



NIOSH
Fire Fighter Fatality Investigation
and Prevention Program

Death in the line of duty...

A summary of a NIOSH fire fighter fatality investigation

November 03, 2009

Career Fire Fighter Dies When Backed Over While Spotting an Apparatus—New Jersey



*Incident scene
(Photo courtesy of police department.)*

SUMMARY

On January 2, 2009, a 57-year-old male career fire fighter (the victim) was fatally injured when he was backed over while spotting an apparatus on the fire scene. The victim was the acting captain the night of the incident and responded in an engine with a crew of three to a reported working structure fire. While en route, the engine had received a radio message to forward lay and supply water for an elevated master stream. Due to the location of the fire structure and hydrant the crew had to lay the supply line beneath a highway overpass. Upon arrival, the engine chauffeur had to drive around a police cruiser and tow truck in order to position the engine to an available hydrant. The engine then dropped off a fire fighter at the hydrant to prepare a forward lay when the incident commander advised them to do a reverse lay. The victim then exited the engine to guide the chauffeur while he backed the engine around the police cruiser and tow truck. The victim walked down the officer's side of the engine and positioned himself at the rear on the officer's side. The fire fighter positioned himself at the driver's side front bumper. The chauffeur was able to negotiate the engine around the police cruiser and tow truck without incident before straightening up to position a feeder line into the scene. The victim walked backwards keeping eye contact with the chauffeur via the officer's side

mirror. While backing, the chauffeur noticed the tow truck drive past him toward the scene. He focused his attention on the tow truck momentarily when he felt the truck run over something. A police officer yelled to the chauffeur to stop the engine because something or someone was just run over. The victim was found underneath the engine just in front of the officer's side rear wheels. He was transported to a local metropolitan hospital where he was pronounced dead. The chauffeur was not cited in the fatal incident. Key contributing factors identified in this investigation include loss of direct communications between driver and spotter, driver distractions, possible loss of footing by the victim, and possible failure of the automatic reverse braking system.

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

- ***Ensure that standard operating procedures (SOPs) are developed, implemented, and enforced on safe backing of fire apparatus (e.g., visual and audio communication, use and position of spotter(s)) and include adequate training and testing methods (e.g. written and practical tests) to ensure fire fighter comprehension.***
- ***Consider evaluating current safety equipment used on fire apparatus to assist drivers during backing operations and consider supplementary safety equipment (e.g., additional mirrors, automatic sensing devices, and/or video cameras) for further assistance.***
- ***Implement proper procedures for inspection, use, and maintenance of safety equipment used to assist in the backing of fire apparatus to ensure the equipment functions properly when needed.***

INTRODUCTION

On January 2, 2009, a 57-year-old male career fire fighter (the victim) was fatally injured when he was backed over while spotting an apparatus on the fire scene. On March 30, 2009, the International Association of Fire Fighters requested that the National Institute for Occupational Safety and Health (NIOSH) investigate this incident. On April 13–16, 2009, two safety and occupational health specialists from the NIOSH Fire Fighter Fatality Investigation and Prevention Program traveled to New Jersey to investigate this incident. The NIOSH investigators interviewed the fire chief and fire director from the victim's department, the engine chauffeur and fire fighter, and the fire scene incident commander. The investigators met with the New Jersey Public Employees Occupational Safety and Health Program (PEOSH) incident investigator and representatives and reviewed their photographs, investigative findings, and safety and health standards for fire department personnel. NIOSH investigators also met with representatives from the local fire fighter's union and uniformed officer's union.

Investigators reviewed law enforcement investigative photographs and investigative reports, the New Jersey State Police Commercial Vehicle Crash Report, the autopsy report, training records of the victim and engine chauffeur, and visited the incident scene. NIOSH investigators also spoke with investigators from the New Jersey Division of Fire

Safety, local police and sheriff's office, and personnel from the medical examiner's office.

FIRE DEPARTMENT

The career department involved in this incident is comprised of 269 uniformed fire fighters. The department has seven stations and serves a population of approximately 124,000 in a geographical area of 12 square miles.

Although the fire department has provided annual driver/operator training courses that focused on several driving topics including backing, they had not developed and implemented standard operating procedures that will assist fire fighters in safely backing an apparatus. In March 1994, due to an increase in overhead door damage, a general order was issued that addressed procedures for leaving and returning from quarters.¹ In regards to backing, the general order states, "To ensure pedestrian safety and to stop the flow of traffic when returning into quarters, the apparatus shall be guided on both sides." NIOSH investigators observed this general order being used while meeting with the fire department. The State of New Jersey motor vehicle regulations do not require that emergency vehicle operators possess any special training or driver's licenses such as a commercial driver's license.

TRAINING AND EXPERIENCE

The victim had been with this department for more than 28 years. He had completed certification courses in Fire Fighter I, Hazardous Materials Operations, Basic First Aid and Cardiopulmonary Resuscitation (CPR), and various weekly and monthly fire service-related topics. The victim had also completed various online and instructor-led training courses on the incident command system. The engine chauffeur had been with this department for more than 18 years. He had completed certification courses in Fire Fighter II, Hazardous Materials Operations, Basic First Aid and CPR, and various weekly and monthly topics related to the fire service. The chauffeur had completed various online and instructor-led training courses on the incident command system.

The victim and engine chauffeur had completed certification training on highway incident and traffic safety, a department-instructed fire apparatus driver/operator course, and National Safety Council's course, *Coaching the Emergency Vehicle Operator II—Fire*.² Both apparatus driver/operator courses focused on basic fundamental driving skills such as backing, turning, intersection safety, braking, and speed control. Written and maneuvering skills tests were administered. The engine was equipped with an automatic reverse braking system when the vendor delivered it to the fire department, and the engine chauffeur had received initial training on how the system functioned from the vendor.

EQUIPMENT AND PERSONNEL

The victim was the acting officer on the engine along with the chauffeur and fire fighter. The apparatus involved in the incident was a 1996 enclosed cab engine with an automatic transmission, diesel engine, and an air brake system ([see Photo 1](#)). The apparatus' gross vehicle weight rating (GVWR) was 32,360 lbs. The engine had two axles with six wheels (two in the front and four in the rear). The engine measured 28 ft (length) x 8 ft 7 in (width) x 9 ft 5 in (height). The apparatus was also equipped with an automatic reverse braking system³ mounted to the rear step of the apparatus ([see Photo 2](#)).



Photo 1. Apparatus involved in the backing incident.
(Photo courtesy of police department.)



Photo 2. This reverse braking system is attached to the rear bumper of the apparatus and is designed to actuate the rear brakes when pressure is applied to the rubber

sensor.

(Photo courtesy of sheriff's office.)

This automatic reverse braking system was developed in the early 1980s, introduced in the United Kingdom in 1983, and then became available in the United States in 1986. This reverse braking system was an optional safety feature that was installed on the apparatus prior to the fire department taking possession in 1996. The system aids driver/operators while backing an apparatus by locking the rear brakes when the system comes in contact with an object. *Note: The manufacturer's manual notes that this system does not exempt the driver/operator from using conventional backing aids such as side and rear mirrors or spotters.*³ The rubber sensor is mounted six inches beyond the vehicle's rear end to provide an area where vehicle damage could be reduced due to the short distance traveled after automatic brake application. The sensor has an air chamber which is sealed at either end. The air chamber detects or senses a compression of the wall of the chamber, as little as 0.05 psi, causing the pressure inside to increase and then transmit down to a control/switch unit which triggers the brakes to actuate. The system is designed to operate when the apparatus is in reverse gear and backing at a slow rate of speed. The instruction manual recommends a function test be done after initial installation and at least once a week thereafter. For the involved apparatus, the last documented function test was performed in March 2008; at that time, the system was working properly.

After the incident, the apparatus and scene were processed by local police before the apparatus was escorted by state police to the fire department's headquarters. The apparatus was secured there until state police could perform a vehicle inspection. The state police performed a standard commercial vehicle crash inspection in the presence of a fire department mechanic and investigators from the New Jersey Division of Fire Safety. Items inspected included the air brake system, brakes, steering, suspension, tires, lighting, and low air pressure indicators. The inspection was completed within three days of the incident and the apparatus was found to have no mechanical violations. The state police inspection did not include an inspection of the automatic reverse braking system because it was an optional device and their investigators were not certified to test it. However, when pressure was applied to the rubber sensor while backing, the system failed to actuate the brakes. It could not be determined whether the backing system was functional at the time of the incident, but there was damage to the bumper and rubber sensor that could not be attributed to the fatal incident ([see Photos 3 and 4](#)).



Photos 3 and 4. Pictures show damage to rear bumper and rubber sensor.
(Photo courtesy of PEOSH.)

From these findings, the New Jersey Division of Fire Safety recommended that repairs be made before placing the apparatus back in service. The automatic reverse braking system control unit was replaced following the inspection, and then placed back in service. The fire department also inspected eight other apparatus that had the same reverse braking system installed. Three of these apparatus had damaged or insufficient operating parts within the system that affected proper operation. These three systems were also repaired.

TIMELINE

The timeline for this incident includes the initial call to the 911 center at 0213 hours for a structure fire. Only the engine directly involved in the incident is discussed in this timeline. No en route times were documented for initial responding units for the structure fire. The engine was part of the initial assignment dispatched. The engine's dispatch, arrival, and key events include the following:

- **0213 Hours**
911 dispatch center received a call for a residential structure fire
- **0215 Hours**
911 center dispatched the residential structure fire assignment
- **0226 Hours**
Engine on scene
- **0234 Hours**
Emergency Medical Services transported victim to hospital

PERSONAL PROTECTIVE EQUIPMENT

It was reported to NIOSH investigators that the victim was seen wearing a full array of personal protective clothing and equipment, consisting of turnout gear (coat and pants), helmet, rubber fire boots, and a self-contained breathing apparatus. NIOSH investigators were unable to inspect the victim's gear because it was destroyed prior to this investigation due to biological contamination. The turnout coat and pants were black with reflective trim and lettering. The turnout coat had 3 in reflective lime yellow triple trim stripes around the waist and chest of the coat, and at wrist and elbow locations on both coat arms. There were also (6) 3 in reflective letters on the back of the turnout coat. The turnout pants had 3 in yellow/silver triple trim stripes above the pant cuffs.

WEATHER AND ROAD CONDITIONS

The weather at the time of the incident was clear with temperatures below freezing. The incident occurred on a municipal roadway underneath a turnpike overpass approximately 186 ft from the fire scene. The road surface was blacktop and concrete and was straight, level, and dry. No construction occurred in the area of the incident and no concrete dividers existed to separate the eastbound and westbound lanes. The area was reported to have been well lit when the incident occurred.

INVESTIGATION

On January 2, 2009, at 0213 hours, the 911 center received an emergency call for a residential structure fire. At 0215 hours, the 911 center dispatched a residential structure fire assignment which included three engines, a ladder truck, a rescue truck, and a battalion chief. The engine involved in this incident was one of the three initial engines dispatched. The fire scene incident commander initially assigned the engine to forward lay a feeder line to supply water to the ladder truck for an elevated master stream. Due to the layout of the incident scene, the engine had to lay the supply line underneath a highway overpass. The engine approached the fire scene from the west and was positioned at a hydrant approximately 300 feet from the fire scene on the other side of the highway overpass. The engine chauffeur had to negotiate around a police cruiser and a tow truck that were blocking the roadway. The engine's fire fighter exited from the officer's side to prepare the hydrant and pull the feeder line for a forward lay. The fire scene incident commander then radioed the engine and advised them to perform a reverse lay from the aerial truck so that the engine could pump from the hydrant. The victim then exited from the officer's seat, walked down the officer's side and positioned himself at the rear of the engine, officer's side. The victim guided the engine chauffeur as he negotiated around the police cruiser and tow truck in reverse, repositioning the engine so that it was facing away from the fire scene. The fire fighter left the hydrant and then walked over to the driver's side front bumper and positioned himself there to assist the chauffeur in backing as well. Once the engine was straightened up and backing toward the fire scene, the tow truck repositioned on the driver's side. The window, which was down on the driver's side, allowed the chauffeur to briefly look over his left shoulder and observe what the tow truck operator was doing. *Note: The chauffeur stated that he had*

maintained eye contact with the victim via the officer's side mirror until this occurred. At the same time the tow truck was being repositioned, the officer of the aerial truck observed the victim walking behind the engine at an angle toward the driver's side and looking toward the fire scene. Note: It is believed that the victim was trying to get to a better vantage point to assist the chauffeur in backing the engine and may not have realized how close he was to the engine. The officer of the ladder truck witnessed what appeared to be the victim being hit by the engine and then stumbling. As the engine continued to back up, the victim was run over by the engine.

Witnesses interviewed reported seeing the victim fall down before being backed over by the engine. *Note: The victim may have been contacted by the engine's rear step, or he may have stumbled causing him to fall, before being run over.* The chauffeur remembers looking in his driver's side mirror and seeing a police officer waving his arms in the air and shouting, "Stop, you ran over something or someone!" The chauffeur immediately stopped the engine and was directed by police to shut the engine down, apply the brake, and stay in the engine's cab. The fire fighter grabbed the wheel chocks and chocked the engine. The victim was discovered underneath the engine on the officer's side, just in front of the rear wheels. He was removed from underneath the engine by fire fighters and police officers and then transported to a local metropolitan hospital where he was pronounced dead. Witnesses also noted that the back-up alarm and lights were operating when the incident occurred.

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 ultimately led to the fatality:

- Loss of direct communication between the driver and victim.
- Driver distractions at a crucial time in the incident.
- Possible loss of footing by the victim.
- Possible failure of the automatic reverse braking system to actuate the rear brakes.

CAUSE OF DEATH

According to the county medical examiner's autopsy report, the victim died from blunt force trauma to the head, torso, and upper extremities.

RECOMMENDATIONS

Recommendation #1: Fire departments should ensure that standard operating procedures (SOPs) are developed, implemented, and enforced on safe backing of fire apparatus (e.g., visual and audio communication, use and position of spotter(s)) and include adequate training and testing methods (e.g. written and practical tests) to ensure fire fighter comprehension.

Discussion: The National Fire Protection Association (NFPA) 1500 *Standard on Fire Department Occupational Safety and Health Program* states, “The fire department shall develop standard operating procedures for safely driving fire apparatus during nonemergency travel and emergency response and shall include specific criteria for vehicle speed, crossing intersections, traversing railroad grade crossings, the use of emergency warning devices, and backing of fire apparatus.”⁴ A SOP on backing fire apparatus should include driver responsibilities (i.e., mirror adjustment and safe path of travel) and the use of a spotter(s). At least one crew member, preferably two crew members, should be positioned to assist a driver during backing operations. A spotter should be positioned at the rear of the fire apparatus on either the driver’s or officer’s side so that they are visible in the side-view mirrors. If more than one spotter is available, one can be positioned at the rear of the fire apparatus and one at the front or only at the rear, on either side of apparatus. The use of more than one spotter will assist the driver in negotiating tight spaces such as alleyways. The SOP should state that members assigned to assist in backing apparatus be in communication with the driver/operator through the use of department-approved hand signals, one-on-one communication, intercom system, or two-way radio devices. To avoid confusion, it is important to designate only one spotter to communicate with the driver.

The National Solid Waste Management Association and the Waste Equipment Technology Association released the *Manual of Recommended Safety Practices*, a comprehensive collection of safety practices for workers engaged in solid waste collection. Refuse truck operators are required to maneuver around vehicles and structures and are faced with having to routinely operate their trucks in reverse on a daily basis. This manual details procedures specific to backing safely, acting as a spotter during backing, and working around mobile equipment.⁵ The fire service could adopt these safety practices for backing fire apparatus and use this manual as a reference to develop or evaluate their own backing procedures.

Drivers need to make sure they maintain visual contact with the spotter(s) and stop backing immediately when visual contact is lost. Backing should only be resumed when visual contact is reestablished and the designated spotter gives appropriate direction to continue. It is important that the driver focuses on backing, is not distracted by dispatch traffic, and is not utilizing a cell phone or handheld radio communication device while engaged in backing maneuvers. When spotters are assisting with backing a fire apparatus they need to stay visible within the designated side-view mirrors, stay away from the driver’s blind spots, stay clear of the fire apparatus’ path of travel, avoid walking backwards, and signal the driver to stop when a person or object comes within the apparatus’ path of travel or when the spotter needs to change positions.⁶ OSHA regulations require employers to train workers to recognize and avoid unsafe conditions

that may be present in their work environments and to provide training on the regulations applicable to their work.⁷

The United States Fire Administration's (USFA) manual, Safe Operation of Fire Tankers states, "One of the most common types of crashes that can be traced to failure to follow SOPs is those that involve backing the apparatus."⁸ During this incident, the fire apparatus was backing at the same time the victim was observed walking behind the apparatus at an angle. The chauffeur was momentarily distracted by the movement of the tow truck, when this occurred. A general order on backing into a fire station had been issued in 1994¹, but a comprehensive SOP had not been developed or implemented on backing.

Recommendation #2: Fire departments should consider evaluating current safety equipment used on fire apparatus to assist drivers during backing operations and consider supplementary safety equipment (e.g., additional mirrors, automatic sensing devices, and/or video cameras) for further assistance.

Discussion: Modern technology has provided the fire service with a variety of electronic devices that can assist in improving fire apparatus and fire fighter safety. Fire apparatus are currently being equipped with additional mirrors, cameras, and apparatus-mounted sensing devices (e.g., infrared and ultrasonic) to aid in backing maneuvers. Additional mirrors mounted and angled so that blind spots are eliminated can assist the driver while backing. A rear-view camera mounted on the rear of the apparatus provides a view of the obstructed area (blind area directly behind the vehicle) on a video monitor in the cab. Sensor systems (radar or sonar systems designed as backing aids) provide an alarm in the cab when an individual or other obstacle is detected at the rear of an apparatus. A combination of a camera and a sensor system may offer the best protection, especially on a congested fireground or at a motor vehicle incident.

As in this incident, newer apparatus are being equipped with automatic sensing devices, often referred to as Backstops®, that will cause the vehicle's brakes to lock up and stop the apparatus when the device senses contact with an object.⁸ This type of device does not prevent the crash but only minimizes potential damage from striking an object. Even though these technological devices may provide an additional measure of safety, they do not substitute for visible spotters.

Recommendation #3: Fire departments should implement proper procedures for inspection, use, and maintenance of safety equipment used to assist in the backing of fire apparatus to ensure the equipment functions properly when needed.

Discussion: NFPA 1500 Standard on Fire Department Occupational Safety and Health Program states, "All fire apparatus shall be inspected at least weekly, within 24 hours after any use or repair, and prior to being placed in service or used for emergency purposes, in order to identify and correct unsafe conditions."⁴ Written policies and procedures should incorporate a preventative maintenance program that will provide information on proper inspection, maintenance, and repair of apparatus and its

equipment. This program should also provide guidance for documenting, notifying, filing, and securing maintenance checks and records, including requirements to place an apparatus out of service. Also, all operating and maintenance instructions and manuals shall be provided and maintained for those performing routine tests, inspections, and servicing functions.⁹

The apparatus involved in this incident was equipped with an after-market reverse braking system which was mounted to the rear bumper. The last documented service test was performed more than eight months prior to the fatal incident. The manufacturer recommends the system be checked daily or weekly to insure proper operation.³ The system was found to be not working when examined by New Jersey Fire Safety Division investigators during the state police commercial vehicle inspection. However, the system was not tested by the manufacturer or a third-party certification facility to verify that the device failed to actuate the rear brakes. A component for this reverse backing system needed to be replaced to allow it to operate again. *Note: It has not been determined beyond a reasonable doubt that the system failed to operate during the fatal incident or that the victim came into contact with the sensor, but these cannot be ruled out as potential contributing factors in the fatal incident.* Three other apparatus within the fire department's fleet also needed maintenance performed on their installed systems.

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INVESTIGATOR INFORMATION

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