



Volunteer Fire Fighter Dies after Suffering a Head Injury While Operating a Platform Aerial Ladder—Rhode Island



Incident scene after victim was removed.
(Photo courtesy of police department.)

SUMMARY

On June 29, 2009, a 67-year-old male volunteer fire fighter (victim) suffered a severe head injury while he operated a platform aerial ladder from within the platform. The victim was recorded by a nearby security surveillance camera as he entered the platform of the aerial ladder, and extended and

The National Institute for Occupational Safety and Health (NIOSH), an institute within the Centers for Disease Control and Prevention (CDC), is the federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. In fiscal year 1998, the Congress appropriated funds to NIOSH to conduct a fire fighter initiative. NIOSH initiated the Fire Fighter Fatality Investigation and Prevention Program to examine deaths of fire fighters in the line of duty so that fire departments, fire fighters, fire service organizations, safety experts and researchers could learn from these incidents. The primary goal of these investigations is for NIOSH to make recommendations to prevent similar occurrences. These NIOSH investigations are intended to reduce or prevent future fire fighter deaths and are completely separate from the rulemaking, enforcement and inspection activities of any other federal or state agency. Under its program, NIOSH investigators interview persons with knowledge of the incident and review available records to develop a description of the conditions and circumstances leading to the deaths in order to provide a context for the agency's recommendations. The NIOSH summary of these conditions and circumstances in its reports is not intended as a legal statement of facts. This summary, as well as the conclusions and recommendations made by NIOSH, should not be used for the purpose of litigation or the adjudication of any claim. For further information, visit the program Web site at <http://www.cdc.gov/niosh/fire> or call toll free at 1-800-CDC-INFO (1-800-232-4643).



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raised the aerial ladder up toward an open fire station bay door. Another fire fighter is seen moments later exiting from the bay door, and calling for the victim, then mounting the apparatus and walking up the aerial ladder. When the fire fighter arrived at the platform he noticed the victim's head was pinned between the header of the bay door and the platform railing. The fire fighter operated the controls in the platform to relieve the pressure on the victim's head. He repositioned the platform aerial ladder to the ground, off the driver's side. The victim was removed from the platform and transported to a local hospital before being airlifted to a trauma center. The victim succumbed to his head injury on June 30, 2009. Key contributing factors identified in this investigation include use of a platform aerial ladder for a task that may have been conducted more safely by means of a ground ladder, working alone, not wearing a helmet, and potentially diminished vision as a result of recent eye surgery.

NIOSH investigators have concluded that, to minimize the risk of similar occurrences, fire departments should

- ***Develop, implement, and train on policies and standard operating procedures that govern aerial apparatus (e.g., safe operation, appropriate use, and low clearances).***
- ***Ensure that members operating an aerial ladder wear appropriate personal protective equipment including head protection.***
- ***Consider adopting NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments to ensure that fire fighters, officers, and medical physicians fully understand the requirements to clear a fire fighter to return to duty.***

INTRODUCTION

On June 30, 2009, a 67-year-old male volunteer fire fighter (the victim) died from a head injury, sustained one day earlier, while operating a platform aerial ladder from within the platform. On July 6–9, 2009, a safety and occupational health specialist and a general engineer from the NIOSH Fire Fighter Fatality Investigation and Prevention Program investigated this incident. The NIOSH investigators met with the fire chief, chief officers of the fire district, and the district fire marshal. The investigators met with the police department investigator and reviewed his photographs, investigative findings, witness statements, and preliminary investigative report. NIOSH investigators also met with representatives from a private consultant group hired by the fire district to reconstruct the incident and reviewed their photographs and investigative findings.

Investigators reviewed training records of the victim, the apparatus operation and safety manual, fire department standard operating procedures (SOPs), aerial ladder inspection and maintenance records and visited the incident scene. NIOSH investigators also had a conference call with the medical



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examiner while visiting the police department, and investigators spoke with a representative from the Rhode Island Department of Labor and Training assigned to the incident.

FIRE DEPARTMENT

The volunteer fire department is comprised of 55 volunteer fire fighters. The department has one station and serves a population of 25,000 in a geographical area of 3 square miles.

The fire department established a standard fire scene operational guide for truck company operations. This guide provides information on positioning an aerial apparatus, staffing, tool selection, building construction, search and rescue, and ventilation.¹ The guide does not provide procedures for the safe use and operation of an aerial ladder truck during emergent and non-emergent situations. The fire department made the manufacturer's aerial platform operation and safety manual available to all members of the department for review. This document addressed items such as safe loading, waterway operation, breathing air system, safety interlock system, and control panels.²

TRAINING and EXPERIENCE

The victim had been with this department for more than 42 years. He had held all available nominated positions within the department, except for fire chief. He was currently serving as a fire fighter, a position which included duties involving apparatus maintenance. He was in charge of scheduling routine maintenance inspections and shuttling apparatus between the fire station and maintenance/vendor facilities. He was trained to make minor repairs such as replacing light bulbs or windshield wiper blades. He was also certified as an air pack technician by a self-contained breathing apparatus (SCBA) manufacturer and maintained department SCBAs.

According to the fire chief, the victim had operated an aerial ladder since he joined the fire department more than 42 years ago. He trained members within his fire department on how to drive and operate their aerial ladder. He also traveled to neighboring departments and provided them with the same training as well. The fire department has a 600-hour, tiered driver/operator program. Members wanting to operate a fire department apparatus must first train on a quick-response vehicle such as a sport utility vehicle. They can then progress through apparatus such as a brush truck, engine, tanker, and rescue vehicle and then finish with the largest apparatus, an aerial ladder truck. The written program included skill check-off sheets for all apparatus; comprehension of the manufacturer's manuals, safe operation, and required personal protective equipment; and successful completion of written and practical competencies. The victim had completed this required training and was authorized to train new driver/operators. When the fire department took possession of the platform aerial ladder in 2001, they received manufacturer-led training from a certified vendor. The



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victim attended and completed this training. The state of Rhode Island does not require training to operate an aerial ladder.

Medical Findings. The fire chief stated that the victim was suffering from cataracts in both eyes and possibly intermittent blurred vision. The fire chief did not know the extent of the victim's visual impairment. Two weeks prior to the incident, the victim had surgery to remove the cataract from one eye, with the second cataract surgery already scheduled prior to the incident. The victim verbally advised the fire chief that he was cleared for duty but needed to stay away from smoke. No written documentation was provided to the fire chief stating the victim was medically cleared to return to duty and perform specific job tasks.

EQUIPMENT AND PERSONNEL

Tower 2 (T2) with the victim only



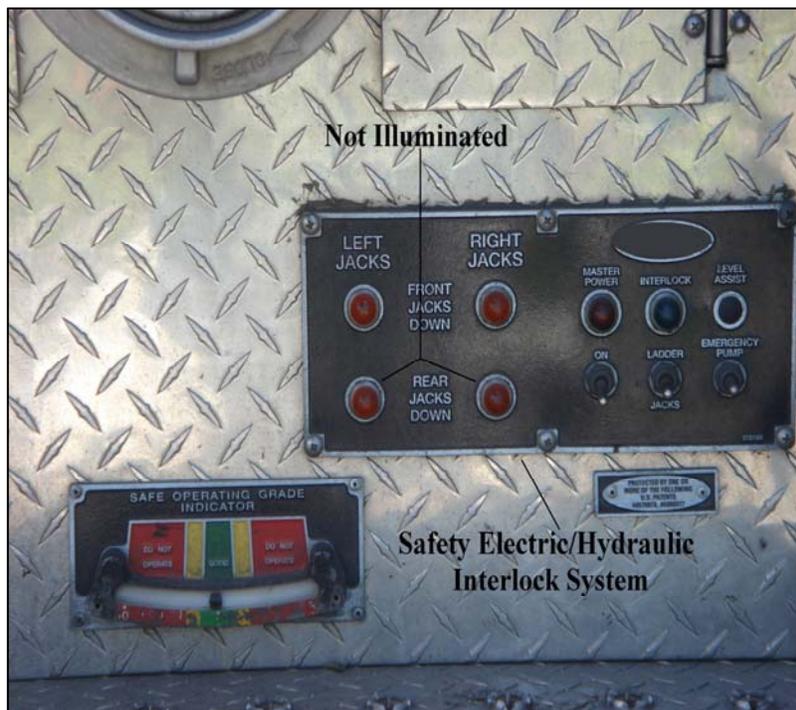
The apparatus involved in this incident was a 2000, 95-ft rear-mounted platform aerial ladder (see Photo 1). The fire department took possession in 2001 of this demo model from a local vendor. The gross vehicle weight rating of the apparatus was 73,000 lbs. The apparatus had an automatic transmission, diesel engine, an air brake system, and three axles with ten wheels (two in the front and eight in the rear).

Photo 1. Platform aerial apparatus.
(NIOSH photo.)

The apparatus measured approximately 46 ft (length) x 8 ft (width) x 12 ft (height). The digital display on the dashboard of the apparatus read 51,431 odometer miles and 4,745 engine hours when documented at the scene of the incident.



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A safe operating grade indicator was available at the tailboard along with a safety electric/hydraulic interlock system (see Photo 2). This system prevented the operation of the aerial ladder until all four outrigger jacks were set firmly for normal operating conditions. At that point, the hydraulic power is then transferred to the turntable so the aerial ladder can be operated. *Note: The fire fighter who discovered the victim recalls the “rear jacks down” indicator lights were not illuminated when he mounted the apparatus. The light bulbs were functional.*

Photo 2. Safe operating grade indicator and safety interlock system.
(NIOSH photo.)

The vehicle is stabilized by two sets of out-and-down, scissor style outriggers which are mounted under the frame. It is believed that the rear jack lights were not lit because excessive pressure was added to the front of the apparatus when the platform was wedged under the header of the bay door. This added pressure to the front of the apparatus caused the weight to shift to the front, thus relieving the pressure needed to actuate the rear jack lights. All are hydraulically operated with an electronic automatic leveling system.



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The platform is constructed entirely of aluminum with a protected working surface which measures 66 in (length) x 33 in (width) x 42 in (height); two front outward swinging corner gates protected by lift-up corner guardrails when in the opened position; and a tubular lift-up gate for access between the platform and ladder (see Photo 3). *Note: Once the tubular lift-up gate was lifted up it could be swung in/out to allow access to/from the platform.*



Photo 3. Aerial platform.
(NIOSH photo.)

The aerial ladder could be operated from the rear-mounted turntable or from within the platform. The victim operated the aerial ladder while in the platform. The aerial ladder controls were electric-over-hydraulic. This type of control set-up allowed for a one-second delay to be incorporated in the system to reduce the shock load on the aerial ladder resulting when the hydraulic valve is operated from the fully closed to the fully open position and vice versa. The control panel contained three knobs that operated the ladder: (1) extension/retraction, (2) left/right rotation, and (3) up/down (see Photo 4).



Photo 4. Control knobs located within the platform.
(NIOSH photo.)

Two weeks prior to the incident the apparatus passed its yearly inspection and performance test certification as recommended by NFPA 1911 *Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus*.³ Following the guidelines within NFPA 1911, the platform aerial ladder was re-inspected following the incident. The apparatus was placed out of



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service following this re-inspection due to structural defects found on critical components. *Note: These defects were not noted in the annual inspection and are believed to have occurred during the fatal incident.*

TIMELINE

The timeline for this incident includes approximate times obtained from a video surveillance camera documented by police investigators. The camera was located on a structure next to the fire station. Only the victim, the fire fighter who discovered the victim, and the apparatus directly involved in the incident are discussed in this timeline. The camera view was obscured at times, but observed key events include the following:

- **1418 Hours**
Victim returns from a motor vehicle incident.
- **1429.53 – 1433.06 Hours**
Victim drives T2 around to the rear of the fire station and positions it at an angle facing the fire station, exits the cab of T2 to prepare the ladder operation, climbs the rear of T2, and performs an unknown task before dismounting the apparatus.
- **1434.35 – 1434.53 Hours**
Victim mounts the turntable from the rear again, operates controls at the turntable, and then walks the aerial ladder before entering the platform of T2.
- **1435.11 – 1435.41 Hours**
The victim extends the aerial ladder into the open bay door and then raises it before all movement of the aerial ladder stops.
- **1436.07 – 1437 Hours**
The fire fighter exits through the opened bay door of the fire station, mounts T2 from the rear, and operates the aerial ladder from the platform, positioning it to the ground, on the driver's side of T2, to facilitate removal of the victim.

PERSONAL PROTECTIVE EQUIPMENT

It was reported to NIOSH investigators that the victim was wearing a t-shirt, jeans, and slip-on shoes. The victim's structural fire fighting gear and helmet were found inside the fire station bay.



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WEATHER

The weather on the day of the incident was partly cloudy with an approximate temperature of 75°F.

INVESTIGATION

**Note: The following investigation synopsis details the events that may have led to the fatal incident. A security surveillance camera recording the operation of the aerial ladder truck, a witness statement from the fire fighter who discovered the victim, and information provided from an accident reconstruction team were used to reconstruct the events leading to the incident. The victim had just returned from a motor vehicle incident where he did not operate the responding unit and the jaws-of-life was used, was by himself after the motor vehicle incident, and the events leading up to the fatal incident were not witnessed by other fire department members.*

On June 30, 2009, at approximately 1425 hours, it is believed that the victim was attempting to use a 12-ft pike pole to push open a scuttle hatch that was located within the fire apparatus bay ceiling when the pike pole slipped off the scuttle causing the scuttle to close against the wooden handle of the pike pole (see Photo 5). It is believed that the victim was unable to remove the pike pole due to it catching on the lip of the ceiling and scuttle hatch. At approximately 1430 hours, a nearby surveillance camera



Photo 5. Pike pole stuck in scuttle hatch.
(Photo courtesy of police department.)



Photo 6. Position of platform aerial ladder.
(Photo courtesy of police department.)



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recorded the apparatus being driven around from the front of the fire station to the rear of the fire station.

The apparatus was positioned on the apron at an angle facing the rear doors of the fire apparatus bay (see Photo 6). The victim was observed exiting the apparatus and then later operating the aerial ladder from within the platform. *Note: It is believed that the victim was intending on using the aerial apparatus to retrieve the pike pole.* A fire fighter, who had been at the fire station since 1330 hours, walked into the apparatus bay to find the bay doors up and the aerial platform positioned through the rear of the bay. He walked over to the apparatus and yelled up toward the platform to find out what the victim was doing. *Note: He assumed it was the victim because the victim was at the station on a daily basis.* There was no response from within the platform. The fire fighter walked down the driver's side of T2 and mounted the apparatus from the rear turntable. *Note: The fire fighter recalls the "rear jacks down" indicator lights were not illuminated when he mounted the apparatus; all four outriggers were set.* He started to ascend the ladder and noticed that the ladder was not bouncing. He thought this was odd because when the aerial ladder was elevated, in a cantilevered position, the ladder had a slight bounce to it.

When he reached the platform, he called the victim's name again and received no response. He noticed that all the safety and access gates were in the closed position. He discovered the victim positioned in the right corner of the platform, to the fire fighter's right side, with his back facing him. The fire fighter also noticed that the victim's head was pinned between the bay door header and top guardrail on the platform.

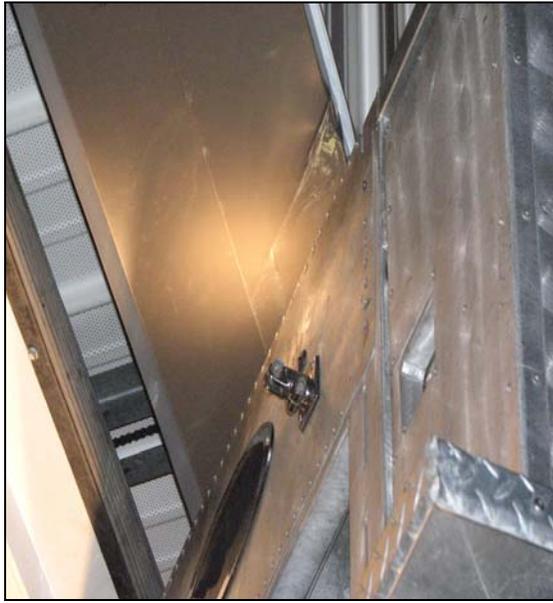
The fire fighter operated the platform controls while he contacted 911. He was able to relieve the pressure off the victim's head as he repositioned the platform to ground level, off the driver's side. The victim was removed from the platform and transported to a local hospital before being airlifted to a trauma center. The victim succumbed to his head injury the following day.

Incident Reconstruction

An outside consultant group was retained by the fire chief to perform a reconstruction of the events that may have led to the victim's fatal injury. The platform aerial ladder was placed in the exact position when the incident occurred. Individuals operated the aerial ladder from within the platform and were able to line the platform up to the damage marks received to the door header and platform guardrail (see Photos 7 and 8). Due to low clearance between the platform and door header, the victim could not have operated the platform while standing. He may have been kneeling or bent over while he was operating the platform controls. He would have had to make sure that he positioned himself below the 42-in platform guardrail height in order to clear the door header. It is believed that as he continued to extend and raise the platform, the victim may have lifted his head momentarily to visualize how close the top of the platform was to the door header when his head got pinned between the header and the platform guardrail. He was not wearing a helmet.



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Photos 7 and 8. The photo on the left shows the platform lined up with the damage to the door header. The photo on the right shows the position the platform is believed to have been in when the victim's head got pinned.
(Photos courtesy of consultant group.)

CONTRIBUTING FACTORS

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in the injury or fatality. NIOSH investigators identified the following items as key contributing factors in this incident that may have led to the fatalities:

- Use of a platform aerial ladder for a task that may have been conducted more safely by means of a ground ladder.
- Working alone.
- Head protection not worn while operating an aerial ladder.
- Potentially diminished vision as a result of recent eye surgery.

CAUSE OF DEATH

According to the medical examiner's autopsy report the victim died from blunt force trauma.



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RECOMMENDATIONS

Recommendation #1: Fire departments should develop, implement, and train on policies and standard operating procedures that govern aerial apparatus (e.g., safe operation, appropriate use, and low clearances).

Discussion: The fire department had developed standard operating procedures that governed ladder company operations, but not safe and appropriate use of the apparatus. Written policies and SOPs enable individual fire department members an opportunity to read and maintain a level of assumed understanding of operational procedures. The NIOSH Alert, *Preventing Injuries and Deaths of Fire Fighters*, identifies the need to establish and follow fire fighting policies and procedures.⁴ To be effective, policies and procedures should be developed, fully implemented, enforced, and periodically revised. Being able to safely operate an aerial apparatus is paramount. Operators are tasked with having to negotiate the large apparatus through traffic, correctly position it at an incident for maximum use, avoid overhead hazards such as power lines and structures, and potentially work under stressful situations. A strong foundation established through SOPs and annual training will better adapt the aerial operator to make sound and safe decisions on the apparatus' operation.

During this incident, it is believed that the victim was attempting to reach the pike pole that was stuck in the scuttle by using the platform aerial ladder. The victim operated the platform aerial ladder from the platform by himself. Some jurisdictions prefer that fire fighters operating within a platform have primary control of the aerial device since they are at a better vantage point than the operator on the ground or turntable, but an operator should always be stationed at the primary control panel so that they can override the controls when a hazard exists or fire fighters within the platform become incapacitated.⁵ In this incident, if the use of the platform aerial ladder was deemed the best device to assist in retrieving the pike pole, then the victim could have adequately protected himself within the platform and allowed an aerial operator to operate the platform and ladder from the turntable, although operation in this manner may not have completely eliminated the risk of injury from low clearances. The use of the aerial apparatus would have provided him ample fall protection, but negotiating the platform through the apparatus bay door, which had a very low clearance, posed an overhead hazard that proved fatal (see Photo 9). It is believed that if the victim had not raised his head while operating the platform, and was not alone, the incident may not have occurred.



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Photo 9. The level of clearance observed between door header and platform railing.
(Photo courtesy of consultant group during reconstruction of the incident.)

Fire departments should develop policies addressing when an apparatus, especially an aerial ladder, should be used during emergency and non-emergency situations. The use of a ground ladder may have been better suited to retrieve the pike pole. Carefully planning a task and identifying potential risks can be helpful.

Recommendation #2: Fire departments should ensure that members operating an aerial ladder wear appropriate personal protective equipment including head protection.

Discussion: Work surfaces that are mobile and capable of being elevated into the air pose a hazard to individuals working within them. Fire fighters are tasked with having to work from elevated aerial platforms and ladders, and they must be protected from hazards such as fire and smoke, falling objects, falling from the platform, and elevated structures (e.g., power lines, tree limbs, and balconies). Protective helmets should be worn in any work environment that presents a significant risk of head injury. OSHA 29 CFR 1926.100(a) states, “Employees working in areas where there is a possible danger of head injury from impact, or from falling or flying objects, or from electrical shock and burns, shall be protected by protective helmets.”⁶

During this incident, the victim was attempting to maneuver a platform aerial ladder into an apparatus bay while working from the platform. The door header did not provide ample clearance and posed a hazard. The victim was discovered with his head pinned between the door header and platform



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guardrail. The victim was discovered without head protection, and it is feasible to believe that the injuries received may not have been fatal if the victim had been wearing an appropriate form of head protection (i.e., a fire helmet) because it may have taken the initial impact lowering the potential for the victim's head to have been pinned.

Recommendation #3: Fire departments should consider adopting NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments to ensure that fire fighters, officers, and medical physicians fully understand the requirements to clear a fire fighter to return to duty.

Discussion: Guidance regarding medical evaluations and examinations for structural fire fighters can be found in NFPA 1582 *Standard on Comprehensive Occupational Medical Program for Fire Departments*⁷ and in the IAFF/IAFC *Fire Service Joint Labor Management Wellness/Fitness Initiative*.⁸ According to these guidelines, the fire department should have an officially designated physician who is responsible for guiding, directing, and advising the members with regard to their health, fitness, and suitability for duty as recommended by NFPA 1500 *Standard on Fire Department Occupational Safety and Health Program*. The physician should review job descriptions and essential job tasks required for all fire department positions and ranks in order to understand the physiological and psychological demands of fire fighters and the environmental conditions under which they must perform, as well as the personal protective equipment they must wear during various types of emergency operations and equipment they may be required to operate.⁹

The fire chief stated that the victim was suffering from cataracts in both eyes and possibly intermittent blurred vision. The fire chief did not know the extent of the victim's visual impairment. Two weeks prior to the incident, the victim had surgery to remove the cataract from one eye, with the second cataract surgery already scheduled prior to the incident. The victim verbally advised the fire chief that he was cleared for duty but needed to stay away from smoke. No written documentation stating the victim was medically cleared to return to duty and perform specific job tasks was provided to the fire chief. NFPA 1582, A.9.12.3.1 states, "Diseases of the eye such as...cataracts...can result in the failure to read placards and street signs or to see and respond to imminently hazardous situations. Members should be cleared for duty by the ophthalmologic surgeon who understands the essential job tasks associated with fire fighting."⁸ NFPA 1582 *Standard on Comprehensive Occupational Medical Program for Fire Departments*⁸ provides specific information regarding disorders of the eyes or vision that can affect specific fire fighting tasks and that a physician can use to accurately evaluate an individual's ability to return to duty. The fire fighter's vision and recent eye surgery may have been a contributing factor during the incident, but there is no way to be certain.



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INVESTIGATOR INFORMATION

This investigation was conducted by Stacy C. Wertman, Safety and Occupational Health Specialist, and Matt Bowyer, General Engineer, with the Fire Fighter Fatality Investigation and Prevention Program, Fatality Investigations Team, Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH located in Morgantown, WV. This report was authored by Stacy C. Wertman. A technical review was provided by Kevin Roche, Assistant Fire Marshal of Phoenix Fire Department.