



NIOSH

Fire Fighter Fatality Investigation
and Prevention Program

Death in the line of duty...

A summary of a NIOSH fire fighter fatality investigation

July 6, 1998

Single-Family Dwelling Fire Claims the Lives of Two Volunteer Fire Fighters--Ohio

SUMMARY

On February 5, 1998, two male volunteer fire fighters (Victim #1 and Victim #2) died of smoke inhalation while trying to exit the basement of a single-family dwelling after a backdraft occurred. A volunteer Engine company composed of four fire fighters and one driver/operator were the first responders to a structure fire at a single-family dwelling 3 miles from the fire department. When the Engine company arrived, one fire fighter on board reported light smoke showing from the roof. The four fire fighters (including Victim #1) entered the dwelling through the kitchen door and proceeded down the basement stairs to determine the fire's origin. The four fire fighters searched the basement which was filled with a light to moderate smoke. A few minutes later, a fifth fire fighter from Rescue 211 (Victim #2) joined the group. After extinguishing a small fire in the ceiling area, Victim #2 raised a ceiling panel and a backdraft occurred in the concealed ceiling space. The pressure

and fire from the backdraft knocked ceiling tiles onto the fire fighters, who became disoriented and lost contact with each other and their hoseline. Two fire fighters located on the basement staircase exited the dwelling with assistance from two fire fighters who were attempting rescue. One fire fighter was rescued through an exterior basement door and the two victims' SCBAs ran out of air while they were trying to escape. Both fire fighters died of smoke inhalation and other injuries. Additional rescue attempts were made by other fire fighters but failed due to excessive heat and smoke and lack of an established water supply. NIOSH investigators concluded that, in order to prevent similar incidents, fire departments should:

- **utilize the first arriving engine company as the command company and conduct an initial scene survey**



Figure: Basement where fatalities occurred.

The **Fire Fighter Fatality Investigation and Prevention Program** is conducted by the National Institute for Occupational Safety and Health (NIOSH). The purpose of the program is to determine factors that cause or contribute to fire fighter deaths suffered in the line of duty. Identification of causal and contributing factors enable researchers and safety specialists to develop strategies for preventing future similar incidents. To request additional copies of this report (specify the case number shown in the shield above), other fatality investigation reports, or further information, visit the Program Website at:

<http://www.cdc.gov/niosh/firehome.html>

or call toll free **1-800-35-NIOSH**

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- ***implement an incident command system with written standard operating procedures for all fire fighters***
- ***provide a backup hose crew***
- ***provide adequate on-scene communications including fireground tactical channels***
- ***train fire fighters in the various essentials of, but not limited to, how to operate in smoke-filled environments, basement fire operations, dangers of ceiling collapse, ventilation practices, utilizing a second hoseline during fire attack, and identifying pre-backdraft, rollover, and flashover conditions***
- ***appoint an Incident Safety Officer.***

INTRODUCTION

On February 5, 1998, five male volunteer fire fighters, including the two victims, ages 43 and 29 years old, entered a single-family dwelling that had light smoke showing from the roof. The fire fighters entered the dwelling through the kitchen door and proceeded down the basement stairs to determine the fire's origin. After extinguishing a small ceiling fire, a ceiling tile was lifted and a backdraft occurred in the concealed ceiling space which disoriented the fire fighters. Two fire fighters died of smoke inhalation and other injuries, one fire fighter had to be rescued, and the other two fire fighters escaped with some assistance.

On February 10, 1998, Richard Braddee and Tommy Baldwin, Safety and Occupational Health Specialists from the Division of Safety Research, traveled to Ohio to conduct an investigation of this incident. Meetings were conducted with fire department officers, the surviving three volunteer fire fighters of the initial fire attack crew, and a representative from the local Fire Investigation Task Force. Copies of photographs of the incident site and the transcription of dispatch tapes were obtained, and a site visit was conducted. The 33-member volunteer fire department involved in the incident serves a population of 7,800 in a geographic area of 84 square miles. The fire department requires all new fire fighters to complete Fire Fighter Level I training which consists of 36 hours of training and is required by the State of Ohio. The required training is designed to cover personal safety, forcible entry, ventilation, fire apparatus, ladders, self-contained breathing apparatus, search and rescue, and hose practices. Recertification in-service training is conducted on an annual basis. The victims had approximately 5 and 10 years of fire fighting experience, respectively. The fire department had an active equipment inspection and maintenance program. Any equipment found to be defective was repaired or replaced immediately.

The site of the incident was a 20-year-old, one-story, single-family residence measuring 28' x 50'. The ranch-style residence was constructed of wood framing, had a shingled roof and hardboard siding. The residence had a 26-foot-long deck attached to the west side and a full basement about 8 ½-feet high with a 16-inch dropped ceiling. Access to the basement was gained through either an interior stairway from the kitchen or an exterior stairway which was located on the north side of the residence. The residence



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contained a full kitchen both upstairs and in the basement, had full carpeting, and was heated by a natural gas furnace. Three smoke detectors were present in the residence, but the occupant stated they did not operate. The residence was about 3 miles from the fire department involved in the incident.

Although eight volunteer fire departments were involved in this incident, only those directly involved up to the time of the fatal incident are mentioned in this report.

INVESTIGATION

On February 5, 1998, at 0210 hours, a fire call was received by the Sheriff's Office from the occupant of a private residence near the incident site. The Sheriff's Office dispatched the automatic response group for structure fires which consisted of three local volunteer fire departments. At 0220, Engine 211 with four fire fighters and a driver/operator, including Victim #1, responded to the alarm. Rescue 211 with the Chief and two fire fighters, including Victim #2 also responded. Additionally Squad 211 (ambulance), and Tanker 211 responded with six personnel. Altogether 4 pieces of equipment and 13 personnel arrived at the fire scene between 0226 and 0231 hours. By 0238 hours, all three automatic response fire department units were on the scene.

Engine 211 crew were first to arrive at 0226 hours and reported that smoke was showing from the roof. A 1¾-inch crosslay handline was pulled and laid to the kitchen door. Information was relayed by a relative of the owner of the dwelling to the Engine 211 crew that heavier smoke had been observed in the southwest corner of the basement, possibly at the circuit breaker box under the stairway. The Engine 211 crew

prepared to enter the house by arming their PASS devices, turning on their SCBAs, and checking each others' gear. The 1¾-inch handline was charged, and upon entry into the kitchen, they noticed light smoke. Rescue 211 arrived at 0227 hours with the Chief and two fire fighters, including Victim #2, and the Chief assumed command. The Engine 211 driver/operator requested a supply line be laid to the tanker and the Chief assisted in laying the line. The Chief returned to the residence and saw light gray smoke emanating from the kitchen door. While inside the residence, four of the fire fighters from Engine 211 encountered a closed, interior door leading to the basement. The fire fighters opened the basement door and proceeded down the basement steps. Victim #1 and another fire fighter, who carried a two-way VHF radio, stayed at the top of the steps and helped advance hose. Three fire fighters, two of whom were carrying the charged hoseline, began a right-hand search pattern to locate the circuit breaker box. After finding no fire at the breaker box, the crew moved to another part of the basement. As the crew progressed back around the steps, their hoseline became caught between the legs of a metal folding chair. As they advanced the hoseline further into the basement, the chair was pulled under the staircase and collapsed onto the hose which pinched off the water supply. In the interim, Victim #2, who also carried a two-way VHF radio, broke the window from the exterior basement door then opened the door and yelled to the interior crew that this was a second way out. Victim #2 went back up the exterior stairwell then entered the kitchen on the first floor and met another fire fighter who yelled down the stairs that he and Victim #2 would search the first floor. A second 1¾-inch hoseline was pulled off Engine 211, taken into the first floor kitchen through the interior door and laid partially down the steps into

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the basement. The line was charged in anticipation of being used in the basement fire attack. The fire fighters in the basement saw light to moderate gray, puffing smoke at the basement ceiling and then lazy orange flames from the ceiling area. The two fire fighters including Victim #2, went down the interior stairs and followed the hoseline and joined the three fire fighters in the basement. They were advised to get down because the fire was in the ceiling area. They saw a small fire at a fluorescent light fixture midway in the basement between the interior staircase and the northeast corner (see Figure). This fire was extinguished with the last available water due to the hose being pinched off. The crew, unaware of the water situation, waited a moment to watch conditions. Fire then traveled across the ceiling and re-entered the walls and several fire fighters saw the smoke puffing out from between the ceiling and wall. Victim #2 then passed by the crew and used an axe to lift a ceiling tile in the center of the basement to check flame spread. The concealed ceiling space had reached the smoldering stage (i.e., high temperatures and considerable quantities of soot and combustible fire gases had accumulated) and when the ceiling tile was lifted, oxygen was introduced into the ceiling space and a backdraft occurred. Seconds after the backdraft, visibility went black and ceiling tiles collapsed onto the fire fighters from the pressure created by the backdraft. Disoriented from the heat and smoke and fallen ceiling tiles, the fire fighters began crawling out of the basement following the hoseline, but soon lost the hose. Victim #2 told a fire fighter to hit the fire with water from the hoseline, which he attempted, but there was no water in the hose. At 0243 hours a radio transmission was given "In the basement...send water" (charge the hoseline with water). Fire had vented up the stairway and burned through both hoselines, causing them to burst and freely flow water. The crew began to crawl back toward the staircase with Victim #1 in front, and the other fire fighters following. The PASS devices of Victims #1 and #2 began to sound due to heat activation and the SCBA low-air alarms also began to sound. At 0243 hours, Victim #2 radioed for help and the Chief ordered the apparatus air horns sounded for all to evacuate the house. The crew in the basement heard the horns. At 0244 hours, another radio transmission "Need water!" was received from the basement. One fire fighter, suffering from the intense heat, became unconscious and collapsed to the floor. Another fire fighter remembered the direction of the second exit and continued to feel for the hose as he tried to orient himself. He then found another fire fighter and they went up the steps and were assisted out of the house by the rescue team. At 0245 hours, the radio transmission "Guys inside to IC" (Incident Command) was received. The Chief began to advance a 2½-inch hoseline down the exterior basement stairwell to assist with fire extinguishment and heard PASS devices sounding from inside the basement. He was driven back by heat and smoke. He advised his Assistant Chief of the situation, relinquished command to the Assistant Chief, and went to Squad 211 to recover.

One of the fire fighters who had just exited the residence informed the rescuers that other fire fighters were still inside. A two-person rescue crew entered the basement from the exterior door and rescued the unconscious fire fighter who was about 3 feet from the door. At 0303 hours, a radio transmission was received from Squad 211: "We have two fire fighters that are in critical condition." Four additional attempts were made to rescue the victims but the rescuers were driven back due to intense heat and fire. The bodies

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were later recovered after the fire was extinguished. A post-incident investigation revealed the point of origin of the fire was in the area of the furnace.

CAUSE OF DEATH

The cause of death listed by the medical examiner was asphyxiation due to smoke inhalation, burns and crushing trauma injuries to the chest.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Fire departments should utilize the first arriving engine company as the command company and conduct an initial scene survey.^{2, 3, 4}

Discussion: Since incident command and size-up are the responsibility of the first officer on-scene, the first arriving engine company should concentrate its efforts on establishing a command post, performing initial size-up, coordinating communications, and relaying information and additional requirements to dispatch. Scene safety is greatly enhanced by waiting to perform operations until adequate resources are on-scene. An initial scene survey, or size-up, should occur at each incident. Size-up is an evaluation made by the officer in charge which enables him to determine his course of action and to accomplish his mission. A fire situation can change drastically and rapidly. The commanding officer must quickly survey and analyze the situation and quickly weigh the various factors. Factors to consider include: the type of occupancy, nature of the fire situation, structure involved, and the fire itself. Based on evaluation of these factors, the commanding officer should decide what action should be taken to control the emergency. The next step is to formulate a plan of operation given the resources available, and implement that plan.

Recommendation #2: Fire departments should implement an incident command system with written standard operating procedures for all fire fighters.^{1, 2, 4}

Discussion: The system should establish roles and responsibilities for all personnel involved. It should ensure personnel accountability and safety and should provide a well-coordinated approach to all emergency activities. All fire department personnel should be thoroughly trained on this system and receive periodic refresher training. All training should be documented.

Recommendation #3: Fire departments should provide a back-up hose crew.^{1, 2, 3, 5, 6}

Discussion: A second manned attack hoseline should be established to provide back-up for the initial attack line to assist with fire extinguishment and fire fighter rescue. The National Fire Protection Association (NFPA) and the Occupational Safety and Health Administration recommend that four persons (two-in and two-out), each with protective clothing and respiratory protection be provided when interior operations are taking place. Also, a rapid intervention team should be established to effect fire fighter rescue. NFPA 1500, 6-5.2 states that "A rapid intervention crew shall consist of at least two members and shall be available for rescue of a member or a team if the need arises. Rapid intervention crews shall be fully equipped with the appropriate protective clothing, protective equipment, SCBA, and any specialized rescue equipment that might be needed given the specifics of the operation under way."

Recommendation #4: Fire departments should provide adequate on-scene communications

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including fireground tactical channels.^{1, 2, 4, 6}

Discussion: Communication should be an ongoing component of on-scene operations. NFPA 1561 states that the communications system shall meet the requirements of the fire department for routine and large-scale emergencies. Emergency scenes become very hectic within a short period of time. Radio communications occurring between incident command, attack crews, pumper operators, mutual aid companies, and dispatch can easily be missed. It is imperative that on-scene operations be given fireground tactical radio channels which are separate from the normal dispatch frequencies. Fire fighters operating on-scene must be capable of communicating between themselves and incident command without being “talked over” by dispatch or other companies. In a small fire department, one radio channel for dispatch and one fire ground communications channel might be sufficient for most situations. A larger fire department requires several additional radio channels to provide for the volume of communications relating to routine incidents and for the complexity of multiple alarm situations. Interior attack crews should have adequate radio communication with incident command and with other attack crews to provide for personnel accountability, coordination of efforts, report on flame spread, fire extinguishment, and other pertinent information. As incident command becomes aware of changing conditions, vital information can be given directly to the attack crews. The radio capabilities should also provide for communications with mutual aid resources or other agencies that could be expected to respond to a major incident. The system should be developed to provide reserve capacity for unusually complex situations where effective communications could become critical.

Recommendation #5: *Fire departments should train fire fighters in the various essentials of how to operate in smoke-filled environments, basement fire operations, dangers of ceiling collapse, ventilation practices, utilizing a second hoseline during fire attack, and identifying pre-backdraft, rollover, and flashover conditions.*^{2, 3, 6, 7}

Discussion: The essentials of fire fighting are numerous and varied, and require initial and refresher training on a monthly, annually, or an as needed basis. NFPA 1500 recommends that all personnel who may engage in structural fire fighting participate in training at least monthly. Ideally, this monthly training will serve to reinforce safe practices until they become automatic. Other types of training are required on an “as needed” basis. For example, training is required when new procedures or equipment are introduced.

Recommendation #6: *Fire departments should appoint an Incident Safety Officer.*^{3, 4, 8}

Discussion: The Incident Safety Officer (ISO) is appointed by the Incident Commander at each emergency scene. The duties of the ISO are to monitor the scene and report the status of conditions, hazards, and risks to the incident commander, ensure fire fighter rehabilitation occurs, the personnel accountability system is being utilized, and monitor radio communications to ensure all areas of the scene are capable of communicating to incident command.

References:

1. 29 Code of Federal Regulations 1910.120(q)(3), Hazardous Waste Operations and Emergency Response. (Incident Command, Two-In/Two-Out

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2. Essentials of Fire Fighting, 3rd edition, Fire Protection Publications, 1998. (Incident Command, Back-Up Hose Crew, Rapid Intervention Team, Communications).
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 4. National Fire Protection Association. NFPA 1561, Standard on Fire Department Incident Management System. National Fire Protection Association, Quincy, MA. (Incident Command, Communications), 1995 Edition.
 5. Dunn Vincent. Hoseline Placement at Structural Fires, Firehouse, August 1997
 6. Dunn Vincent. Safety and Survival on the Fireground, PennWell, Tulsa, Oklahoma, 1992.
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 8. National Fire Protection Association. NFPA 1521, Standard for Fire Department Safety Officer. National Fire Protection Association, Quincy, MA,
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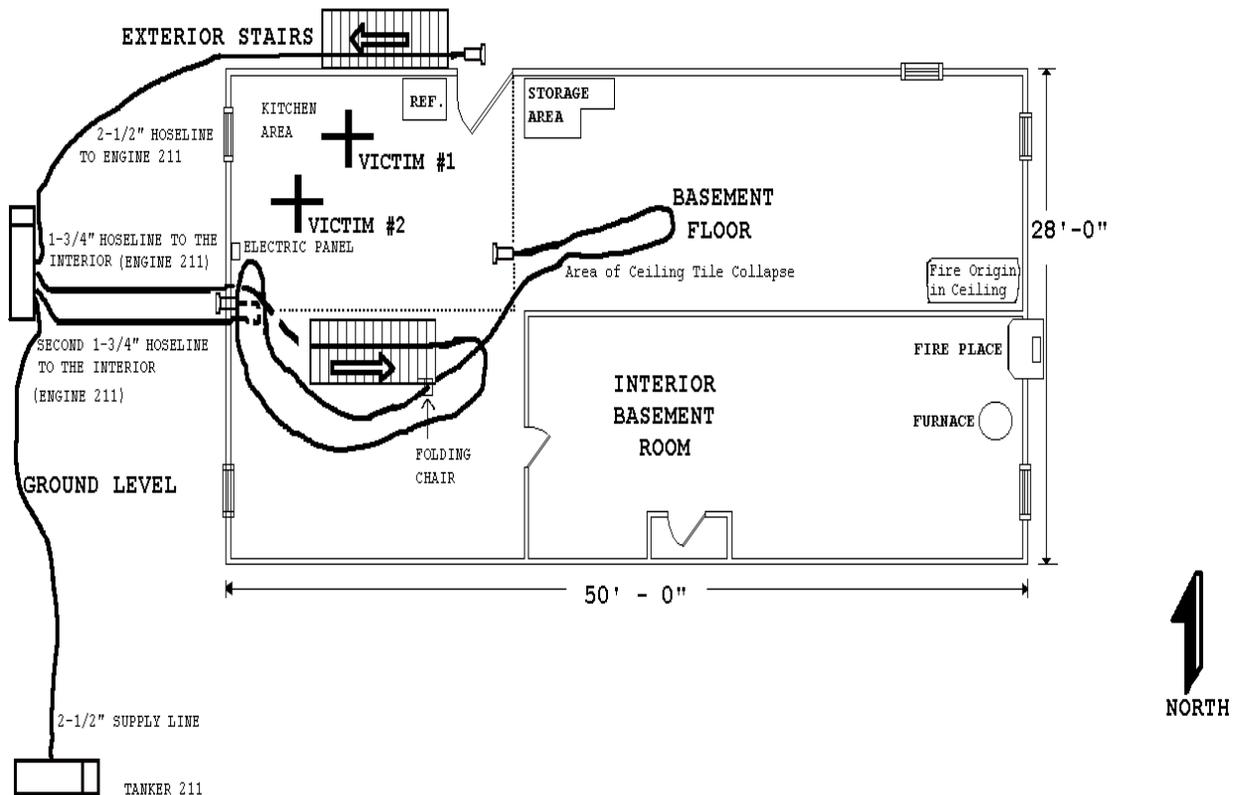


Figure: Basement where fatalities occurred.

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**Figure. Fire Dwelling
Basement Floor Plan
FACE 98F06**

One-story, 20-year old single-family dwelling with full basement measuring 28' x 50'. Wood-frame construction with shingle roof and hardboard siding. Three smoke detectors present-none operable.





Fatality Assessment and Control Evaluation
Investigative Report #98F-06

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