NFPA®

1402

Standard on Facilities for Fire Training and Associated Props

2019

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NFPA® 1402

Standard on

Facilities for Fire Training and Associated Props

2019 Edition

This edition of NFPA 1402, *Standard on Facilities for Fire Training and Associated Props,* was prepared by the Technical Committee on Facilities for Fire Training and Associated Props. It was issued by the Standards Council on November 5, 2018, with an effective date of November 25, 2018, and supersedes all previous editions.

This edition of NFPA 1402 was approved as an American National Standard on November 25, 2018.

Origin and Development of NFPA 1402

In 1963, a subcommittee of the Fire Service Training Committee developed a document titled *How to Build Firemen's Training Centers.* That informative report was published and circulated as a guide and served to improve the scope and efficiency of fire fighter training. By 1985, the report had evolved into the first edition of NFPA 1402, *Guide to Building Fire Service Training Centers.* Revisions to NFPA 1402 were published in 1992 and 1997.

The Fire Service Training Committee appointed a task group to review the 1997 edition and make recommendations concerning the functionality of the document. After that review, the task group recommended a general updating of NFPA 1402, which was undertaken for the 2002 edition.

In addition to minor edits to address the general evolution of the subject, the committee placed more emphasis in the 2002 edition on needs analysis before design and construction, establishing policies and procedures for effective use of the structure, and the environmental impact of training and training props.

New material was added to the chapter on gas-fired burn props. The chapter on design and construction was renamed Selecting an Architect/Engineer (A/E) and placed more emphasis on the important roles played by these professionals and on the contract documents that form the foundation of projects for building fire service training centers. The chapter on burn buildings was renamed Live Fire Training Structure and placed more attention on these structures, especially regarding the impact of repeated high temperatures.

The 2007 edition of the guide included updated material on needs and cost analysis, training center components and considerations, and infrastructure considerations and exposures. The guide also included many new and updated illustrations.

The 2012 edition included a rewritten Chapter 7, Design and Construction Process, to aid the user in the workflow. Chapter 10, Live Fire Training Structure, was also rewritten to clarify some issues and make the document more user friendly, with Section 10.7 including suggested gas-fired live fire training safeguards.

The 2019 edition changes from a guide to a standard, changing the title to *Standard on Facilities for Fire Training and Associated Props.* A new technical committee, Facilities for Fire Training and Associated Props, was formed in 2015 to oversee the document. This new committee worked extensively to convert recommended language to mandatory language throughout the document, as well as to update requirements throughout to reflect general technological and industry updates. Two new chapters on gas-fueled live fire training systems were added. The chapter on smoke buildings was removed and replaced with a chapter on requirements for technical rescue training facilities. A new chapter on fire investigation training facilities was also added.

Two new annexes were added as well, providing guidance on the design and construction of fire service training centers and administrative and classroom buildings.

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This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This committee shall have primary responsibility for the design, construction, and maintenance of facilities for fire training and for fire training props. Responsibilities of the committee include standards relating to gas-fire props; training structures, props, and simulators used for live fire training, rescue training and related tactical and skill training exercises.

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NFPA 1402

Standard on

Facilities for Fire Training and Associated Props

2019 Edition

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in advisory sections of this document are given in Chapter 2 and those for extracts in the informational sections are given in Annex E. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text should be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex E.

Chapter 1 Administration

1.1 Scope. This standard contains the minimum design, construction, and maintenance requirements for fire service training centers, fire training structures and props, gas-fueled and flammable liquid–fueled live fire training systems, mobile fire training props, and associated training props.

1.2 Purpose.

1.2.1 The purpose of this standard is to establish consistent, minimum criteria for facilities, structures, and props that are used for conducting fire and rescue training classes and exercises.

1.2.2* The building code(s) and gas code(s) do not address the unique and specific requirements for specialized fire training structures, props, and systems. The minimum requirements of this standard are intended to bridge that gap.

1.3 Application.

1.3.1 This standard supplements, not supersedes, the building code(s) and gas code(s).

1.3.2 For any items covered by this standard and other NFPA standards on training, and for any conflicting items between them, the most stringent requirement shall govern.

1.3.3 The items listed in 1.3.3.1 through 1.3.3.4 are covered by this standard, whether located at a fire service training center or located elsewhere, such as at a fire station.

1.3.3.1 The design, manufacturing, installation, certification, testing, commissioning, and maintenance of gas-fueled live fire training systems and flammable liquid–fueled live fire training systems used for live fire training are covered by this standard.

1.3.3.2 The design, manufacturing, installation, certification, testing, commissioning, and maintenance of mobile training props are covered by this standard.

1.3.3.3 The design, construction, and maintenance of training structures and props used for live fire training are covered by this standard.

1.3.3.4 The design, construction, and maintenance of training structures and props used for rescue training, hazmat training, and related tactical training exercises that do not require live fire are covered by this standard.

1.3.4* Acquired structures used for live fire training evolutions are not covered by this standard.

1.3.5* Conventional facilities found at fire service training centers are typically not covered by this standard unless they are also being used a training structures or props. Further information can be found in Annexes B, C, and D.

1.4 Retroactivity. The provisions of this standard reflect a consensus of what is necessary to provide an acceptable degree of protection from the hazards addressed in this standard at the time the standard was issued.

1.4.1 Unless otherwise specified, the provisions of this standard shall not apply to facilities or structures that existed or were approved for construction or installation prior to the effective date of the standard. Where specified, the provisions of this standard shall be retroactive.

1.4.2 The requirements of Chapters 4, 5, and 8 through 14, and Sections 6.2 and 7.2 shall apply to existing facilities.

1.4.3 The requirements of Sections 6.1 and 7.1 shall apply to existing facilities beginning 3 years from the effective date of this standard.

1.4.4 In those cases where the authority having jurisdiction determines that the existing situation presents an unacceptable degree of risk, the authority having jurisdiction shall be permitted to apply retroactively any portions of this standard deemed appropriate.

1.4.5 The retroactive requirements of this standard shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction, and only where it is clearly evident that a reasonable degree of safety is provided.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems,* 2016 edition.
NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection,* 2017 edition.
NFPA 30, *Flammable and Combustible Liquids Code,* 2018 edition.
NFPA 54, *National Fuel Gas Code,* 2018 edition.
NFPA 58, *Liquefied Petroleum Gas Code,* 2017 edition.
NFPA 70®, *National Electrical Code*®, 2017 edition.
NFPA 86, *Standard for Ovens and Furnaces,* 2015 edition.
NFPA 1403, *Standard on Live Fire Training Evolutions,* 2018 edition.
NFPA 5000®, *Building Construction and Safety Code*® ,2018 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI Z21.21/CSA 6.5, *Automatic valves for gas appliances*, 2017.

2.3.2 ASCE Publications. American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA 20191-4400.

ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*, 2010.

2.3.3 ICC Publications. International Code Council, 500 New Jersey Avenue, NW, 6th Floor, Washington, DC 20001.

International Building Code, 2015.

2.3.4 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 508A, *Standard for Industrial Control Panels*, 2001, revised 2014.

2.3.5 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA *101*®, *Life Safety Code*®, 2018 edition.
NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids,* 2017 edition.
NFPA 1006, *Standard for Technical Rescue Personnel Professional Qualifications,* 2017 edition.
NFPA 1410, *Standard on Training for Initial Emergency Scene Operations,* 2015 edition.
NFPA 1451, *Standard for a Fire and Emergency Service Vehicle Operations Training Program,* 2018 edition.
NFPA 1500™, *Standard on Fire Department Occupational Safety and Health Program,* 2018 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* 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.

3.2.2 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.3* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.4 Shall. Indicates a mandatory requirement.

3.2.5 Should. Indicates a recommendation or that which is advised but not required.

3.2.6 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase "standards development process" or "standards development activities," the term "standards" includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1 Acquired Prop. A piece of equipment acquired by the AHJ for the purposes of conducting fire training evolutions, technical rescue training, hazardous materials training, or other fire rescue training whether including live fire or not.

3.3.2 Acquired Structure. A building or structure acquired by the AHJ from a property owner for the purposes of conducting fire training evolutions, technical rescue training, hazardous materials training, or other fire rescue training whether including live fire training or not.

3.3.3 Appliance. See 3.3.17, Gas-Fueled Training Appliance.

3.3.4 Burn Room. Space or compartment inside a live fire training structure in which live fires are conducted.

3.3.5 Containerized Training Structure. A structure consisting of one or more shipping (intermodal) containers assembled together for the purpose of conducting live fire, nonlive fire, rescue, hazmat, and/or other related training evolutions. If the containerized training structure is to support live fire training, then it is classified as a live fire training structure.

3.3.6 Dead Loads. Dead loads consist of the weight of all materials of construction incorporated into the building including but not limited to walls, floors, roofs, ceilings, stairways, built-in partitions, finishes, cladding and other similarly incorporated architectural and structural items, and fixed service equipment including the weight of cranes. [**ASCE/SEI 7:**3.1.1]

3.3.7* Designed Anchor Point. An anchor point designed by an engineer or other qualified person, and installed in accordance with the manufacturer's recommendations, to support the forces generated in rope rescue systems.

3.3.8 Emergency Medical Services. The provision of treatment, such as first aid, cardiopulmonary resuscitation, basic life support, advanced life support, and other pre-hospital procedures including ambulance transportation, to patients. [**1500,** 2018]

3.3.9 Evolution. A set of prescribed actions that result in an effective fireground activity. [**1410,** 2015]

3.3.10 Factored Load. Working load multiplied by a factor of safety that is greater than 1.

3.3.11 Fire Investigation Burn Cell (Burn Cell). A smaller subdivision of either a fire investigation training structure or fire investigation training prop, designed or intended to contain the arrangement of fuels used in fire investigation training.

3.3.12 Fire Investigation Set (Set). The constructed, arranged, or adapted use of furniture, fixtures, equipment, and fuels intended for burning as part of fire investigation training, within a fire investigation burn cell.

3.3.13 Fire Investigation Training Prop. A vehicle, vessel, equipment, or fabricated mock-up acquired or specifically built or manufactured to facilitate fire conditions, behavior, and patterns for conducting fire investigation training. This prop is not used for live fire training.

3.3.14 Fire Investigation Training Structure. A permanent structure acquired or specifically built to facilitate fire conditions, behavior, and patterns for conducting fire investigation training on a repetitive basis, with each use being a single burn. This structure is not used for live fire training.

3.3.15 Fire Prop. A noncombustible assembly used for repeatable live fire training exercises containing the gas burners of the gas-fueled training appliance and located inside the burn space.

3.3.16* Gas-Fueled Live Fire Training System. An engineered system comprised of the gas-fueled training appliance(s), the associated piping, and the fire prop(s).

3.3.17 Gas-Fueled Training Appliance. An engineered product comprised of burner controls, safety systems, and ignition system used to operate the fire prop.

3.3.18 Highline System. A system of using rope or cable suspended between two points for movement of persons or equipment over an area that is a barrier to the rescue operation, including systems capable of movement between points of equal or unequal height. [**1006,** 2017]

3.3.19 Intermittent Pilot. A pilot that burns during light-off and while the main burner is firing.

3.3.20 Interrupted Pilot. A pilot that is ignited and burns during light-off and is automatically shut off at the end of the trial-for-ignition period of the main burner(s).

3.3.21 Liquid-Fueled Live Fire Training System. A training prop used for live fire training on a repetitive basis, fueled by gasoline, diesel, kerosene, reduced-emissions flammable liquid, or other flammable or combustible liquid.

3.3.22 Live Fire. Any open flame capable of emitting thermal load or toxic by-products of combustion that would necessitate the use of personal protective equipment (PPE).

3.3.23 Live Fire Training Prop. A training prop utilized for conducting live fire training evolutions on a repetitive basis.

3.3.24* Live Fire Training Structure. A structure utilized for conducting live fire training evolutions on a repetitive basis.

3.3.25 Live Loads. Live loads are those produced by the use and occupancy of the building or other structure and do not include construction or environmental loads such as wind load, snow load, rain load, earthquake load, flood load, or dead load. Live loads on a roof are those produced (1) during maintenance by workers, equipment, and materials; and (2) during the life of the structure by movable objects such as planters and by people. [**ASCE/SEI 7:**4.1]

3.3.26 Means of Egress. A continuous and unobstructed way of travel from any point in a building or structure to a public way consisting of three separate and distinct parts: (1) the exit access, (2) the exit, and (3) the exit discharge. [***101,*** 2018]

3.3.27 Means of Escape. A way out of a building or structure that does not conform to the strict definition of means of egress but does provide an alternate way out. [***101,*** 2018]

3.3.28 Mobile Training Prop. A training prop intended to be transported over roads for conducting fire, rescue, hazmat, or related training evolutions on a repetitive basis, whether including live fire or not, at different locations.

3.3.29 Mock-Up. A noncombustible assembly that can be used in association with the fire prop to change its appearance to enhance training realism.

3.3.30 Owner/Operator. The organization with fiscal responsibility for the operation, maintenance, and profitability of the facility. [**654,** 2017]

3.3.31 Portable Training Prop. A training prop that is not permanently mounted to a trailer or fixed to the ground and can be moved around the training site. Transportation on roadways requires a trailer or transport vehicle.

3.3.32 Qualified Person. A person who, by possession of a recognized degree, certificate, professional standing, or skill, and who, by knowledge, training, and experience, has demonstrated the ability to deal with problems related to the subject matter, the work, or the project. [**1451,** 2018]

3.3.33 Seismic Forces. The assumed forces prescribed herein [ASCE/SEI 7], related to the response of the structure to earthquake motions, to be used in the design of the structure and its components. [**ASCE/SEI 7:**11.2]

3.3.34 Technical Search and Rescue. The application of special knowledge, skills, and equipment to resolve unique and/or complex search and rescue situations. [**1006,** 2017]

3.3.35* Training Prop. A facility utilized for conducting fire, rescue, hazmat, or related training evolutions on a repetitive basis, whether including live fire or not.

3.3.36 Training Structure. A live fire training structure, training tower, or containerized training structure.

3.3.37 Training Tower. A multistory building or structure specifically built for conducting fire, rescue, hazmat, and/or other related training evolutions on a repetitive basis, without the use of live fire. A training tower could be constructed of conventional materials (masonry, concrete, steel, or wood), or it could be a containerized training structure. If the multistory building or structure is to support live fire training, then it is classified as a live fire training structure.

3.3.38 Trial-for-Ignition Period (Flame-Establishing Period). The interval of time during light-off that a combustion safeguard allows the fuel safety shutoff valve to remain open before the flame detector is required to supervise the flame.

3.3.39* Working Load. The force specified for weight of materials and personnel, actions, environmental effects, differential movement, and restrained dimensional changes with no factor of safety applied.

Chapter 4 Establishing Policies and Standard Operating Procedures

4.1 Written Policies and Procedures.

4.1.1* Written policies and standard operating procedures for the fire training center and each training structure and prop shall be established by the AHJ.

4.1.2 The following shall be incorporated into the written policies and procedures:

(1) Requirements of other NFPA standards
(2) Manufacturers' requirements and recommendations for proper use of training structures and props

Chapter 5 Site and Infrastructure

5.1 Water Supply.

5.1.1* In addition to domestic and fire protection water that is required for occupied building(s) and facilities on site, the water required for training evolutions shall be provided.

5.1.2 When hydrants are supplied at the training center, the hydrant connection(s) shall be those specified by the AHJ.

5.2 Security.

5.2.1* The training center shall be capable of restricting access to unauthorized personnel.

5.2.1.1 Props that present a special hazard, as determined by the AHJ, shall be provided with additional security measures.

5.3* Personnel Gross Decontamination. The training center shall facilitate personnel wash-down after training exercises that expose personnel to products of combustion in accordance with the requirements of the AHJ.

5.4* Environmental Consideration. The training center shall be designed to meet the minimum environmental requirements of the AHJ as they relate to fire training centers.

Chapter 6 Training Structures and Props — General

6.1 Design and Construction.

6.1.1* Training structures and props shall meet the design and construction requirements of the AHJ and local building official, including whether a building permit or professional engineering stamp are required.

6.1.2 Training structures and props shall be designed for loading from wind, earthquakes, snow, ice, retained soil, flood, operations, equipment, and any other applied loading.

6.1.2.1 Training structures and props shall be positioned and anchored to ensure stability.

6.1.3 Training structures and props shall be designed and built for exposure to weather and seasonal temperature changes.

6.1.4 Depending on their intended use, training structures and props shall be designed and built for exposure to training water and impact forces inherent in training, such as impact from high pressure hose streams, tools, and self-contained breathing apparatus (SCBA) tanks.

6.1.5 Stairs in or adjacent to training structures and props shall meet requirements of the building code for tread and riser dimensions, stair and landing widths, and railing heights and strengths.

6.1.6 Guardrails and handrails at training structures and props shall be provided at locations required by the building code for an occupied building and shall meet the building code requirements for height and loading.

6.1.7 Where railing(s) would prohibit the intended use of the training structure or prop, such as pitched roofs of training structures simulating residential occupancy or the wing of a simulated aircraft prop, railings shall be permitted to be optional.

6.1.8* Floors and roofs of training structures and props shall be designed to support dead loads plus a minimum live load of 50 lb/ft^2 (244 kg/m^2), unless heavier live loads are anticipated or required by the building code or AHJ.

6.1.9* Drainage for training water used in training structures and props shall be provided in the design.

6.1.9.1* If floors and roofs slope to interior or exterior drains, then the floor and roof structures shall be designed to support the weight of the maximum quantity of water that could accumulate on the floors and roofs if the drains clog.

6.1.10 Calcium aluminate concrete ("refractory concrete") shall not be used for structural slabs, beams, walls, columns, or other load-bearing structural components.

6.1.11* Grounding and bonding locations at or on training structures and props shall be provided in accordance with the requirements of the AHJ.

6.1.12 When standpipes and/or sprinklers are subjected to freezing temperatures, they shall be equipped with a drainage system and instructions posted to prevent damage to the system.

6.2* Maintenance.

6.2.1 Training structures and props shall be maintained by the owner/operator or an entity retained by the owner/operator.

6.2.2 When standpipes are installed, they shall be maintained and inspected in accordance with NFPA 14.

Chapter 7 Live Fire Training Structures

7.1* Design and Construction.

7.1.1 Live fire training structures shall meet the requirements of Chapters 6 and 7.

7.1.2 Structural components in burn rooms and all structural components supporting, enclosing, and bracing burn rooms and structural components outside burn rooms that are exposed to flame impingement, fire extension, and heat from training fires shall be constructed of noncombustible materials.

7.1.3* Live fire training structures shall be designed by a licensed design professional to meet the structural requirements of the building code for materials, vertical loads, lateral loads, long-term loads, permanent foundations, and stability.

7.1.3.1 If the AHJ has not adopted a building code, the structural requirements of the latest edition of the *International Building Code* or *NFPA 5000* shall apply.

7.1.4* All components in burn rooms and components in areas outside burn rooms that are exposed to flame impingement, fire extension, and heat from training fires shall be designed for exposure to high temperatures, high volumes of water, thermal shock, steam, expansion and contraction, and other project and site-specific design considerations.

7.1.4.1* Load-bearing structural elements that will be exposed to temperatures exceeding 350°F (177°C), whether in or out of a burn room, shall be protected with a thermal lining or other thermal protection system to keep temperatures at the face of the structural elements at or below 350°F (177°C).

7.1.4.2 Components shall be free of asbestos.

7.1.4.3 Components shall be free of plastic, rubber, and sealed components that could burst when heated.

7.1.5 All burn rooms shall have, as a minimum, one of the following:

(1) Two doors that exit the burn room to an adjacent room or to an exterior grade, a balcony, a roof, or stairs
(2) One door to an adjacent room and one window to either another room, a balcony, a roof, or another tenable location

Exception: In the case of a gas-fired burn room where the fire cannot be between the participant and the door, one door shall be acceptable.

7.1.6* Burn areas that are fully below grade shall be prohibited, but burn areas that are at a belowgrade level but with full, at-grade walkout capability at a minimum of one full side of the training structure shall be permitted.

7.1.7 Electrical conduits, wiring, and devices shall not be permitted in Class A burn rooms or compartments.

Exception: Low-voltage wiring, conduits, and devices shall be permitted in Class A burn rooms and, except for thermocouples, shall be protected from the heat of training fires.

7.1.8 Doors and window shutters that are exposed to elevated temperatures related to live fire training shall meet the following requirements:

(1) Resist binding when exposed to temperature cycles associated with live fire training, which could cause significant expansion and contraction
(2) Operate from both sides of the door or shutter without special tools or keys during live fire training

7.1.9* The site area around the live fire training structure shall be free of combustible materials for a distance of at least 10 ft (3 m) and designed to accommodate the training requirements.

7.2 Maintenance, Evaluations, and Testing.

7.2.1* The structural integrity of live fire training structures shall be evaluated and documented annually by the owner/operator or AHJ.

7.2.1.1 If visible structural defects are found, such as cracks, rust, spalls, or warps in structural floors, columns, beams, walls, or metal panels, the owner/operator shall have a follow-up evaluation conducted by a licensed professional engineer with live fire training structure experience and expertise, or by another qualified professional as determined by the owner/operator or AHJ.

7.2.2* The structural integrity of the live fire training structure shall be evaluated and documented by a licensed professional engineer with live fire training structure experience and expertise, or by another qualified professional as determined by the AHJ, at the following intervals:

(1) For gas-fired live fire training structures, at least once every 10 years or more frequently if determined to be required by the evaluator.
(2) For non-gas-fired live fire training structures, at least once every 5 years or more frequently if determined to be required by the evaluator.
(3)* For structures constructed with calcium aluminate refractory structural concrete, every 3 years or more frequently if determined to be required by the evaluator.

7.2.2.1 The structural evaluation of structures constructed with calcium aluminate refractory structural concrete shall include removal of concrete core samples from the structure to check for delaminations within the concrete.

7.2.2.2* Part of the live fire training structure evaluation shall include, at the same intervals listed in 7.2.2, the removal and reinstallation of a representative area of thermal linings (if any) to evaluate the concealed conditions behind the linings.

Chapter 8 Gas-Fueled Live Fire Training Systems — Interior

8.1 General.

8.1.1* A gas-fueled fire training system shall include, at a minimum, a gas-fueled training appliance and a fire prop that generates and controls repeatable flames for training fire fighters on suppression techniques.

8.1.2 Burners, along with associated valves, regulators, safety controls, and other auxiliary components, shall be selected for the intended application, type, and pressure of the fuel gases to be used and the temperatures to which they are subjected.

8.1.3 Fire props and mock-ups shall maintain structural integrity while being used for training in accordance with NFPA 1403.

8.1.3.1 After extended use, mock-ups shall be able to be maintained or replaced without the replacement of the fire prop.

8.2 Gas Equipment.

8.2.1 Fuel Storage. Installation of LP-Gas storage and handling systems (if applicable) shall comply with NFPA 58 or other applicable standards as recognized by the AHJ.

8.2.2 Gas Piping and Fittings.

8.2.2.1 Piping from the point of delivery to the equipment isolation valve shall comply with NFPA 54 or other applicable standards as recognized by the AHJ.

8.2.2.2 Fuel gas piping materials shall be in accordance with NFPA 54 or other applicable standards as recognized by the AHJ.

8.2.2.3 Fuel gas piping shall be sized to provide flow rates and pressure to maintain a stable flame throughout the burner operating range.

8.2.3 Control of Contaminants.

8.2.3.1 A sediment trap shall be installed downstream of the appliance isolation valve and upstream of all other fuel gas system components.

8.2.3.2 Sediment traps shall have a vertical leg with a minimum length of three pipe diameters [minimum of 3 in. (80 mm)] of the same size as the supply pipe.

8.2.3.3 A minimum of one gas filter or strainer shall be installed in the fuel gas piping and shall be located to protect the downstream gas components.

8.2.4 Exterior Shutoff. A system fuel shutoff valve shall be located on the fuel gas supply line on the exterior of the structure or prop, immediately adjacent to the supply line entry point into the structure or prop, and be accessible for access and service, as follows:

(1) The valve shall be a quarter-turn valve with stops.
(2) The handle shall remain affixed to valve and shall be oriented with respect to the valve port to indicate the following:
    (a) An open valve when the handle is parallel to the pipe
    (b) A closed valve when the handle is perpendicular to the pipe
(3) The valve shall be accessible.
(4) The valve shall be able to be operated from full open to full close and return without the use of tools.

8.2.5 Appliance Isolation Valves. Manually operated equipment isolation valves shall meet the following requirements:

(1) They shall be provided for each appliance.
(2) They shall be quarter-turn valves with stops.
(3) Handles shall remain affixed to valves and shall be oriented with respect to the valve port to indicate the following:
    (a) An open valve when the handle is parallel to the pipe
    (b) A closed valve when the handle is perpendicular to the pipe
(4) They shall be accessible.
(5) They shall be able to be operated from full open to full close and return without the use of tools.

8.2.6 Fuel Pressure Regulators.

8.2.6.1 A fuel pressure regulator shall be furnished wherever the supply pressure exceeds the system operating or design parameters or wherever the supply pressure is subject to fluctuations.

8.2.6.2 Vents shall be designed to prevent the entry of water and insects without restricting the flow capacity of the vent.

8.2.6.3 Regulators, relief valves, and gas pressure switches shall not be required to be vented to an approved location in the following situations:

(1) Where a listed regulator–vent limiter combination is used
(2) Where a regulator system is listed for use without vent piping
(3) Where a regulator incorporates a leak limiting system that prevents or restricts the escape of gas into a space large enough and with sufficient natural ventilation so that the escaping gas does not present a hazard
(4) Where a fuel pressure switch employs a vent limiter rated for the service intended

8.2.6.4 Vents from appliances operating at different fuel pressure control levels shall not be manifolded together.

8.2.6.5 Vents from appliances served from different fuel pressure reducing stations shall not be manifolded together.

8.2.6.6 Vents from systems using different fuel sources shall not be manifolded together.

8.2.6.7 Vent lines from multiple regulators and pressure switches of single or multiple appliances, where manifolded together, shall be piped in such a manner that any gas being vented from one ruptured diaphragm does not backload the other devices.

8.2.6.8 The cross-sectional area of the manifold line shall not be less than the greater of the following:

(1) The cross-sectional area of the largest vent plus 50 percent of the sum of the cross-sectional areas of the additional vent lines
(2) The sum of the cross-sectional areas of the two largest vent lines

8.2.6.9 A vent between safety shutoff valves, where installed, shall meet the following conditions:

(1) Shall not be combined with other vents
(2) Shall terminate to the exterior

8.2.6.10 Overpressure Protection.

8.2.6.10.1 Overpressure protection shall be provided in either of the following cases:

(1) When the gas supply pressure exceeds the pressure rating of any downstream component
(2) When the failure of a single upstream line regulator or service pressure regulator results in a supply pressure exceeding the pressure rating of any downstream component

8.2.6.10.2 Overpressure protection shall be provided by any one of the following:

(1) A monitoring regulator installed in series with the service or line pressure regulator in accordance with NFPA 54
(2) A full-capacity pressure relief valve
(3) An overpressure cutoff device, such as a slam-shut valve or a high-pressure switch in combination with a compliant shutoff valve

8.2.6.11 Safety Shutoff Valves.

8.2.6.11.1 Each main and pilot fuel gas burner system shall be separately equipped with at least two safety fuel gas shutoff valves in series that automatically shut off the fuel to the burner system in each of the following events:

(1) Interruption of electrical power
(2) Activation of any interlocking safety devices
(3) Activation of the combustion safeguard
(4) Failure of the operational controls
(5) Activation of manual shutdown stations

8.2.6.11.2 Each safety shutoff valve shall automatically shut off the fuel to the burner system after interruption of the holding medium (such as electric current or fluid pressure) by one of the interlocking safety devices, combustion safeguards, or operational controls.

8.2.6.11.3 Where multiple fire props share a common interior space, the safety shutdown of one fire prop shall result in the safety shutdown of all fire props in that space, as shown in Figure 8.2.6.11.3.

8.2.6.11.4 Safety shutoff valves shall not be used as modulating control valves unless they are designed as both safety shutoff and modulation valves and tested for concurrent use.

8.2.6.11.5 Safety shutoff valves shall not be open-close cycled at a rate that exceeds that specified by its manufacturer.

8.2.6.11.6 Valve components shall be of a material selected for compatibility with the fuel handled and for ambient conditions.

8.2.6.11.7 Safety shutoff valves in systems containing particulate matter or highly corrosive fuel gas shall be operated at time intervals in accordance with the manufacturer's instructions in order to maintain the safety shutoff valves in operating condition.

8.2.6.11.8 Valves shall not be subjected to supply pressures in excess of the manufacturer's ratings.

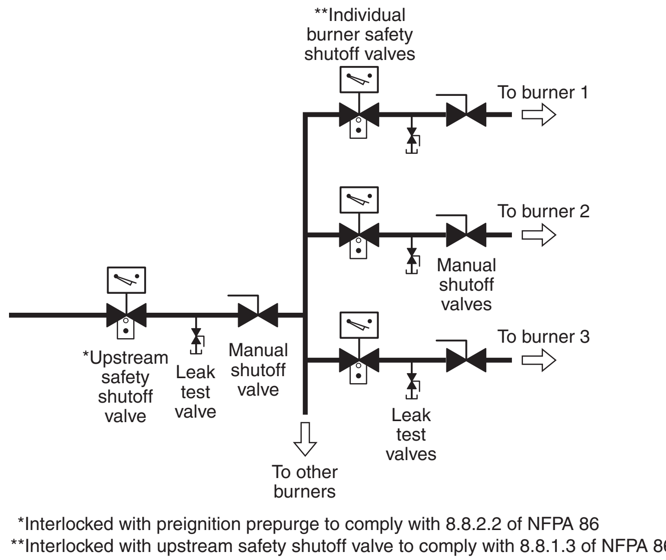

FIGURE 8.2.6.11.3 Multiple Burner System Valve Train Diagram.

8.2.6.11.9 The safety shutoff valves shall close in 1 second or less upon being de-energized.

8.2.6.11.10 Each main and pilot fuel gas burner system shall be separately equipped with either of the following:

(1) Two safety shutoff valves wired in parallel and piped in series
(2) A pilot train with an input greater than 20,000 Btu/h (6 kW) up to and including 400,000 Btu/h (120 kW) equipped with two safety shut-off valves piped in series and wired in parallel and certified in accordance with ANSI Z21.21/CSA 6.5, *Automatic valves for gas appliances*, or one safety shut-off valve certified in accordance with ANSI Z21.21/CSA 6.5 and marked C/I

8.3 Fuel Types.

8.3.1 Liquefied versions of flammable gas and flammable liquids shall not be piped into or utilized inside a structure or training prop and therefore shall not be used for interior live fire training. *(For the use of combustible liquids inside of a training structure, refer to Chapter 14.)*

8.3.2 Fuel vapor at pressures exceeding 20 psig (138 kPag) shall not be piped into any training structure.

8.3.3 Flammable liquids, as defined in NFPA 30, shall not be used in interior live fire training systems.

8.4 Main Gas Burners and Pilot Burners.

8.4.1 Burners shall be used only with the fuels for which they are designed.

8.4.2 All pressures required for operation of the combustion system shall be maintained within the design ranges throughout the firing cycle.

8.4.3 Burners shall have the ignition source sized and located in a position that provides ignition of the pilot within the design trial-for-ignition period.

8.4.4* The pilot ignition source shall be applied at the design location with the designed intensity to ignite the flame pilot burner air-fuel mixture.

8.4.5 Pilot burners shall be mounted to prevent unintentional changes in location and in direction with respect to the main flame burners.

8.4.6* No substitute for flame pilot burners shall be utilized to ignite main burners.

8.4.7 All main burners shall be ignited directly from a confirmed and monitored pilot flame.

8.4.7.1 Pilot burners shall be positioned and fixed as close as practical to ensure pilot flame impinges on the first points of gas release of the related main burner element(s) to ensure positive ignition.

8.4.8 The live fire system shall include either an intermittent pilot or an interrupted pilot.

8.4.9 Manually lighting flammable gas fires in interior training spaces or altering a manufacturer's appliance shall not be permitted.

8.4.9.1 Intermittent Pilot Burners.

8.4.9.1.1 Intermittent pilot flames shall be interlocked to control fuel delivery valves to prevent fuel from flowing without a confirmed pilot flame being present.

8.4.9.1.2 Pilot flames shall be continuously monitored for the duration of the demand for flame on the main burner(s).

8.4.9.1.2.1 Upon loss of pilot flame, all related burner gas supply valves shall automatically close.

8.4.9.2 Interrupted Pilot Burners.

8.4.9.2.1 Interrupted pilot flames shall be interlocked to control fuel delivery valves to prevent fuel from flowing without a confirmed pilot flame being present during the main flame establishment period.

8.4.9.2.2 Main flames shall be continuously monitored for the duration of the demand for flame on the main burner(s).

8.4.9.2.3 Upon loss of main flame confirmation, all related burner gas supply valves shall automatically close.

8.5 Control System.

8.5.1 Electrical System — Safety Devices.

8.5.1.1 All wiring and equipment shall be in accordance with *NFPA 70*, or other applicable standards as recognized by the AHJ.

8.5.1.2 Control panels shall be designed and manufactured in compliance with UL 508A, *Standard for Industrial Control Panels*, or other applicable standards as recognized by the AHJ.

8.5.1.3 Combustion safeguards, flame detectors, and safety shutoff valves shall be listed for combustion safety service or approved by a nationally recognized testing laboratory (NRTL) if a listed device is not commercially available for use in the design environment.

8.5.1.4 Safety devices shall be selected, applied, and installed in accordance with this standard and the manufacturer's instructions.

8.5.1.5 Safety devices shall be located or guarded to protect them from physical damage.

8.5.1.6 Safety devices shall not be bypassed electrically or mechanically.

8.5.1.7 Where a system includes a "built-in" test mechanism that bypasses any safety device, it shall be interlocked to prevent operation of the system while the device is in the test mode, unless listed for that purpose.

8.5.2 Emergency Stops.

8.5.2.1 At least one manual emergency (e-stop) switch shall be provided at one entry point to each burn room, in order to initiate a safety shutdown.

8.5.2.2 Each e-stop switch shall be connected into the control system as a safety interlock.

8.5.2.3 A safety shutdown of the burner system shall require manual intervention of an operator to re-establish normal operation of the system.

8.5.2.4 Where wireless controls are used in place of hard-wired e-stop switches for safety shutdown functions, wireless control signal failure shall be supervised and a signal failure shall initiate a safety shutdown.

8.5.3 Burner Management System (BMS).

8.5.3.1 Gas-fueled live fire training systems shall include a listed commercial flame safeguard system or a programmable controller used in accordance with Section 8.4 of NFPA 86.

8.5.3.2 The activation of any safety interlock in the BMS shall result in a safety shutdown of the associated burner(s).

8.5.3.3 Safety interlocks shall meet one or more of the following criteria:

(1) Be hardwired without relays in series and ahead of the controlled device
(2) Be connected to an input of a programmable controller logic system complying with Section 8.4 of NFPA 86
(3) Be connected to a relay that represents a single safety interlock that is configured to initiate safety shutdown in the event of power loss
(4) Be connected to a listed safety relay that represents one or more safety interlocks and initiates safety shutdown upon power loss

8.5.4 Safe Start Check. The control system must be designed to constantly monitor all safety systems for satisfactory operation.

8.5.5 System Operation and Safety Shutdowns.

8.5.5.1 Safety devices shall not be removed or rendered ineffective.

8.5.5.2 High Fuel Gas Pressure Sensor — Safety Shutdown. The system shall contain a system fuel high-pressure sensor that meets the following criteria:

(1) Interlocked into the trainer control system
(2) Located downstream of the system pressure-reducing regulator(s)
(3) Have a set point below the lowest rated operating pressure of any gas component positioned downstream of the final pressure control

(4) Have a trip that causes all of the system burner(s) to shut down and the event to be indicated to the trainer control system

8.5.5.3 Combustion Air.

8.5.5.3.1 The fuel-burning system design shall provide a supply of clean combustion air mechanically delivered in amounts prescribed by the appliance manufacturer across the full range of burner operation.

8.5.5.3.2 Products of combustion, steam, simulated smoke, and other contaminants shall not be mixed with or introduced into the combustion air supply.

8.5.5.3.3 Where combustion air is provided mechanically, combustion airflow or pressure shall be proven and interlocked with the safety shutoff valves so that fuel gas cannot be admitted prior to establishment of combustion air and so that the gas is shut off in the event of combustion air failure.

8.5.5.3.4 Where a combustion air adjustment is provided, adjustment shall include a locking method to prevent an unintentional change in setting.

8.5.5.4 Exhaust Ventilation System.

8.5.5.4.1 An exhaust ventilation system capable of removing heat, smoke, and unburned gas shall be installed for each burn room in the live fire training structure.

8.5.5.4.2 The exhaust fan shall be rated for continuous high-temperature operation and shall be listed.

8.5.5.4.3 The exhaust ventilation system shall be sized, when operating at high speed, to provide a minimum of one air change per minute in the related live fire training space(s).

8.5.5.4.3.1 The exhaust ventilation system shall be commanded to run at high speed during all e-stop events to meet the minimum requirement of one air change per minute in the related live fire training space(s).

8.5.5.4.3.2 The exhaust ventilation system shall continue to run at high speed until the initiating e-stop event is cleared.

8.5.5.4.4 The ventilation system shall be interlocked with the fire generation control system so that a failure of the ventilation system shall inhibit the operation of the main burners of the related burn props in the space that the ventilation system serves.

8.5.5.4.4.1 During burn evolutions, the ventilation system shall not be required to operate at high speed.

8.5.5.4.5 The exhaust ventilation system shall be monitored for operation using an airflow sensor or other method of ensuring that a failure of the exhaust ventilation system is sensed by the fire generation control system.

8.5.5.4.6 The exhaust ventilation system airflow sensor shall not be capable of being bypassed or overridden to yield a false indication of positive airflow.

8.5.5.4.7* Provision for a quantity of makeup air shall be admitted to burn rooms to provide the air volume required for the safety exhaust ventilation system to operate at rated maximum airflow when all doors and windows to the burn room are fully closed.

8.5.5.4.8 The exhaust ventilation extraction point for the burn room shall be at or near the uppermost horizontal surface of the burn space.

8.5.5.4.8.1 The extraction opening shall be permitted to be in the ceiling surface or at the highest point of a vertical burn room wall.

8.5.5.4.9 Exhaust ventilation fans shall be located in areas where they can be inspected and maintained.

8.5.5.4.10 Exhaust ventilation fans shall have local power disconnects provided in accordance with *NFPA 70*.

8.5.5.5 Exhaust Ventilation Ductwork.

8.5.5.5.1 If exhaust ventilation ductwork is provided as part of the exhaust ventilation system design, the provisions in 8.5.5.5.2 through 8.5.5.5.6 shall be followed.

8.5.5.5.2 Ductwork shall be constructed entirely of corrosion-resistant metal capable of meeting the intended installation and conditions of service.

8.5.5.5.3 The installation shall be protected where subject to physical damage.

8.5.5.5.4 All ductwork shall be made tight throughout and shall have no openings other than those required for the operation and maintenance of the system.

8.5.5.5.5 All ductwork shall be braced where required and shall be supported by corrosion-resistant metal hangers or brackets.

8.5.5.5.6 Exhaust fans, exhaust ducts, or both shall not discharge near openings or other air intakes where effluents can be entrained and directed to locations creating a hazard.

8.5.5.6 Temperature Monitoring System.

8.5.5.6.1 One or more interlocked temperature monitoring devices that measure the temperatures within the live fire training environment shall be installed in each burn room.

8.5.5.6.2 A measuring device shall be mounted at a level of 5 ft (1.5 m) above finished floor (AFF), at a location between the gas-fueled appliance and first point of ventilation and where trainees are expected to frequent.

8.5.5.6.3 A high-temperature shutdown shall occur when temperature reaches the lower of 500°F (260°C) or 50°F (10°C) below the temperature limits of all PPE, to avoid injuries and equipment damage.

8.5.5.6.4 Upon activation of a high-temperature shutdown, all burners in the related space shall be automatically shut down, and forced, full-volume mechanical ventilation of the related training space shall be initiated automatically by the control system.

8.5.5.6.5 The ventilation operation shall continue until the measured temperature on the interlocked temperature monitoring system(s) falls below the set point.

8.5.5.7 Combustible Gas Detection System.

8.5.5.7.1 Combustible gas detection shall be provided in training and equipment spaces where the possibility exists for the accumulation of unburnt gases either released during the operation of a gas-fueled live fire training system or leaked within the unventilated confines of an equipment area.

8.5.5.7.2 The gas detection system shall be interlocked to the control system to cause a system safety shutdown and activate an alarm when the level exceeds 25 percent of the lower explosive limit (LEL).

8.5.5.7.3 Forced, mechanical ventilation of the training space shall be initiated automatically by the control system when the safety shutdown occurs at the 25 percent LEL and continue until the measured LEL on all interlocked gas detection system falls below 10 percent.

8.5.5.7.4 Combustible gas detection installed within training and equipment spaces shall be designed to be continuously monitored during all live fire training activities.

8.5.5.7.5 Failure of the gas detection system shall inhibit the operation of live fire initiation within the related area of coverage of the failed gas detection system.

8.5.5.7.6* For live fire training structures with more than one room that includes a gas-fueled live fire training system, the gas detection systems shall be interlocked between any training rooms where the communication of gas could occur.

8.5.5.7.7 When interlocked, the gas detection system in remote rooms shall have the ability to cause a safety shutdown for all related gas-fueled live fire training systems.

8.5.5.7.8 Combustible gas detection shall be executed either by a direct monitoring gas detection system fixed gas sensor head installed within the live fire training room or by a drawn sample extraction gas detection system.

8.5.5.7.9 Direct Monitoring Combustible Gas Detection.

8.5.5.7.9.1 Direct monitoring systems shall include all of the following characteristics:

(1) Be rated to operate within the high levels of humidity and moisture experienced under live fire training conditions
(2) Include a spray shield and moisture prevention device
(3) Be mounted in a location that will have temperatures within the normal operating range of the gas detector
(4) Allow gas samples to be taken between burn room entrance and the burner at a height where the fuel gas is expected to be present
(5) Continuously respond and react to the dynamic changes in unburned gas levels within the live fire training space
(6) Be designed to have a sensor that is nonpoisonable

8.5.5.7.9.2 Drawn Sample Extraction Gas Detection. Sample extraction gas detection systems shall include all of the following characteristics:

(1) Be rated to operate within the high levels of humidity and moisture experienced under live fire training conditions
(2) Include a moisture prevention device
(3) Utilize a pump to continuously draw samples of the live fire training environment
(4) Allow draw samples to be taken in proximity to the equipment, between burn room entrance and the burner at a height where the fuel gas is expected to be present
(5) Provide filtering to prohibit the solid contaminants from the sampled space from entering the sampling lines
(6) Provide monitoring devices to detect flow rate deviations caused by disconnected sampling lines, clogged sampling lines, dirty filters, and sample pump failures
(7) Continuously respond and react to the dynamic changes in unburned gas levels within the training space

8.5.5.7.9.3 Combustible Gas Sensing Locations.

(A)* The gas sensor/sample inlets shall be mounted in the airflow path between the live fire training system and ventilation outlets where they are most likely to detect the gas concentration.

(B)* The gas sensor/sample inlets shall be mounted in an area where it is accessible to routine maintenance and inspection.

(C) Protection for the gas sensor/sample inlet shall be provided in an area where it will be subjected to physical abuse, which would damage or impede the performance of the sensing system.

8.5.5.8 Operator Interface.

8.5.5.8.1 Operator Present Capability.

8.5.5.8.1.1 An operator present *deadman* feature shall be included in the control system for every fire prop.

8.5.5.8.1.2 Failure to maintain the operator present condition shall cause the related fire(s) to be immediately stopped.

8.5.5.8.1.3 The operator present feature shall not be disabled or bypassed.

8.6* System Operations and Maintenance Training.

8.6.1 Personnel who operate, maintain, or supervise the system shall be thoroughly instructed and trained in their respective job functions under the direction of a qualified person(s).

8.6.2 Personnel who operate, maintain, or supervise the system shall be required to demonstrate an understanding of the equipment, its operation, and practice of safe operating procedures in their respective job functions.

8.6.3 Personnel who operate, maintain, or supervise the system shall receive regularly scheduled refresher training and shall demonstrate understanding of the equipment, its operation, and practice of safe operating procedures in their respective job functions.

8.6.4 The training program shall cover start-up, shutdown, and lockout procedures in detail.

8.6.5 The training program shall be kept current with changes in equipment and operating procedures, and training materials shall be available for reference.

8.6.6 Operating instructions that include all of the following shall be provided by the live fire system manufacturer:

(1) Schematic piping and wiring diagrams
(2) Start-up procedures
(3) Shutdown procedures
(4) Emergency procedures, including those occasioned by loss of fuel gas, loss of electric power, ventilation malfunction, combustible gas levels, temperature levels, or interruption of other utilities
(5) Maintenance procedures, including gas detection calibration, ventilation maintenance, interlock performance testing, and gas train pressure testing

8.7 Commissioning.

8.7.1 Commissioning shall be required for all new installations or for any changes that affect the safety system.

8.7.2 All components shall be installed and connected in accordance with the system design.

8.7.3 During commissioning, all piping that conveys flammable gases shall be inspected for leaks.

8.7.4 The gas-fueled live fire training system shall not be released for operation before the installation and testing of the required safety systems have been successfully completed.

8.7.5 Burner management systems shall be tested and verified for compliance with the design criteria when the burner management systems are installed, replaced, repaired, or updated.

8.7.6 Documentation shall be provided to the end user or to the approval authority that confirms that all related safety devices and safety logic are functional.

8.7.7 Any changes to the original design made during commissioning shall be reflected in the as-built documentation.

8.7.8 Set points of all safety interlock settings shall be documented.

8.7.9 Records of inspection, testing, and maintenance activities shall be provided to the owner.

8.8 Approvals.

8.8.1 Gas-fueled live fire training systems shall be listed or labeled by a third-party NRTL to ensure compliance with the requirements of this standard.

8.8.2 All safety critical components of the gas-fueled live fire training system shall be rated and labeled for the intended use.

8.8.3 The local electrical codes as appropriate and specified by the AHJ shall be adhered to in regards to the design and installation of the gas-fueled live fire training system.

8.9 Maintenance and Testing.

8.9.1 A regularly scheduled maintenance program shall be implemented based on the manufacturer's recommendations and include visual, operational, servicing, and calibration.

8.9.2 Maintenance inspections shall be conducted daily during use.

8.9.2.1 Maintenance service and calibration shall be conducted annually.

8.9.3 Safety devices shall be maintained in accordance with the manufacturer's instructions.

8.9.4 It shall be the responsibility of the system manufacturer to provide instructions for inspection, testing, and maintenance.

8.9.5 It shall be the responsibility of the user to establish, schedule, and enforce the frequency and extent of the inspection, testing, and maintenance program, as well as the corrective action to be taken.

8.9.6 All safety interlocks shall be tested for function annually.

8.9.7 The set point of temperature, pressure, or flow devices used as safety interlocks shall be verified annually.

8.9.8 Safety device testing shall be documented annually.

8.9.9 Gas pressure relief devices shall be visually inspected annually to ensure that they are unobstructed and properly labeled.

8.9.10 Testing frequency shall be annually.

8.10* Auxiliary Equipment.

8.10.1 The smoke generation system (if applicable) shall be interlocked into the safety network, and in the event of an e-stop or emergency shutdown, the production of smoke shall stop and any smoke duct fans shall shut off.

8.10.2 The sound system (if integrated into the live fire training system) shall be interlocked into the safety network, and in the event of an e-stop or emergency shutdown, all sound(s) shall stop.

8.10.3 The data logging system (if applicable) shall be interlocked into the safety network, and in the event of an e-stop or emergency shutdown, the data logging system shall continue operating or begin recording if not already.

8.10.4 The video recording system (if applicable) shall be interlocked into the safety network, and in the event of an e-stop or emergency shutdown, the video recording system shall continue operating or begin recording if not already operating.

Chapter 9 Gas-Fueled Live Fire Training Systems — Exterior

9.1 General.

9.1.1* A gas-fueled live fire training system shall include at a minimum, a gas-fueled training appliance and fire prop that generates and controls repeatable flames for training fire fighters on suppression techniques.

9.1.2 Burners, along with associated valves, regulators, safety controls, and other auxiliary components, shall be selected for the intended application, type, pressure of the fuel gases to be used, and the temperatures to which they are subjected.

9.1.3 Fire props and mock-ups shall maintain structural integrity while being used for training in accordance with NFPA 1403.

9.1.3.1 After extended use, mock-ups shall be able to be maintained or replaced without the replacement of the fire prop.

9.1.4 Mock-ups shall maintain structural integrity while being used for training in accordance with NFPA 1403.

9.1.4.1 After extended use, mock-ups shall be able to be maintained or replaced without the replacement of the fire-generating appliance.

9.2 Gas Equipment.

9.2.1 Fuel Storage. Installation of LP-Gas storage and handling systems (if applicable) shall comply with NFPA 58 or other applicable standards as recognized by the AHJ.

9.2.2 Gas Piping and Fittings.

9.2.2.1 Piping from the point of delivery to the equipment isolation valve shall comply with NFPA 54 or other applicable standards as recognized by the AHJ.

9.2.2.2 Fuel gas piping materials shall be in accordance with NFPA 54 or other applicable standards as recognized by the AHJ.

9.2.2.3 Fuel gas piping shall be sized to provide flow rates and pressure to maintain a stable flame throughout the burner operating range.

9.2.3 Control of Contaminants.

9.2.3.1 A sediment trap shall be installed downstream of the appliance isolation valve and upstream of all other fuel gas system components.

9.2.3.2 Sediment traps shall have a vertical leg with a minimum length of three pipe diameters [minimum of 3 in. (80 mm)] of the same size as the supply pipe.

9.2.3.3 A minimum of one gas filter or strainer shall be installed in the fuel gas piping and shall be located to protect the downstream gas components.

9.2.4 Appliance Isolation Valves.

9.2.4.1 Manually operated equipment isolation valves shall meet the following requirements:

(1) They shall be provided for each appliance.
(2) They shall be quarter-turn valves with stops.
(3) Handles shall remain affixed to valves and shall be oriented with respect to the valve port to indicate the following:
    (a) An open valve when the handle is parallel to the pipe
    (b) A closed valve when the handle is perpendicular to the pipe
(4) They shall be accessible.
(5) They shall be able to be operated from full open to full close and return without the use of tools.

9.2.5 Fuel Pressure Regulators.

9.2.5.1 A fuel pressure regulator shall be furnished wherever the supply pressure exceeds the system operating or design parameters or wherever the supply pressure is subject to fluctuations.

9.2.5.2 Vents shall be designed to prevent the entry of water and insects without restricting the flow capacity of the vent.

9.2.5.3 Safety Shutoff Valves.

9.2.5.3.1 Each appliance shall be separately equipped with at least two safety fuel gas shutoff valves in series that automatically shut off the fuel to the burner system in each of the following events:

(1) Interruption of electrical power
(2) Activation of any interlocking safety devices
(3) Activation of flame safeguard (if applicable)
(4) Failure of the operational controls
(5) Activation of manual shutdown stations

9.2.5.3.2 Each safety shutoff valve shall automatically shut off the fuel to the burner system after interruption of the holding medium (such as electric current or fluid pressure) by one of the interlocking safety devices, or operational controls.

9.2.5.3.3 Safety shutoff valves shall not be used as modulating control valves unless they are designed as both safety shutoff and modulation valves and tested for concurrent use.

9.2.5.3.4 Safety shutoff valves shall not be open-close cycled at a rate that exceeds that specified by its manufacturer.

9.2.5.3.5 Valve components shall be of a material selected for compatibility with the fuel handled and for ambient conditions.

9.2.5.3.6 Safety shutoff valves in systems containing particulate matter or highly corrosive fuel gas shall be operated at time intervals in accordance with the manufacturer's instructions in order to maintain the safety shutoff valves in operating condition.

9.2.5.3.7 Valves shall not be subjected to supply pressures in excess of the manufacturer's ratings.

9.2.5.3.8 The safety shutoff valves shall close in 1 second or less upon being de-energized.

9.2.5.3.9 Each main fuel gas burner system shall be separately equipped with two safety shutoff valves wired in parallel and piped in series.

9.2.6 Overpressure Protection.

9.2.6.1 Overpressure protection shall be provided in either of the following cases:

(1) When the gas supply pressure exceeds the pressure rating of any downstream component
(2) When the failure of a single upstream line regulator or service pressure regulator results in a supply pressure exceeding the pressure rating of any downstream component

9.2.6.2 Overpressure protection shall be provided by any one of the following:

(1) A monitoring regulator installed in series with the service or line pressure regulator in accordance with NFPA 54
(2) A full-capacity pressure relief valve
(3) An overpressure cutoff device, such as a slam-shut valve or a high-pressure switch in combination with a compliant shutoff valve

9.2.6.3 Hydrostatic relief valves shall be installed on liquid LP-Gas lines as directed by NFPA 58.

9.3 Fuel Types. Liquefied versions of flammable gas shall be permitted for use in exterior live fire training systems. *(For the use of combustible and flammable liquids for exterior live fire training systems, refer to Chapter 13.)*

9.4 Main Gas Burners and Pilot Burners.

9.4.1 Burners shall be used only with the fuels for which they are designed.

9.4.2 All pressures required for operation of the combustion system shall be maintained within the design ranges throughout the firing cycle.

9.4.3 Burners shall have the ignition source sized and located in a position that provides ignition of the pilot or main flame within the design trial-for-ignition period.

9.4.4 The pilot ignition source (e.g., electric spark, hot wire, pilot burners) shall be applied at the design location with the designed intensity to ignite the flame pilot burner air-fuel mixture.

9.4.5 Pilot burners shall be mounted to prevent unintentional changes in location and in direction with respect to the main flame burners.

9.4.6 Pilots shall be mounted to prevent unintentional changes in location and in direction with respect to the main flame burners.

9.4.7 At least one of the main burners must be ignited by the pilot ignition source.

9.4.7.1 Adjacent main burners shall be permitted to be ignited by other main burners.

9.4.8 Manually lighting gas-fueled live fire training systems or altering a manufacturer's appliance shall not be permitted.

9.5 Control System.

9.5.1 Electrical System — Safety Devices.

9.5.1.1 All wiring and equipment shall be in accordance with *NFPA 70* or other applicable standards as recognized by the AHJ.

9.5.1.2 Control panels shall be designed and manufactured in compliance with UL 508A, *Standard for Industrial Control Panels,* or other applicable standards as recognized by the AHJ.

9.5.1.3 Combustion safeguards (if applicable), flame detectors (if applicable), and safety shutoff valves shall be listed for combustion safety service or approved by a nationally recognized testing laboratory (NRTL) if a listed device is not commercially available for use in the design environment.

9.5.1.4 Safety devices shall be selected, applied, and installed in accordance with this standard and the manufacturer's instructions.

9.5.1.5 Safety devices shall be installed, used, and maintained in accordance with the manufacturer's instructions.

9.5.1.6 Safety devices shall be located or guarded to protect them from physical damage.

9.5.1.7 Safety devices shall not be bypassed electrically or mechanically.

9.5.1.8 Where a system includes a "built-in" test mechanism that bypasses any safety device, it shall be interlocked to prevent operation of the system while the device is in the test mode, unless listed for that purpose.

9.5.2 Emergency Stops.

9.5.2.1 At least one e-stop switch shall be provided for each prop in order to initiate a safety shutdown.

9.5.2.1.1 Each manual emergency switch shall be connected into the control system as a safety interlock.

9.5.2.2 A safety shutdown of the burner system shall require manual intervention of an operator to re-establish normal operation of the system.

9.5.2.3 Where wireless controls are used in place of hard-wired e-stop switches for safety shutdown functions, wireless control signal failure shall be supervised, and a signal failure shall initiate a safety shutdown.

9.5.3 Safe Start Check. The control system shall be designed to constantly monitor all safety systems for satisfactory operation.

9.5.4 System Operation and Safety Shutdowns.

9.5.4.1 Safety devices shall not be removed or rendered ineffective.

9.5.4.2 Operator Interface.

9.5.4.2.1 Operator Present Capability.

9.5.4.2.1.1 An operator present *deadman* feature shall be included in the control system for every fire prop.

9.5.4.2.1.2 Failure to maintain the operator present condition shall cause the related fire(s) to be immediately stopped.

9.5.4.2.1.3 The operator present feature shall not be disabled or bypassed.

9.6* System Operations and Maintenance Training.

9.6.1 Personnel who operate, maintain, or supervise the system shall be instructed and trained in their respective job functions under the direction of a qualified person(s).

9.6.2 Personnel who operate, maintain, or supervise the system shall be required to demonstrate an understanding of the equipment, its operation, and practice of safe operating procedures in their respective job functions.

9.6.3 Personnel who operate, maintain, or supervise the system shall receive regularly scheduled refresher training and shall demonstrate understanding of the equipment, its operation, and practice of safe operating procedures in their respective job functions.

9.6.4 The training program shall cover startup, shutdown, and lockout procedures in detail.

9.6.4.1 Maintenance, calibration, and lockout procedures shall also be taught.

9.6.5 The training program shall be kept current with changes in equipment and operating procedures, and training materials shall be available for reference.

9.6.6 Operating instructions that include all of the following shall be provided by the live fire system manufacturer:

(1) Schematic piping and wiring diagrams
(2) Start-up procedures
(3) Shutdown procedures
(4) Emergency procedures, including those occasioned by loss of fuel gas, loss of electric power, ventilation malfunction, combustible gas levels, temperature levels, or interruption of other utilities
(5) Maintenance procedures, including gas detection calibration, ventilation maintenance, interlock performance testing, and gas train pressure testing

9.7 Commissioning.

9.7.1 Commissioning shall be required for all new installations or for any changes that affect the safety system.

9.7.2 All components shall be installed and connected in accordance with the system design.

9.7.3 During commissioning, all piping that conveys flammable gases shall be inspected for leaks.

9.7.4 The gas-fueled live fire training system shall not be released for operation before the installation and testing of the required safety systems has been successfully completed.

9.7.5 Burner management systems shall be tested and verified for compliance with the design criteria when the burner management systems are installed, replaced, repaired, or updated.

9.7.6 Documentation shall be provided to the end user or to the approval authority that confirms that all related safety devices and safety logic are functional.

9.7.7 Any changes to the original design made during commissioning shall be reflected in the as-built documentation.

9.7.8 Set points of all safety interlock settings shall be documented.

9.7.9 Records of inspection, testing, and maintenance activities shall be provided to the owner.

9.8 Approvals.

9.8.1 Gas-fueled live fire training systems shall be listed or labeled by a third-party NRTL to ensure compliance with the requirements of this standard.

9.8.2 All safety critical components of the gas-fueled live fire training system shall be rated and labeled for the intended use.

9.8.3 The local electrical codes as appropriate and specified by the AHJ shall be adhered to in regard to the design and installation of the gas-fueled live fire training system.

9.9 Maintenance and Testing.

9.9.1 A regularly scheduled maintenance program shall be implemented based on the manufacturer's recommendations and include visual, operational, servicing, and calibration.

9.9.2 Maintenance inspections shall be conducted daily during use, and maintenance service and calibration shall be conducted annually.

9.9.3 Safety devices shall be maintained in accordance with the manufacturer's instructions.

9.9.4 It shall be the responsibility of the system manufacturer to provide instructions for inspection, testing, and maintenance.

9.9.5 It shall be the responsibility of the user to establish, schedule, and enforce the frequency and extent of the inspection, testing, and maintenance program, as well as the corrective action to be taken.

9.9.6 All safety interlocks shall be tested for function annually.

9.9.7 The set point of temperature, pressure, or flow devices used as safety interlocks shall be verified annually.

9.9.8 Safety device testing shall be documented annually.

9.9.9 Gas pressure relief devices shall be visually inspected annually to ensure that they are unobstructed and properly labeled.

9.9.10 Testing frequency shall be annually.

9.10 Auxiliary Equipment.

9.10.1 The smoke generation system (if applicable) shall be interlocked into the safety network, and in the event of an e-stop or emergency shutdown, the production of smoke shall stop and any smoke duct fans shall shut off.

9.10.2 The sound system (if integrated into the live fire training system) shall be interlocked into the safety network, and in the event of an e-stop or emergency shutdown, all sound(s) shall stop.

9.10.3 The data logging system (if applicable) shall be interlocked into the safety network, and in the event of an e-stop or emergency shutdown, the data logging system shall continue operating or begin recording if not already.

9.10.4 The video recording system (if applicable) shall be interlocked into the safety network, and in the event of an e-stop or emergency shutdown, the video recording system shall continue operating or begin recording if not already operating.

Chapter 10 Mobile and Transportable Training Props

10.1* Vehicle Design.

10.1.1 Vehicles shall comply will all local, federal, provincial, and state motor vehicle regulations and other requirements set by the AHJ.

10.1.2 Live fire mobile training props shall be constructed of noncombustible materials.

10.1.3 All components in burn rooms and components in areas outside burn rooms that are exposed to flame impingement, fire extension, and heat from training fires shall be designed for exposure to high temperatures, high volumes of water, thermal shock, steam, expansion and contraction, and other project-specific design considerations.

10.1.3.1 Elements of the live fire mobile training prop that will be exposed to temperatures exceeding 350°F (177°C), whether in or out of a burn room, shall be protected with a thermal lining or other thermal protection system to keep temperatures at the face of the structural elements at or below 350°F (177°C).

10.1.3.2 Components shall be free of asbestos.

10.1.3.3 Components shall be free of plastic, rubber, and sealed components that could burst when heated.

10.1.4 All burn rooms shall have, as a minimum, one of the following:

(1) Two doors that exit the burn room to an adjacent room or to an exterior grade, a balcony, a roof, or stairs
(2) One door to an adjacent room and one window to either another room, a balcony, a roof, or another tenable location

Exception: In the case of a gas-fired burn room where the fire cannot be between the participant and the door, one door shall be acceptable.

10.1.4.1 Electrical conduits, wiring, and devices shall not be permitted in Class A burn rooms or compartments.

Exception: Conduits, wiring, and devices for a temperature monitoring system shall be permitted in Class A burn rooms and, except for the thermocouple, shall be protected from the heat of training fires.

10.1.5 Doors and window shutters that are exposed to elevated temperatures related to live fire training shall meet the following requirements:

(1) Resist binding when exposed to temperature cycles associated with live fire training, which could cause significant expansion and contraction
(2) Operate from both sides of the door or shutter without special tools or keys during live fire training

10.2 Live Fire Mobile and Portable Training Props.

10.2.1 Live fire mobile training props that include interior gas-fueled live fire training systems shall comply with the requirements set forth in Chapter 8.

10.2.2 Live fire mobile training props or live fire portable training props that include exterior gas-fueled live fire training systems shall comply with the requirements set forth in Chapter 9.

10.3 Fuel Storage.

10.3.1 All fuels shall be stored in approved safety containers and vessels and secured during transport in compliance with all local, federal, provincial, and state motor vehicle regulations and other requirements set by the AHJ.

Chapter 11 Technical Rescue Training Props

11.1 Technical Rescue Training Props.

11.1.1 Technical rescue training props shall comply with the requirements of Chapter 6 and Chapter 11.

11.1.2* All technical rescue training props that present a hazard shall have signage to identify the hazard.

11.2* High Angle Rope Rescue Training Props.

11.2.1 Any item that will be used as an anchor point, whether a rope anchor, structural member, or other component, shall be designed for a working load of at least 1000 lb (454 kg) and an ultimate load of at least 10,000 lb (4536 kg) applied in any direction that is transferred into the structural system of the training structure or prop.

11.2.1.1 For anchor points used for structure-to-structure or structure-to-ground highline systems, the structural system of the training structure or prop to which the anchor points are attached shall be designed for the applied loads, including overall lateral stability.

11.2.2* Designed anchor points shall be identified by a method approved by the AHJ.

11.2.3* Designed anchor points shall be visually inspected and documented at least annually by a qualified person as determined by the AHJ.

11.2.3.1* If defects are visible, testing shall be performed by a qualified person as determined by the AHJ to determine if the anchor point meets the load requirements and needed repairs shall be performed.

11.3* Confined Space Rescue Training Props.

11.3.1* A confined space prop shall have immediate access to the outside of the prop at intervals not exceeding 50 ft (15.2 m).

11.3.2* Confined space props shall not be constructed fully below grade.

11.4* Trench Rescue Training Props.

11.4.1* A permanent trench rescue prop shall be designed by a qualified person approved by the AHJ to prevent actual trench collapse during training.

11.4.2 A trench rescue prop shall have at least one walkout located no more than 50 ft (15 m) from any point within the prop.

11.5* Structural Collapse Training Props. A rubble pile prop shall include the input from a qualified person approved by the AHJ to reduce the risk of collapse, shifting, or other movement that could injure personnel.

Chapter 12 Hazardous Materials Training Props

12.1* Hazardous Materials Training Props.

12.1.1 The requirements of this chapter shall be in addition to Chapter 6.

12.1.2* Previously used training props or repurposed equipment or materials shall be certified as being clean and rendered safe by a qualified person as determined by the AHJ prior to transport to the training center and acceptance.

12.1.2.1 Written certification shall be retained as part of the maintenance and inspection file for the prop.

12.1.3* If leak and spill simulators (pipe flanges, tanks, drums, gas cylinders, intermodal, or other containers) are to be pressurized, they shall be pressurized with inert material regulated to a working pressure of no greater than 50 percent of the pressure rating of the weakest component of the assembly.

12.1.3.1 The simulator shall have a pressure relief device.

12.1.3.2 The pressurization system shall have a locally or remotely operated valve for emergency shutdown.

12.1.3.3 Liquid materials used to simulate leaks and spills shall consist of nonhazardous, environmentally neutral/friendly materials approved by the AHJ.

12.1.3.4 Liquid solutions and gas used for pressurizing leak and spill props shall be clearly identified and marked on the container and lines, with a safety data sheet (SDS) kept on file.

12.1.3.5* Pressurized hazmat props shall be designed with a quick purge valve.

12.1.4 Portable props used for hazmat training, including but not limited to rollover simulators, rail cars, and closed loop transfer tank truck props, shall be designed so that they can be stabilized upon setup at the training location and the stability of the prop is maintained during all phases of the training evolution.

12.1.5 If closed loop transfer training operations are to be conducted at the fire training center, the training center shall be designed to provide containment for product runoff and accidental material release.

12.1.6 Fall protection shall be provided on props as required and specified by the AHJ or statutory requirements.

Chapter 13 Combustible and Flammable Liquids Used in Interior and Exterior Activities

13.1* The Use of Combustible and Flammable Liquids in Training Centers.

13.1.1 Training center interior or exterior props that use combustible liquids with flash points above 100°F (38°C) shall be specifically designed to accommodate a defined quantity of fuel.

13.1.2 Training center exterior props that use flammable liquids with flash points below 100°F (38°C) shall be specifically designed to accommodate a defined quantity of fuel.

13.1.3 Interior props that use flammable liquids shall not be permitted.

13.2 Design Considerations.

13.2.1 Training props utilizing combustible and flammable liquids shall be specifically designed and constructed to be operated within design limitations.

13.2.2 Combustible and flammable liquid training props shall be designed with adequate cooling or thermal protection to prevent structural fatigue.

13.2.3 When using water to cool, it shall be applied to surfaces exposed to fire in order to maintain structural integrity in accordance with NFPA 15.

13.2.4 Training props shall be designed and constructed with appropriate containment to prevent the unwanted spread of burning liquids and potential contamination to unprotected surfaces.

13.2.5 Firestops and other control measures shall be utilized to prevent burning combustible and flammable liquids from entering water collection and treatment systems.

13.3 Emergency Shutdown Devices.

13.3.1 Emergency shutdown devices (ESDs) shall be installed on training props to control the fuel delivery system.

13.3.2 ESDs and fuel supplies to the training props shall be located in an area where visibility of the training evolution is clear, but not so close as to endanger the fueling technician, as deemed appropriate by the AHJ.

13.4* Fuel Management. The AHJ shall establish safe fuel limits on props using combustible and flammable liquids prior to students being allowed to use the training prop.

13.5 Environmental Considerations.

13.5.1 Environmental stewardship shall be designed into the facility's master plan.

13.5.2* The AHJ shall be responsible for obtaining required permits from the local, state, and federal authorities.

13.5.3 Training centers and related props utilizing combustible and flammable liquids in an interior/exterior setting shall be designed to capture, collect, and route the water used during training evolutions to a treatment facility for processing or as required by the AHJ.

13.5.4 Secondary containment shall be installed for flammable or combustible liquid fuel storage tankage as specified by the AHJ's spill prevention control and countermeasure plan.

13.6 Protection of Fuel Supplies and Piping. Combustible and flammable liquid supply and distribution piping to training props shall be isolated, protected, and/or guarded from impact or damage.

13.7 Reliability of Fuel Distribution System. Combustible and flammable liquid distribution systems shall be constructed and maintained to ensure reliable operation.

13.8* Recirculation Protection. Combustible and flammable liquid pumps that supply material to the training prop shall be equipped with recirculation protection.

13.9 Separation of Fuel Storage. Spacing between combustible and flammable liquid training props shall be provided based on a hazard analysis by the AHJ.

13.10 Inspection and Maintenance.

13.10.1 An inspection and maintenance program shall be implemented by the AHJ.

13.10.2 The integrity of props and systems shall be evaluated and documented annually by the owner/operator or AHJ.

Chapter 14 Fire Investigation Training Structures, Props, Burn Cells, and Sets

14.1* General. The requirements of this chapter shall be in addition to the requirements of Chapter 6.

14.2 Design and Construction.

14.2.1 Permanent fire investigation training structures shall be constructed of noncombustible materials.

14.2.2 Wood and other combustible materials shall be allowed for use in constructing burn cells or sets, either freestanding or within the fire investigation training structure.

14.3 Maintenance.

14.3.1 Prior to each use of a fire investigation training structure, the structural condition shall be evaluated and documented and any necessary repairs completed and documented by the owner/operator or AHJ.

14.3.2 Prior to each use of a fire investigation training prop, burn cell, or set, the condition shall be evaluated and any necessary repairs completed by the owner/operator or AHJ.

Annex A Explanatory Material

Annex A is not a part of the recommendations of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.2.2 This standard provides minimum requirements for fire training facilities that are not covered by the codes and guidance for designers who are interpreting the codes for fire training facilities.

Fire training structures are not occupied buildings. Building code requirements for many occupied building items, such as fire protection, HVAC, finishes, and accessibility per the Americans with Disabilities Act (ADA), do not apply to fire training structures. This standard describes which portions of the building code(s), as a minimum, apply to fire training structures, props, and systems.

Gas-fueled live fire training systems are not directly covered by codes and standards published by NFPA, UL, and other organizations. This standard provides minimum requirements specific to gas-fueled live fire training systems.

A.1.3.4 Many acquired structures used for live fire training are constructed of wood or other combustible materials, such as old houses that have been donated to a fire department. NFPA 1403 covers the requirements for using these structures for live fire training. Acquired structures are intended to be for temporary use until they are taken out of service as live fire training structures.

Some acquired structures might be constructed of noncombustible materials, such as concrete, masonry, or steel. If such a structure is to be converted into a permanent live fire training structure (more than three days total of live fire training), then it should meet the minimum requirements of this standard. Acquired structures that are constructed of wood or other combustible materials do not meet the requirements of this standard for use as permanent live fire training structures.

A.1.3.5 Examples of facilities that are typically not covered by this standard are as follows:

(1) Parking areas
(2) Storm water management systems
(3) Occupied buildings, with functions such as offices, classrooms, auditoriums, dining facilities, rest rooms, locker rooms, fitness rooms, break rooms, conference rooms, libraries, storage rooms, A/V equipment rooms, and computer rooms
(4) Storage buildings
(5) Apparatus storage and/or maintenance buildings
(6) Outdoor pavilions

A.3.2.1 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.3 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.7 Designed Anchor Point. These can be individual premanufactured components that are installed on a prop, or they can be integral parts of the structure that are identified by a qualified person as being an anchor point.

A.3.3.16 Gas-Fueled Live Fire Training System. These systems are commonly referred to as "gas props," "gas simulators," and "gas-fired props."

A.3.3.24 Live Fire Training Structure. Commonly referred to as *burn buildings* or *burn towers*, live fire training structures include structures built of noncombustible conventional building materials, such as concrete, masonry, and steel, as well as containerized training structures in which live fire training evolutions are conducted. This includes fixed structures that are marketed as *mobile props*, such as the following:

(1) Pre-engineered metal structures that can be disassembled and transported to a new site
(2) Containerized structures in which one or more containers are assembled, whether single story or multistory

Live fire training structures do not include the following:

(1) Fire behavior labs (also known as *flashover containers*) that are made from two offset shipping containers for the sole purpose of demonstrating fire behavior
(2) Mobile live fire training props
(3) Fire investigation training structures and props
(4) Acquired structures used for live fire training unless the acquired structure is intended to be used for live fire training evolutions for more than 3 days total, in which case it would need to follow the requirements of this standard
(5) Structures that are used for training in the use of SCBA where only smoke conditions are created, without a live fire, and the participants are not subjected to risk of the effects of fire other than the smoke produced
(6) Structures that simulate industrial applications under live fire conditions in which no personnel enter or stand upon the structure, such as a refinery fire simulation

Live fire training structures could be designed to support the following training objectives:

(1) Fire behavior
(2) Fire spread or extension
(3) Interior fire attack
(4) Rescue
(5) Ventilation
(6) Forced entry
(7) Laddering
(8) Various simulated occupancies similar to those found in the surrounding region

A.3.3.35 Training Prop. Examples of training props are a Class A car fire prop, confined space prop, drafting pit, collapse rescue prop, trench rescue prop, or roof ventilation prop. Live fire training structures, training towers, and containerized structures are considered "training structures" instead of "training props." Training props, however, could become sizeable, such as multistory confined space props, underground drafting pits, and collapse rescue props.

A.3.3.39 Working Load. An example of a working load in a technical recue environment would include the weight of the rescuer(s), patient, equipment, and any other forces applied to the system.

A.4.1.1 Written policies and standard operating procedures should be developed for the safe and effective use of the training center and associated props. Policies and procedures should at a minimum, where applicable, include the following:

(1) Use of each of the training structures, props, and simulators, including live fire, nonlive fire, and rescue training.
(2) List of anchor points that have been designed for rope rescue training.
(3) Required list of visual inspections at the beginning of each training day, such as live fire training structures and anchor points.
(4) Defining minimum qualifications for the instructors.
(5) Minimum instructor-to-student ratios for each type of training.
(6) Reporting training injuries, including accident root cause analysis and data collection.
(7) Rehabbing students and instructors during training evolutions.
(8) Communications during training evolutions.
(9) Weather monitoring during training evolutions and precautionary steps to prevent weather-related injuries. Examples of weather conditions to address in the policy and SOP include but are not limited to storm tracking, lightning detection, wet globe temperature readings, heat index, and wind chill index.
(10) Briefings on hazmat props and materials used for training.
(11) Driving mobile props.
(12) Inspecting, reporting damage to, repairing damage to, and providing routine maintenance for training structures, props, simulators, and mobile props.
(13) Incorporating, as a minimum, the state and/or AHJ requirements for curriculum and mandatory training requirements for recruits and in-service personnel.
(14) Use of the training center by other agencies

A.5.1.1 When training water is supplied by mobile water supply apparatus or static water source(s), there should be adequate maneuvering room and paving designed to accommodate those operations. Water flow requirements for live fire training evolutions are provided in NFPA 1403. Water flow requirements for nonlive fire training evolutions, such as master flow streams, pump testing, and pump operations under nonlive fire conditions, should be determined by the AHJ and/or training center personnel.

For flammable and combustible liquid training props, special consideration should be given to both aboveground and belowground infrastructure. Due to the large water supply needed for combustible and flammable liquid fire-fighting operations, special attention should be given to the sizing, spacing, and location of the following:

(1) Hydrants
(2) Manifolds
(3) Fire water headers and distribution piping
(4) Monitors

A.5.2.1 Security measures that could be utilized include the following:

(1) Access control, as follows:
    (a) Perimeter fence
    (b) Lockable buildings, training structures, elevator shafts, drafting pits, rescue props, hazmat props, underground utility covers, and exterior valves and cabinets
    (c) Visitor/personnel access control doors in buildings and gates on the site
(2) Video surveillance, as follows:
    (a) Security cameras
    (b) Security lighting around the site
(3) Intrusion detection, as follows
    (a) Motion detector
    (b) Break glass detection system

A.5.3 With growing awareness of fire fighter health statistics, any fire training center that includes live fire training or other operations that expose personnel to carcinogens should support personnel gross decontamination on site. This could include potable water available on the site adjacent to the training areas for personnel to wash contaminants off gear and/or wipes that do not require water. Shower facilities on site would enhance decontamination capabilities.

A.5.4 It is unusual for an AHJ to restrict the burning of clean Class A fuels (straw, hay, wood, and excelsior) at fire training centers. If the AHJ has no specific environmental requirements, consideration should be given to designing and constructing environmentally friendly features at the training center. Some examples are as follows:

(1) If Class A fires are going to be used to deliver live fire training, a means of capturing and cleaning the water runoff from the training exercises should be provided, so that soot and uncombusted solids are removed from the training water before it is sent to storm or sanitary.
(2) A graywater collection and pump system could be considered for recycling training water.
(3) The classroom building could incorporate environmentally friendly features or could meet a sustainability certification level.
(4) If foam is to be used during training exercises, a means of foam retention and treatment should be provided.
(5) If flammable liquids are to be stored or used, the fuel storage and flammable liquids training areas should be designed to ensure that flammable liquids do not contaminate the ground, water, and sewers.

A.6.1.1 Any training prop that has above or below grade elements in or on which personnel will temporarily occupy is included in this section.

Single story and multi-story pre-engineered metal training structures and containerized training structures are fixed training structures that require structural design. Even if a pre-engineered training structure or containerized structure could be disassembled, transported to a different location, and reassembled, it should be designed as a permanent training structure that requires strength, stability, and permanent foundations that meet the requirements of the building code. Alterations to containers reduce the structural capacity of the containerized structure and should be designed and detailed by a professional engineer.

See A.1.2.2 for additional information.

A.6.1.8 Heavier live loads could be encountered in or on certain training structures or props. For example, a simulated collapsed building training structure that has large pieces of concrete and other heavy objects placed on floors and roofs to simulate partial or total collapses could have a live load in excess of 50 lb/ft^2 (244 kg/m^2) and should be designed for the anticipated loads.

A.6.1.9 Floors and roofs should slope at least ⅛ in./ft (10 mm/m), and preferably ¼ in./ft (21 mm/m), to drains or through-wall scuppers.

A.6.1.9.1 Floor and roof drains are subject to clogging and, in the case of training structures and props that include the use of LP-Gas, can collect uncombusted gas. It is generally recommended to drain floors and roofs through scuppers at exterior walls.

A.6.1.11 For convenience, permanent grounding and bonding points could be located near or on certain fixed training structures and props or at locations on the training grounds where portable/mobile training structures and props will be temporarily set up.

A.6.2 All buildings and structures require periodic inspections and maintenance. This is especially true for training structures and props that are exposed to water and/or abuse inherent in training exercises. Scheduled inspections and maintenance are important for the safety of personnel using the training structures and props, as well as the long-term durability of these valuable assets. The frequency of inspections and maintenance should be based on factors such as frequency of use, environmental considerations, manufacturer recommendations, and requirements of the AHJ.

A.7.1 There are many different styles of live fire training structures, as shown in Figure A.7.1(a) through Figure A.7.1(f).

A.7.1.3 Licensed design professionals include licensed/registered architects and structural engineers.

A.7.1.4 Non-structural components that could be incorporated into a live fire training structure include but are not limited to doors, window shutters, roof ventilation chopout openings, breach wall openings, and sheetrock pull props. Any combustible components of these could ignite by accident and add to the heat/fuel load of the fire and should be accounted for when determining personnel and building safety. The metal components and framing around these items could warp when exposed to heat. These limitations should be considered during the design.

Exterior doors and shutters that open outward have lower risk of heat damage and better facilitate emergency egress, though some simulations require inward-swinging doors or shutters. Design of doors and shutters should consider safety, durability, and ease of maintenance, given the repeated heating and rapid cooling cycles and the rigorous use that will occur. Conventional fire-rated doors, hardware, and door closers often exhibit durability issues in live fire training structures and, where exposed to heat, could cause safety concerns, such as doors expanding into their own frames and hydraulic door closers becoming pressurized due to heat. Custom detailed doors, shutters, hardware, and hinges should be considered, especially when Class A fuels are being used.

Sprinklers could be provided for training purposes, such as teaching how to chock a sprinkler or demonstrating the effects of sprinkler flows on a fire. Open sprinklers are not reliable as a safety device in a burn room, however, because of repeated heat exposure.

FIGURE A.7.1(a) Representative Class A Live Fire Training Structure. ***(Courtesy of Cheyenne Fire Training Complex, Cheyenne, WY.)***

FIGURE A.7.1(b) Representative Gas-Fired Live Fire Training Structure and Tower. *(Courtesy of Phoenix Fire Training Center, Phoenix, AZ.)*

FIGURE A.7.1(c) Representative Gas-Fired Live Fire Training Structure. *(Courtesy of Tulsa Fire Department Safety Training Center, Tulsa, OK.)*

FIGURE A.7.1(d) Representative Containerized Live Fire Training Structure. *(Courtesy of TC Member Egelin.)*

A.7.1.4.1 Training fires cause accelerated deterioration of the structure due to heat generated by fires and thermal shock generated when cold water is applied to heated surfaces. Where unprotected, concrete might crack, delaminate, or spall, masonry might crack or weaken, and steel might distort, corrode, or melt.

To maximize the useful life of a live fire training structure, thermal linings (fire-resistant coverings) or other thermal protection system should be provided in areas where flames impinge on structural surfaces and where temperatures are expected to exceed 350°F (177°C) during training. It should be considered that heat from a fire could roll into adjacent rooms and could bank down to a floor, causing damage away from areas of direct flame impingement. Specifications for thermal linings to protect live fire training structures should take into consideration temperature rating, thermal shock resistance, strength and resistance to physical abuse, thermal expansion and contraction, secure mounting, ability to resist repeated cycling of rapid heating and rapid cooling during training days, and ease and cost of replacing damaged sections. To provide high-temperature protection to the structural elements of the live fire training structure, the following materials could be utilized to protect the structural components:

(1) Proprietary thermal linings, including exposed insulation panels and hybrid insulating systems, could be attached to the ceiling or wall structures. Care should be taken in the choice of products: some insulation panels might not be rated for the anticipated training temperatures, and some insulation panels might crack or spall below the rated maximum temperature when subjected to fire streams or exposed to the physical abuse inherent in live fire training.
(2) Masonry blocks or bricks, set in mortar at walls and without mortar at floors, provide good insulating capabilities and resistance to spalling and physical abuse. The blocks or bricks and the mortar could be conventional masonry materials or refractory materials.
(3) Calcium aluminate concrete gunite (calcium aluminate concrete that is sprayed onto exposed wall or ceiling surfaces) provides a joint-free surface that is fastened to the structural material with pins and wire mesh, with good strength and resistance to spalling and physical abuse. Despite these benefits, the gunite can spall, which would cause pieces of the concrete to fall out. This could cause a hazardous condition if the concrete piece(s) fall while the room is occupied. The spalls could be patched with a calcium aluminate concrete-based patch material to extend the useful life of the lining.

FIGURE A.7.1(e) Representative Class A Live Fire Training Structure Simulating Row House at Left and Commercial Structure at Right. *(Courtesy of Reading-Berks Fire Training Center, Berks County, PA.)*

FIGURE A.7.1(f) Representative Class A Live Fire Training Structure and Tower. ***(Courtesy of Virginia Beach Fire Training Center, Virginia Beach, VA.)***

(4) Panels made of weathering steel could be inserted into tracks on the walls and ceilings. Mounting should allow for thermal movement of the panel while maintaining secure attachment so that personnel are not injured by falling panels or mounting hardware. The selection of panel material, thickness, and air space depends on the nature, size, frequency, and duration of the fires. Since steel is not an insulator, the design of the steel thermal lining system should include a well-ventilated air space to create a means of protecting the structural elements from heat and thermal shock and/or an insulation suitable for the high heat exposure behind the steel panels.

To extend the life of less durable linings, a fire in a heavy gauge metal drum or crib, with metal plates welded above to prevent flame impingement on the linings, could be used as a smoke and heat simulation method. If used, the drum or crib should be raised above the floor, and the floor should be protected with bricks, patio blocks, or a steel plate. Metal drums or cribs with steel wheels installed for mobility could be considered.

Even with bricks or pavers on floors, fires placed directly on the fire bricks could transmit heat into the floor structure below, especially if a bed of coals burns for a prolonged period of time. This heat soak through the floor lining into the floor structure could cause hidden structural damage to the floor structure. Burn racks or other solutions should be provided as a method of keeping fires and coals elevated above the fire bricks in order to enhance the durability of the floor structure. Providing burn racks is less critical on nonstructural, ground-supported floors.

Other thermal protection systems, such as continuously flowing water over the surface of the structure, could be used instead of a thermal lining system.

A.7.1.6 Burn areas that are fully below grade are hazardous due to risk of higher heat and difficulty in removing accident victims. It is permissible to have below-grade burn areas only if the below-grade level has an at-grade walkout basement condition at a minimum of one full side of the structure. Walkout basement conditions that require exterior steps up to the closest location accessible by ambulance are not acceptable.

A.7.1.9 The site area surrounding a live fire training structure commonly requires paving on all four sides to allow apparatus to maneuver around the structure or paving on one or more sides for apparatus and light-duty sidewalks or pads for foot traffic on the remaining sides. Obstacles, such as curbs and gutters, sidewalks, hydrants, street signs, poles, and cables simulating overhead power lines could be added on one or more sides to provide realistic challenges. Vegetation other than grass should be avoided and fuels should not be stored near the structure.

A.7.2.1 There should be ongoing concern for the progressive damage to live fire training structures associated with live fire training evolutions. Excessive fire intensity and numerous live fire training evolutions can result in accelerated degradation of the live fire training structure and can increase the risk to personnel to an unacceptable level.

Examples of common damage to check for include the following:

(1) Visible structural defects such as cracks, spalls, or warps in structural floors, columns, beams, and walls.
(2) Thermal linings that are intended to protect the structural components. Exposure to live fire training can cause the thermal linings to wear out over time. Portions of thermal linings can loosen and fall out, anchoring devices can loosen, and reinforcing and supporting pieces can corrode, creating a safety concern for occupants. In addition, cracks, holes, openings, gaps, or penetrations in the thermal linings can lead to damage to the structure behind the lining.

(3) Doors in live fire training structures that do not operate properly, sticking shut during training and creating safety problems relating to emergency egress.
(4) A rusted or broken hinge at a second-floor window shutter that could cause the shutter to fall to the ground below.
(5) Loose, rusted, or damaged handrails and guardrails.
(6) Loose or missing stair nosings or damage to stair treads.

Personnel making the annual structural integrity evaluation should understand the structural system that is being evaluated and where damage is most likely to occur, given the unique design of that live fire training structure. For example, live fire training structures constructed of hollow core plank roofs and floors supported on masonry bearing walls tend to exhibit several problems, such as the following, which would be helpful to know when conducting the evaluation:

(1) Cracks that occur in the topping slabs directly over the joints between the planks, causing leaks into the structure and onto thermal linings below
(2) Cracks that occur in the ends of the planks and at the two courses of masonry block below the plank bearing points
(3) Vertical cracks that occur in masonry bearing walls at building corners
(4) Cracks in the bottoms of the planks that occur below the hollow cells and at the bottom corners of the planks
(5) Topping slabs that separate from the tops of the planks, reducing the structural capacity of the structural system
(6) Cracks in the topping slabs near guardrail anchor points that could cause guardrails to loosen

Ideally, the architect/engineer that designed the live fire training structure would have provided a description of what to look for during the periodic evaluations. If no such description was obtained when the live fire training structure was first built, then the AHJ should retain a licensed professional engineer with live fire training structure experience and expertise or other qualified professional as determined by the owner/operator or AHJ to help create such a description.

A.7.2.2 Routine maintenance is important to providing a safe, durable live fire training structure. Periodic engineering evaluations are one step in that process. Live fire training structures present unique engineering problems that are not taught to engineers in college or in their daily practice of engineering office buildings, schools, and fire stations. Before a registered (licensed) professional engineer (P.E.) understands live fire training structure engineering, it takes significant efforts on the part of the P.E. to learn how live fire training structures are used, how repetitive live fire training affects structural and nonstructural elements within the live fire training structure, and what materials have been proven to work (or not work) within such a harsh environment. This effort typically requires research and educational efforts and experience with live fire training structure projects.

Because the required evaluation is for structural integrity, the P.E. performing the evaluation should be a structural engineer or teamed with a structural engineer to perform the evaluation. Many states do not license P.E.s by discipline; "P.E." could refer to a structural engineer or to some other engineering discipline, such as electrical, mechanical, fire protection, or aeronautical. State laws require P.E.s to offer engineering services for only those branches of engineering for which they are qualified. Therefore, a P.E. who is an electrical engineer or fire protection engineer with no structural qualifications would not be allowed, under law, to evaluate the structural integrity of a live fire training structure.

Note that a P.E. with refractive materials experience and expertise, but not live fire training structure experience and expertise, might not have sufficient understanding of how refractory concrete performs in a live fire training structure environment. Many P.E.s with refractive materials experience have gained that experience working with industrial applications in which furnaces are heated and cooled slowly. Certain applications of refractory concrete work well under those furnace conditions. However, the same applications of refractory concrete at times work poorly in the live fire training structure environment, where rapid heating, rapid cooling, and thermal shock deteriorate refractory concrete differently than in a furnace application. Many P.E.s with only refractive materials experience, but no live fire training structure experience, do not know this. As a result, the requirement for live fire training structure experience and expertise has been added to the standard. In many cases, the P.E. retained to evaluate the integrity can also, under the same contract, be required to make recommendations for how to repair, maintain, or improve the live fire training structure.

The phrase "with live fire training structure experience and expertise" must be interpreted by each entity following its own local and state laws and guidelines. The intent is for the P.E. to have performed at least one live fire training structure project previously so that the entity hiring the P.E. will benefit from the educational and research efforts performed, and experience gained, by the P.E. for the previous live fire training structure project(s). This experience could include a previous live fire training structure evaluation, the repair or renovation to an existing live fire training structure, or the design of a new live fire training structure. In many cases, it would be acceptable for a P.E. without live fire training structure experience or expertise to perform the evaluation as long as he or she has teamed with a P.E. with live fire training structure experience or expertise.

A.7.2.2(3) Refractory concrete should not be used as a structural element. Structural calcium aluminate refractory concrete has been found to delaminate (crack and lose bond) along the lines of reinforcing within walls and suspended slabs, presenting serious structural deficiencies that threaten the life and safety of personnel.

A.7.2.2.2 Heat can soak through thermal linings and reach the protected structure, especially if the linings are cracked or otherwise require maintenance when live fire training occurs. This heat could damage the structure, a hidden condition that would otherwise go undetected if the panels are not occasionally removed to expose the hidden conditions.

A.8.1.1 Training mock-ups are metal fabrications that add to the realism of the training system. Mock-ups are either fixed to or removable from the appliance. When training mock-ups are being designed, the types of fires to which they are to be exposed shall be evaluated. In addition to the appliance, additional training mock-ups are added, where necessary, to replicate furniture, structures, or devices involved or at the seat of the fire.

A.8.4.4 Examples of a pilot ignition source are an electric spark and a hot wire.

A.8.4.6 Examples of flame pilot burners are an electric spark and a hot wire.

A.8.5.5.4.7 This provision is commonly provided via wall openings to the exterior such as louvered openings, drainage scuppers, or the undercutting of all burn room doors to provide the design airflow.

A.8.5.5.7.6 Consideration should be given to each structure design where gas could easily migrate to other areas such as hallways, stairwells, floor grating or drains, doors, and windows. In those cases, the fuel gas should be secured to multiple areas until the source of the high gas concentration can be determined.

A.8.5.5.7.9.3(A) Examples of ventilation outlets would be exhaust fans, doors, or vents.

A.8.5.5.7.9.3(B) An example of routine maintenance would be periodic calibration of a gas sensor.

A.8.6 Personnel who operate, maintain, or supervise the appliance(s) should receive regularly scheduled refresher training and should demonstrate understanding of the equipment, its operation, and the practice of safe operating procedures in their respective job functions.

A.8.10 Electronic control systems offer the possibility to include convenience features such as data logging. Data recorded can include temperature variations and simulation times.

A.9.1.1 In addition to the appliance, additional training mock-ups can be added, where necessary, to replicate furniture, structures, or devices involved or at the seat of the fire.

A.9.6 Personnel who operate, maintain, or supervise the appliance(s) should receive regularly scheduled refresher training and should demonstrate understanding of the equipment, its operation, and practice of safe operating procedures in their respective job functions.

A.10.1 The following is a list of benefits for using mobile training units:

(1) Where the personnel to be trained are spread over a large geographical area, a mobile training unit(s) could be an alternative to transporting the personnel to a permanent training center.
(2) Mobile training units could be customized to address the specific needs of a training course or the personnel to be trained.
(3) Mobile training units could decentralize the training programs of a training center, thereby supplementing the training conducted at the center.
(4) Mobile training units could bring training to personnel who ordinarily would not or could not travel to a training center.
(5) Mobile training units could contribute to the ability to provide in-service training to personnel, thereby keeping personnel near their duty station and available for emergency service.
(6) Mobile training units could provide an opportunity to publicize a training program because of their high visibility, mobility, and, usually, large surface areas that could graphically transmit a message to the bystander.
(7) Graphic designs and lettering could indicate to the general public that there is an active training program and that fire fighters are actively training. The message that is delivered could be a fire safety message, using the vehicle as a rolling billboard.

Types of Units.

The types of units could be divided into the following two broad categories:

(1) Vehicles that serve as the training device
(2) Vehicles that transport one or more training props or scenarios

Vehicles that could serve as training devices include the following:

(1) Tankers that leak to simulate hazardous materials spills
(2) Specialized pumping and aerial training vehicles
(3) Portable training towers
(4) Vehicles containing a maze for SCBA training
(5) Portable classrooms
(6) Public fire education trailers for the promotion of residential sprinklers; smoke detectors; stop, drop, and roll; and escape planning
(7) Mobile live fire training systems
(8) Mobile fire behavior laboratories (“flashover simulators”)
(9) Urban search and rescue
(10) Forcible entry
(11) Mobile aircraft fire training systems
(12) Mobile helicopter fire training systems
(13) Mobile confined space
(14) Maritime fire training systems

Vehicles that transport one or more training props or scenarios could range from a pickup truck, van, or station wagon to a trailer or large truck. These vehicles are useful for transporting smaller, more portable training devices and simulators. Devices could include the following:

(1) Computer simulators
(2) Pump panel simulators
(3) Driver training equipment
(4) Rescue tools and equipment
(5) Hazardous materials handling equipment
(6) Exterior live fire training (e.g., LP-Gas extinguishers, LP-Gas pressure vessel, Christmas tree)

A.11.1.2 Examples of technical rescue props that could require signage include a confined space prop and an elevated location without fall protection. Signage could be located at all entry points of the training structure or prop, and/or at the isolated hazard area. The requirements of the AHJ should be followed.

A.11.2 A training prop designed to facilitate training to the Rope Rescue Operations level of NFPA 1006 should include the following:

(1) Designed anchor points
(2) Exposed parts of the structure designed to support a 1000 lb (456 kg) working load
(3) Welded handrails and guardrails
(4) An area designed to practice low point edge transitions (roof top)
(5) An area clear of obstructions to demonstrate ascending and descending proficiencies
(6) A balcony or door-sized opening to perform a pick-off
(7) Flat and solid ground surrounding the prop

A training prop designed to facilitate training to the Rope Rescue Technician level of NFPA 1006 should include items (1) through (7) above and the following:

(1) A tower or exterior anchor points to allow for lead climbing
(2) Two anchor points 50 ft (15 m) to 200 ft (61 m) apart capable of supporting the forces generated by a highline system
(3) An anchor point on the top of the prop to allow for a steep or sloping highline

When designing a prop for rope rescue, the following should be avoided:

(1) Exposed edges in metal clad construction. If using metal siding, be cautious of sharp edges. Also consider how slippery the metal siding can be during rope operations. Coatings can be applied improve traction.
(2) Exclusive use of engineered anchor points. While a training agency might be tempted to only use engineered anchor points, it is important for the student to learn to identify and use parts of the structure for anchoring.
(3) Expanded steel or other type of grating as this leads to the deterioration of rope and software.
(4) Mixed use props such as live fire and rope rescue. The continuous heating and cooling of anchor points, risk of equipment contamination, atmospheric concerns, presence of water, and the gradual deterioration of the structure from heat and heavy use are all reasons to avoid mixed use props.

See Figure A.11.2.

A.11.2.2 Designed anchor points should be identified with signage, paint, or other methods.

A.11.2.3 The visual inspection should include, but is not limited to, corrosion, deformation, pits, burrs, rough surfaces, sharp edges, cracking, rust, buildup of paint, excessive heating, alteration, and missing or illegible labels. The inspection protocols of the anchor manufacturer should be followed.

FIGURE A.11.2 Example of Two Rope Rescue Training Towers. ***(Courtesy of the Justice Institute of British Columbia)***

A.11.2.3.1 A sample test protocol is OSHA 1915, Subpart I, Appendix B.

A.11.3 A training prop designed to facilitate training to the Confined Space Rescue Awareness level of NFPA 1006 should include the following:

(1) A horizontal entry point larger than 30 in. (76 cm) to perform horizontal nonentry retrievals
(2) A vertical entry point larger than 30 in. (76 cm) to perform vertical nonentry retrievals

A training prop designed to facilitate training to the Confined Space Rescue Operations level of NFPA 1006 should include items (1) and (2) above and the following:

(1) A space just inside the prop large enough to hold three people, visible from the opening
(2) An area on top of the prop large enough to accommodate a tripod and associated rigging
(3) Multiple openings, vertical and horizontal, consistent with the type of openings found in the local area
(4) An area to perform lock out

A training prop designed to facilitate training to the Confined Space Rescue Technician level of NFPA 1006 should include items (1) and (2) from the first list above and items (1) through (4) from the second list above and the following:

(1) Adjoining voids, connected by different diameter pipes or passageways
(2) Internal configurations requiring the use of internal rigging such as vertical drops, corners, and different sized openings
(3) Elevated entry points
(4) Angled pipes or passageways

When designing a prop for confined space rescue, the following should be avoided:

(1) Concrete tubes. Concrete wears the equipment quickly. If using concrete tubes consider applying an epoxy or fiberglass coating to the bottom half of the tubes to minimize wear on equipment.
(2) Limited venting. By having limited openings, a dangerous atmosphere might be created within the prop. There should be multiple openings to allow for air flow.

See Figure A.11.3.

A.11.3.1 A confined space prop should be designed so that a person can escape or be retrieved from any part of a confined space prop to a location outside of the confined space by means of a door, walkout, access hatch, direct pull from a safety line, or other means of egress or escape. The intent of the committee is to avoid complicated rescues in the event a participant in the prop requires rescuing.

A.11.3.2 The intent of the committee is not to eliminate the building of confined space props below grade, but to include parts of the prop that are accessible at grade to allow for ease of access for instructors and expedited rescue of students should it be required. The hazards of building confined space props below grade include the inability to access parts of the prop in an emergency.

FIGURE A.11.3 Example of a Confined Space Training Prop. *(Courtesy of Vancouver Fire and Rescue Services)*

A.11.4 A training prop designed to facilitate training to the Trench Rescue Operations level of NFPA 1006 should include the following:

(1) A trench or excavation less than or equal to 8 ft (2 m) in depth, consisting of two straight walls
(2) A permanent means of escape at intervals not exceeding 25 ft (8 m), such as permanent ladders, if temporary means of escape, such as temporary ladders, are not going to be used during operations
(3) Clear area around the trench with minimum trip hazards to lay ground pads

A training prop designed to facilitate training to the Trench Rescue Technician level of NFPA 1006 should include items (1) through (3) above and the following:

(1) A trench or excavation greater than 8 ft (2 m) in depth
(2) An intersecting "T" trench
(3) An "L" trench

See Figure A.11.4.

A.11.4.1 An example of a permanent trench rescue prop would include but is not limited to providing two parallel retaining walls constructed of reinforced concrete, reinforced masonry, or precast concrete blocks.

A.11.5 A training prop designed to facilitate training to the Structural Collapse Rescue Operations level of NFPA 1006 should include the following:

(1) A full or partial building collapse made primarily of light wood frame construction
(2) Areas identified as "no cut" or otherwise identified as structural components

A training prop designed to facilitate training to the Structural Collapse Rescue Technician level of NFPA 1006 should also include a full or partial building collapse containing heavy concrete and steel construction.

The inherent instability and risk of further collapse or movement of a rubble pile is the reason the technical committee has elected to require the input of a qualified person in the design and or construction of the pile. The intent is not to have the rubble pile engineered or certified. It is understood that a rubble pile will never be free of hazards; however, it is believed that the input from a qualified person, such as an engineer with specific training or experience with structural collapse, would improve the safety of the prop. This applies to rubble piles constructed of all types of construction materials including, but not limited to, wood frame, masonry, concrete, and steel.

FIGURE A.11.4 Example of a Walkout at the End of a Permanent Trench Rescue Training Prop. *(Courtesy of Vancouver Fire and Rescue Services)*

A.12.1 The portion of the fire training center used for hazmat training should be designed as flexible, programmed space. It should incorporate features consistent with those present in the jurisdiction with respect to slope and configuration and soil types and should include both paved and unpaved surfaces. Infrastructure consistent with that present within the jurisdiction should be incorporated including, but not limited to, below-grade storm water drains and grates, sewer access openings, and subsurface electrical vaults for the purposes of creating a realistic and challenging training environment with respect to leak and spill control, protecting or defending storm drains or other openings, and establishing decontamination corridors.

Design consideration should be given to creating functional areas for various fixed and mobile props, as well as the potential for future expansion. Outflow termination locations of drains and storm water runoff or capture devices should be marked. Design planning should include adequate space between functional areas so that multiple training evolutions can take place simultaneously without adversely affecting each other.

Training props could include tanker trucks (on wheels, on sides, or both), rail cars (on tracks, on sides, or both), drums, and other vessels to simulate leaks and spills.

A.12.1.2 It is the intent of the committee that the AHJ require documentation stating that any repurposed prop has been cleaned, decontaminated, and otherwise rendered safe with respect to chemical contamination. This is intended to protect the AHJ and the users of the training prop from potential health and environmental exposure hazards, as well as liability for leaks or spills of container or tank residue at the training facility or during initial transport. Examples include pipe manifolds and racks, railroad tank cars, tank trailers or trucks, silos, inter-modal containers, and aboveground storage tanks.

Logistical difficulties in transporting and delivering large and/or heavy training props, such as rail cars, to the site should be considered. There might be a need for advanced planning, permitting, coordination with public utilities, temporary removal of street signs or signals, coordination with other stakeholders, and the services of a professional rigger.

A.12.1.3 It is the intent of the committee that leak and spill props configured to simulate the release of liquids or gasses under pressure utilize known, safe materials operating within reasonable pressures. The AHJ should ensure that liquid mixtures are environmentally neutral or nonhazardous using guidance from applicable regulatory agency stake holders (e.g., DEP, Health Department). Valves controlling both liquid and gas simulants should be marked and identified and easily reached and manipulated by the operator. Dyes, additives, and other compounds used as simulants or their components should be catalogued and an SDS library maintained on site.

A.12.1.3.5 The intent of the quick purge valve is to allow for the flushing of accumulated rust and debris that can form in the prop after periods of dormancy.

A.13.1 There are many different styles of exterior combustible and flammable liquids live fire training props. *[See Figure A.13.1(a) and Figure A.13.1(b).]*

FIGURE A.13.1(a) Chemical Complex Live Fire Training Prop. ***(Courtesy of Texas A&M University Emergency Services Training Institute, College Station, TX)***

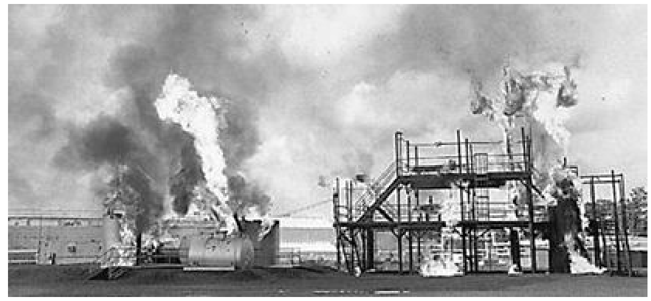

FIGURE A.13.1(b) Three Level Chemical Complex Live Fire Training Prop. ***(Courtesy of Texas A&M University Emergency Services Training Institute, College Station, TX)***

A.13.4 Fuel management is important when using combustible and flammable liquids during training evolutions.

A.13.5.2 Some of these permits could be required prior to the start of construction.

A.13.8 This will prevent overpressuring of the system and provide a pathway for the combustible liquid, not used at the training prop, to be returned to the storage tank. This will protect the supply pumps and their mechanical integrity.

A.14.1 A fire investigation training structure, burn cell, or set should facilitate training for fire investigators to conduct scene examination methods and techniques as established in NFPA 1033 and NFPA 921. These include but are not limited to fire analysis through scene examination of the fuel load or package; fire spread; fire effects; fire suppression technique effects on fire behavior; the effects of fire suppression, ventilation techniques, and wind on fire behavior; and associated patterns. The structure, burn cell, or set should also facilitate fire scene reconstruction, a process of recreating the physical scene during fire scene analysis investigation or through the removal of debris and the placement of contents or structural elements in their prefire positions.

Annex B Nonmandatory Information About Planning, Designing, Constructing, and Maintaining Fire Training Centers

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Needs Analysis.

B.1.1 General. Before going to the challenge and expense of building a fire training center, the need for it should be evaluated. Why is it needed? Who will be taught? What will be taught? What existing training resources are already available? Are they adequate? Are they cost effective?

Modern fire fighting requires serious adult education, both in the classroom and during challenging, hands-on training evolutions. Training needs and programs should be analyzed to determine the required training. If a fire training center is necessary, then the initial step should be to develop a statement on the broad purpose of the center. An example of such a statement follows: “Ever-changing fire characteristics and technologies require fire fighters to receive advanced education and training in fire suppression, fire prevention, rescue, and emergency medical services. A proper learning environment is critical for delivering this education. This fire training center provides the facilities required for fire training and enhances the community's well-being through better fire protection and fire prevention."

B.1.1.1 The construction of a fire training center, regardless of size, requires land, funding, planning, and design. In order to maximize benefits, an assessment of current and future needs should be made. This assessment should consider the following:

(1) Current and future training needs, including number of potential students, their geographical distribution, and the AHJ's annual training requirements (curriculum and hours for recruits, in-service personnel, and others that will use the fire training center)
(2) Existing fire training facilities currently available and the cost of using them
(3) Organizations or departments that might use the training center, including potential teaming partners from within the jurisdiction and around the region
(4) Projected growth of the community and fire department
(5) Viable alternatives to new construction
(6) Fuel sources
(7) Land availability
(8) Suitability of land for purpose
(9) Future plans for land adjoining the facility

B.1.1.2 Resources include money, land, instructors, and support from the government, private enterprise, and the community. The availability of resources should be evaluated to help define the limitations of what the fire training center can deliver.

B.1.2 Alternative Facilities. A new fire training center needs to be justified. The use of existing facilities at the state or regional level should be explored. If the department is located in an industrial area, the possibility of using any available fire training facilities at the local plants should be considered.

B.1.3 New Fire Service Training Center. If it is decided that a new fire service training center is needed, certain factors should be considered.

B.1.3.1 Cost Considerations. The funding sources should be identified, as should initial and ongoing costs, including the following:

(1) Site acquisition
(2) Fees (legal, permitting, architectural, and testing)
(3) Construction
(4) Furnishings
(5) Staffing
(6) Apparatus and equipment
(7) Maintenance (buildings, grounds, training props, and equipment)
(8) Utilities (water, electricity, gas)
(9) Fuel
(10) Noise, smoke, and water abatement
(11) Roadway systems

B.1.3.2 Cost-Benefit Analysis.

B.1.3.2.1 A cost-benefit analysis should be conducted to enable a community to determine whether the investment is cost-effective and if it is feasible to contribute to long-range financial support. This analysis should include consideration of cost-saving opportunities, such as determining which departments and agencies will use the training center, so that costs can be shared by multiple budgets; identifying state, county, and regional training agencies that might wish to sponsor their programs at the training center; and finding local industrial plants that might be willing to contribute to the costs of the training center. An example of one of these options is that local police might share a need for driver training, physical fitness, tower training, and use of various spaces, such as auditoriums, classrooms, offices, and conference rooms. Another example is combining the training center with an in-service fire station, which could satisfy two needs and reduce the total financial impact of separate facilities.

B.1.3.2.2 If the training center is to be shared between multiple departments, agencies, or jurisdictions, then the needs, features, cost-sharing arrangements, and scheduling arrangements should be agreed upon in advance. Ideally, a written letter of understanding or formal contract would be signed by the sharing parties.

B.1.3.2.3 Finding ways to reduce construction, operations, and maintenance costs should be part of the cost-benefit analysis. Modular construction, including pre-engineered structures, could be cost-effective for training structures and administration, classroom, storage, and other facilities. Exploring various site layouts, construction phasing, grant opportunities, and alternatives for training props should be part of the analysis.

B.1.3.2.4 The cost-benefit analysis should include an evaluation of potential cost savings for current training expenditures that might not be necessary if a training center is built. Examples include the following:

(1) Fees paid to use facilities at other training centers
(2) Travel costs, such as fuel, overtime pay, lodging, and per diem, associated with training at other training centers
(3) Costs associated with preparing acquired structures for training evolutions

B.1.3.3 Intangible Benefits. The results of the cost-benefit analysis will likely reveal that the training center will have a net cost, both for construction and future operations and maintenance. Part of the justification will require examining the intangible benefits that a well-trained fire service will provide for the community. The intangible benefits could help a community accept the need for, and cost of, building a new training center. It might be beneficial to organize a commission or advisory group to interface between governing bodies, the fire training agency, and the public. The advisory group should include representatives of the agencies, organizations, and departments that will use the training center. Such a group could weigh the importance of the following potential benefits:

(1) Reduced injuries and deaths of civilians and fire fighters
(2) Reduced number of fires and property damage
(3) Increased efficiency and morale of the fire-fighting force
(4) Improved training capability and public image of the fire department

B.2 Components and Considerations.

B.2.1 General. This chapter lists general components that could be part of a training center. Other components that might be unique to a particular industry are not included. For the purpose of this annex, buildings, training structures, and training props are discussed separately; however, combinations of these components might be necessary or advantageous. As long as the function of an individual component is not compromised, each component can be located wherever it is conducive to effective training and safety. All components listed below are not necessary for an efficient training center. The following list of components could be considered:

(1) Administration and support facilities components, as follows:
   (a) Offices
   (b) Conference areas
   (c) Library, including collections of various media
   (d) Printing and copying area
   (e) Graphics and audiovisual aid preparation area
   (f) Student housing, dorms, and recreation facilities
   (g) Food service facilities, cafeteria, kitchenette, or break room
   (h) Restroom and locker facilities
   (i) Apparatus maintenance and repair center
   (j) Equipment and supply storage and repair facility
   (k) Storage space for various materials
   (l) Communications center
   (m) Data processing area
   (n) Medical area, infirmary, or first aid
   (o) Records storage
   (p) Computer facilities
   (q) Video production area
   (r) Multimedia facilities
   (s) Internet connections
   (t) Broadcasting capabilities
   (u) Self-contained breathing apparatus (SCBA) storage, maintenance, repair, and refilling area
(2) Indoor instructional facilities components, as follows:
   (a) Classrooms ("clean" and "dirty")
   (b) Breakout areas for classes
   (c) Auditorium
   (d) Physical fitness area
   (e) Pool for water rescue training
   (f) Technical rescue training areas
   (g) Special training laboratories components, as follows:
      i. Simulators
      ii. Automatic sprinklers
      iii. Pumps
      iv. Emergency medical services (EMS) and rescue
      v. Fire alarm systems
      vi. Arson laboratory
   (h) Infrastructure for recording classroom sessions and for distance learning equipment
   (i) Storage space for equipment and props
(3) Outside facilities components, as follows:
   (a) Training tower
   (b) Drafting pit
   (c) Live fire training structure
   (d) Emergency vehicle operations course (EVOC) — driver training area
   (e) Flammable liquids and gases and fuel distribution area for outdoor gas-fired props, such as the following:
      i. Fuel spill fire
      ii. Vehicle fire (car, bobtail truck, other)
      iii. Dumpster fire
      iv. LP tank fire
      v. Gas main break fire
      vi. Christmas tree fire
      vii. Industrial fire
   (f) Hazardous materials containment and decontamination areas
   (g) Outside classroom areas (could combine with rehabilitation areas, storage space, and/or restrooms)
   (h) Helicopter landing site
   (i) Respiratory protection training laboratory
   (j) Storage space for portable equipment, vehicles, and props
   (k) Bleachers for outdoor classes or observation of training tower activities
   (l) Fire station
   (m) Outside rehabilitation areas (could combine with outside classroom, storage space, and/or restrooms)
   (n) Technical rescue area (e.g., high angle, collapse, trench, confined space, vehicle extrication)
   (o) Safety monitoring and control areas
   (p) Rail incident training (with or without fire)
   (q) Aircraft incident training (with or without fire)
   (r) Shipboard incident training (with or without fire)
   (s) Fire behavior laboratory ("flashover container") or cell
   (t) Extinguisher training
   (u) Swift water rescue training
   (v) Rapid intervention crew (RIC) ("Saving Your Own") training prop
   (w) Mock city (with or without fire) — could also be used for multiagency training
(4) Infrastructure components, as follows:
   (a) Water distribution, sewer, and other utilities
   (b) Parking facilities (open and covered)
   (c) Site maintenance equipment and facilities
   (d) Environmental cleanup activities
   (e) Communications
   (f) Water filtration and reclamation
   (g) Security infrastructure for site, buildings, storage areas, and training grounds

B.2.2 Donated Land, Buildings, Training Structures, and Training Props. Fire departments are sometimes offered donations of land, buildings, or existing facilities that could be converted into training structures or training props. Such donations should be evaluated before acceptance to ensure that the training, operational, and budgeting needs can be fulfilled safely and in a practical manner. In some cases, the department might not be able to afford the donation, or the donation might not be suitable. The following questions should be considered before accepting donations:

(1) Is the donated land going to be difficult and/or expensive to develop due to any of the following:
   (a) It is an old landfill.
   (b) It contains hazardous materials.
   (c) It includes wetlands.
   (d) It has poor soils that cannot support buildings.
   (e) It includes rock that will be expensive to excavate.
   (f) It is an endangered species habitat or a wildlife preserve.
   (g) It is located in a flood plain.
   (h) It is historic property with developmental restrictions.
   (i) It is located adjacent to neighbors who cannot tolerate noise, smoke, lights at night, or other disruptions inherent in fire training.

(j) It is not located near sources of water, power, sewer, or other utilities.
(k) It poses other problems that would make it difficult or expensive to develop.

(2) Is the donated structure in good structural condition and suitable for conversion into a fire training structure or prop?
(3) Is the structure suitable for live fire training, rappelling, and other types of training?
(4) Is the donated building in good condition and free of asbestos, lead, or other hazardous materials?
(5) Is the building free of structural deficiencies, termites, mold, roof leaks, or other problems that could be expensive to repair?
(6) Will the building code allow the building to be converted into a classroom or administration building?

B.2.3 Planning Considerations. Because a training center is a specialized facility, there are a number of specific features that should be considered. Since a training center will probably be expected to be used for 40 or 50 years, it is desirable to rely on the experience gained by others. The following general guidelines also should be considered:

(1) Conflicts with the local area master plan, land development regulations, and zoning criteria should be avoided.
(2) Possible joint use with other agencies should be investigated.
(3) Available grant funds should be explored.
(4) An environmental impact statement could be required, depending on the requirements of the AHJ.
(5) Existing training centers should be visited for ideas and experience; new training centers might exhibit state-of-the-art features, while older training centers might identify operational and/or maintenance problems to be avoided.
(6) Weather-related problems and the effects of seasonal use should be considered.
(7) It should be determined if any part of the training center will be used at night.
(8) Ample space should be provided between buildings/outdoor facilities to enable simultaneous use.
(9) Ample, secured storage space should be provided for each segment of the training center.
(10) Site landscaping with minimum upkeep that complements the training activities and that buffers the site from neighbors should be selected.
(11) Interior/exterior finishes that require a minimum of maintenance should be chosen.
(12) Heating and air-conditioning equipment should be located where regular maintenance can be performed easily, but the installation of individual units in classroom areas should be avoided.
(13) Locker, restroom, and shower facilities should be provided.
(14) The space needed for guests and visitors, staff, and future users should be identified.
(15) Slip-resistant surfaces should be specified for all stairs and well-traveled paths.
(16) Automatic sprinklers and smoke detectors should be specified for appropriate areas.
(17) Facilities for the storage of fuel used in training should be considered.
(18) Facilities for the refueling of apparatus could be considered.
(19) Communications should be provided between structures and training areas.
(20) Storage for apparatus, especially during cold weather, should be considered.
(21) Drinking water facilities should be provided at all drill sites, including those outdoors.
(22) Emergency shower and eye wash stations should be provided.
(23) Lighting should be provided in as many areas of the buildings, props, and training grounds as practical to assist in locating personnel.
(24) Outdoor break areas for students and instructors should be provided.
(25) Budgets should be established for construction, operations, and maintenance.
(26) Noise ordinances of the local jurisdiction should be followed.
(27) Impacts of existing and future adjacent residential development should be considered.

B.2.4 Legal Assistance. The jurisdiction should retain or consult with its legal counsel prior to purchasing land or entering contracts with architects, engineers, or contractors. All contracts and future proposed uses should be reviewed with appropriate legal counsel.

B.3 Infrastructure Considerations and Exposures.

B.3.1 General. Certain factors that should be considered in determining the location of the training center in the community include the site, water supply, environment, security, support services, and access to utilities.

B.3.2 Site Considerations.

B.3.2.1 Some questions that should be asked when considering site locations include the following:

(1) What land is available?
(2) Does the agency own land that could be considered as a site?
(3) Are there abandoned properties available?

B.3.2.2 The cost of the land should be included in the agency's budget. A sequential spending plan might allow for the purchase of the necessary land one year and the construction of certain buildings thereafter. A sequential plan could enable the community to realize its objective over an extended period of time rather than placing pressure on current resources for immediate large expenditures. On the other hand, using a bond issue to build at the current year's rate and paying off with future dollars could be more cost-effective. Financial consultation is recommended.

B.3.2.3 An architect/engineer (A/E), a civil engineer, or the municipality's staff engineer should be consulted during planning stages, before land is acquired, to determine if there are potential issues that could make the land difficult and/or expensive to develop, such as wetlands, environmental issues, endangered species habitats, wildlife preserves, flood plains, and the presence of hazardous materials.

B.3.2.4 Hidden subsurface conditions could pose logistical and budget problems. A geotechnical engineer should be consulted during planning stages to determine if the soils are suitable for supporting buildings and paving and to identify potential hidden problems, such as rock, loose fill, ledge formations, or a high water table.

B.3.2.5 The area master plan, if one exists, should be taken into consideration. The site of the training center should be located as follows:

(1) Away from the center of community life to minimize negative impact on adjacent land use
(2) As centrally located as possible for the departments and personnel that will be using it, to minimize travel time and remoteness from protection districts

B.3.2.6 If a site requires a zoning or site plan variance, all pertinent facts should be gathered, and a presentation should be made to the planning board. If possible, the area master plan should be used to support the agency's position. The public should be informed of the advantages of the training center to develop public support.

B.3.2.7 The title to the property should be clear. The potential for future expansion is often desirable, so the surrounding land should be surveyed. A land use determination from the planning board for fire training is beneficial. This requires the municipality to check with the agency before allowing other types of usage. If possible, the site should be marked prominently on land maps and should be surrounded by a nonresidential area. A lawyer's guidance could be advantageous in such cases.

B.3.2.8 Vehicle traffic patterns should be studied, and the most convenient route to the training center should be identified. Heavy, noise-producing apparatus should be routed to avoid residential areas. Travel time to the training center for users should be taken into consideration. On-duty personnel who are receiving in-service training at the training center could be required to respond to emergency incidents; therefore, the training center should be located so that it is accessible to appropriate emergency response routes.

B.3.2.9 The size of the site should be ample for planned buildings, training structures and props, emergency vehicle operations course (EVOC), parking, and future expansion. Adequate separation should be planned between buildings, training structures, and props for safety, vehicular movement, and instructional purposes. In some cases, it might be better to conserve on the size of structures than to overcrowd limited land.

B.3.2.10 Site pavement should be suitable for use in all kinds of weather. Any pavement will deteriorate, especially when subjected to hydrocarbons or hot exhausts, though some pavement types are more durable than others.

B.3.2.11 Landscaping and site layout should take into consideration local climatic conditions. Consideration should be given to rain, snow, wind, heat, and other adverse elements that could affect facility operations. Site layout could incorporate a roadway system that is typical of the community for use in driver training.

B.3.3 Water Supply.

B.3.3.1 A loop or grid system with properly placed valves could help to ensure adequate water delivery. Dead-end mains should be avoided. Valves should be placed to segregate sections of the water system to allow for repairs without complete shutdown.

B.3.3.2 Even where there is a hydrant system, drafting could provide an additional source of water. During times of water emergency, drafting might be necessary. Lakes, ponds, streams, man-made cisterns, and dry hydrants are potential drafting sources. Consideration should be given to supplying water from the water distribution system to maintain the water level in the drafting pit.

Elevated, surface, or underground storage could be used. Pumps also could be used to move water at the desired pressure.

B.3.3.3 For durability, the water main should meet the requirements of NFPA 24.

B.3.3.4 A runoff collection pond equipped with a dry hydrant could be used as a water source.

B.3.3.5 Potable water for use by trainees, instructors, visitors, and staff should be provided. This water could come from wells or a municipal source.

B.3.4 Environment.

B.3.4.1 Federal, state, and local environmental protection agencies should be consulted. The results of these consultations could facilitate procurement of the necessary permits and licenses. These consultations should address the problem of waste water (treatment and disposal) and pollution (air, water, and noise). All information should be shared with the A/E.

B.3.4.2 When selecting a site for a training center, it is important to ensure that the training center is environmentally safe. Factors that should be considered from an environmental aspect are water, air, and the soil.

B.3.4.2.1 Governmental agencies have a jurisdictional interest in the location, design, and construction of a training center. These include agencies at the federal level, such as the Army Corps of Engineers and the Environmental Protection Agency. Each state or municipality, or both, has regulatory agencies from which approval might be necessary prior to the construction of a training center. Most of the regulatory agencies do not have the resources or the staff to assist in planning a training center but will, in most cases, review designs.

B.3.4.2.2 There could be an environmental review by professional engineers, geologists, hydrologists, and environmental scientists. These professionals could develop an environmental impact study to determine what effect, if any, the training center will have on the environment.

B.3.4.2.3 Disposal of waste water from fire-fighting operations should be addressed. Waste water varies in its degree of contamination, depending on the evolutions that are performed. If evolutions involve flammable or combustible hydrocarbons or other potentially environmentally detrimental chemicals or compounds, provisions should be made for separating the contaminants from the runoff. (Waste water treatment could be reduced by using propane or natural gas in lieu of flammable liquid.) Separation of contaminants could be accomplished by oil separators, ponding, and bacteriological breakdowns. Care should be taken to prevent contaminating groundwater. The training center should be designed to take advantage of runoff to replenish supplies for training. Consideration should be given to storm water management, including limiting the amount of new impervious surface (buildings and pavement) created, so that runoff does not affect surrounding properties. Care should be taken to prevent damage to any wetlands in the area.

B.3.4.2.4 The prevalent wind direction and force should be considered when selecting the location of a training center and when selecting the location of buildings at the training center. Smoke generated by the training center should not interfere with the surrounding area or buildings. The residue from extinguishing agents and the products of combustion have been found at considerable distances from training sites. The use of a wind sock on the training ground could assist instructors in evaluating the effect of wind on the areas surrounding the training center. Light generated by fires, particularly at night, should be considered if the training center is to be located near an airport, residential communities, or other facilities that might be adversely affected by nighttime lighting. Noise is also a factor that should be considered. The existing terrain should be used to direct noise away from populated areas.

B.3.4.2.5 Taking advantage of the shape and contour of the land to develop runoff patterns and establish locations for various buildings and props, so that they do not interfere with the drainage of the water during all seasons and weather conditions, should be a goal of the designer. The type of soil at the training center location is important. The type of soil and geology affects such factors as foundation type, bearing capacity, pavement durability, and runoff, both above and below the surface. If rock or unacceptable soils are present, it could be expensive to address during earthwork and foundation operations.

B.3.5 Utilities.

B.3.5.1 The use of pumps, air compressors, and simulators, and heat, ventilation, and air-conditioning (HVAC) units, could greatly increase power requirements. An on-site total energy system might be a practical alternative. Such systems consist of a mechanical package on site that provides utility services (e.g., electrical, heating, air-conditioning) for use in buildings. The largest portion of the electrical needs is usually dictated by the number of buildings and their purposes.

B.3.5.2 The need for power, natural gas feed, computer and Internet connections, telephone connections, and other communications should be considered. The distance of the training center from these services could be a factor in determining its location.

B.3.5.3 Electrical outlets should be installed in accordance with *NFPA 70* in sufficient numbers to minimize the use of extension cords.

B.3.6 Support Services. Where housing and food services are to be provided, space should be planned for such purposes. Space requirements might be reduced if food service is provided by a private vendor. Housekeeping and laundry services, vending machine location, janitorial service, ground and facility maintenance, and transportation of staff and trainees should be considered. Provisions should be made to address the recycling requirements of the jurisdiction.

B.4 Design and Construction Process.

B.4.1 Working with an A/E.

B.4.1.1 In general, the components of the training center should be planned, designed, and/or specified by an A/E. To help the success of the project, the agency should designate a representative to be the main point of contact for the A/E, from initial planning through end of construction. It is helpful for the agency's representative to have sufficient time available to attend planning and design meetings with the A/E, answer the A/E's questions, review drawings, periodically observe construction, and attend construction progress meetings. Ideally, the agency's representative would be the chairperson of a committee that is formed to help develop design requirements and provide feedback to the A/E.

B.4.1.2 The A/E should be selected as early as possible to assist with the needs assessment/budget development phase, as well as to continue through design and construction administration phases. Getting the A/E's input on how much land and funding are needed will reduce the risk of having too little land and money when the design phase starts. Many fire training center projects that were funded by a municipality's best guess, before the A/E was selected, started the design phase with an A/E kickoff meeting in which the primary conversation was about the land and budget shortfalls. This is an unfortunate way to start a project that can be avoided by hiring the design specialists up front, to assist with establishing the land and funding requirements.

B.4.1.3 Visiting existing training centers, including ones that have been in operation for a minimum of 5 years, can be a valuable way to learn about successful features, good ideas, plus any inherent construction or operational deficiencies that have come to light through years of use.

B.4.1.3.1 During such visits, training personnel at the existing training center could provide information on which aspects of the training center work well and which do not. They could be asked, "If you could start over and design the training center again, what would you do differently?"

B.4.1.3.2 Such tours could be taken before selecting an A/E, to get better educated on ideas and options before trying to hire a designer, or to learn about the performance of the A/E that designed that training center.

B.4.1.3.3 Tours could also be taken after selecting an A/E, so that the A/E could be on the tour with the agency personnel, allowing collaborative brainstorming.

B.4.2 A/E Selection.

B.4.2.1 It is recommended that the agency hire an A/E with experience in fire training centers. A/E selection should use a qualifications-based (not price-based) selection process, so that credentials can be used as the primary means of selection prior to signing a contract with an A/E. An A/E with good qualifications for the site development and conventional building design (administrative and classroom buildings) might not have the qualifications necessary for the training props (live fire training structure, training tower, outdoor props, and mobile trainers). Specialists for props who provide this expertise internationally are available and could be hired as a consultant by the local A/E or directly by the agency.

B.4.2.2 To better understand the A/E's qualifications and verify that the A/E personnel are people one could work with during a multiyear project, the A/E's firm could be interviewed before the final selection is made and contract signed.

B.4.2.3 If government funds are being used for the project, the AHJ likely has an A/E procurement/selection process that must be followed in order to follow the procurement law of the jurisdiction.

B.4.3 The Design and Construction Process.

B.4.3.1 In a traditional building construction process, known as *design-bid-build*, the agency hires an A/E to program, plan, and design the fire training center. When the design is complete, it is advertised for bids and general contractors (GCs) bid to construct the project. The construction contract is awarded to the responsible low bidder. The GC builds the project in accordance with the A/E's drawings and specifications. Both the agency and A/E observe construction periodically, to help ensure a smooth construction progress and to confirm that that the facilities are, in general, being built in accordance with the drawings and specifications.

B.4.3.2 Other building construction methods exist, including design/build, construction manager at risk (CMAR), construction manager/general contractor (CMGC), guaranteed maximum construction cost (GMCC) with a construction manager, and others. Even though these methods can be effective for certain types of construction projects, they are typically more complicated and less effective for a specialty facility like a fire training center but could be utilized if necessary.

B.4.3.3 Regardless of design and construction process, the A/E's responsibilities include needs assessment, programming, master planning, construction cost estimating, site selection, design of the training center and its components, production of contract documents (drawings and specifications), construction administration, and on-site observation during construction.

B.4.3.3.1 Programming is an exercise with the agency, potential stakeholders, and outside users of a facility led by the A/E to determine and document the needed components, sizes, relationships, functions, and infrastructure/equipment needs. It begins with an evaluation of the agency goals, and training objectives, and needs analysis and concludes with a detailed space and infrastructure needs program document. Programming often includes preparing a preliminary project budget.

B.4.3.4 Fire training structures, training towers, outdoor trainers, mobile trainers, and other training simulations are training props, not conventional buildings for occupancy. The A/E should work with local AHJs to ensure that each AHJ, including building officials and permitting offices, understands the nature of the use and that these structures might not require full building code compliance. The A/E could meet with or write a letter to the appropriate parties at the AHJ early in the design process to explain the nature of the project. This should help facilitate the AHJ's final review before construction begins.

B.4.3.5 Contractors (builders) are contractually obligated to construct the facilities in accordance with approved contract documents, which include the contract, contract terms and conditions, drawings, and technical specifications. The A/E should prepare the contract documents, and the agency should thoroughly understand them before the project is advertised for bids, to ensure that the agency's training needs have been incorporated into the design and to avoid change orders during construction. Design changes after a contract is agreed upon and especially after construction has begun can be expensive, as can retrofits after construction is complete. Therefore, it is important to consider all the potential training needs for each training structure and prop during the design phase. A system of alternatives to be added or deducted could be used to achieve more efficient and fuller use of available funds. The number of alternates should be limited, however, because having too many can complicate the bidding process to the point of receiving confusing bids or bids that are difficult to compare against one another when trying to award the contract to a general contractor.

B.4.3.6 A request for bids normally coincides with the issuance of the contract documents for bidding. A pre-bid conference with the A/E is necessary to ensure that the general contractors that are bidding understand the bidding requirements. An agency representative should be present. Once construction begins, construction progress should be observed by the A/E at periodic intervals or pre-established milestones. The agency should observe construction periodically as well.

B.4.3.7 After construction is completed, record drawings can be prepared by the A/E or the contractor using documentation provided by the contractor. These drawings should be retained after the project has been completed for use during repairs, alterations, and future expansions.

B.4.3.8 The agency's representative should develop a good working relationship with the jurisdiction's procurement and facilities management offices. These offices usually have a level of control over the procurement, design, and construction processes, but the individuals in these offices usually do not understand fire training or the unique nature of the facilities that are required to facilitate the training. It is usually helpful to keep in steady contact with those offices, in order to educate them and ensure that they customize their efforts according to the unique nature of the project, so that they can effectively support it.

B.4.4 Owner's Project Manager.

B.4.4.1 For government-funded projects, the jurisdiction usually assigns a project manager (PM) to the project from its engineering or facilities department, depending on the complexity of the project. The PM should be knowledgeable in building construction and be familiar with the project contract documents. The PM's role is to represent the building agency, attend design and progress meetings, visit the site on a regular basis, review the progress of construction, and support and facilitate the project to help it run smoothly.

B.4.4.2 The PM is typically independent of the A/E and the contractor/builder. The PM is rarely the same person as the agency's representative, because the PM's role is related to the "nuts and bolts" of design and construction, while the role of the agency's representative is related to providing information to the A/E to ensure that training requirements will be met in the constructed training center.

B.4.4.3 The PM for a privately funded project could also be hired by the agency to serve in the capacity described above, except paid by the agency instead of by the jurisdiction. Sometimes the PM is referred to as the clerk of the works.

B.5 Training Tower.

B.5.1 General.

B.5.1.1 There are many potential purposes for a training tower, including the following:

(1) Basic pumper evolutions and hose evolutions
(2) Ladder drills (ground ladders, roof ladders, aerial equipment)
(3) Standpipe training

(4) Mid-rise search and rescue training
(5) Rappelling
(6) High-angle rescue
(7) Building-to-building rescue
(8) Vertical rope work, such as tripod over roof and floor openings
(9) Elevator shaft training
(10) Sprinkler training
(11) Training in the control of building utilities and fire protection systems, possibly including mock meters, panels, pumps, alarms, and control systems
(12) Alternative strategies for wind-driven fires, such as fans, fire curtains, and high rise nozzles

See Figure B.5.1.1(a) and Figure B.5.1.1(b) for examples of training towers.

B.5.1.2 Using a training tower can instill confidence in trainees and further their ability to work at various heights in a skilled manner. Some law enforcement agencies ask fire training centers for permission to use the tower to train in rappel or other skills. Towers can be used for interagency joint training, such as active shooter, counterterrorism, natural disasters, and mass casualty incidents.

FIGURE B.5.1.1(a) Representative Training Tower. ***(Courtesy of Tidewater Regional Fire Training Center, Newport News, VA)***

FIGURE B.5.1.1(b) Representative Training Tower. ***(Courtesy of Tallahassee Fire Department, Tallahassee, FL)***

B.5.1.3 Training towers are expensive to build, especially with the provision of sufficient fire resistance to withstand heat of training fires. Soot and dirt resulting from such fires could make it difficult to use the tower for other training scenarios. It could be preferable to use the tower for training evolutions that do not include live fire and to conduct interior fires in a separate training structure. If live fire training is planned for the tower, see Chapter 7 of this document.

B.5.1.4 The area around the training tower should be designed to accommodate the training needs. This commonly requires paving on one to four sides to allow apparatus to maneuver around the tower. Obstacles, such as the curb and gutter, sidewalks, hydrants, street signs, poles, and cables simulating overhead power lines could be added on one or more sides to provide realistic challenges. *(See Figure B.5.1.4.)*

B.5.2 Height. The height of the tower could be typical of the buildings found in the locale. Consideration should be given to future community development. Training tower heights commonly range between 40 ft (12 m) and 70 ft (21 m) tall.

B.5.3 Dimensions.

B.5.3.1 The tower should be at least 20 ft × 20 ft (400 ft^2) [6 m × 6 m (36 m^2)] in floor area per level. This dimension should accommodate interior stairwell openings and allow room for fire companies to maneuver hoselines.

B.5.3.2 A rectangular footprint could allow for an interior, enclosed stairway and an exterior fire escape to provide two means of entrance or egress to each level. A rectangular configuration could provide more interior floor space for hose stretching practice than a square configuration.

FIGURE B.5.1.4 Simulated Overhead Power Lines Near Training Structure for Laddering Skills. *(Courtesy of Reading-Berks Fire Training Center, Berks County, PA)*

B.5.4 Stairways. Stairways in the training tower might be interior, exterior, or both. Stairways should provide not only a means of access between floor levels but also should simulate fireground conditions. A variety of types, widths, and situations could be realistically represented. Stairways included in the tower should be located to maximize available interior floor area. Stairway treads in the tower should be slip-resistant; open-grate treads could prevent water accumulation. The size of all stair landings should be planned to provide for personnel and equipment that must be maneuvered around corners. Floor numbers could be indicated on landings.

B.5.5 Exterior Openings.

B.5.5.1 Door and window openings should be sized and located to simulate situations existing in the community. Window sills should be capable of withstanding abuse from rope and ladder evolutions, with options including heavy wooden sills or concrete sills with bullnosed corners.

B.5.5.2 Doors and windows could be fully framed to simulate situations existing in the community or could be steel or wood shutters. Where it is not possible for the tower to include various types of doors and windows, a separate display mock-up including an example of each type could be constructed. Those areas located near ocean or river shipping facilities could take into consideration the doors or hatches found on ships.

B.5.6 Fire Escapes. An exterior fire escape could be placed on the tower if they are commonly found in the community. The bottom of the fire escape could terminate as a stair to the ground or a vertical ladder. The top of the fire escape could end at the top floor or the roof or could rise over the roof by means of a vertical gooseneck ladder. Caged vertical ladders might be desirable if they are representative of community construction.

B.5.7 Sprinkler and Standpipe Connections. The training tower could include provisions for standpipe connections at all floor levels. These connections not only provide the opportunity to develop the proper procedures for connecting to, and providing a water supply for, the system but also could be utilized for simulated fire attack by fire forces operating in a high-rise building. Siamese connections could be installed and identified at ground level to accommodate auxiliary water supplies. Section valves could be installed in systems at each floor, or at selected locations, to enable the instructor to shut down only sections, not entire systems, for training purposes. Drains with easy access and permanent signs to remind members to drain training standpipes or sprinkler systems during cold weather could be included to reduce risk of damaged standpipes due to freezing.

B.5.8 Roof Openings. Roof openings could be provided for the practice of ventilation procedures, especially if not already provided at a live fire training structure or at a ground-level roof prop. Various sized openings on flat and sloped roof surfaces could be designed into the structure so that different situations and types of roof conditions could be simulated

B.5.9 Coping. Where not covered by the roof, the topmost section of the walls or parapets should have a coping or parapets should have a coping to reduce abrasion on ropes and be capable of resisting ladder impact and climbing exercises.

B.5.10 Drains. Each floor of the tower should be equipped with floor drains or scuppers to accommodate training water. In areas subject to freezing temperatures, conventional floor drains might not be effective. Where scuppers are used, the water discharge should be directed to areas that will not interfere with activities below the openings. Regardless of the types of drains that are selected, their installation should ensure the quick runoff of water.

B.5.11 Sprinkler Laboratory. The need for a laboratory from which sprinkler systems can be operated, demonstrated, and inspected should be considered. This function could be located in a dirty classroom or other facility instead of the tower.

B.5.12 Alarm System Laboratory. Consideration should be given to an area where several different types of operable fire alarm systems are located. This function could be located in a dirty classroom or other facility instead of the tower.

B.5.13 Fire Extinguishing Systems. Consideration should be given to providing an area that allows the installation of fire extinguishing systems for demonstration purposes. This function could be located in a dirty classroom or other facility instead of the tower.

B.5.14 Special Training Features. Special features could be included in the tower to accommodate local area needs. For example, a 36 in. (910 mm) diameter pipe could connect two floors for caisson and mine shaft rescue simulation. An elevator could be installed to be used in the simulation of elevator emergencies and for the movement of personnel and equipment. Anchor points for rope evolutions should be provided.

B.6 Smoke Building.

B.6.1 General.

B.6.1.1 The purpose of the smoke building is to acquaint trainees with the skills and abilities necessary for survival in smoke-laden atmospheres.

B.6.1.2 The smoke building should be designed to allow for the constant surveillance of the trainees by the instructor. This objective could be accomplished by having the instructor accompany the trainee, by having the instructor observe the trainee through windows, or by using thermal imaging.

B.6.2 Flexibility. The smoke building's interior configuration could be changeable, so that various situations could be created. The use of modules or segments that could be quickly changed provides for additional flexibility.

B.6.3 Safety.

B.6.3.1 The smoke building should have entry points and escape hatches at frequent intervals in case of an emergency.

B.6.3.2 Any area of a maze that cannot be seen and reached by the instructor should have the walls or ceilings top hinged so that any section could be opened. This allows trainees to be continually accessible to the instructor.

B.6.3.3 Smoke rooms could have sensors built into the floor that indicate the location of the trainees.

B.6.3.4 Provisions should be made for the quick ventilation of the building. Consideration should be given to stopping or quickly redirecting the smoke being introduced into any given section of the smoke building, which could be accomplished by the use of blowers or exhaust fans.

B.6.3.5 Communication capabilities between the instructor and trainees should be designed into the system. These capabilities could provide safeguards as well as the ability to transmit instructions to the trainees.

B.6.4 Smoke. Smoke used in the smoke building should be nontoxic and of a known composition. Specially designed mechanical equipment could be installed in the smoke building to produce nontoxic smoke for training purposes.

B.7 Outside Activities.

B.7.1 General. Ample outside space should be provided for a variety of uses, including auto extraction, ventilation, forcible entry, drafting, exterior fires, property conservation, and other training scenarios. Specific layouts would be needed for permanent installations for training in the areas discussed in this chapter. *(See Figure B.7.1.)*

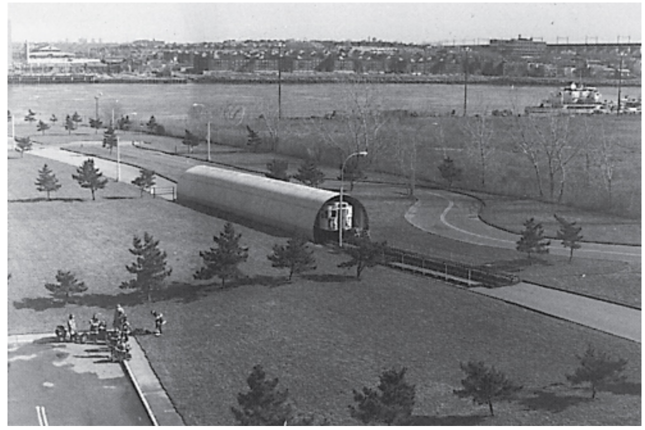

FIGURE B.7.1 Outdoor Training Scenario: Train in Tunnel. ***(Courtesy of New York Fire Department Academy, New York, NY)***

B.7.2 Electrical. Electrical safety could be taught by constructing various electrical wiring systems. Some electrical problems that might be addressed are downed wires, vaults, transformers, meters, and main disconnects. A local utility company could be requested to participate in the planning phase of this section of the training center.

B.7.3 Drafting Area.

B.7.3.1 A drafting area could be desirable to facilitate the training of pump operators and to test pumper apparatus. The drafting area could consist of a drafting pit (underground cistern), stormwater retention pond, or natural body of water, such as a pond, lake, or river. *(See Figure B.7.3.1.)*

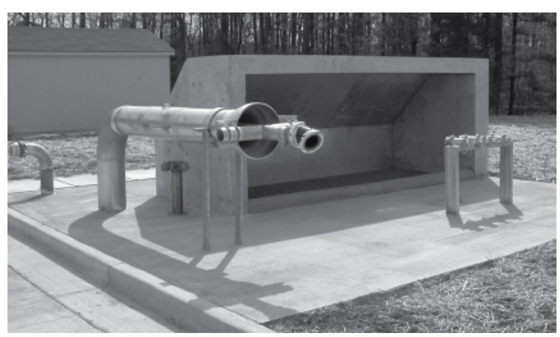

FIGURE B.7.3.1 Outdoor Drafting Pit. ***(Courtesy of Woodman Road Fire Training Center, Henrico County, VA)***

B.7.3.2 In general, a capacity of at least 20,000 gal (75,700 L) of water should be provided, assuming water will be recycled to the drafting area. Where the drafting area also serves as the sole supply of water for training, larger quantities could be needed.

B.7.3.3 The size of the drafting area and the configuration of water return elements, interior baffles, and other features should be designed to reduce or minimize the heating of the water, turbulence, and air entrapment.

B.7.3.4 The drafting area should be proportioned so that the water will be at least 4 ft (1.2 m) deep, with the top surface of the water no more than 10 ft (3 m) below the pump intake (preferably less), so that the water level will not drop lower than 10 ft (3 m) below the pump intake during pump operations. Drafting area proportions should match the anticipated apparatus that would be used, including apparatus that is anticipated for future use.

B.7.3.5 The drafting area should have at least one 6 in. (0.15 m) diameter dry hydrant with an intake strainer at the bottom of the dry hydrant, close to the bottom of the water supply, and at least 2 ft (0.6 m) below the top surface of the water. If large flows are anticipated, two dry hydrants should be considered.

B.7.3.6 A drafting pit should have access openings at the top, both for maintenance personnel and for suction hard sleeves. The access openings should have hinged covers that are capable of supporting personnel.

B.7.3.7 There should be a collection tube or hood to direct pumper discharge back into the drafting area. The tube or hood configuration should allow for handlines to be held in place by a stand or other means, so that personnel do not have to hold handlines during pump operations.

B.7.3.8 Instrumentation should be placed in a protected location. It might be advantageous to locate instruments in an area removed from apparatus noise. In this case, an intercom system might be needed between the instrumentation area and the pump operator. Where portable instrumentation could be used, provisions should be made for the units.

B.7.3.9 Paving adjacent to the drafting area should be concrete to support apparatus weight and to be resistant to exhaust heat during prolonged pump operations.

B.7.4 Apparatus Driver Training Course.

B.7.4.1 The design features of apparatus driver training courses should challenge the abilities of the student driver based on the customary or anticipated problems encountered in a particular jurisdiction and by matching the challenges to practical situations. In addition, course components should reflect national professional qualification standards for driver training certification. *(See Figure B.7.4.1.)*

B.7.4.2 Limited resources, high property values, and availability of sufficient property adjacent to the proposed training center could impact the design features of the driver training course. Incorporating driver training space within the road network around the drill field area of the training center could be a practical solution to budgetary or property concerns, but this arrangement could necessitate setting scheduling priorities if other training exercises could not be performed safely while the road network is being used for driver training.

B.7.4.3 An arrangement that should be considered is a combination of two separated yet interconnected areas, such as a drill field incorporating the training structures and props and a separate driver training area with roadways, hills or inclines, and lane markers. These two areas should be interconnected, so that movement from one to the other is accomplished readily and without interference; however, they should be separated in some manner, so that entry from one area to the other requires a deliberate effort, thus protecting the activities in progress in each area at any given time.

FIGURE B.7.4.1 Example of Driver Training Course.

B.7.4.4 Student, staff, and visitor parking areas should be segregated from driver training areas and should be posted with signs or located within some physical barrier or fence. Apparatus involved in driver training exercises should not enter parking areas, and areas of training should be posted with signs to avoid accidental access by unauthorized vehicles.

B.7.4.5 The components of a driver training course should incorporate the following basic driving maneuvers as a minimum:

(1) Serpentine
(2) Alley docking
(3) Opposite alley pull-in
(4) Diminishing clearance
(5) Straight-line driving
(6) Backing
(7) Station parking
(8) Confined space turnaround

B.7.4.5.1 The basic components listed in B.7.4.5 would ideally be accommodated with a dedicated paved area measuring 400 ft × 300 ft or 2.8 acres (122 m × 91 m). If that is not feasible within the site, a smaller paved area measuring 300 ft × 200 ft or 1.4 acres (91 m × 61 m) could be used, or driver training could be incorporated into the road network, as described in B.7.4.2.

B.7.4.5.2 In addition to the basic components, a hill-incline ramp, with sufficient angle to test the student driver's ability to "hold" apparatus, or to demonstrate stopping on an incline, could be valuable.

B.7.4.6 Whether safety cones are used to mark the course (this could accommodate variances in apparatus size and flexibility in time-sharing with other agencies) or permanent obstacles are erected, the course design should depend on the following:

(1) Knowledge of the standard width of streets and intersections in the geographical location
(2) Specifications for highway and road construction in the area served, with emphasis on weather and climate conditions
(3) Length, type, and specifications (turning ratio and wheel base) for new, old, and anticipated apparatus
(4) Snow removal and grass-cutting maintenance
(5) Storm drainage of driving track and skid pad
(6) Weight and size of vehicles

B.7.5 Outside Classrooms/Dirty Classrooms/Rehab Building.

B.7.5.1 Outside classrooms could be useful for providing covered shelter for students and instructors near the training props, so that personnel do not have to relocate to the administration/classroom building for various functions. An outside classroom could be used as a dirty classroom for briefing before a training evolution and debriefing afterwards, and as a place to rehabilitate and rehydrate between evolutions. It could also be used for emergency shelter during a storm.

B.7.5.2 Features that should be considered for outside classrooms include the following:

(1) Open (no walls) on three sides, with a wall at the fourth side, preferably at the side with the greatest sun exposure for hotter climates, or enclosed structures with overhead coiling or sectional doors on three sides that can be opened or closed based on weather conditions
(2) White board on the wall for use by instructors
(3) Fans and misting fans
(4) Storage rooms and rest rooms
(5) Water fountain(s), vending machines, or both
(6) Benches or other seating
(7) Overhead infrared heat
(8) Hydration station for filling portable water coolers
(9) Ice machine
(10) Floor drains, hose bib, and hose reel for washing floors
(11) Wall racks for portions of PPE during a debriefing
(12) Flat screens to display briefing videos and post-evolution live video
(13) Charging stations for portable electronic devices
(14) Dirty classrooms should be designed to withstand the movement of fire fighters with soiled gear. Floor drains and hose bibs to wash down floor areas should be considered. Wall racks for storage of PPE while students attend a class or briefing should also be considered.

B.7.6 Mock City.

B.7.6.1 Mock cities typically consist of training props that simulate streets and various buildings that might be found in the region surrounding the training center. A mock city could be used by fire departments and other agencies for various training exercises (e.g., police departments could use it for arrest, search and seizure, crowd control, hostage, and other scenarios). In addition, a mock city could be used by various public safety and governmental agencies simultaneously to train for responding to major events, such as natural disasters, terrorist attacks, and riots.

B.7.6.2 The mock city could consist of a road network connecting various structures. The roads should be realistic, including the paving, curb and gutter, sidewalks, poles, signs, traffic signals, hydrants, and other features commonly found in roadways.

B.7.6.3 The structures in a mock city should be unoccupied training props and could simulate houses, apartments, schools, gas stations, banks, motels, offices, or other buildings. The structures should be designed to be durable for repeated training scenarios. A live fire training structure, a training tower, partially collapsed buildings, or combinations thereof, could be incorporated into the mock city, as could a rubble pile (fully collapsed structure), a vehicle extrication area, a trench rescue simulator, and tanker trucks simulating hazmat spills.

B.7.7 Fire Behavior Lab ("Flashover Container").

B.7.7.1 A fire behavior lab could be considered for the teaching of basic fire behavior (but not fire attack or other training scenarios).

B.7.7.2 The fire behavior lab should have two means of egress plus elevation offsets and ventilation hatches designed to demonstrate various phases of fire.

B.7.7.3 A fire behavior lab that does not require fire fighter entry to observe the fire behaviors should be considered.

FIGURE B.7.7.4 Mobile Fire Behavior Lab. ***(Courtesy of Gaston College, Dallas, NC)***

B.7.7.4 Several vendors manufacture fire behavior labs in both fixed and transportable configurations. *(See Figure B.7.7.4.)*

Annex C Administrative and Classroom Building Guidance

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

C.1 General.

C.1.1 This annex addresses the many components that should be considered when planning an administration/classroom building.

C.1.2 Certain components are needed only if the building is to be used for administrative purposes; others are pertinent only to a classroom building. However, if the purposes are to be combined, all of the items specified in this annex should be considered. Only those items needed for the individual situation should be included to produce a viable administration/classroom building. The programming exercise will evaluate and document the needed components and their size, relationships, and technical requirements.

C.1.3 Allowances for structure, walls, partitions, circulation, custodial/maintenance, and mechanical and electrical space needs will be included in a programming exercise as either specific program space needs in square feet or as a percentage allowance area of the net program spaces.

C.1.4 Whether the building would serve as an emergency shelter during an event or backup emergency operations/communication center should be considered. This program consideration could impact size, location, mechanical and electrical systems, and seismic/structural loading design requirements.

C.2 Access and Circulation.

C.2.1 Wayfinding and Image. The administration/classroom is typically the primary access point for the fire training center. It is the front door to the center for visitors, guests, and outside agencies that might use the center. The administration/classroom building should bridge the secure/nonsecure areas of the center to provide an obvious and welcoming entrance to visitors and guests and project a professional image. *[See Figure C.2.1(a) through Figure C.2.1(d).]*

FIGURE C.2.1(a) Welcoming and Professional Entry. ***(Courtesy of Kitsap County Cencom, Kitsap, WA.)***

C.2.2 Public Use. If public use or use by other outside stakeholder groups is expected, means should be provided for public access to auditoriums, classrooms, restrooms, and break areas while maintaining the security of the remainder of the building.

C.2.3 Circulation and Break Spaces. Adequate lobby, queuing, and circulation spaces for classroom and auditorium/large meeting room spaces should be provided.

C.2.4 Reception. A central reception area serves as a point of welcome for visitors and a security control point. It can include waiting space for guests, posting of daily events, and wayfinding information.

C.2.5 Signage and Wayfinding. Interior and exterior signage should be considered to provide a professional identity and means for wayfinding for the building and training center as a whole.

C.2.6 Emergency Response from the Administration/Classroom Building. If the facility will be used by in-service first responders, direct access should be provided from offices, auditoriums, and conference and classroom areas to where their emergency response vehicles will be staged.

C.2.7 Emergency Response to the Administration Classroom Building. A parking area for emergency response vehicles should be provided. Transportation for multiple victims should be considered.

C.2.8 Maintenance and Deliveries. The administration/classroom building should be the control point for third-party maintenance/repair service providers and for deliveries to the center.

C.2.9 Solid Waste. Exterior facilities for solid waste disposal including recyclables should be located where accessible by the local solid waste service without compromising security of the site, training vehicles, or emergency response vehicles.

FIGURE C.2.1(b) Representative Administration/Classroom Building. ***(Courtesy of Gaston College, Dallas, NC.)***

FIGURE C.2.1(c) Representative Administration/Classroom Building. *(Courtesy of Glendale Regional Public Safety Training Center, Glendale, AZ.)*

FIGURE C.2.1(d) Representative Administration/Classroom Building. (*Courtesy of Cheyenne Fire Training Complex, Cheyenne, WY.)*

C.3 Program Elements.

C.3.1 Offices.

C.3.1.1 Office space should be provided for permanent and temporary staff, which could include the officer in charge, assistant administrator, instructors, and clerical personnel. Additional office space requirements are dictated by agencies housed at the training center. Properly designed open office space could add flexibility. Closet and storage space should be included.

C.3.1.2 Typical office space of 120 ft^2 (11.1 m^2) provides for a desk plus credenza, bookcase, or file cabinet and two guest chairs for small meetings.

C.3.1.3 Office space used to discuss personnel issues should be acoustically separated. *(See Section C.4.)*

C.3.2 Conference Rooms.

C.3.2.1 A conference room could be used for staff meetings, press conferences, and other on-site functions that need clean space, chairs, tables, and other items to support a variety of different groups and their needs. At a minimum there should be one conference room that will accommodate all permanent center staff.

C.3.2.2 Conference rooms should consider audio-visual technology needs and acoustical separation. *(See Section C.4.)*

C.3.3 Auditorium/Large Meeting Room.

C.3.3.1 An auditorium/large meeting room could be used for classrooms, seminars, promotional ceremonies, and community activities. Movable chairs could increase the utility of this component. Tiered seating should be considered for improved sightlines in larger rooms.

C.3.3.2 The floor and the wall coverings could be designed to withstand indoor basic training when inclement weather precludes outside activities, unless other indoor training spaces are provided.

C.3.3.3 Auditorium/large meeting rooms should consider audio-visual technology needs. *(See Section C.4.)*

C.3.3.4 Auditorium/large meeting room features should incorporate features described in the classroom. *(See Section C.4.)*