



Volunteer Fire Fighter Killed and Career Chief Injured During Residential House Fire - Tennessee

SUMMARY

On March 1, 2002, a 21-year-old male volunteer fire fighter (the victim) died after becoming separated, disoriented, and lost as he, the Chief, and other fire fighters were trying to escape from the interior of a fully involved house fire. Two fire fighters eventually pulled the victim out of the house into the front yard, but he was unresponsive and not breathing. The victim received cardiopulmonary resuscitation and was transported to the local hospital where he was pronounced dead on arrival. NIOSH investigators concluded that, to minimize the risk of similar occurrences, fire departments should

- *ensure that Incident Command (IC) conducts a complete size-up of the incident before initiating fire fighting efforts, and continually evaluates the risk versus gain during operations at an incident. Departments should also ensure that the first officer or fire fighter inside evaluates interior conditions and reports them immediately to Incident Command*
- *ensure that adequate numbers of staff are available to operate safely and effectively*
- *ensure that a Rapid Intervention Team is established and in position immediately upon arrival*
- *use evacuation signals when command personnel decide that all fire fighters should be evacuated from a burning building or other hazardous area*
- *ensure that a separate Incident Safety Officer, independent from the Incident Commander, is appointed*
- *ensure that team continuity is maintained*
- *ensure that ventilation is closely coordinated with the fire attack*
- *instruct and train fire fighters on initiating emergency traffic (Mayday-Mayday) when they become lost, disoriented, or trapped*



Site of the Incident

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. The program does not seek to determine fault or place blame on fire departments or individual fire fighters. 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

www.cdc.gov/niosh/firehome.html
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- ***ensure that backup lines are equal to or larger than the initial attack lines***
- ***ensure that fire fighters are equipped with a radio that does not bleed over, cause interference, or lose communication under field conditions***

INTRODUCTION

On March 1, 2002, a 21-year-old male volunteer fire fighter (the victim) died after becoming separated, disoriented, and lost as he, the Chief, and other fire fighters were trying to escape from the interior of a fully involved house fire. On March 4, 2002, the U.S. Fire Administration (USFA) notified the National Institute for Occupational Safety and Health (NIOSH) of this fatality. On April 8, 2002, a safety and occupational health specialist and the team leader from NIOSH's Fire Fighter Fatality Investigation and Prevention Program investigated the incident. They conducted interviews with the Chief and the assistant chief of the department and with the other officers and fire fighters involved in this incident. NIOSH investigators reviewed copies of the department's standard operating guidelines (SOGs), pictures of the incident, training records of the victim, reports completed by the Tennessee State Fire Marshal's Office, and the death certificate.

The combination fire department has 30 uniformed personnel (9 career and 21 volunteer), and serves a population of approximately 7,760 in an area of about 3.5 square miles. The 21-year-old victim had been a volunteer fire fighter for a total of 3 years, 6 months of which were with this department. The State has no training requirements before a fire fighter is permitted to participate in a structure fire. However, the department requires 79 hours of basic and live fire training before any fire fighter can participate in interior fire fighting operations. Also, the department requires a minimum of 12 hours of Safety and Fire

Department Orientation, and a minimum of 4 hours of additional training per month. The victim had successfully completed the departmental orientation requirements. This orientation covers equipment familiarization and location as well as hose loads and operations. Before becoming a volunteer with this department, the victim completed a Self-Contained Breathing Apparatus (SCBA) Search and Rescue Course, 79 hours of Basic/Live Firefighting, and 16 hours of Incident Command System training, in addition to other miscellaneous training.

Structure. The single-story residence was of wood-frame construction and had a partial basement. The roof was constructed of plywood sheeting covered with asphalt shingles, and the exterior walls were of wood covered with vinyl siding. The main floor and the partial basement consisted of approximately 2,064 square feet. The attic, used for storage, was being renovated at the time of the incident. The dwelling had two exterior doors, a door in the front (A-Side) and a sliding glass door in the back (C-Side)(see Figure).

Weather. The temperature was 53.6^oF with a wind speed of 8.1 mph on the day and time of the incident.

INVESTIGATION

On March 1, 2002, a 21-year-old male volunteer fire fighter (the victim) died after becoming separated, disoriented, and lost as he, the Chief, and other fire fighters were trying to escape from the interior of a fully involved house fire. On March 1, 2002, at about 1508 hours, Central Dispatch received a telephone call of a potential house fire. The fire department fire inspector, who had just cleared the scene of a motor vehicle incident and was in the area, saw smoke coming from the residence as Central Dispatch was dispatching the call. First on the scene, he reported smoke showing on the B-Side of the residence. Next to arrive was a probationary fire



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fighter in his privately owned vehicle (POV). At 1510 hours, Engine 6 arrived with a driver/operator and fire fighter. Shortly thereafter, the Chief and assistant chief arrived, and the assistant chief assumed incident command (IC) and called for a second alarm. Fire fighters connected a 5-inch supply line to Engine 6 and stretched a 1 3/4-inch hoseline to the front door and a 1 3/4-inch hoseline to the D-Side. At this time, the victim arrived from his workplace in a City vehicle, and he and the Chief entered the house and joined the probationary fire fighter and the fire fighter from Engine 6 in conducting a primary search. Finding no occupants, the Chief and the victim exited the house and retrieved the 1 3/4-inch hoseline at the front door for an interior attack. When the Chief and victim reentered the house, the fire inspector and the IC placed a positive pressure ventilation fan at the front door. The IC then conducted a walk-around of the structure and broke out a sliding glass door on the C-Side to assist with ventilation. As the IC walked back to the A-Side, he met the Chief and the victim, who had just exited the house (fire was now showing from the eaves on the B- and C-Sides). At 1517 hours, Engine 4 arrived with a Lieutenant driving, and fire fighters pulled a 1 1/2-inch backup line from the Engine to the front door.

The Chief, a Lieutenant, and the victim reentered the house and continued the interior attack with the 1 3/4-inch preconnect line. Making no progress on the fully involved fire in the bedroom (Figure), the fire fighter from Engine 6 was ordered to bring in the 1 1/2-inch backup line from Engine 4. While the fire fighter used the 1 1/2-inch line, the victim and Chief used the 1 3/4-inch hoseline to fight the fire; however, their efforts had little effect in knocking down the fire. At about 1523 hours, the booster tank on Engine 4 ran dry, and the 1 1/2-inch line lost pressure. Following the Chief's orders, the fire fighter dropped the line and brought a charged 1 3/4-inch line into the interior to continue fire fighting. Several minutes

passed and conditions worsened. Fire was now showing from the eaves on all four sides of the residence.

At about 1533 hours, the IC saw fire venting through the roof on the B-Side and rolling into the A-Side front room. Using his radio, he ordered the interior teams to exit the building. About 1 minute passed, and the IC transmitted another radio order: "Come out of there now!" *Note: During the entire time that radio communications were being made, many of the IC's transmissions were not being received. Other radio operators reported static and garbled transmissions. Central Dispatch contacted the IC several times, alerting him that his radio transmissions were breaking up and not being fully received.* At about the same time, the interior fire fighter's SCBA low-air alarm sounded, and he told the Chief he had to exit. As interior conditions deteriorated further, the Chief made a decision to evacuate the structure. The fire fighter departed first, followed by the Lieutenant, then the Chief, and lastly, the victim. The fire fighter went to the front yard to change his air bottle, and the Lieutenant went to the street where he removed his SCBA and bunker coat. The Chief made it to the front door and collapsed. The IC saw him and helped drag him into the street where he was administered first aid for the burns he had received to his hands and left arm. At this time (about 1535 hours), a personal accountability report was taken and the victim was determined to be missing.

The structure now fully involved, fire fighters used the deck gun from Engine 6 to try to control the fire. At approximately 1553 hours, fire fighters saw the victim lying on the floor of the front room (Figure) about 5 feet from the front door. After two attempts, fire fighters grabbed the victim by his SCBA straps and dragged him into the front yard. He was not breathing and was unresponsive. He received cardiopulmonary



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resuscitation and then was transported to the local hospital where he was pronounced dead on arrival.

CAUSE OF DEATH

The medical examiner reported the cause of death as due to asphyxiation. The victim's carboxyhemoglobin level was listed at 31.8%.

RECOMMENDATIONS AND DISCUSSION

Recommendation #1: Fire departments should ensure that Incident Command (IC) conducts a complete size-up of the incident before initiating fire fighting efforts, and continually evaluates the risk versus gain during operations at an incident. Departments should also ensure that the first officer or fire fighter inside evaluates interior conditions and reports them immediately to Incident Command. ^{1,2}

Discussion: One of the most important size-up duties of the first arriving officers is locating the fire and determining its severity. This information lays the foundation for the entire operation. It determines the number of fire fighters and the amount of apparatus and equipment needed to control the blaze, assists in determining the most effective point of fire extinguishment attack, and provides information for the most effective method of venting heat and smoke. A proper size-up begins from the moment the alarm is received, and it continues until the fire is under control. The initial size-up conducted by the first-arriving officer allows the officer to make an assessment of the conditions, allowing the resulting decisions to be proactive as opposed to reactive. The following general factors are important considerations: (1) occupancy type involved; (2) smoke conditions; (3) type of construction; (4) age of structure; (5) exposures; and (6) time considerations such as time of incident, time fire was burning before arrival, time fire was burning after arrival, and type of attack. Interior size-up is just as

important as exterior size-up. The first officer or fire fighter inside the structure should evaluate interior conditions and report them to the IC immediately. Since the IC is staged at the command post (outside), the interior conditions should be communicated as soon as possible and on a regular basis. Interior conditions could change the IC's strategy or tactics. Therefore, it is important for the IC to immediately obtain this type of information to help make the proper decisions. In this instance, a thorough exterior and interior size-up may have revealed fire extension from the bedroom into the attic and kitchen areas. Communicating the changing interior conditions may have helped identify the deteriorating conditions. The additional information may have helped in the decision-making process and the development of an effective attack plan which may have included a defensive attack.

Recommendation #2: Fire departments should ensure that adequate numbers of staff are available to operate safely and effectively. ^{1,3}

Discussion: NFPA 1720 recommends that an occupational safety and health program be provided to form the basis of protecting the health and safety of fire fighters in accordance with NFPA 1500, Standard on Fire Department Occupational Safety and Health Program.

As stated in NFPA 1500 (A.6.4.1.1) " It is recommended that a minimum acceptable fire company staffing level should be four members responding on or arriving with each engine and each ladder company responding to any type of fire. The minimum acceptable staffing level for companies responding in high-risk areas should be five members responding or arriving with each engine company and six members responding or arriving with each ladder company. These recommendations are based on experience derived from actual fires and in-depth



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fire simulations and are the result of critical and objective evaluation of fire company effectiveness. These studies indicate significant reductions in performance and safety where crews have fewer members than the above recommendations. Overall, five member crews were found to provide a more coordinated approach for search and rescue and fire suppression tasks.”

Recommendation #3: Fire departments should ensure that a Rapid Intervention Team is established and in position immediately upon arrival. ⁴

Discussion: A Rapid Intervention Team (RIT) should respond to every major fire. The team should report to the officer in command and remain at the command post until an intervention is required to rescue a fire fighter(s) or civilians. The RIT should have all tools necessary to complete the job—e.g., a search rope, first-aid kit, and a resuscitator to use in case a fire fighter needs assistance. Many fire fighters who die from smoke inhalation, from a flashover, or from being caught or trapped by fire actually become disoriented first. They are lost in smoke and their SCBAs run out of air, or they cannot find their way out through the smoke, become trapped, and then fire or smoke kills them. The primary contributing factor, however, is disorientation. The RIT will be ordered by the IC to complete any emergency search or rescue. This will provide the suppression companies an opportunity to regroup and take a roll call instead of performing rescue operations. When the RIT enters to perform a search-and-rescue, they should have full cylinders on their SCBAs and be physically prepared. When a RIT team is used in an emergency situation, another RIT team should be put into place in case an additional emergency situation arises. This additional RIT team should be comprised of fresh, well-rested fire fighters.

Recommendation #4: Fire departments should use evacuation signals when command personnel decide that all fire fighters should be evacuated from a burning building or other hazardous area. ⁵

Discussion: Evacuation signals are used when command personnel decide that all fire fighters should be evacuated from a burning building or other hazardous area because conditions have deteriorated beyond the point of reasonable safety. All fire fighters should be familiar with their department’s method of sounding an evacuation signal. There are several ways this communication can be done. The two most common methods are to (1) broadcast a radio message ordering all fire fighters to evacuate, and (2) to sound an audible warning device on the apparatus at the fire scene for an extended period of time. The message should be broadcast several times to make sure all fire fighters hear it.

Recommendation #5: Fire departments should ensure that a separate Incident Safety Officer, independent from the Incident Commander, is appointed. ^{1,4,6}

Discussion: According to NFPA 1561, paragraph 4-1.1, “the Incident Commander shall be responsible for the overall coordination and direction of all activities at an incident.” This shall include overall responsibility for the safety and health of all personnel and for other persons operating within the incident management system. While the Incident Commander (IC) is in overall command at the scene, certain functions must be delegated to ensure adequate scene management is accomplished. According to NFPA 1500, paragraph 6-1.3, “as incidents escalate in size and complexity, the incident commander shall divide the incident into tactical-level management units and assign an incident safety officer to assess the incident scene for hazards or potential hazards.”



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The incident safety officer (ISO), by definition is “an individual appointed to respond to or assigned at an incident scene by the incident commander to perform the duties and responsibilities specified in this standard. This individual can be the health and safety officer or it can be a separate function.” According to NFPA 1521, paragraph 2-1.4.1, “an incident safety officer shall be appointed when activities, size, or need occurs.” Each of these guidelines complements each other and indicates that the Incident Commander is in overall command at the scene, but oversight of all operations is difficult. The IC can be assisted in managing on-scene fire fighter health and safety by delegating the function of safety and health oversight to the ISO.

Recommendation #6: Fire departments should ensure that team continuity is maintained.⁷

Discussion: Each fire fighter should be assigned to a team of two or more and given specific assignments to help reduce the chance of injuries. Team continuity relies on knowing who is on your team, knowing the team leader, staying within visual contact at all times (if visibility is obscured, then teams should remain within touch or voice distance of each other), communicating needs and observations to the team leader, rotating to rehabilitation and staging as a team, and watching your team members (practice a strong “buddy-care” approach). These key factors help to reduce the risks involved in fire fighting operations by providing personnel with the added safety net of fellow team members.

Recommendation #7: Fire departments should ensure that ventilation is closely coordinated with the fire attack.⁸

Discussion: Chapter 10 of the *Essentials of Fire Fighting, 4th edition*, states that “ventilation must be closely coordinated with fire attack. When a

ventilation opening is made in the upper portion of a building (vertical ventilation), a chimney effect (drawing air currents from throughout the building in the direction of the opening) occurs.” However, window and door ventilation (horizontal ventilation) should be coordinated with fire extinguishment. Only after a charged hoseline is in place and ready for extinguishment is ventilation of windows and doors most effective. Ventilation is necessary to improve a fire environment so that fire fighters can approach a fire with a hoseline for extinguishment. Additionally, smoke, heat, and gases should be vented above the fire to minimize conditions necessary for a flashover. This should be completed as soon as possible. Incident Command should determine if ventilation is needed and where. The type of ventilation should be determined based on evaluation of the structure and conditions on arrival. Ventilation decisions should be a part of the initial size-up.

Recommendation #8: Fire departments should instruct and train fire fighters on initiating emergency traffic (Mayday-Mayday) when they become lost, disoriented, or trapped.⁹

Discussion: As soon as fire fighters become lost or disoriented, trapped or unsuccessful at finding their way out of a hazardous situation (e.g., interior of structure fire), they must recognize that fact and initiate emergency traffic. They should manually activate their personal alarm safety system (PASS) device and announce “Mayday-Mayday” over the radio. A “Mayday-Mayday” call will receive the highest communications priority from Central Dispatch, Incident Command, and all other units. The sooner Incident Command is notified and a RIT is activated, the greater the chance of the fire fighter being rescued. Fire fighters should initiate emergency traffic while they are still capable and not wait until they are too weak or low on air to call for help. *Note: The victim was equipped with a working radio, and a*



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personal alert safety system (PASS) device was integrated into his self-contained breathing apparatus. The PASS device had activated; however, the victim was partially lying on the device, which muffled its alarm.

Recommendation #9: Fire departments should ensure that backup lines are equal to or greater than the initial attack lines.¹⁰

Discussion: Backup lines are needed to protect the crew on the initial attack line and to provide additional flow if needed. Given that a single 1 3/4-inch hose line is sufficient for most residential fires (in terms of rate of flow), the backup hoseline is additional insurance. In larger-area fires, the backup hoseline again provides insurance against rate-of-flow miscalculation and provides additional protection for retreating fire fighters. Backup lines should be at least as large as the initial attack line. If the attack was begun with a 1 3/4-inch hoseline, then the backup hoseline should be a 1 3/4-inch, 2-inch, or a 2 1/2-inch line. Although backup lines can be used to augment the initial attack, the defined purpose of a backup hoseline is to provide flow in addition to what is needed to extinguish the fire.

Recommendation #10: Fire departments should ensure that fire fighters are equipped with a radio that does not bleed over, cause interference, or lose communication under field conditions.¹¹

Discussion: Radio communication is one of the most important functions on the fireground. When situations arise on the fireground, radio transmissions need to be clear and timely. Radios need to be reliable, in good working condition, fully charged, ready to use, and free of any interference or bleedover. Fire departments should also take into consideration the frequency on which the radio communication system

will operate. The National Fire Protection Association (NFPA) recommends that frequency bands should be separated by 15 kHz in the VHF high band. The separation in the frequencies is to avoid possible interference.

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INVESTIGATOR INFORMATION

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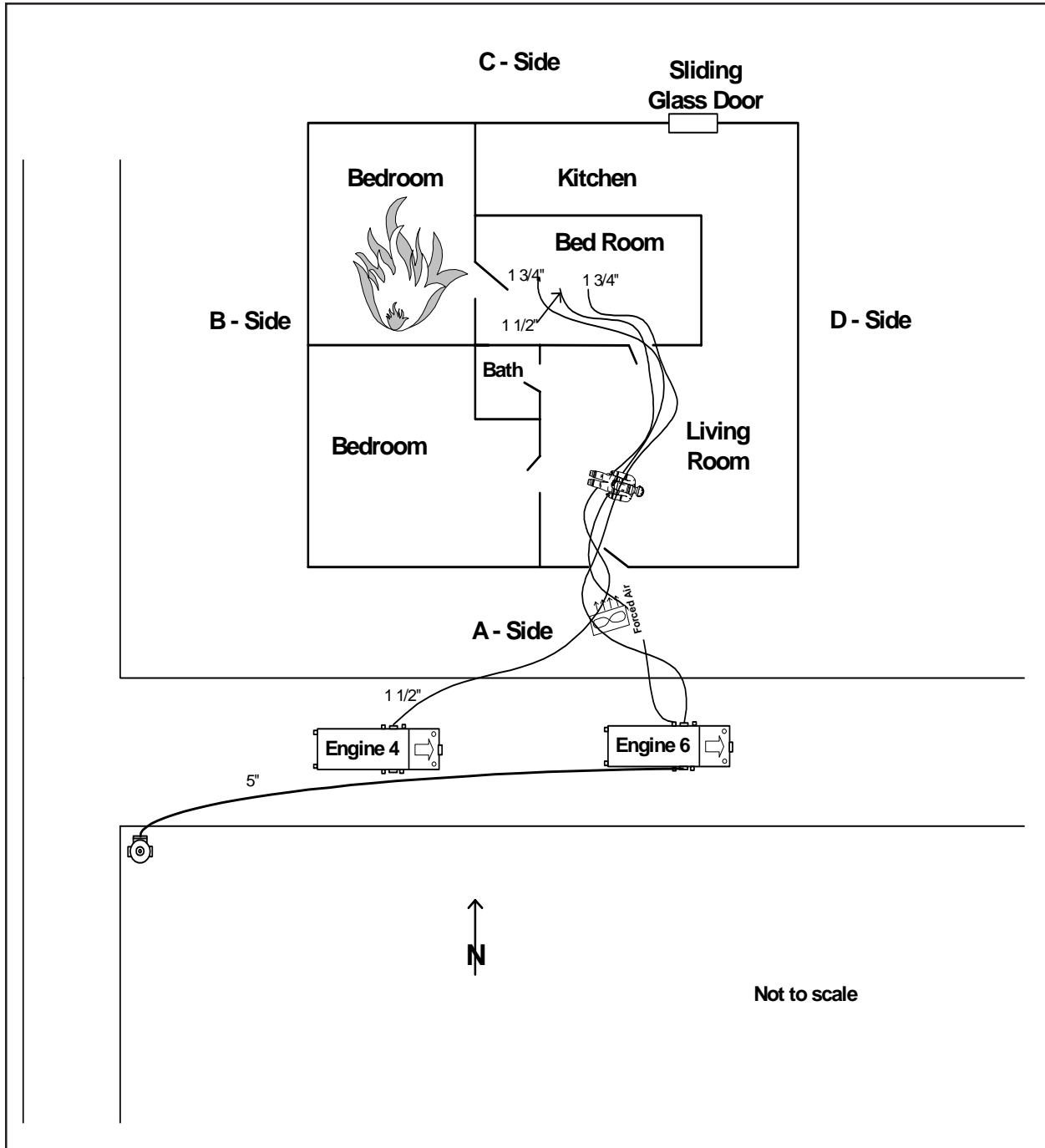


Figure. Residential House Fire - Floor Plan; Overhead View

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