issues. Periodic assessments are critical toward ensuring that existing fire protection remains effective as facility occupancy changes occur.

For more information on the content of an FHA, see the Standard Review Plans in the Supplemental Reading Section at the end of Module 1.0.

Guidance on the Development of FHA

The purpose of an FHA is to comprehensively and qualitatively assess the risk from fire within individual fire areas in a facility. This should include an assessment of the risk from fire and related perils (direct flame impingement, hot gases, smoke migration, fire-fighting water damage, etc.) in relation to existing or proposed fire safety features to ensure that the facility can be safely controlled and stabilized during and after a fire. The level of detail necessary is directly related to the complexity of the facility and the potential risk to the public and facility operators.

An FHA that addresses all relevant fire safety issues should be performed for all new facilities. A preliminary FHA should be performed for new facilities early in the design phase to ensure an acceptable level of protection is provided as the design is evolving. It should be updated when significant changes occur within an individual fire area.

An FHA should be performed under the direction of a fire protection engineer, with support from systems, electrical, and mechanical engineers, as well as operations staff, as needed.

An acceptable tool that may be used in the development of an FHA is a fire model, as applied by qualified fire protection engineers. However, the use of such models is predicated on their

being conservative and validated. As of this date, NRC has not sanctioned the use of any one model for use in an FHA; therefore, the NRC considers individual models on a case by case basis.

Elements of FHAs

An FHA should contain, but not be limited to, a conservative assessment of the following fire safety issues:

- Description of construction
- Fire protection features including administrative controls.
- Description of fire and explosion hazards including chemical incompatibilities.
- Protection of essential Items Relied On For Safety (IROFS)
- Life safety considerations
- Critical process equipment
- High value property
- Damage potential
- Maximum credible fire loss (MCFL) and maximum possible fire loss (MPFL)
- Fire department/brigade response
- Recovery potential
- Potential for a toxic, biological, and/or radiological incident due to a fire and drainage of contaminated fire water.
- Emergency planning
- Security and Safeguards considerations related to personnel egress and firefighter access.
- Natural hazards (earthquake, flood, wind)
- Impact on fire safety
- Exposure fire potential

The FHA should be documented including all assumptions.

Fire Protection Systems and Features

The FHA should assume that an automatic fire protection system will malfunction. If redundant automatic fire protection systems are provided in the area, only the system that causes the most vulnerable condition is assumed to fail. Passive fire protection features, such as fire-rated barriers and continuous fire-rated cable wraps, are assumed to remain viable.

Fire Areas

The focus of the FHA should be the individual fire areas that make up the facility. A fire area is defined as a location bounded by fire-rated construction, having a minimum fire resistance rating of two hours, with openings protected by equivalently rated fire doors, dampers, and penetration seals. The boundaries of exterior fire areas (yard areas) should be as determined by the delegated authority. Where a facility is not subdivided by fire-rated construction, the fire area should be defined by the exterior walls and roof of the facility and/or complex.

Fire Propagation

Fire propagation and the potential for fire-induced radiological dispersal through the facility air distribution system or through the facility's roof should be considered. These effects should be considered for the normal operating mode of the air distribution system as well as alternate modes, such as shutdown, that may result from the fire.

Flammable and Combustible Materials

The quantity and associated hazards of flammable and combustible materials that can be expected to be found within the fire area should be factored into the analyses. Consideration should also be given to the presence of transient combustibles associated with storage and maintenance activities. Averaging combustible loading as a means to characterize the fire severity is not considered an acceptable technique.

High Bay Locations

FHAs for high bay locations should consider the effects of smoke and hot gas stratification that may occur at some intermediate point below the roof or ceiling. Similarly, the effect of smoke movement through doors and dampers held open by fusible links needs to be addressed.

Self-Check Questions 4-1:

INSTRUCTIONS: Complete the following questions. Answers are located in answer key section of this module.

1. List the primary components of a Fire Protection Program.

2. What is the purpose for periodic reviews of the Fire Protection Program documents?

3. What is the purpose of a Fire Hazards Analysis (FHA)?

4. List some elements of an FHA.

5. What NFPA standard provides guidance on preparing an FHA?

Learning Objectives

When you finish this section, you will be able to:

4.1.3 Identify important characteristics of passive engineered fire protection features.

4.1.4 Identify high risk process components.

4.1.5 Identify indicators that the fire protection systems are properly maintained.

FIRESAFE DESIGN AND CONSTRUCTION OF FACILITIES

Care should be taken to ensure the fire safe design and construction of the buildings within a facility. Additionally, any modifications to buildings within a facility must also be made with fire safety a priority.

Passive Engineered Controls

Passive engineered controls are created to confine fires or reduce the growth of fires. They include:

- Building Construction
- Ventilation System

Building Construction

The process buildings should be designed and constructed to qualify as Type I construction, as classified by NFPA 220, Types of Building Construction. This requires that the structural members of the buildings, including walls, columns, beams, floors, and roofs, are constructed of approved noncombustible or limited combustible materials and have specified minimum fire resistance ratings. If nonprocess areas are housed in the same or adjoining buildings, the entire building complex should be of Type I construction.

To confine fire to its area of origin and prevent its spread, areas containing processes or materials involving fire hazards should be separated by structural barriers into fire areas. A fire barrier is an example of a passive engineered control. In particular, solvent extraction process areas, boiler rooms, incinerators, warehouses, control rooms, switchgear rooms, computer rooms, maintenance shops, fire pump areas, and office areas should be separate fire areas. Structural barriers, including walls, floors, ceilings, and roofs, that bound fire areas, should have a minimum of 1-hour fire resistance rating.

Openings in the barriers comprising boundaries of fire areas should have doors or fire stops (penetration seals) installed. Such devices should have at least the same fire resistance rating as the barriers in which they are installed. Over time the opening protection can degrade – fire doors may not latch properly, fire stopping may fall apart, raceway barriers may be removed, etc. Follow the appropriate guidance in the NRC Inspection Procedure to insure these remain in good working order.

When a process building is near installations, such as flammable liquid or gas storages, the risk of exposure fires (originating in such installations) to the process building should be evaluated and appropriate protective measures taken. NFPA 80A, Protection of Buildings from Exterior Fire Exposures, provides guidance on such exposure protection. NFPA 30, Flammable and Combustible Liquids Code, provides minimum separation distances from tank storages.

The building design should provide for safe means of egress for personnel in the event of a fire emergency. Egress routes should be clearly marked. NFPA 101, Life Safety Code, provides guidance on egress design and the requirements for protection of egress routes.

Provision should be made for protection of the facility from lightning damage. The installation of such protection should comply with NFPA 780, Lightning Protection Code.

All electrical wiring and installations should be made, used, and maintained in accordance with NFPA 70, National Electrical Code, and other standards that apply to special situations, such as NFPA 70B, Recommended Practice for Electrical Equipment Maintenance; NFPA 70E, Standard for Electrical Safety in the workplace; NFPA 79, Electrical Standard for Industrial Machinery; and NFPA 75, Standard for the Protection of Information Technology Equipment.

Ventilation System

The ventilation system should be designed to isolate affected areas during fire accidents and to provide channels for exhausting fire products, through filters if necessary, to outside the plant. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, provides guidance on ventilation design for fire protection. NFPA 92A, Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences, provides guidance on utilizing the vent system to remove smoke.

Where a ventilation system is required to prevent the release of radioactive material to the atmosphere, all materials of construction and all filters for the system should be fire resistant. To reduce the possibility of radioactive contaminants being introduced into the exhaust system, fresh air inlets should be located where contaminants are less likely. High efficiency particulate air (HEPA) filters should conform with Underwriters Laboratories Standard UL-586, Test Performance of High Efficiency, Particulate, Air Filter Units, also designated ANSI B 132.1, High Efficiency Air Filtration Units.

If a heat removal system such as a water spray system is required for the final filter plenum, it should operate automatically (with manual override) upon abnormal rise of the effluent temperature.

Heating furnaces should be installed in accordance with NFPA 54 (ANSI Z223), National Fuel Gas Code, if gas-fired, or NFPA 31, Standard for Installation of Oil-Burning Equipment, if oil-fired. The installation of electrical duct heaters should comply with NFPA 70, National Electrical Code.

HIGH RISK FIRESAFE MANUFACTURING PROCESSES, EQUIPMENT, AND STORAGE

Manufacturing processes, equipment, and materials storage areas should be fire safe and should be designed and operated in a fire safe manner. Those processes, equipment and storage areas includes:

- Processes Involving Flammable and Combustible Liquids and Gases
- Machining Operations of Combustible Metals
- Incinerators
- Boilers and Boiler Furnaces
- Stationary Combustion Engines
- Storage and Handling of Flammable and Combustible Liquids and Gases
- Hot Cells
- Gloveboxes
- Laboratories

Processes Involving Flammable and Combustible Liquids and Gases

Processes involving solvents or other chemical substances that may be classified as flammable liquids or as combustible liquids, Class II, according to NFPA 30, Flammable and Combustible Liquids Code, should be isolated from each other and from the remainder of the facility by locating them either in separate buildings or in spaces enclosed by barriers having a minimum fire resistance rating of one hour.

Process areas with flammable liquids or some combustible liquids may require that all electric motors, switch gears, lighting, and other electrical installations in these areas, be of the explosion-proof type and installed in accordance with NFPA 70, National Electrical Code. No open flame should be permitted in these areas, except for construction or maintenance work with the process shut down.

Where a process involving a flammable or combustible liquid or gas is in the same fire area as an ignition source, such as an open flame, one or more analyzers should be installed strategically to monitor the flammable or combustible vapor or gas concentration in the air. The analyzers should activate both visible and audible alarms whenever the vapor

concentration exceeds a set limit, for example, 10 percent of the lower flammable limit. Simultaneously, ignition sources and flammable gas supplies in the area should be turned off automatically.

The areas should be provided with automatic fire detection and automatic explosion prevention/suppression systems. NFPA 69, Standard on Explosion Prevention Systems, provides guidance on design, selection, and installation of such systems.

Where process equipment requires lubricating oil to reduce heat and friction (typically found in pumps, compressors, centrifuges, etc), it is important to consider how the type of lubricating oil is used and is being stored. The combustibility of lubricating oils can vary dramatically. The properties of lubricating oil can be found in the associated materials safety data sheet (MSDS) which should be available for inspection. Lubrication can be self-contained or supplied via a system. When a piece of equipment has self-contained lubricating oil, consider the situation if a leak were to occur, along with the frequency and methods for replacement. Lubrication systems typically contain much high amounts of oil and can vary in size and attributes. When a lubrication system is utilized consider how much oil is present, where it is stored, what is its temperature, and if the interconnecting piping is stable.

Machining Operations of Combustible Metals

Metals such as uranium and zirconium, and their alloys, are known to be combustible, especially when in a finely divided form. Machining operations in the facility should, therefore, be evaluated for the potential for combustible dust cloud formation and combustible scrap accumulation from operations, such as sawing, grinding, machining, and abrasive cutting. Fire protection measures for these metals are similar. NFPA 482, Standard for the Production, Processing, Handling, and Storage of Zirconium, provides guidance.

No open flames should be permitted in the areas where machining operations of combustible metals are performed. If maintenance operations, such as welding, are to be performed in the vicinity, machining operations should be halted, and metal scraps should be removed.

Machining operations on combustible metals should be performed in enclosures with a dust-collection system in operation. The collected dust should be ducted to a dust collector and also a HEPA filter, if required, for removal of radioactive particles. The collection hood and duct leading to the filter should be designed to minimize deposition of the fines and to facilitate cleaning.

Scrap generated by machining operations and accumulated in the immediate area should be swept as frequently as necessary and collected underwater in covered metal containers. Such collections should be removed daily from the process areas. Dust and sludge collected in the dust separators and ducts should be removed as often as necessary.

Extinguishing agents suitable for the particular metal fire, as well as suitable scoops or applicators, should be readily available to the operator performing the machining.

Incinerators

Incinerators should be separated from the remainder of the facility by fire barriers having a minimum 1-hour fire resistance rating.

Where the incinerator is required to burn radioactive contaminated waste, its exhaust should be ducted to a filtration system before release to the environment. The exhaust may also be ducted to the facility off-gas system. Such ducts should be designed to minimize deposition of particulate effluent and to facilitate cleaning.

Depending on the temperature of the exhaust, a cooling water spray and passage through a liquid precipitation separator may be required for both cooling and dust separation.

Boilers and Boiler Furnaces

Boilers for the supply of steam for process operation and boiler furnaces should be separated from the remainder of the facility by fire barriers having a minimum 1-hour fire resistance rating.

The construction and operation of the boiler furnaces should comply with the relevant standards in the NFPA 85, Boiler and Combustion Systems Hazards Code, depending on the type of furnace and the fuel used.

The fuel storage tanks should be separated from the furnace area by fire barriers having a minimum 1-hour fire resistance rating. The fuel lines should be laid out to minimize possibility of damage.

Stationary Combustion Engines

Stationary combustion engines, if located in part of a structure housing fuel processes, should be in enclosures having a fire resistance rating of at least one hour. Combustion engines are used for generating electricity or with a fire pump.

Fuel storage tanks, except for day tanks, should be located outside the facility and be constructed in accordance with NFPA 30, Flammable and Combustible Liquids Code. Unenclosed day tanks should be constructed and have capacities limited according to NFPA 37, Standard for the installation and use of Stationary Combustion Engines and Gas Turbines.

The engine exhaust system should be designed to prevent ignition of any combustible materials such as the roof by contact with hot metal surfaces or by leaking exhaust gases or sparks.

The stationary combustion engine room should be ventilated effectively to minimize accumulation of combustible vapor and mitigate the possibility of explosion. NFPA 37 provides guidance.

Storage and Handling of Flammable and Combustible Liquids and Gases

The construction, installation, operation, and maintenance of combustible liquid storage and the related loading and dispensing systems should comply with NFPA 30, Flammable and Combustible Liquids Code.

Indoor storage of flammable and combustible liquids may be permitted in limited quantities in approved closed containers for the purpose of day-use (such as for diesel engine operation) and maintenance work. Appropriate portable fire extinguishers should be available.

Whenever dictated by proximity of other flammable or combustible storage tanks, steel supports of above-ground storage tanks should be protected from exposure fires located in a common diked area, or by proximity of a tank-trunk loading/unloading area.

The construction, installation, operation, and maintenance of bulk gas (including liquefied gas) storage and the related loading and dispensing systems should comply with good industry practice and the relevant NFPA standards, as applicable, for example, NFPA 50, Standard for Bulk Oxygen Systems at Consumer Sites; NFPA 50B, Standard for Liquefied Hydrogen Systems at Consumer Sites; and NFPA 54, National Fuel Gas Code.

Hot Cells

The construction materials for hot cells should be noncombustible. The internal surface coatings should be noncombustible or limited combustible.

The liquid-filled windows should contain a noncombustible medium. Hydraulic fluids in the master-slave manipulators should be of the nonflammable type.

Where process materials and equipment present a fire hazard, the quantities of combustible materials and the sources of ignition should be maintained at the absolute minimum. If flammable gases or vapors may be present in explosive proportions, an inert atmosphere should be provided when operating the hot cell.

Where combustible materials are used in a hot cell, extinguishing agents, compatible with the materials handled, and their delivery systems should be provided within the hot cell. Nuclear criticality concerns should be considered in selecting extinguishing media.

Filters for the exhaust air from a hot cell should be of noncombustible construction. Further guidance for hot cell for protection is provided in NFPA 801, Standard Fire Protection for Facilities Handling Radioactive Materials.

Gloveboxes

The construction materials for gloveboxes may be of the limited combustible type if only noncombustible process materials are used within them. Otherwise, the glovebox, except for the gloves, should be of noncombustible construction.

If combustible materials are used, or if there is the possibility of an explosive mixture forming within the glovebox, the relevant guidance provided for hot cells should also apply. Use of combustible materials should be justified within a fire hazards analysis.

Laboratories

The fire protection methods of laboratories handling radioactive materials are similar to those of chemical laboratories. Guidance is provided in NFPA 45, Standard Fire Protection for Laboratories Using Chemicals.

FIRE PROTECTION SYSTEM MAINTENANCE

Fire protection systems include fire detection and alarm systems, fire suppression equipment, and fire protection water systems. Documentation should be available to verify that fire protection equipment is properly maintained and is adequate for the identified fire hazards in a specific area.

Fire Detection and Alarm Systems

Automatic fire detectors of appropriate types should be installed in all areas having substantial combustibles that are infrequently visited or are occupied only part of the 24-hour day. Automatic combustible vapor and gas detectors should be installed in areas where there is a potential for leakage of flammable or combustible liquids or gases.

Automatic fire detectors and combustible vapor/gas detectors should actuate audible and visible alarms in the area of origin of the alarm, as well as at a central constantly supervised monitoring station. Such monitoring stations should constantly have available information on the status and functioning of the fire and combustible vapor/gas detection systems and of the installed fire suppression systems, including a zone indication of the origin of an alarm. These systems should comply with the requirements of NFPA 72, National Fire Alarm and Signaling Code.

Manual fire alarms actuators (pull-boxes) or telephones should be available at strategic locations such as near area exits for personnel to sound the alarm.

Actuation of any fire suppression system, such as flow through a sprinkler system, should actuate visible and audible alarm systems.

Fire Suppression Equipment

Automatic water sprinkler coverage is the preferred method of fire suppression for most areas having significant fire hazard. Notable exceptions are areas where moderation control is necessary to prevent accidental nuclear criticality and areas with concentrations of energized electrical equipment, including computer installations and control rooms. NFPA 13, Standard for the Installation of Sprinkler Systems, provides guidance for selection and design of sprinkler systems.

Gaseous Suppression Systems

Plant areas having significant fire hazards, and where water is unsuitable as a suppression agent, should be protected by other systems employing gaseous suppression agents such as inert gases, carbon dioxide, Halon (where already installed), Halon alternative, and high- or low-expansion foam, as appropriate. Gaseous suppression systems include:

- Carbon dioxide (CO_2). Carbon dioxide extinguishing systems, an industry standard, employ high-pressure CO_2 cylinders. Preventive maintenance includes verifying agent quantity of the cylinders. Consideration should also be given to: the minimum required CO_2 concentration, distribution, soak time, and ventilation control; he anoxia and toxicity hazards associated with CO_2; the possibility of secondary thermal shock (cooling) damage; conflicting requirements for venting during CO_2 injection to prevent over pressurization vs. sealing to prevent loss of agent; and location and selection of the activating detectors. CO_2 systems should comply with the requirements of NFPA 12, Standard on CO_2 Extinguishing Systems. Depletion of oxygen in an area is a concern.
- Halon. Halon fire extinguishing systems contain a gas that interrupts the chemical reaction that takes place when fuels burn. The systems, which are often used to protect electrical equipment, should comply with the requirements of NFPA 12A, Standard on Halon 1301 Fire Extinguishing Systems, or perhaps the old NFPA 12B, Standard on Halon 1211 Fire Extinguishing Systems. Preventive maintenance includes verifying agent quantity of the Halon cylinders. Consideration should also be given to: the minimum required Halon concentration, distribution, soak time, and ventilation control; the toxicity of Halon; the toxicity and corrosive characteristics of the thermal decomposition products of Halon; and location and selection of the activating detectors. Because Halon can deplete the ozone layer, there are alternatives that may be appropriate for fire suppression.

- Halon alternative. These systems use "clean agents" such as FM-200, FE-13 and Inergen, alternatives to the traditional Halon 1301. The clean agents must comply to standards in NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems. Preventive maintenance includes verifying agent quantity of the cylinders. Consideration should also be given to: the minimum required clean agent concentration, distribution, soak time, and ventilation control; the toxicity of the clean agent; the toxicity and corrosive characteristics of the thermal decomposition products of the clean agent; the conflicting requirements for venting during clean agent injection to prevent over pressurization vs. sealing to prevent loss of agent; and location and selection of the activating detectors.
- Dry chemical system. These systems contain an extinguishing agent such as Purple-K dry chemical, ABC dry chemical or BC type of powder. They use a compressed, non-flammable gas as a propellant and protect from hazards involving flammable liquids, wood and paper. These agents are designed for extinguishing Class "A" and "B" fires and approved for use in electrical Class "C" fire situations. Industrial systems are often installed for the protection of paint spray booths, dip tanks, pumps, and other equipment. Dry chemical is an effective alternative to water and other costly clean agents.

Water-based Systems

Special hazard automatic suppression systems also include water-based systems, which can be an alternative to Halon and CO2. These systems include:

- Water mist system. Water mist suppression may be useful in specialized situations, particularly where the application of water needs to be restricted. Utilizing a fine spray mist, this system has many advantages, including low toxicity, low cost, and proven fire-suppression capabilities. These systems offer protection without the deluge and damage of traditional water-based systems and cool the fire area. Because of the cooling effect, these systems help to prevent re-ignition. Water mist is most effective when the system is correctly dimensioned and adjusted to the area of application. Water mist is not suited for general use. Water mist systems should conform to appropriate standards such as NFPA 750, Standard on Water Mist Fire Protection Systems.
- Foam-water sprinkler and spray systems. Foam concentrates offer protection for flammable liquid fires. Guidance on the selection and design of foam systems is provided in NFPA 11, Standard for Low Expansion Foam and Combined Agent Systems, and NFPA 11A, Standard for Medium-and High-Expansion Foam Systems. Foam sprinkler and water spray systems should also conform to standards NFPA 16, Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems.

Fire Protection Water System

Adequate supply of water for the installed fire protection systems should be ensured. Additional supply of fire fighting water that may be needed by an outside fire department should be planned for in consultation with them. Compatible connections should be provided for outside fire department use. The fire-water distribution system should be designed and constructed for high reliability. NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances, should be used for guidance.

The fire pump installation should be adequate to deliver water at full pressure at the farthest hydrant, standpipe, and hose station, or sprinkler system. The installation should comply with the requirements of NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection.

Provisions should be made for alternate sources of power for fire pumps, so that failure of one source will not disable the installation. A diesel engine-driven pump is typically used in addition to an electrically driven one.

The fire protection water-distribution system should be designed so that the failure of a single component, for example, a pump or valve, does not prevent the ability to deliver fire fighting water to any part of the facility.

Fire Protection Equipment Maintenance, 2.05

According to NFPA 600, Standard on Industrial Fire Brigades, periodic inspections and maintenance of fire equipment should be established. These inspections and maintenance operations should be carried and reports filed with management.

To ensure currency, maintenance records of fire protection equipment should be reviewed.

Self-Check Questions 4-2:

INSTRUCTIONS: Complete the following questions. Answers are located in answer key section of this module.

1. List some areas that should be identified as separate fire areas.

2. List two purposes for the ventilation system during a fire.

3. Machining operations on combustible metals should be performed in enclosures with an operating:

4. What is the minimum fire resistance rating for the barrier between an incinerator and the remainder of the facility?

5. For what purpose is the stationary engine room ventilated?

6. Construction materials for hot cells should be: .

7. What is the preferred method of fire suppression for most areas having significant fire hazard?

Learning Objectives

When you finish this section, you will be able to:

4.1.6 Identify administrative and engineering controls to be considered during an inspection.

4.1.7 Identify factors of pre-fire planning.

4.1.8 Identify good industry practices for maintaining a fire safe facility.

TYPES OF MANAGEMENT CONTROLS

Management controls can be classified as either administrative or engineered.

Administrative Controls. Policies and procedures established by management to ensure that fire safety principles are implemented effectively to maintain safe operating conditions. Requires manual actions to prevent fires, activate alarms, and maintain systems.

Engineered Controls. Design and operating limits that effectively reduce the risks associated with fire (engineering fire area boundaries, suppression and detection systems.)

Policies encourage an attitude of safety consciousness and reinforce the importance of safety.

Procedures usually expand upon work policies and work habits to ensure that physical controls are being implemented.

Examples of Administrative Controls

Fire Emergency Plan

NFPA 801 requires licensees to establish fire emergency plans for each area of the facility. Employers need to implement a written fire emergency plan to complement the fire evacuation plan. The written plan should be available for employee review.

Control of Transient Combustibles/Flammable Materials and Ignition Sources

During facilities tours and walkdowns, the inspector should assess whether or not combustible/flammable materials are controlled in accordance with the licensee's or certificate holder's procedures. At a minimum, this should include:

- Controls related to the quantity and handling of combustibles in and around the facility so that the potential for a significant, damaging fire is minimized.
- Requirements that storage of combustible materials should not be allowed in locations where accumulation of combustible materials could occur, i.e. above suspended ceilings or below raised floors, under glove boxes or other process equipment, under stairs and/or in stairwells.
- Requirements for handling of waste, scrap, rags, trash, and other combustible material resulting from work activity. These materials shall be disposed of in approved waste receptacles, or removed from the building at least once per day at the end of the work shift.
- Controls for storage of materials susceptible to spontaneous ignition, such as oily rags. In addition, metals such as uranium and zirconium, are known to be combustible, especially when divided in a finely form.
- Requirements that prevent the storage of unnecessary combustible materials near ducts and HEPA filters in housings/ducts of filter rooms that are in service.
- Requirements to prevent accumulation of combustible materials in mechanical rooms, electrical rooms, or process areas.
- Requirements to prevent blockage of access to active fire protection equipment and emergency exit paths from facilities.
- Controls on the use of non combustible containers for storage of combustible trash.
- Provisions to clean spills of flammable or combustible liquids.
- Hot work must not be permitted in flammable (explosive) atmospheres; near large quantities of exposed, readily ignitable materials; in areas not authorized by management; or on metal partitions, walls, or roofs with a combustible covering or with combustible sandwich-type panel construction.
- Floor must be free of combustibles, such as wood shaving. If the floor is of combustible material, it must be kept wet or otherwise protected.

- If combustibles are closer than 35 feet to the welding or cutting process and the work cannot be moved or the combustibles relocated at least 35 feet away, they must be protected with flame-resistant covers or metal guards or curtains. This also applies to walls, partitions, ceilings, or roofs of combustible construction.
- Openings in walls, floors, or ducts must be covered if within 35 feet of the work. Be alert for cutting conditions that could propel sparks overhead or downward, where combustibles are within a 35 foot sphere of the point of operation.
- Cutting or welding on pipes or other metal in contact with combustible walls, partitions, ceilings, or roofs must not be performed if close enough to cause ignition by heat conduction.
- Charged and operable fire extinguishers must be readily available. Trained fire watchers must be posted. In general, the posted fire watchers should not be engaged in any other activities and should remain posted for at least 30 minutes after the hot work is complete.

In addition, the program should require routine housekeeping and control of combustible materials inspections. The inspections should consist of a walkdown of the facility to identify all unnecessary combustible materials. Material identified during the inspection should be documented.

Compensatory Measures

Each echelon of fire protection defense in depth (i.e., prevent fires, detect and suppress fires, and the design of safety systems to limit fire damage), should meet certain minimum requirements; however, strengthening any one can compensate in some measure for weaknesses, known or unknown, in others.

In some cases, reductions in defense in depth can be immediately corrected. For example, combustibles can be removed if found in a combustible free zone. In other cases, more time is needed to correct the problem (e.g., repair an inoperable fire detection system or install a missing fire barrier). In still other cases, fire protection features are purposefully removed from service (e.g., a fire barrier penetration seal may be removed to allow a new cable run).

When immediate corrective actions cannot be taken, compensatory measures are implemented to mitigate the increased fire risk created by the degraded, inoperable, or nonconforming condition until permanent corrective actions can be implemented. The use of compensatory measures, on a short term basis, is an integral part of licensee's or certificate holder's fire protection programs. In most cases, such measures can effectively compensate for the reduction in fire protection defense-in-depth until the operability of the degraded or inoperable fire protection feature can be restored or the nonconformance can be corrected.

For typical fire protection system deficiencies (e.g., inoperable fire detection and suppression systems) the plant administrative procedures should specify the appropriate compensatory measures. Fire watches are the most common form of compensatory measure for typical fire protection system deficiencies. Fire watches are personnel trained to inspect for the control of ignition sources, fire hazards, and combustible materials; to look for signs of incipient fires; to provide prompt notification of fire hazards and fires; and, in some cases, to take actions to begin fire suppression activities.

The primary purpose of the fire watch is to look for fire hazards and other conditions that could lead to a fire. Therefore, the fire watch strengthens the first echelon of fire protection defense in depth (fire prevention) by compensating for the weakness introduced by the inoperable, degraded, or nonconforming condition. Fire watches may also detect fires, call out the fire brigade, give exact information regarding the nature and location of the fire to the fire brigade, and initiate fire suppression activities for incipient stage fires.

These actions all strengthen the second echelon of fire protection defense in depth (fire detection and suppression). Whether or not a fire watch engages in incipient stage fire fighting activities is based on the individuals' training and procedures.

- For identified impaired fire protection features, assure that compensatory actions (usually a posted fire watch) are established and continue until such time that the component is restored.

- Ensure that the duties of posted compensatory action fire watchers are adequate and fire watch rounds are completed within specified procedural time frames.

Examples of Engineered Controls

Automatic Sprinkler Systems

Automatic sprinkler systems throughout the workplace are among the most reliable fire suppression systems. The fire sprinkler system detects the fire, sounds an alarm and puts the water where the fire and heat are located.

Automatic Fire Suppression Systems

Automatic fire suppression systems require proper maintenance to keep them in serviceable condition. When it is necessary to take a fire suppression system out of service while business continues, the employer should temporarily substitute a fire watch of trained employees standing by to respond quickly to any fire emergency in the normally protected area. The fire watch should interface with the employer’s fire prevention procedures and emergency action plan.

Pre-discharge Alarm Systems

Signs should be posted about areas protected by total flooding fire suppression systems that use agents which are a serious health hazard such as carbon dioxide, halon, etc. Such automatic systems should be equipped with area predischarge alarm systems to warn employees of the impending discharge of the system and allow time to evacuate the area. There should be an emergency action plan to provide for the safe evacuation of employees from within the protected area. Such plans are to be part of the overall evacuation plan for the workplace facility.

Day-to-Day Supervision

Licensees should establish and maintain a fire protection program for the facility. The overall management of the program should be under the direction of a senior level individual who has been given the authority and staff assistance to implement measures relating to fire protection throughout the facility.

The requirement to provide subject matter expert technical support to a facility is commonly addressed in day-to-day activities. The Code of Federal Regulations (CFR) and NFPA codes and standards mandate conformance with applicable fire safety requirements.

The ability of facility managers and other plant personnel to consult with the staff on fire safety code and security system-related issues ensures that site activities are performed safely and securely and that plant modifications and other construction-related activities are implemented in accordance with accurate interpretations of requirements.

Written requests for such analyses are acknowledged promptly. Initial assessment is performed or scheduled within one week (or mutually agreed upon alternative). Final report or evaluation, if necessary, is completed within agreed schedule.

Fire Safety Review Committee

To ensure adequate implementation of the Fire Protection Program, the inspector should review the Fire Safety Review Committee's (or similarly titled management organization) meeting minutes and follow-up action reports to:

- Determine the frequency of meetings
- Identify deficiencies reported
- Consider actions taken

PRE-FIRE PLANNING FACTORS

Pre-fire planning addresses factors contributing to fire losses in buildings from both technical and operational perspectives. From the standpoint of fire dynamics, the primary factors to be evaluated are ignition, including cause and origin, flame spread and fire growth, including enclosure effects, and smoke production and propagation.

From the standpoint of the response of buildings to fires, the primary factors to be evaluated are:

- Construction features
- Fire detection/alarm systems
- Suppression systems,
- Mechanical systems, including heating, ventilating, and air conditioning (HVAC) systems and elevators.

These should be evaluated both from the standpoint of compliance with building codes and fire safety standards and from the standpoint of their influence on actual fire losses.

A Pre-Fire Plan should assign individual and alternate responsibilities for:

- Suppressing incipient fires
- Calling for the site fire brigade and, if necessary, offsite fire department assistance
- Personnel evacuation
- Orderly shutdown of processes
- Safeguarding and control of radioactive materials

The Pre-Fire Plan should clearly indicate, preferably with the help of site plans and drawings, the location of firefighting equipment such as portable extinguishers, automatic fire suppression systems, block valves, standpipes, hydrants, and hoses. It should indicate the areas of concentration of combustibles, storage areas of flammable or combustible liquids, and areas where use of water for fire suppression is restricted. The policy of fighting fires in water exclusion areas due to criticality concerns should also be included.

GOOD INDUSTRY PRACTICES

Quarterly inspections or cleaning of exhaust and collector systems used to convey flammable or combustible contaminants are recommended to prevent accumulation of deposits. If quarterly inspections are not conducted, these systems should be inspected and cleaned annually at a minimum. Fire dampers installed in these systems should be inspected and tested annually to ensure they are operational.

All building areas should be inspected at least semiannually (if not monthly) to determine that appropriate fire prevention practices are being followed, fire protection is provided, and that the level of fire protection is consistent with the requirements.

Fire protection, fire detection, and other emergency control equipment should be inspected and maintained according to the manufacturer's recommendations.

Fire extinguishers should have maintenance-type inspections performed annually according to the manufacturers' specifications. The easiest way to verify if a portable extinguisher is being maintained by a monthly "quick check" is to check the tag attached to the extinguisher. Hydrostatic pressure testing of the fire extinguishers should be performed according to the requirements identified in NFPA 10, Standard for Portable Fire Extinguishers.

Fire doors, including stairwell doors, should have a maintenance-type inspection performed annually according to the manufacturers' recommendations. Doors should close freely and fully engage the latch or keepers when closed. Automatic closing mechanisms should be tested to ensure proper operation. Annual inspections should be documented.

Special or high-hazard operation alarms, interlocks, and process fail-safe controls should be thoroughly tested periodically. Tests should include manual and automatic emergency power operation (EPO) circuits.

HVAC systems require annual testing of smoke duct detectors, motorized and link-operated dampers, exhaust fans, fan belts, and filters. All results should be thoroughly documented.

Fire alarms, smoke detectors, and heat detectors should be inspected/tested annually. It is recommended that manual pull stations, fire alarm evacuation devices and devices protecting critical operations be inspected/tested semiannually.

Fire/emergency vehicles should be inspected at least monthly.

Self-Check Questions 4-3:

INSTRUCTIONS: Complete the following questions. Answers are located in answer key section of this module.

1. Define administrative controls.

2. Define engineered controls.

3. List examples of administrative controls that a fire inspector may request.

4. List examples of engineered controls.

5. All building areas should be inspected at least _____ to determine that appropriate fire prevention practices are being followed, fire protection is provided, and that the level of fire protection is consistent with the requirements.

6. What is the easiest way to verify if a portable fire extinguisher is being maintained?

7. List examples of documentation that should indicate whether fire protection equipment is being properly maintained.

8. Who is responsible for the prevention of fire loss?

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Learning Objective

When you finish this section, you will be able to:

4.1.9 Identify the responsibilities of management to provide fire protection training to facility personnel.

FIRE PROTECTION TRAINING

The organization, training, and equipment of the fire brigade should be adequate to respond to credible fire emergency, with assistance from off-site fire departments, where such assistance is available.

NFPA 600, Standard on Industrial Fire Brigades describes the requirements for the organization, training, and personal protective equipment of fire brigades whenever they are established by employers. Fire Brigade Management should be responsible for the prevention of fire loss. They should:

- Establish policy
- Establish authority and assign responsibility
- Provide budgeted funding for such items as meetings, training, and equipment

Organization of Fire Brigade

In its simplest form, the organization consists of the manager of the property assisted by selected personnel. In properties with complex or hazardous operations and where more persons are available, they should be organized into a team or teams to function as a private fire brigade.

The availability of fire-fighting assistance from a public or private fire department may affect the nature of the private fire brigade organization. These do not necessarily take the place of a private fire brigade. The organization should be such that a fire brigade is on duty during each working shift and at periods when the plant is shut down.

Fire Brigade Training

The employer should provide a training program to ensure an adequate number of personnel to perform assigned duties during a fire emergency. General plant personnel should receive fire extinguisher education annually. The FireBrigade and FireWatch should receive "hands-on" training. The employer shall assure that training and education is conducted frequently enough

to assure that each member of the fire brigade is able to perform the member's assigned duties and functions satisfactorily, and in a safe manner so as not to endanger fire brigade members or other employees.

Guidance provided in NFPA 600 Standard Industrial Fire Brigades states, "Training should provide a means by which all fire brigade members increase knowledge and develop skills to perform individually or as a team member of the brigade. Teamwork and skill are the backbone of a good brigade."

The training should include the principles and practices of fire fighting and the handling of other emergencies to the extent and degree required by the type of fire brigade established. The training program should keep in mind the problems presented with new hazards in the property and new equipment and procedures for its protection.

Training documentation includes minutes of meetings held, subjects taught, examinations given, and the names of the attendees and the instructors. Documentation should also include training files for each fire brigade member.

Fire Brigade Drills

Drills should be used to check the ability of members and leadership, use of equipment, and effectiveness of the team operation.

As directed in NFPA 600, "The depth and frequency of drills will vary based on the type of brigade established, but should be of sufficient depth and frequency to check the ability of members to carry out their assigned responsibilities and perform the operations they are expected to carry out with the fire equipment provided." Occasionally, drills should be conducted under adverse weather conditions to work out special procedures needed under those conditions.

A critique should follow each drill to fully discuss what happened, to correct any flaws in procedures, and to discover any areas that may need additional training.

Documentation should be maintained to show that:

- Drills have been held at least annually
- Drills have been duly critiqued
- Drills are repeated if serious deficiencies were identified
- Joint drills with off-site emergency responders are held at least biennially

Evacuation drills should be conducted for all facility personnel.

REVIEW OF NRC PROCEDURES

In review, the fire protection inspection objectives, as stated in NRC Inspection Procedure 88054 (Triennial), are to:

- Program for control of combustibles and ignition sources within the plant;
- Program to ensure adequate fire detection and suppression capability;
- Program to ensure that the material condition, design, and qualification testing of passive fire protection features is adequate;
- Program to ensure that compensatory measures will be in place for out-of-service, degraded or inoperable fire protection equipment, systems or features;
- Program to ensure that feasible and reliable emergency operating actions will be taken if required to mitigate the adverse affects of a fire; and
- Program to assure that maintenance and facility changes continue to meet applicable codes and standards and license or certificate basis.

The inspection objectives, as stated in NRC Inspection Procedure 88055 (Annual), are to:

- Effectiveness of controls for combustibles and ignition sources within the plant;
- Operability of fire detection and suppression equipment and systems;
- The material condition of passive fire protection features; and
- Effectiveness of compensatory measures in place for out-of-service, degraded or inoperable fire protection equipment, systems or features.

The inspection procedure identifies three areas by which the licensee might be assessed:

- Documentation
- Implementation
- Assessment of equipment and facilities

Copies of NRC Inspection Procedures 88054 (Triennial) and 88055 (Annual) are available in Appendix B of this self-study guide (Tab 10).

MODULE 4.0: INSPECTION REQUIREMENTS FOR FIRE PROTECTION PROGRAMS

SUMMARY

Identifying the inspection requirements for a fire protection program at fuel cycle facilities is critical to maintain readiness for possible fire hazard. Inspections provide assurance that measures taken to achieve safe, reliable facility operations remain effective and that operations remain safe.

Schedule an appointment with your administrator before you go any further.

ANSWER KEY

SELF-CHECK QUESTIONS 4-1

1. List the primary components of a Fire Protection Program.
   - Management support
   - Administrative controls (for example, day-to-day supervision, hot work permits)
   - Annual Fire Hazards Analysis (FHA)
   - System for planning and follow-up for correction of deficiencies identified by the FHA, periodic audits, or inspection reports
   - Fire protection equipment maintenance and testing
   - Fire brigade training

2. The documented Fire Protection Program needs to be periodically reviewed and updated to reflect changing site circumstances and new requirements.

3. The purpose of an FHA is to comprehensively and qualitatively assess the risk from fire within individual fire areas in a facility.

4. An FHA should contain, but not be limited to, a conservative assessment of the following fire safety issues:
   - Description of construction
   - Fire protection features
   - Description of fire hazards
   - Protection of essential safety class systems
   - Life safety considerations
   - Critical process equipment
   - High value property
   - Damage potential
   - Maximum credible fire loss (MCFL) and maximum possible fire loss (MPFL)
   - Fire department/brigade response

- Recovery potential
- Potential for a toxic, biological, and/or radiological incident due to a fire
- Emergency planning
- Security and Safeguards considerations related to fire protection
- Natural hazards (earthquake, flood, wind)
- Impact on fire safety
- Exposure fire potential

5. NFPA 801, Standard for Fire Protection for Facilities Handling Radioactive Materials, provides guidance on considerations when preparing FHAs, however, other nationally recognized codes and standards may be used as guidance when appropriate.

6. To determine the frequency of meetings
   - To identify deficiencies reported
   - To consider actions taken
   - To ensure adequate implementation of the Fire Protection Program

SELF-CHECK QUESTIONS 4-2

1. Any of the following
   - Solvent extraction process areas
   - Boiler rooms
   - Incinerators
   - Warehouses
   - Control rooms
   - Switchgear rooms
   - Computer rooms
   - Maintenance shops
   - Fire pump areas
   - Office areas

2. List two purposes for the ventilation system during a fire.
   - To isolate affected areas during fire accidents
   - To provide channels for exhausting fire products, through filters if necessary, to outside the plant

3. Machining operations on combustible metals should be performed in enclosures with an operating:

   Dust-collection system

4. What is the minimum fire resistance rating for the barrier between an incinerator and the remainder of the facility?

   A minimum 1-hour fire resistance rating

5. For what purpose is the stationary engine room ventilated?
   - To minimize accumulation of combustible vapor
   - To mitigate the possibility of explosion

6. Construction materials for hot cells should be

   Noncombustible

7. What is the preferred method of fire suppression for most areas having significant fire hazard?

   Automatic water sprinkler coverage

SELF-CHECK QUESTIONS 4-3

1. Define administrative controls.

   Policies and procedures established by management to ensure that fire safety principles are implemented effectively to maintain safe operating conditions.

2. Define engineered controls.

   Design and operating limits that effectively reduce the risks associated with fire.

3. List examples of administrative controls that a fire inspector may request.
   - The facility's Fire Emergency Plan
   - Fire evacuation plan
   - Housekeeping procedures
   - Maintenance records
   - Hot work permits

4. List examples of engineered controls.
   - Automatic sprinkler systems
   - Automatic fire suppression systems
   - Predischarge alarm systems

5. All building areas should be inspected at least _____ to determine that appropriate fire prevention practices are being followed, fire protection is provided, and that the level of fire protection is consistent with the requirements.

   Semiannually

6. What is the easiest way to verify if a portable fire extinguisher is being maintained?

   Check the tag attached to the extinguisher.

7. List examples of documentation that should indicate whether fire protection equipment is being properly maintained.
   - Quarterly inspection report of exhaust and collector systems
   - Annual cleaning report for exhaust and collector systems
   - Report of annual maintenance-type inspections of fire extinguishers
   - Documentation of annual inspection of fire doors, latches, and automatic closing mechanisms
   - Reports of testing special or high-hazard operation alarms, interlocks, and process fail-safe controls.

- Semiannual inspection reports for manual pull stations and fire alarm evacuation devices
- Monthly inspection sheets for fire/emergency vehicles

8. Who is responsible for the prevention of fire loss?

   Management

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