



NIOSH
Fire Fighter Fatality Investigation
and Prevention Program

Death in the line of duty...

A Summary of a NIOSH fire fighter fatality investigation

May 18, 1999

Two Volunteer Fire Fighters Were Killed and One Fire Fighter and One Civilian Were Injured During an Interior Fire Attack in an Auto Salvage Storage Building-North Carolina

SUMMARY

On November 6, 1998, two male volunteer fire fighters (from two different departments) died trying to exit a burning auto salvage storage building. Arriving on the scene of a metal pole building with light smoke showing, the Chief of Department #1 assumed command and discussed the possible origin of fire with the owner of the structure. The Incident Commander (IC) then decided to ventilate by ordering a fire fighter to open one of two small roll-up garage doors on the north face of the structure. He proceeded to the southwest corner of the structure where he ordered the owner to tear off metal exterior wall panels with his forklift. Once ventilation was completed, three members of Department #2 (Chief, Assistant Chief, and fire fighter) and three members of Department #3 (Captain, Lieutenant, and fire fighter) advanced two 1 1/2-inch lines through the front door of the building which was filled with light smoke. As fire fighters proceeded to the rear of the structure to determine the fire's origin, heavy black smoke collected below the ceiling, and small flames trickled over the ceiling's skylights. Approximately 80 feet inside the structure,

fire fighters found what they believed to be the seat of the fire and began to apply water. As fire fighting activities proceeded, fire fighters transferred the lines to other fire fighters because the low-air alarms on their self-contained breathing apparatus (SCBA) were sounding. Approximately 11 minutes into the attack, the IC ordered both crews to exit to discuss further strategy. As the crews began to exit, an intense blast of heat and thick, black smoke covered the area, forcing fire fighters to the floor. The Chief (Victim #1) and Assistant Chief from Department #2 were knocked off the hose line and their SCBA low-air alarms began to sound as they radioed for help and began to search for an exit. The two departed in different directions and the Assistant Chief eventually ran out of air and collapsed. He was found immediately and assisted from the burning building. As fire fighters pulled the unconscious Assistant Chief to safety, the Lieutenant (Victim #2) from Department #3 reentered the structure to search for Victim #1. During his search, the Lieutenant ran out of air, became disoriented, and failed to exit. Victim #2 was discovered equipped with a Personal



This photo depicts the front door of the burning structure where both victims entered to perform an interior fire attack

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**

Fatality Assessment and Control Evaluation
Investigative Report #98F-32

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Alert Safety System (PASS); however, it was not turned on. Victim #1 was known to have entered without a PASS device. Additional rescue attempts were made but proved to be unsuccessful.

NIOSH investigators conclude that, to reduce the risk of similar occurrences, fire departments should:

- *ensure that fire command always maintains close accountability for all personnel at the fire scene*
- *ensure that vertical ventilation takes place to release any heat and smoke directly above the fire*
- *ensure that Rapid Intervention Teams be established and in position*
- *ensure that fire fighters wear and use PASS devices when involved in interior fire fighting and other hazardous duties.*

INTRODUCTION

On November 6, 1998, two male volunteer fire fighters died while performing an interior fire attack in an auto salvage storage building fire. The 29-year-old Chief (Victim #1) of Department #2 and the 24-year-old Lieutenant (Victim #2) of Department #3 entered the structure through the front door with four additional fire fighters to locate the origin of the fire. Approximately eleven minutes after they entered the structure, they were separated from their hose line and knocked to the floor by intense heat and thick, black smoke. Victim #1 became disoriented and his self-contained breathing apparatus (SCBA) ran out of air as he searched for an exit. Victim #2, who had exited earlier, reentered the structure to search for Victim #1, also became disoriented and his SCBA ran out of air. Both victim's bodies were removed from the structure approximately 5 hours

later. One fire fighter and one civilian were transported to a local hospital where they were treated and released.

On December 8-11, 1998, an investigation of this incident was conducted by NIOSH investigators. Meetings were conducted with members of the volunteer fire departments involved, representatives from the State Fire Marshal's Office, and the owner of the structure. Copies of photographs, training records, Standard Operating Procedures (SOPs), and the fire ground attendance log were obtained from the fire department, along with a copy of the dispatch log. A site visit was conducted and blueprints of the structure were obtained from the owner.

Fire Department #1 is comprised of 31 fire fighters and serves a population of approximately 11,000 in a geographic area of 21 square miles. Department #2 is comprised of 23 fire fighters and serves a population of approximately 5,000 in a geographic area of 19.4 square miles. Department #3 is comprised of 40 fire fighters and serves a population of approximately 11,000 in a geographic area of 15.6 square miles. Each fire department provides all new fire fighters with their own training program which covers the National Fire Protection Association Fire Fighter Level I objectives, search and rescue, confined space entry, pump operations, and hazardous material operations. The State requires each fire fighter to complete 36 hours of department certification each year. Each fire fighter is placed on a 6-month probation period after acceptance in the department. Refresher training courses are continued throughout the year. The training records of both victims were also reviewed and appeared up to date. Victim #1 had 15 years of fire fighting experience while Victim #2 had 8 years experience.

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INVESTIGATION

On November 6, 1998, at 1058 hours, the following departments responded to a possible structure fire at an auto salvage yard:

- Department #1, which included Car 1 (Chief), Engine 5 (Assistant Chief), 1st Responder (Lieutenant), Tanker (Lieutenant), Utility Truck (fire fighter), and 17 additional fire fighters who arrived by privately owned vehicles (POV).
- Department #2 included Engine 2 (Chief and Assistant Chief), and seven additional fire fighters who responded by POV.
- Department #3 included Engine 1 (Lieutenant and fire fighter), Tanker (Captain), Chief and 6 fire fighters who responded by POV.

The Chief in Car 1 was the first to arrive on the scene at 1104 hours and reported light smoke emitting from the southwest corner of a storage building at an auto salvage yard. Upon arrival he assumed command and completed a size-up evaluation of the metal-pole storage building which measured 100 by 100 feet, with the height of the roof being 20 feet (Photo 1). After completing his initial size-up, he was approached by the owner of the structure who informed him of the approximate location of the fire's origin. The owner explained the structure was used to store metal hoods, light bulbs, radiators, oil pumps, fenders, and bumpers on the first level. The second level contained plastic, fiberglass, and rubber car components. The owner also described the layout of the structure as a grid of storage racks 6 feet wide standing approximately 18 feet high, with aisles ranging from 3 feet to 6 feet in width (see Diagram).

Engine 5 from Department #1 and Engine 1 and a Tanker from Department #3 arrived on the scene at 1107 hours and Engine 2 from Department #2 arrived

at 1109 hours. Engine 5 connected to a hydrant across the highway and laid 800 feet of 5-inch supply line to the northeast corner of the structure. Engine 5 also placed a positive pressure ventilation (PPV) fan at the front door while the Captain from Department #3 opened one of the steel roll-up doors on the north end for ventilation purposes (see Diagram). The IC proceeded to the southwest corner with the owner and ordered the owner to use his forklift to tear off the metal siding to assist in ventilation. Fire fighters from each department pulled two, 200-foot, 1 ½-inch lines off Engine 5 and placed them at the entrance.

As the owner pulled sections of metal siding from the structure, the IC relayed to the Chief of Department #3 (who was Outside Operations) that ventilation was taking place and black smoke was emitting from the opening. Vertical ventilation was attempted by removing sections of siding, but proved to be unsuccessful due to lack of apparatus on the fire ground. Fire fighters were unable to reach the top sections of metal siding that covered the roof.

The IC then ordered the Outside Operations to have fire fighters close the roll-up doors on the northeast end and prepare the attack and backup crews for entry through the front door of the structure. At 1121 hours, the IC ordered the Outside Operations to send the two crews inside the structure to locate the seat of the fire. The initial attack crew consisted of Department #2 (Chief [Victim #1], Assistant Chief, and a fire fighter) and the backup crew of Department #3 (Captain, Lieutenant [Victim #2], and a fire fighter). Both crews were equipped with turnout gear, SCBAs, and at least one member of each crew had a radio. The backup crew were all equipped with Personal Alert Safety System (PASS) devices, but the attack crew were not. The two crews entered through the front door walking in an upright position. They reported conditions of light gray smoke banking down from the ceiling approximately 4 feet from the

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ground with approximately 5 feet of visibility. The crews advanced inside approximately 20 to 25 feet before they stopped to evaluate conditions. They noticed small spot fires throughout the structure but still had not reached what they felt was the seat of the fire. The backup crew proceeded further into the structure and now became the attack crew. As they advanced, the backup crew (Department #2) stated they spotted fire trickling overhead across the ceiling. They also stated that the smoke above them was thick and black, but heat was never a problem at their level. At 1124 hours, the Chief of Department #2 (Victim #1) radioed the IC requesting additional hose. He also stated that conditions on the interior were good and the PPV fans apparently were working. Noticing the hose line was getting caught outside the office door, the IC ordered a fire fighter from Department #1 to enter the structure and assist in advancing the line. Proceeding further, the crew's hose lines intertwined and positions of the crews switched a second time. With Department #2 back on the attack line, Victim #1 and the Captain of Department #3 proceeded further and located what they believed was the seat of the fire. As the Captain notified the attack crew to advance the line, Victim #1 further evaluated conditions. At 1129 hours, the attack crew opened water on the fire. The Captain of Department #3 had to exit along with a fire fighter of Department #2 due to low-air alarms. Right before their exit, the Lieutenant of Department #3 (Victim #2) exited, changed his bottle, and reentered the structure to his original position on the line. Victim #1 exited the structure to obtain a flashlight and reentered the same way he exited during the initial attack. When the Captain and fire fighter exited to change their air bottles, the same fire fighter pulling hose advanced on the line to replace one of the fire fighters who had exited to change his air bottle. Radio transmissions from the inside to the IC were broken up and at 1132 hours the IC radioed the inside crews to exit and bring their hose lines with them. He also directed the Captain from Department #3 to enter

the structure and verbally tell the crews to retreat and bring their hose lines with them. Believing the fire was under control, the IC decided to pull the crews out to regroup and begin mop up operations. At 1132 hours, the Assistant Chief of Department #2 and Victim #1 were pulling the attack hose line out of the structure when they were hit by an intense blast of heat that created thick, black smoke, knocking them off the hose line and to the floor. As they searched for the hose line in total darkness, the Assistant Chief stated both his and Victim #1's SCBA low-air alarms began to sound. The Assistant Chief stated that at this time he spotted heavy fire where they had previously applied water. The Assistant Chief found the hose line, but could not follow it because it was looped three times and intertwined with the back up line. He then stood up to run and fell to the ground, finding that he was completely out of air. He yelled to Victim #1 to radio for help as he searched for a way to exit. At 1134 hours, Victim #1 radioed IC in a loud, excited tone of voice which the IC was unable to understand. The IC told Victim #1 to slow down and repeat the message. Victim #1 radioed the IC a second time, telling him to send someone in on their line to get them out.

The Assistant Chief stated that he and Victim #1 were still within 3 to 5 feet of each other when he reached out and felt a hose line which he thought was a line leading in the direction of exit. The Assistant Chief yelled at Victim #1 and told him they needed to go in the direction of the line, and Victim #1 yelled back stating they should go a different way. They yelled the same statements a second time before the Assistant Chief decided to follow the hose line. At that time, the Assistant Chief thought that Victim #1 was following him on the line. The Assistant Chief stated the heat was so intense that he recalled the concrete spalling during his exit.

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The IC sent two additional fire fighters inside (fire fighter from Department #1 and the Chief of Department #3) to assist the two disoriented fire fighters. As the two fire fighters entered on the line, they were met by fire fighters dragging out an unconscious fire fighter, later identified as the Assistant Chief. As they pulled the Assistant Chief to safety, fire fighters stated they saw Victim #2 at the front door assisting in the search. A second fire fighter from Department #1 was also given assistance on his exit. At 1139 hours, all fire fighters exited. The IC ordered a head count of all department members and then radioed dispatch requesting a rescue for a downed fire fighter. About this time Victim #2 reentered the burning structure by himself. The Chief and fire fighter reentered and split off into different directions, the fire fighter following the backup line, while the Chief followed the attack line. Following the attack line, the Chief attempted to crawl to the area where Victim #1 was last seen, but had to retreat and exit due to his low air alarm sounding. The Chief stated that conditions were deteriorating and it was getting hotter as he proceeded to the rear of the structure. As the Chief exited, he came in contact with the fire fighter who was following the backup line and they exited together. The IC (Chief of Department #1) donned his SCBA and turned over Incident Command to the Assistant Chief (a 2nd Assistant Chief of Department #2) and entered the building alone. After searching approximately 5 minutes the Chief exited and called off all rescue attempts due to deteriorating interior conditions. The Chief then took back command and ordered the Assistant Chief to radio for a Snorkel Truck from a nearby City department and additional manpower from neighboring volunteer departments. Department #4 responded, and arriving upon the scene, their Chief took over as Outside Operations and completed the removal of both victims.

Both victims were removed approximately 5 hours after the initial call. Neither fire fighter appeared to

have been pinned or trapped by debris. Victim #1 was discovered lying in one of the storage racks near the rear of the structure, and Victim #2 was discovered in an aisle near the front (see Diagram). Victim #2 was recovered with a PASS device attached to his equipment, but it was in the off position. Victim #1 was known to have entered the structure without a PASS.

CAUSE OF DEATH

According to the medical examiner, the cause of death for Victim #1 was listed as carbon monoxide poisoning and smoke inhalation. The cause of death for Victim #2 was listed as carbon monoxide poisoning.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Fire departments should ensure that fire command always maintains close accountability for all personnel at the fire scene. ^{1, 3, 4}

Discussion: Accountability on the fire ground is paramount and may be accomplished by several methods. It is the responsibility of every officer to account for every fire fighter assigned to his or her company and relay this information to Incident Command. Accountability on the fire ground can be maintained by several methods: by a system using individual tags for every fire fighter and officer responding to an incident, or by a company officer's riding list stating the names, assigned tools, and duties of each member responding with every fire company. One copy of the list should be posted in the fire apparatus and one copy carried by the company officer. The list posted in the apparatus is used if the company officer or the entire company is reported missing. Additionally, fire fighters should not work beyond the sight or sound of the supervising officer unless equipped with a portable radio. This member should communicate with the supervising officer by portable radio to ensure accountability and indicate

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completion of assigned duties. Standard Operating Procedures (SOPs) should address accountability including the location and the duties of the responding fire companies. Just as company officers should know the location of all fire fighters assigned to the company, the chief officer in command should know the operating locations of officers and companies assigned on the first-alarm assignment. As a fire increases and additional fire companies respond to the fire, a communication assistant with a command board should assist the Incident Commander with accounting for all fire companies at the scene, at the staging area and at rehabilitation. One of the most important aides for accountability at a fire scene is an incident management system. It should be established by the officer in command of the incident. During this incident, command had accounted for fire fighters involved in the initial attack; however, when the rescue attempts were in progress for Victim #1, Victim #2 reentered the structure to assist in the search. Victim #2's location was unclear until the fire was extinguished.

Recommendation #2: Fire departments should ensure that vertical ventilation takes place to release any heat and smoke directly above the fire. ^{2, 5}

Discussion: Ventilation is necessary to improve the fire environment in order for fire fighters to approach a fire with a hose line for extinguishment. Additionally, smoke, heat, and gases should be vented above the fire to prohibit conditions necessary for a flashover. If the room in question has a skylight, vent it!² This should be completed as soon as possible. Vertical ventilation will delay heat build-up at the ceiling level of the burning room; it may also delay flashover long enough to make a quick search for a victim; and it may assist in the advancement of an attack hose line.

There are some fires that do not flash over, in which fire growth is different. Fires in very large areas may

not exhibit flashover. There may be no smoke build-up or sudden flash. If, however, the interior finish or its contents are combustible, flame spread may be extremely rapid, and fire fighters cannot escape faster than flame spread. Fire tests conducted on some plastic furnishings reveal a flame spread of as much as 2 feet per second. When a fire fighter enters a large room to search for fire after penetrating more than 5 feet beyond an exit, the point of no return is reached. If rapid flame front spreads along the under side of a combustible ceiling, the fire fighter cannot escape faster than the flames will spread. In this incident, horizontal ventilation took place approximately 30 feet from where the fire was believed to have started. Vertical ventilation was attempted by pulling sections of metal siding, but this effort failed due to the lack of apparatus on the fire ground. Fire fighters attempted to remove metal siding from the roof sections but could not reach the roof due to the lack of apparatus.

During the fire fighters' interior attack, the conditions dramatically changed, causing intense heat surrounded by thick, black smoke causing fire fighters to become disoriented. The fire fighters were approximately 70 feet inside the structure which housed auto parts along with flammable plastic products.

Recommendation #3: Fire departments should ensure that Rapid Intervention Teams be established and in position. ^{1, 2}

Discussion: A Rapid Intervention Team (RIT) should respond to every major fire. They should report to the officer in command and remain at the staging area until an intervention is required to rescue a fire fighter. The Rapid Intervention Team should have all the tools necessary to complete the job, e.g., a search rope, rescue rope, first-aid kit and a resuscitator to use in case a fire fighter needs assistance. These teams can intervene quickly to rescue fire fighters who

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become disoriented, lost in smoke-filled environments, trapped by fire, involved in structural collapse, or run out of breathing air. Many fire fighters who die from smoke inhalation, flashover, or are caught or trapped by fire, actually become disoriented first. In this incident fire fighters were near the entrance, but they were not designated as the RIT. When assistance on the interior was needed, the RIT could have provided the assistance as all additional fire fighters exited for a roll call. All fire fighters could then be accounted for.

Recommendation #4: Fire departments should ensure that fire fighters wear and use PASS devices when involved in interior fire fighting and other hazardous duties.¹⁻³

Discussion: A Personal Alert Safety System (PASS) device should be part of every fire fighter's equipment. The electronic device, designed to sound a shrill alarm if a fire fighter falls unconscious and/or becomes immobile, can allow other fire fighters to locate the downed fire fighter quickly. The fire fighter can also manually activate the alarm if needed. If possible, a fire fighter who becomes trapped or disoriented should activate the PASS device. In this incident, Victim #1 was located without a PASS device and Victim #2 was located with a PASS device which was not activated. As rescue attempts were made the fire fighters could not locate Victim #1 due to excessive heat and dark smoke conditions. Victim #2 was located in an area where fire fighters were not searching but possibly could have located him if the victim's PASS device had been activated.

REFERENCES

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INVESTIGATOR INFORMATION

This incident was investigated by the following: Frank C. Washenitz II and Kimberly L. Cortez, Safety and Occupational Health Specialists, Surveillance and Field Investigations Branch, Division of Safety Research. Timothy R. Merinar, General Engineer, Respirator Branch, Division of Respiratory Disease Studies.

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Photo By: Goldsboro News-Argus

Photo 1: This photo depicts an aerial view of the burning structure

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