



# WORKPLACE SOLUTIONS

*From the National Institute for Occupational Safety and Health*

## Preventing Deaths and Injuries to Fire Fighters during Live-Fire Training in Acquired Structures

### Summary

Fire fighters are subjected to many hazards when participating in live-fire training. Training facilities with approved burn buildings should be used for live-fire training whenever possible. However, when acquired structures are used for live-fire training, NIOSH strongly recommends that fire departments follow the national consensus guidelines in NFPA 1403, standard on live-fire training evolutions [NFPA 2002a] to reduce the risk of injury and death. These guidelines are summarized in the recommendations in this document.

### Description of Exposure

Live-fire training exercises are a crucial element in the structural fire fighting curriculum. Live-fire training is often conducted in burn buildings designed and approved for such training. Unlike burn buildings, acquired structures are obtained from a private property owner and are not designed or intended for live-fire applications. Several factors associated with live-fire training in acquired structures create safety concerns for fire departments: insufficient or unstable structural components (i.e. floors, railings, stairs, chimneys, and ceilings), limited access to entry and exit paths, hidden combustible materials, debris, and inadequate ventilation [NFPA 2002a].

During 1983–2002, 10 fire fighters died as a result of injuries while participating in live-fire training exercises at acquired structures [Fahy 2003]. During 2000–2002, the NIOSH Fire Fighter Fatality Investigation and Prevention Program investigated three incidents involving four fire fighters who sustained fatal traumatic injuries while participating in live-fire training in acquired structures [NIOSH 2000, 2001, 2002]. Two of these cases are described below.

### Case Studies

#### Case 1

A volunteer fire fighter (the victim) died and two other fire fighters were injured during a live-fire training exercise in a two-story duplex. The victim and another

er fire fighter played the role of trapped fire fighters under a table on the second floor. The victim did not have any formal training, and the other fire fighter had been with the department for about 1 year. A burn barrel on the second floor was not producing enough smoke, so the instructor lit a second flare to ignite a foam mattress sleeper sofa next to the stairs on the first floor. The fire rapidly progressed up the stairway, trapping the fire fighters on the second floor. The trapped fire fighters were recovered from their original position and removed from the structure. The victim was unresponsive, and advanced life-saving procedures were initiated en route to the local hospital where he was pronounced dead. The cause of death was listed as asphyxia due to smoke inhalation [NIOSH 2001].

## Case 2

A career lieutenant and a career fire fighter died while participating in live-fire training at an acquired vacant structure. The fire was built in a closet with five wooden pallets and bales of straw as fuel. To produce a larger fire, fire fighters added a twin-sized urethane foam mattress to the fire. The search and rescue team (the two victims) entered the structure to “rescue” a mannequin. The fire intensified, and smoke filled the burn room and the hallway. The Incident Commander (IC) ordered ventilation so a window was broken. Heavy smoke followed by intense flames were emitted. A flashover is believed to have occurred seconds after the window was vented. (Flashover is when all surfaces and objects in a space have been heated to their ignition temperatures.) The IC and fire fighters on the scene did not realize that the victims were in the burn room at the time of the flashover. Failing to contact the two victims by radio, the IC sent in the Rapid Intervention Team. Approximately 10 minutes after the flashover, the IC called for an accountability check on the radio and receiving no response from the victims, he sounded the air horns to evacuate the structure. The attack crew then found one of the victims lying on the floor next to the closet where the fire had been ignited. The second victim was found lying next to the window of the burn room. The victims were both transported by ambulances to a local hospital where they were pronounced dead. The cause of death for both was smoke inhalation and thermal injuries [NIOSH 2002].

## Controls

Whenever possible, NIOSH recommends that training facilities with approved burn buildings be used for live-fire training. To minimize risks when participating in live-fire training, NIOSH recommends that fire departments comply with NFPA 1403 [NFPA 2002a], including the following precautions:

## Instructors

- Ensure that the instructor in charge is aware of his or her responsibility for overall coordination of the training and compliance with NFPA 1403.
- Ensure that instructors are qualified to provide live-fire training. Verify instructor [NFPA 2002b] and officer qualifications [NFPA 2003a] through national certifying agencies such as the National Professional Qualifications Board, the International Fire Service Accreditation Congress, or through a State fire board or commission.

## Site Set Up

- Ensure that the acquired structure is adequate and safe to be used for live-fire training. Use Appendix B of NFPA 1403 as a checklist for pre-burn planning, building preparation, and pre-burn/post-burn procedures.
- Develop, implement, and train fire fighters in standard operating procedures (SOPs) for live-fire training.
- Conduct a pre-burn briefing session for all participants, and establish an evacuation plan and signal.
- Ensure that a sufficient water supply is available.
- Ensure that the fuels used in the live-fire training have known burning characteristics.
- Inspect the structure for possible environmental hazards.
- Do not use flammable or combustible liquids in live-fire training.

- Do not set fires for live-fire training in any designated exit paths.
- Do not allow anyone to play the role of victim inside the structure during live-fire training.
- Establish a method of fire ground communication among the IC and fire fighters.
- Ensure that proper ventilation is in place before the onset of a controlled burn and is coordinated with interior operations.
- Ensure that backup personnel are standing by with equipment, ready to provide assistance or rescue.
- Ensure that all fire fighters participating in live-fire training have had minimum basic training.
- Ensure that each fire fighter is equipped with NFPA-compliant full protective clothing, a NIOSH approved self-contained breathing apparatus (SCBA), and a personal alert safety system (PASS).
- Establish rehabilitation operations at training exercises that pose the risk of fire fighters exceeding a safe level of physical or mental endurance [NFPA 2003b].

## Site Safety

- Appoint a separate, adequately trained safety officer that has the authority to intervene in any aspect of the live-fire training.
- Ensure that all participants are accounted for when entering and exiting the building.
- Assign only one person as the ignition officer. Ensure that he or she is not a fire fighter participating in the training.
- Ensure that the ignition officer lights only one training fire at a time.
- Ensure that a charged hose line is present while igniting the fire.
- Use a thermal imaging camera during live-fire training situations to observe fire fighters and monitor heat conditions for safety.

## Training Participants

- Follow Standard Operating Procedures (SOPs) established by the department.
- Use NFPA-compliant full protective clothing, an SCBA, and a PASS device, as provided by the department.
- Do not enter a hazardous environment alone. Enter only as a team of two or more.
- Be familiar with the fire department's evacuation plan and signal.

## States

- Ensure that acquired structures that will be used in live-fire training are inspected to identify and eliminate hazards.
- Develop a procedure to issue permits to use inspected acquired structures for live-fire training.
- Check NFPA 1403 for voluntary guidelines on issuing permits [NFPA 2002a].

## Acknowledgments

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## References

- NFPA [2002a]. NFPA 1403, standard on live fire training evolutions. Quincy, MA: National Fire Protection Association.
- NFPA [2002b]. NFPA 1041, standard for fire service instructor professional qualifications. Quincy, MA: National Fire Protection Association.
- NFPA [2003a]. NFPA 1021, standard for fire officer professional qualifications. Quincy, MA: National Fire Protection Association.
- NFPA [2003b]. NFPA 1584, recommended practice on the rehabilitation of members operating at incident scene operations and training exercises. Quincy, MA: National Fire Protection Association.
- NIOSH [2000]. Volunteer assistant chief dies during a controlled-burn training evolution—Delaware. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational

Safety and Health, DHHS (NIOSH) Publication No. F2000-27. Fire Fighter Fatality Investigation Report F2000-27. [[www.cdc.gov/niosh/face200027.html](http://www.cdc.gov/niosh/face200027.html)]

NIOSH [2001]. Volunteer fire fighter dies and two others are injured during live-fire training—NY. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2001-38. Fire Fighter Fatality Investigation Report F2001-38. [[www.cdc.gov/niosh/face200138.html](http://www.cdc.gov/niosh/face200138.html)]

NIOSH [2002]. Career lieutenant and fire fighter die in flashover during a live-fire training evolution—FL. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2002-34. Fire Fighter Fatality Investigation Report F2002-34. [[www.cdc.gov/niosh/face200234.html](http://www.cdc.gov/niosh/face200234.html)]

Fahy R (rfahy@NFPA.org) [2003]. NFPA Live-fire training deaths. Personal communication email message to Jay Tarley (jst9@cdc.gov), February 10, 2003.

## For More Information

The information in this document is based on fatality investigations and expert review. More information about the Fire Fighter Fatality Investigation and Prevention Program is available at [www.cdc.gov/niosh/firehome.html](http://www.cdc.gov/niosh/firehome.html)

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