



Volunteer Fire Fighter Struck and Killed by Backing Fire Apparatus at Rural Brush and Structure Fire – Illinois

Executive Summary

On December 2, 2012, a 45-year-old male volunteer fire fighter died when he was struck by a backing fire apparatus at the scene of a rural brush fire that had extended into a vacant structure. The victim was one-of-two fire fighters on the first-arriving fire apparatus (brush truck). The victim immediately got out of the apparatus and positioned himself behind the apparatus on the driver-side to direct the driver in backing the brush truck up a steep incline in the gravel roadway to get closer to the burning structure. The victim tripped or fell and was struck by the backing brush truck. The second due fire apparatus arrived on-scene just as the incident occurred and crew members helped with emergency medical efforts. There were a number of bystanders in the area but there were no known eye-witnesses to the incident. The incident occurred at night in a poorly-lighted rural area.



Incident scene (facing North). The victim was near the bottom of the steep incline when struck.
(Photo NIOSH)

Contributing Factors

- *Narrow un-even road surface*
- *Dark, poorly-lit conditions with fire burning behind the victim*
- *Victim was not wearing an adequate amount of hi-visibility retro-reflective clothing*
- *A flashlight or other signaling device not used*
- *Backing a manual transmission fire apparatus up a steep incline.*

Key Recommendations

- *Fire departments should ensure that standard operating procedures regarding the safe backing of fire apparatus are in place and enforced*

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- *Fire departments should ensure that all fire fighters are trained in and recognize the importance of situational awareness*
- *Fire departments should ensure apparatus operators are trained through a program compliant with NFPA 1451*
- *Fire departments should ensure that all fire fighters wear the appropriate personal protective clothing and equipment, including high visibility clothing that meets the requirements of NFPA 1500 and NFPA 1971*
- *Fire departments and authorities having jurisdiction should consider retiring and replacing fire apparatus after they have reached 25 years of age*
- *Fire departments and authorities having jurisdiction should be aware of programs that provide assistance in obtaining alternative funding, such as grant funding, to replace or purchase fire apparatus and equipment*
- *Fire departments, authorities having jurisdiction and apparatus manufacturers should consider evaluating and equipping older fire apparatus and vehicles with current safety equipment to assist drivers during backing operations (e.g., rear view video cameras, automatic sensing devices, additional mirrors, etc.).*



**Brush Truck involved in incident.
(NIOSH photo)**

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 1998, Congress appropriated funds to NIOSH to conduct a fire fighter initiative that resulted in the NIOSH “Fire Fighter Fatality Investigation and Prevention Program” which examines line-of-duty-deaths or on duty deaths of fire fighters to assist fire departments, fire fighters, the fire service and others to prevent similar fire fighter deaths in the future. The agency does not enforce compliance with State or Federal occupational safety and health standards and does not determine fault or assign blame. Participation of fire departments and individuals in NIOSH investigations is voluntary. Under its program, NIOSH investigators interview persons with knowledge of the incident who agree to be interviewed and review available records to develop a description of the conditions and circumstances leading to the death(s). Interviewees are not asked to sign sworn statements and interviews are not recorded. The agency’s reports do not name the victim, the fire department or those interviewed. The NIOSH report’s summary of the conditions and circumstances surrounding the fatality is intended to provide context to the agency’s recommendations and is not intended to be definitive for purposes of determining any claim or benefit.

For further information, visit the program website at www.cdc.gov/niosh/fire or call toll free 1-800-CDC-INFO (1-800-232-4636).



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Introduction

On December 2, 2012, a 45-year-old male volunteer fire fighter died when he was struck by a backing fire apparatus at the scene of a rural brush fire that had extended into a vacant structure. On December 4, 2012, the U.S. Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH) of this incident. NIOSH investigators with the Fire Fighter Fatality Investigation and Prevention Program contacted the fire department that was involved in this incident to arrange an investigation. On December 16, 2012, a safety engineer with the NIOSH Fire Fighter Fatality Investigation and Prevention Program traveled to Illinois to investigate this incident. The NIOSH investigator met with the fire chief, assistant chief, and the captain in charge of training. The previous fire chief was also present. Interviews were conducted with the fire department members who were involved in the incident. The NIOSH investigator met with the local county sheriff's department chief deputy who investigated the fatality and the deputy sergeant in charge of the county emergency 911 dispatch center. The NIOSH investigator visited the incident site to take photographs and measurements. The NIOSH investigator obtained copies of the fire department's standard operating procedures, training records, and vehicle information for the apparatus involved in this incident. The NIOSH investigator also obtained copies of the 911 dispatch audio, the chief deputy's case report, and the county medical examiner/coroner's certificate of death.

Fire Department

This volunteer fire department has 1 station with 22 active members which serve a population of approximately 11,000 within an area of about 50 square miles. The fire department is incorporated as a fire protection district within the state of Illinois.

The fire protection district provides fire and first responder (emergency medical services) protection to a rural farming community that includes a church, an elementary school (grades K through 8), a grain elevator and a number of small businesses. The fire protection district currently has 5 fire vehicles including a 2006 pumper with 1000 gallon tank, a 2012 tanker with a 3000 gallon tank, a 1984 box van used as a utility vehicle to carry self-contained breathing apparatus, tools, rescue equipment and related materials, a 1976 pumper (brush truck) with 500 gallon tank, and a 1999 sport-utility vehicle used for first responder medical calls. The fire protection district operates from a centrally-located station. All fire department apparatus are maintained on an as-needed basis by a local vehicle maintenance garage.

The fire department has written policies and procedures, which are made available to all department members and are also available at the station. These include a procedure for the driver of a responding unit to the location of an emergency. This procedure covers operating the vehicle in compliance with all traffic laws, enforcing seat belt use by all occupants before the vehicle is put into motion, maintaining safe control of the vehicle while in motion, and addresses safe backing. *Note: The*

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procedure states: “A firefighter will be at the rear of the vehicle and in sight of the driver to ensure safe backing.”

In order to become a member, the fire protection district requires the prospective member to be at least 18 years old and be a district resident. No prior fire service training or experience is necessary. After submitting an application and being selected, the new member would be on a 12-month probationary period during which the new member would be required to complete 24 hours of basic fire fighter training provided by the fire department. The new member would also be expected to complete first responder (basic emergency medical technician (EMT)) training. All fire department members are required to maintain current cardio-pulmonary resuscitation (CPR) and blood-borne pathogen training.

Training and Experience

The State of Illinois does not have any mandatory state training requirements for volunteer fire fighters or fire officers. It is up to each fire department or authority having jurisdiction to implement training requirements to meet their own needs. The Illinois Fire Service Institute (IFSI) coordinates a statewide training program for individuals interested in becoming a fire fighter. This program offers a 24-hour Basic Fire Fighter course as well as Fire Fighter II and Fire Fighter III certification.

The fire department does not require a person wanting to join the department to have any prior fire fighting training or experience. Persons interested in joining the fire department submit a written application that is reviewed by the fire department. All fire department members who are involved in structural firefighting operations are required to participate in monthly training and must complete a minimum of 24 hours of training each year. This training consists of the following subject areas:

- | | |
|------------------------------------------|-------------------------------------------------|
| a) Hazardous Materials - 8 Hours | b) Self Contained Breathing Apparatus - 2 Hours |
| c) Pump Operations - 2 Hours | d) Shuttle Operations - 2 Hours |
| e) Drivers Certification - 2 Hours | f) Personal Protective Equipment - 2 Hours |
| g) Blood borne Pathogens / CPR - 2 Hours | h) Extrication - 4 Hours |
| Total Training = 24 Hours | |

The fire department has a designated training officer who oversees the training program.

The victim joined the fire department in 1997 and had 15 years of fire fighting experience. Departmental records showed the victim had received training in hazardous materials awareness; weapons of mass destruction response – technical rescue awareness; hazardous materials awareness (refresher); fire fighter essentials I and II; various first responder training (pediatrics, diabetics, childbirth, etc.); environmental emergencies; understanding the dangers of meth labs; auto extrication, railway safety; IS-00100A Introduction to the Incident Management System (ICS 100); IS-00200 ICS for Single Resources and Initial Action Incidents (ICS 200); and IS-00700 National Incident Management System (NIMS). The fire department documented numerous monthly training sessions held at the department including self-contained breathing apparatus training, pump operations,

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powered hand tool operations, air bags, lights, and hose tests. The victim was medically cleared for respirator use.

Equipment and Personnel

The incident involved a 1976 model brush truck staffed by two fire fighters, one of which was the victim. The vehicle was manufactured in October 1975 for use as a fire truck. The vehicle (Brush Truck 12) was equipped with a gasoline engine, 5-speed manual transmission, 2-axles, four-wheel drive and hydraulic drum brakes. The gross vehicle weight rating (GVWR) was 24,000 pounds with the front axle rated for 7,500 pounds and the rear axle rated for 17,500 pounds. The vehicle was equipped with a 500 gallon tank and two powered 1-inch hose reels mounted at the rear (see Photo 1). The vehicle had a large blind spot behind it and the rear view mirrors provided limited visibility (see Photo 2). The truck was equipped with rear-mounted auxiliary floodlights but it is not known if they were not activated at the time of the incident (see Photo 2). The taillights would have provided minimal illumination to the rear. The truck was equipped with an audible backup alarm that automatically sounds when the truck is put into reverse.



Photo 1. Rear of Brush Truck 12. Note hose reels mounted at the back of the apparatus. The victim likely intended to pull one of these hoses to use to combat the burning structure.
(NIOSH photo)

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Photo 2. Photo of the driver side mirror on Brush Truck 12. Photo shows the narrow field of view that someone seated in the driver seat would typically see when using the driver side mirror to view the area behind and on the left side of the vehicle.

(NIOSH photo)

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The truck's rear bumper was approximately 95 inches wide and the top of the bumper was approximately 21 inches above ground level. The wheel base was approximately 13 feet, 4 inches and the total length was approximately 160 inches.

Timeline

The timeline for this incident is limited to the initial response of units to a reported brush fire on December 2, 2012, which included the brush truck involved in this incident.

- **1934 Hours**
Fire department was dispatched for a brush fire
- **1938 Hours**
Brush Truck 12 en route (driver and victim)
- **1940 Hours**
Rescue 20 en route (driver and 3 fire fighters)
- **1953 Hours**
Rescue 20 Captain (the driver) requested dispatch to page mutual aid fire department to stand by
- **1955 Hours (approximate)**
Brush Truck 12 on scene
- **1956 Hours**
Rescue 20 marked on scene (Brush Truck 12 did not mark on scene)
- **2006 Hours**
Civilian notified dispatch a fire fighter had been struck by fire apparatus

Personal Protective Equipment

At the time of the incident, the victim was wearing his structural fire fighting turnout pants over normal street clothing, rubber fire boots and a fire helmet. He was not wearing a turnout coat or self-contained breathing apparatus. *NOTE: The condition of the victim's attire was not considered to be a contributing factor to this incident. However, the victim may have been more visible to the driver had he been wearing his turnout coat or a hi-visibility retro-reflective vest. The victim's personal protective equipment and clothing were not evaluated by NIOSH.* No flashlight was found in the vicinity of the victim upon arrival of the other first responders.

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It should also be noted that in June 2009, the Federal Highway Administration (FHWA) adopted as final, an Interim Final Rule that amended its regulations to address safety concerns raised by the fire fighting community regarding high-visibility safety apparel.¹ The purpose of adopting the Interim Final Rule as final was to reflect the exemption of fire fighters from the requirement to use high-visibility safety apparel, as defined in 23 Code of Federal Regulations, Part 634, when exposed to hazardous conditions where the use of such apparel may increase the risk of injury to firefighter personnel. In other words, fire fighters who are engaged in fire fighting and other emergency response activities are not required to wear hi-visibility safety vests if the vest would interfere with the performance of their activities, such as donning a self-contained breathing apparatus or present an additional hazard, such as increased risk of burn injuries.

Weather and Road Conditions

The weather at the time of the incident (1930 hours) was cloudy with an approximate temperature of 62 degrees Fahrenheit (62°F).² The incident occurred on a narrow, unmarked, two-lane road traveling north and south within a private, recreational community that bordered a river. The terrain was wooded and steeply sloped. A number of recreational cottages and permanent residences were located within the community. The roadway surface was mainly gravel and dirt. Some parts of the roadway had been reinforced with concrete, such as to fill potholes and on areas that were steeply inclined. Brush Truck 12 was attempting to back up a steep incline at the time of the incident. The road surface changed from packed dirt and gravel to concrete near the spot where the victim was struck (see Photo 3 and Photo 4) and was reported to the NIOSH investigator to be dry when the incident occurred. Weather records indicated there had been no precipitation in the area in the past 24 hours.² The roadway at the incident location was approximately 10 feet, 4 inches wide. Both roadway shoulders consisted of earthen materials, vegetation and fallen leaves. Wooden ties were stacked along the shoulder closest to the river to provide a barrier to the steep drop off (see Photo 3). Weather and speed were not considered as factors in this incident. The road surface likely was a contributing factor.

Investigation

On December 2, 2012, a 45-year-old male volunteer fire fighter died when he was struck by a backing fire apparatus at the scene of a rural brush fire that had extended into a vacant structure. At 1934 hours, the local fire protection district was dispatched to a brush fire in a rural area about 6 miles to the northeast. Volunteer fire fighters immediately reported to the station. Brush Truck 12 went en route at 1938 hours with a captain (the driver) and a fire fighter (the victim) onboard. At 1940 hours, Rescue 20 went en route with a captain (the driver) and three fire fighters onboard. Several minutes later, Pumper 17 went en route with the Fire Chief (the driver) and a fire fighter onboard. A number of fire fighters responded to the scene in their privately-owned vehicles (POV).

The fire was located in a rural area that bordered the west side of a river that flowed south. The area included a private community that was home to a number of camping lots, recreational cottages and permanent residents. The recreational cottages were locally referred to as “clubhouses”. Access to the community was via a two-lane asphalt-paved county road. The streets within the community were

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narrow, winding, and poorly illuminated at night. The road surface was mainly gravel and packed earth with a few spots reinforced with concrete, such as on steeply sloped inclines and over some potholes. The responding fire fighters were familiar with the area and the drivers chose to access the area on a road that they felt provided the easiest access for the fire department vehicles. While en route, the captain on Rescue 20 radioed dispatch and requested that a mutual aid volunteer fire department be placed on stand-by.

Brush Truck 12 arrived on-scene at approximately 1955 hours. They observed that the brush fire had spread into a vacant clubhouse that was now fully involved. Dispatch was notified that a structure was involved and now on fire. Brush Truck 12 and Rescue 20 approached the scene from west to east. The brush fire and the burning clubhouse were located south of the roadway and at the top of a steep hillside (see Photo 3 and Photo 4). An intersection of two roads was located approximately 200 feet below the burning clubhouse. Brush Truck 12 turned left into the intersection and then began backing toward the burning structure. The victim dismounted from the vehicle to guide the driver in backing the vehicle up a steep incline in the road (see Photo 5). Brush Truck 12 backed through the intersection over a distance of approximately 70 feet at the point where the road sharply narrowed in width and began to slope uphill to where the fire was burning.

A number of bystanders had gathered around the intersection as Brush Truck 12 arrived. As the brush truck was backing across the intersection, bystanders began yelling for the driver to “cut it”. The driver stopped, pulled forward and began backing again. For an unknown reason, the victim, who was positioned behind the brush truck, either slipped or fell in the roadway and was struck by the backing brush truck. It is possible that the victim could have been distracted by the yelling of the bystanders or by the fire burning close behind him. *Note: There were no known eye-witnesses to the fire fighter being struck and the driver was not available to be interviewed for this investigation. Civilian bystanders reported hearing a sound that some thought was the apparatus hitting the railroad ties.*

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Photo 3. Incident scene looking north. Note the remains of the structure that burned (just visible at the left) and its close proximity to the roadway.
(NIOSH photo)

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Photo 4. Incident scene facing south. Brush Truck 12 approached the scene from the west (right side of photo), turned left and was attempting to back up the inclined road seen in the background. The remains of the structure that burned can be seen at the top of the hill on the right side of the road. Also note the wooden ties placed along the roadway edge, to protect against driving off the road and going over a steep embankment, visible on the left side of the photo.

(NIOSH photo.)

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Photo 5 . Incident scene looking north. Note the steeply sloping hillside and the river which can be seen at the upper right corner. Also note the wooden ties placed along the roadway edge as a barrier to driving off the road. Approximate location where the fire fighter was struck is noted. The on-scene ambulance was staged further up this hill.
(NIOSH photo)

Rescue 20 arrived on scene as Brush Truck 12 was beginning to back up the incline. When the fire fighters on Rescue 20 dismounted their vehicle, they immediately observed a commotion among the bystanders and they quickly realized that a fire fighter had been struck. Fire fighters on scene immediately began providing medical attention to the victim who was lying in the road a few feet behind Brush Truck 12. No flashlight was found in the vicinity of the victim.

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At approximately 2006 hours, a civilian bystander called 911 and reported that a fire fighter had been struck by a fire truck. Per the county's standard operating procedures, an ambulance had already been dispatched and was on-scene, staged at the top of the hill a short distance from the fire. The ambulance was quickly summoned to proceed to the intersection where the victim was located. *Note: As good safety practice, all fire departments are encouraged to dispatch a dedicated EMS ambulance and have it staged and ready for service at all structure fires.*

Fire fighters placed the victim onto a backboard and then loaded him into the ambulance for transport to the local hospital. The victim was pronounced dead upon arrival at the hospital. Responding mutual aid departments quickly brought the fire under control after the victim was transported.

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:

- Narrow un-even road surface
- Dark, poorly-lit conditions with fire burning behind the victim
- Victim was not wearing an adequate amount of hi-visibility retro-reflective clothing
- A flashlight or other signaling device not used
- Backing a manual transmission fire apparatus up a steep incline.

Cause of Death

According to the death certificate, the medical examiner listed the victim's cause of death as crushing injuries to the pelvis, abdomen and chest due to or the consequences of a fire apparatus backing over the victim.

Recommendations

Recommendation #1: Fire departments should ensure that standard operating procedures regarding the safe backing of fire apparatus are in place and enforced.

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."³ An 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

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apparatus on either the driver's or officer's side so that they are visible in the side rear-view mirrors. If more than one spotter is available, one can be positioned at each end of the fire apparatus or both positioned at the rear, on either side of the 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.**

NFPA 1451 *Standard for a Fire and Emergency Services Vehicle Operations Training Program* (2013 editions), Chapter 8.2.8 states that driver / operators shall be trained in how to adjust mirrors to provide the optimal field of vision and work with a partner to identify the remaining blind spots. These procedures should be following so that mirrors are properly adjusted at the beginning of each shift or before operating the apparatus.⁴ In addition, NFPA 1002 *Standard for Fire Apparatus Driver/Operator Professional Qualifications* (2009 edition), chapter 4.3.1(B); 4.3.3 and 4.3.4 all provide job performance requirements for mirror adjustment, backing skills and the use of spotters.⁵

The International Association of Fire Chiefs (IAFC) *Guide to IAFC Model Policies and Procedures For Emergency Vehicle Safety* document provides guidance intended to help fire departments in developing the basic policies and procedures required to support the safe and effective operation of all fire and emergency vehicles; this includes fire apparatus, rescue vehicles, ambulances, command and support units, privately owned vehicles (POVs), and any other vehicles operated by fire department members in the performance of their duties.⁶ This document covers the backing of fire apparatus and the use of spotters. Page 12 states "The spotter(s) shall be on the ground, to the rear of the vehicle, and shall remain visible to the driver at all times. **If the driver loses sight of the spotter(s) at any time, the driver shall immediately stop the vehicle.**" This document also contains the following information related to nighttime backing operations – "**The spotter will ensure that the spotlights on rear of apparatus are turned on before allowing apparatus to be backed.** A flashlight may be carried, but at no time will it be directed toward the mirror."

In this incident, the first arriving apparatus carried a crew of two fire fighters. The victim exited the fire apparatus to aid the driver in backing the apparatus up a steep incline in the roadway so that they could begin fire suppression operations where the brush fire had spread into a structure. For unknown reasons, the victim was struck by the backing apparatus. The Fire Department's suggested procedures manual included a procedure for backing fire apparatus which states: "A firefighter will be at the rear of the vehicle and in sight of the driver to ensure safe backing. The driver will have on visual warning lights while backing." **Fire fighters acting as spotters should be trained to maintain visual contact with the driver/operator at all times. If the driver loses visual contact with the spotter, the driver should immediately stop the vehicle until it can be confirmed with the spotter that it is safe to resume backing.** This incident occurred at night. The dark conditions and the fire burning above and behind the backing apparatus may have contributed to the poor visibility. It is possible that the victim and/or the driver could have been distracted by the yelling of the bystanders or by the fire burning

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close behind him. No flashlight was found in the vicinity of the victim upon arrival of the other first responders.

Recommendation #2: Fire departments should ensure that all fire fighters are trained in and recognize the importance of situational awareness.

Discussion: The book *Essentials of Fire Fighting and Fire Department Operations* defines situational awareness as an awareness of the immediate surroundings.² On the fireground, every fire fighter should be trained to be constantly alert for changing and unsafe conditions. This applies not only to the conditions found within a burning structure, but to the exterior fireground as well. Fire fighters may encounter a wide variety of surface features that they must walk across while performing fireground tasks. For example, surfaces may be wet, slippery, ice-covered, uneven, and may be vegetation-covered or include debris from the burning structure. Such surfaces present the possibility of slipping and tripping hazards that the fire fighter should not overlook. Additionally, backing a manual transmission vehicle such as the brush truck involved in this incident can be a difficult task. To keep the engine from stalling while slowly backing uphill, the driver has to increase the engine speed, but too much engine speed can affect the vehicle's traction on the steep surface. This requires the driver to increase attention to the operation of the vehicle, which would decrease the driver's ability to focus on situational awareness.

In this incident, the victim was engaged in helping the apparatus driver back the vehicle into position to begin fire suppression operations. The incident occurred on a narrow dirt and gravel roadway at the point where the road grade changed from nearly level to a steep uphill incline. The incline was partially covered with concrete and the change in surface may have presented a tripping hazard. The area was poorly lighted and the incident occurred after dark. A near-vertical drop-off was located just east of the roadway and wooden railroad ties were stacked along the road edge to prevent a vehicle from driving off the edge of the road and going over the drop-off. It was reported that a number of bystanders were yelling "cut it" as the fire apparatus began to back up, which could have distracted both the victim and driver.

Recommendation #3: Fire departments should ensure that all fire fighters wear the appropriate personal protective clothing and equipment, including high visibility clothing that meets the requirements of NFPA 1500 and NFPA 1971.

Discussion: The need to wear personal protective equipment that includes hi-visibility retro-reflective, striping and trim arises from the fact that personnel need to be highly visible while engaged in fire fighting and emergency operations. Serving as a spotter to aid a backing vehicle, directing or blocking traffic near an incident scene, and other roadside duties are examples where hi-visibility protective clothing enhances the safety of the fire fighter by making the wearer more visible to others in the area. Fire department personnel should wear the appropriate clothing that is referenced in the fire departments SOG's and if relevant, required by state laws. Additionally, the fire department should provide each member with the appropriate protective clothing and protective equipment to provide

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protection from the hazards to which the member is or is likely to be exposed. Such protective clothing and protective equipment shall be suitable for the tasks that the member is expected to perform.³ All emergency responders who are not involved in fire suppression activities should be wearing ANSI approved high visibility garments when working near moving traffic or vehicles.

NFPA 1971 *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, 2013 Edition, Chapter 6.2, “Additional Design Requirements for Structural Fire Fighting Protective Garments Elements Only”, specifies the requirements for hi-visibility reflective and retro-reflective striping and trim that must be located on the outside of turnout clothing including turnout pants and coats.⁸ This section includes examples of different options for reflective trim location intended to make the wearer as visible as possible in low-visibility situations. This section indicates that the only required reflective trim on the turnout pants be located around the bottom of the pant legs while the turnout coat is required to have a significantly larger amount of reflective trim.

In this incident, the victim was reported to be wearing his structural fire fighting turnout pants over normal street clothing, rubber fire boots and a fire helmet. The incident occurred after dark. The use of a turnout coat or a hi-visibility vest would have provided the victim with additional hi-visibility retro-reflective striping and trim, which would have made the victim more visible to the driver. The use of a flashlight or other signaling device could have also helped to increase his visibility.

To meet minimum requirements for high visibility apparel, responders should only use vests that meet a Class II requirement of ANSI/ISEA 107-2010 (or subsequent revisions) or the requirements of ANSI/ISEA 207-2006 for Public Safety Vests. These minimum requirements include 1) use of fluorescent background material, 2) the fluorescent material may be yellow-green, orange-red, or red, 3) retro-reflective material arranged for 360 degree visibility, and 4) the garments should be labeled as compliant with ANSI/ISEA 107-2010 or ANSI/ISEA 207-2006. *Federal Regulation 23 CFR 634* states, “The purpose of the regulations in this part is to decrease the likelihood of worker fatalities or injuries caused by motor vehicles while working within the right-of-way on Federal-aid highways.” NFPA 1500, Chapter 8.7.10 states, “When members are operating at a traffic incident and their assignment places them in potential conflict with motor vehicle traffic, they shall wear a garment with fluorescent and retro-reflective material visible from all directions.”³ All responders who are not involved in fire suppression activities should be wearing ANSI compliant high visibility garments when working near moving traffic and don the retro-reflective vests during scene clean-up following extinguishment.

It should also be noted that in June 2009, the Federal Highway Administration (FHWA) adopted as final, an Interim Final Rule that amended its regulations to address safety concerns raised by the fire fighting community regarding high-visibility safety apparel.¹ The purpose of adopting the Interim Final Rule as final was to reflect the exemption of fire fighters from the requirement to use high-visibility safety apparel, as defined in 23 Code of Federal Regulations, Part 634, when exposed to hazardous conditions where the use of such apparel may increase the risk of injury to firefighter personnel. In other words, fire fighters who are engaged in fire fighting and other emergency response

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activities are not required to wear hi-visibility safety vests, if the vest would interfere with the performance of their activities, such as donning a self-contained breathing apparatus or present an additional hazard, such as increased risk of burn injuries.

Recommendation #4: Fire departments and authorities having jurisdiction should consider retiring and replacing fire apparatus after they have reached 25 years of age.

In addition it is recommended that apparatus manufactured prior to 1991 that are less than 25 years old, that have been properly maintained, and that are still in serviceable condition should be placed in reserve status and upgraded to incorporate as many features as possible of the post-1991 fire apparatus edition.

Discussion: In this incident, the fire apparatus was manufactured in 1976, making it over 36 years old. With the department's low call volume (30-40 incidents per year), the truck was in good condition but due to its age, lacked a number of modern features such as power steering, automatic transmission, enhanced lighting and backup sensor capability.

To maximize fire fighter safety as well as the safety of the traveling public, it is important that fire apparatus be equipped with the latest safety features and operating capabilities. In the last 10 to 15 years, much progress has been made in upgrading the safety features and capabilities of fire apparatus. Significant improvements involving fire fighter safety of fire apparatus have been the standard since 1991, and fire departments should consider the value (or risk) to fire fighters of keeping pre-1991 fire apparatus in first-line service. Apparatus manufactured prior to 1991 usually only included a few of the safety upgrades required by recent editions of the NFPA fire department apparatus standards.⁹

It is a generally accepted fact that fire apparatus, like all types of mechanical devices, have a finite life. The length of that life depends on many factors, including vehicle mileage and engine hours, quality of the preventive maintenance program, quality of the driver training program, whether the fire apparatus was used within the design parameters, whether the apparatus was manufactured on a custom or commercial chassis, quality of workmanship by the original manufacturer, quality of the components used, and the availability of replacement parts, to name a few.¹⁰ NFPA 1901 *Standard for Automotive Fire Apparatus* and NFPA 1906 *Standard for Wildland Fire Apparatus* both contain language recommending that fire apparatus over 25 years old should be retired from service and replaced with newer models.^{11,12}

Additionally, backing a manual transmission vehicle such as the brush truck involved in this incident can be a difficult task. To keep the engine from stalling, the driver has to increase the engine speed, too much engine speed can affect the vehicle's traction on the steep surface. In some cases, the driver may have to keep one foot on the gas throttle while using the other to slip the clutch. More modern fire apparatus with automatic transmissions should be easier to operate under the same conditions.

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Recommendation #5: Fire departments should be aware of programs that provide assistance in obtaining alternative funding, such as grant funding, to replace or purchase fire apparatus and equipment.

Discussion: While it is important that fire departments seek constant improvements and upgrades to their fire apparatus and equipment, some departments may not have the resources or programs to replace or upgrade their apparatus and equipment as often as they should. Alternative funding sources, such as federal grants, are available to purchase fire apparatus and equipment. Additionally, there are organizations that can assist fire departments in researching, requesting, and writing grant applications.

Useful resources related to equipment include:

Federal Emergency Management Agency (FEMA), Assistance to Firefighters Grant (AFG) Program

<http://www.fema.gov/assistance-firefighters-grant>

The primary goal of the Assistance to Fire Fighters Grant (AFG) Program is to provide critically needed resources such as emergency vehicles and apparatus, equipment, protective gear, training for responders, and other needs to help fire departments protect the public and emergency workers from fire and related hazards. FEMA grants are awarded to fire departments to enhance their ability to protect the public and fire service personnel from fire and related hazards. The Grant Programs Directorate of FEMA administers the grants in cooperation with the United States Fire Administration. This Web site offers resources to help fire departments prepare and submit grant requests.

National Volunteer Fire Council (NVFC), Grants & Funding

<http://www.nvfc.org/training-education/courses/grants-and-funding-training>

The NVFC provides an online resource center to assist departments applying for various types of fire grants, including narratives from successful past grant applications and a listing of federal grant and funding opportunities.

FireGrantsHelp.com

www.firegrantshelp.com

A nongovernmental group, FireGrantsHelp's mission is to provide firefighters and departments with a comprehensive resource for grant information and assistance. FireGrantsHelp.com provides an extensive database of information on federal, state, local, and corporate grant opportunities for first responders.

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Additional resources related to staffing and training include:

FEMA, Staffing for Adequate Fire and Emergency Response (SAFER) Grants

www.firegrantsupport.com/safer/

SAFER grants provide funding directly to fire departments and volunteer firefighter interest organizations to help them increase the number of trained, front-line fire fighters in their communities and to enhance the local fire departments' abilities to comply with staffing, response, and operational standards established by NFPA and the Occupational Safety and Health Administration.

National Fire Protection Association (NFPA), Safer Act Grant

www.nfpa.org/SAFERActGrant

NFPA provides excerpts from NFPA 1710 and NFPA 1720 and other online resources to assist fire departments with the grant application process.

Federal Excess Personal Property Program

www.fs.fed.us/fire/partners/fepp

The Federal Excess Personal Property Program is administered by the US Forest Service. This program refers to Forest Service-owned property that is on loan to State Foresters for the purpose of wildland and rural fire fighting. Most of the property originally belonged to the US Department of Defense. Once acquired by the Forest Service, property is loaned to State Coordinators for fire fighting purposes. State Foresters may place property with local fire departments to improve local fire programs.

Department of Defense Firefighter Program

<http://www.fs.fed.us/fire/partners/fepp/DODprogram/index.html>

In cooperation with the US Forest Service, excess Department of Defense equipment is made available for wildland and rural fire fighting purposes through the Federal Excess Personal Property Program.

Rural & Volunteer Fire Assistance

<http://www.fs.fed.us/fire/partners/vfa/>

The US Forest Service, Volunteer Fire Assistance Program (VFA), formerly known as the Rural Community Fire Protection Program (RCFPP) can provide Federal financial, technical, and other assistance to State Foresters and other appropriate officials to organize, train, and equip fire departments in rural areas and rural communities to suppress fires. A rural community is defined as having 10,000 or less population.

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Recommendation #6: Fire departments, authorities having jurisdiction and apparatus manufacturers should consider evaluating and equipping older fire apparatus and vehicles with current safety equipment to assist drivers during backing operations (e.g., rear view video cameras, automatic sensing devices, additional mirrors, etc.).

Discussion: Modern technology has provided motor vehicles with a variety of electronic devices that can assist in safe backing, parking and general maneuvering. These technologies can be added to fire apparatus to aid in improving fire fighter and fire apparatus 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 reduced or 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.¹⁰ Even though these technological devices may provide an additional measure of safety, **they do not substitute for visible spotters**. NFPA 1901 Annex D and NFPA 1906 Annex D both contain guidelines to assist fire departments and authorities having jurisdiction with the determination of how to properly equip older fire apparatus with safety equipment to assist drivers during backing operations.^{11,12}

Recommendation #7: Fire departments should ensure that a complete situational size-up is conducted on all structure fires.

Discussion: Although there is no evidence that the following recommendation would have prevented this fatality, it is being provided as a reminder of a good safety practice. Among the most important duties of the first officer on the scene is conducting an initial 360 degree situational size-up of the incident. A proper size-up begins from the moment the alarm is received, and it continues until the fire is brought under control either offensively or defensively. The size-up should include an evaluation of factors such as the following:

- Location and volume of the fire
- Required fire flow
- Building construction
- Commercial versus residential structure
- Water supply
- Length of time the fire has been burning, recognizing burn time may have affected structural stability
- Conditions on arrival
- Occupancy
- Fuel load

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- Presence of combustible or hazardous materials
- Exposures
- Roof and wall loads
- Time of day
- Available staffing on scene or en route
- Weather conditions
- A realistic evaluation of the ability to conduct an offensive attack with available resources.¹³

Even before the IC takes command of an incident he will be faced with having to determine what critical tasks must be performed to bring the incident under control, and whether he can handle delegating these tasks before becoming overwhelmed.

The incident scene size-up must be viewed as a 2-part process: 1) determining the conditions of the incident scene, and 2) determining whether the fire department has on scene, has in route, or is in need of additional resources to address the challenge presented by what has been identified during the first part of the size-up process.

In this incident, the first arriving crew immediately began to position the brush truck to put a hand line into operation on the burning structure. A 360 degree size-up was not performed. Taking the time to size up the incident scene could have led to considerations for alternate strategies for attacking the fire (such as driving straight up the hill, instead of backing), alternate routes to access the structure, deciding if the brush truck was the proper vehicle to initiate fire suppression activities, and may have resulted in a different outcome.

Fire departments should be aware of the 2010 International Association of Fire Chiefs' (IAFC) Rules of Engagement (ROE) of Structural Firefighting.¹⁴ These guidelines recommend that ICs conduct or obtain a 360-degree situational incident size-up, determine the occupant survival profile, and conduct an initial risk assessment.

Recommendation #8: Fire departments should ensure that all fire apparatus driver / operators are trained by a program compliant with NFPA 1451 Standard for a Fire and Emergency Services Vehicle Operations Training Program and achieve certification to NFPA 1002 Standard for Fire Apparatus Driver / Operator Professional Qualifications.

Discussion: This recommendation is being offered as a recommended best safety practice for the fire service. The purposes of both NFPA 1451 *Standard for a Fire and Emergency Services Vehicle Operations Training Program* and NFPA 1002 *Standard for Fire Apparatus Driver / Operator Professional Qualifications* are to ensure that persons who drive and operate fire apparatus are properly trained and qualified.^{4,5}

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Recommendation #9: Authorities having jurisdiction such as the National Fire Protection Association Technical Committee on Fire Service Training should consider including the role and responsibilities of the vehicle spotter along with the role and responsibilities of the apparatus driver / operator in relevant NFPA standards when a spotter is deployed.

Discussion: As noted in previous recommendations and discussion text, various NFPA standards identify the need for a spotter during fire apparatus backing procedures. Current NFPA standards do not address the role and responsibilities of the spotter in the same detail that the role and responsibilities of the driver / operator are defined. The NFPA and other authorities having jurisdiction who are responsible for developing and enforcing backing procedures should adequately address spotter roles and responsibilities.

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Investigator Information

This incident was investigated by Timothy R. Merinar, Safety Engineer and Project Officer, with the Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH located in Morgantown, WV. An expert technical review was provided by Chief Kevin D. Quinn representing the National Volunteer Fire Council. A technical review was also provided by the National Fire Protection Association, Public Fire Protection Division.

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Additional Information

Emergency Responder Safety Institute

The Emergency Responder Safety Institute (ERSI) serves as an advisory group of public safety leaders and transportation experts committed to reducing deaths and injuries to America's emergency responders. Every day, our nation's firefighters, EMTs/paramedics, state troopers, police officers, sheriff's deputies, tow operators, and departments of transportation responders are exposed to the grave hazards inherent in emergency responses on the nation's highways and roadways. ERSI is dedicated to the safety of these men and women by engaging in and promoting activities that include developing educational material to support responder safety training; promoting the National Unified Goal (NUG) for Traffic Incident Management (TIM) including responder safety; safe, quick clearance and interoperable communications; encouraging the development of TIM Teams, promoting collaboration, communication and cooperation among the nation's emergency responders and keeping emergency responders up to date on national rules, regulations and trends related to safe roadway incident operations. <http://www.respondersafety.com/default.aspx>.

Be Right Be Bright is a training video showing the safety benefit of wearing hi-visibility clothing while working along roadways. This video can be found on the Emergency Responder Safety Institute website: <http://www.respondersafety.com/BeRightBeBright.aspx>.

International Association of Fire Chiefs, *Guide to IAFC Model Policies and Procedures For Emergency Vehicle Safety*

This document provides guidance for developing the basic policies and procedures required to support the safe and effective operation of all fire and emergency vehicles; this includes fire apparatus, rescue vehicles, ambulances, command and support units, privately owned vehicles (POVs), and any other vehicles operated by fire department members in the performance of their duties.

International Association of Fire Chiefs, *Rules of Engagement for Firefighter Survival*

The International Association of Fire Chiefs (IAFC) is committed to reducing firefighter fatalities and injuries. As part of that effort the nearly 1,000 member Safety, Health and Survival Section of the IAFC has developed DRAFT "Rules of Engagement for Structural Firefighting" to provide guidance to individual firefighters, and incident commanders, regarding risk and safety issues when operating on the fireground. The intent is to provide a set of "model procedures" for Rules of Engagement for Structural Firefighting to be made available by the IAFC to fire departments as a guide for their own standard operating procedure development.

http://www.iafcsafety.org/downloads/Rules_of_Engagement.pdf

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Emergency Vehicle and Roadway Scene Safety

The International Association of Fire Fighters, Division of Occupational Health, Safety & Medicine in conjunction with the U.S. Department of Homeland Security, United States Fire Administration developed an on-line training module to help ensure that fire fighters have a greater awareness of the issues affecting fire fighter safety relative to riding on fire apparatus and operating at roadway emergency scenes. The fire fighter will also understand basic strategies for improving safety during vehicle and roadway incident operations.

<http://www.iaff.org/hs/evsp/PowerPoint%20Presentation%20in%20PDF.pdf>

Vehicle Backing Safety Fact Sheet

The Texas Department of Insurance, Division of Workers' Compensation (TDI, DWC) in conjunction with the National Safety Council, developed a vehicle backing safety fact sheet. The use of safe vehicle backing tips by employers and employees can help prevent accidents while on the job. This fact sheet provides a number of recommendations for safely backing a vehicle, including a walk-around, use of spotters, the installation of rear-vision cameras and the need to practice safely backing a vehicle.

<http://www.tdi.texas.gov/pubs/videoresource/fsvehiclebackin.pdf>

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