



Volunteer Fire Department Probationary Member Is Killed After the Pumper/Tanker He Was Operating Leaves the Roadway and Overturns—Alabama

Executive Summary

On October 17, 2013, a 28-year-old male volunteer probationary member lost his life after the pumper/tanker he was operating left the roadway and overturned. The probationary member called 9-1-1 to report a structure fire in another house behind his residence. He donned his structural firefighting gear and waited for his department to arrive at the fire. After making an initial fire attack with other fire fighters, he left the hoseline and went to his department's engine to change the bottle of his self-contained breathing apparatus (SCBA). The pump operator stated she didn't know where spare bottles were on that apparatus. While still wearing his structural firefighting gear, he left the incident scene in his personal vehicle and responded to his department's nearby substation. He left the substation driving Engine 2, a 2,500-gallon pumper/tanker. While returning to the incident scene, Engine 2 left the roadway in a curve and overturned. The probationary member received fatal injuries during the rollover and was pronounced dead on the scene. He was not wearing a seat belt.



View of incident scene.

(Photo courtesy of insurance company.)

Contributing Factors

- No department- or state-required driver training program
- Inexperienced driver
- Not wearing a seat belt
- Driving or entering a curve at a speed not negotiable for a large vehicle such as a pumper/tanker
- Exiting a curve on a narrow roadway with a minimal shoulder
- Vehicle overturned
- Incident management system not implemented at the fire scene

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Key Recommendations

- *Fire departments and authorities having jurisdiction should ensure that all drivers complete a comprehensive driver training program, such as NFPA 1451 Standard for a Fire and Emergency Services Vehicle Operations Training Program, and NFPA 1002 Standard for Fire Apparatus Driver/Operator Professional Qualifications before allowing a member to operate a fire department apparatus.*
- *Fire departments should ensure that department drivers/operators are trained in the unique characteristics of driving a tanker and maintaining control.*
- *Fire departments should ensure that seat belts are properly worn at all times by apparatus drivers and occupants.*



Another view of the incident scene.
(Photo courtesy of the insurance company.)

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 Web site at www.cdc.gov/niosh/fire or call toll free 1-800-CDC-INFO (1-800-232-4636).



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Introduction

On October 17, 2013, a 28-year-old male volunteer probationary member lost his life after the pumper/tanker he was operating left the roadway and overturned. On October 18, 2013, the U.S. Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH) of this incident. On November 10–15, 2013, a safety and occupational health specialist from the NIOSH Fire Fighter Fatality Investigation and Prevention Program traveled to Alabama to investigate this incident. The NIOSH investigator interviewed the fire chief and fire department members involved with the incident. The investigator also spoke with local and state law enforcement agencies that investigated and reconstructed the crash. The NIOSH investigator spoke with representatives from the fire department's insurance carrier.

The NIOSH investigator drove through, photographed, and documented the vehicle incident scene and the initial fire scene. The NIOSH investigator also documented and photographed personal protective equipment (PPE) similar to that worn by the victim. The NIOSH investigator reviewed available dispatch radio transcripts, the state uniform traffic crash report, vehicle maintenance records and specifications, and available standard operating guidelines (SOGs) of the fire department. The NIOSH investigator documented and photographed the pumper/tanker at a local salvage yard.

Fire Department

At the time of this incident, this rural volunteer fire department operated out of two stations with 16 active members serving a population of approximately 700 within an area of about 70 square miles. The department had an engine, a pumper/tanker (Engine 2), two rescue trucks, and two support apparatus. This department responds to approximately 100 calls a year.

At the time of the NIOSH investigation, the fire department had established SOGs. However, these SOGs were limited to day-to-day administrative operations and did not provide any guidance for seat belt use, vehicle operation, or driver training. The department had a verbal policy requiring all drivers and occupants to wear a seat belt in department apparatus when in motion. SOG #8 stated, "Members must have a CDL [commercial driver's license] or EVOC [emergency vehicle operator's course] to drive a truck."¹ The NIOSH investigator determined that the department was unable to implement SOG #8 since the last EVOC in the area had been in January 2013.

Training and Experience

The probationary member had been with this department for approximately 90 days and was scheduled to be voted in as a full member at the next business meeting. He had no prior fire service or EVOC certifications or training. He had been allowed to operate the tanker three–five times prior to the

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incident, under the supervision of the fire chief, but had not responded with lights and sirens. It appeared that during this incident, he decided to leave the fire scene on his own initiative to retrieve Engine 2.

Neither the fire department nor the state fire college required a volunteer fire department member to take an official driver training program or certification course. However, the state fire college does offer apparatus driver courses throughout the year. At this department, the fire chief would ride with a new driver until they both felt comfortable in the ability of the driver to control and operate the apparatus safely. No formal written SOG or driver training program had been developed or implemented.

Equipment and Personnel

Engine 2 was a 2009, tandem axle, 2-door cab pumper/tanker with a GVWR of 54,600 pounds, 3 axles, 10 wheels, a 1,250-gallon-per-minute pump, and a 2,500-gallon tank (see Photo 1). According to the specifications manual, Engine 2 was built according to NFPA 1901 *Standard for Automotive Fire Apparatus*, 2009 edition. The apparatus tires were in good condition. In 2009, the victim's department had purchased Engine 2 new from a local fire apparatus distributor. The engine was diesel powered, with a 5-speed automatic push-button control transmission and air brakes. It was also outfitted with an exhaust brake. Engine 2 had a 240-inch wheel base, with a front axle rating of 14,600 pounds and a tandem rear axle rating of 40,000 pounds. The cab was constructed of steel and independently mounted to the chassis on rubber mounting points (see Photo 2).

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**Photo 1. Engine 2 after being delivered to the salvage center.
(NIOSH photo.)**

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**Photo 2. Damage sustained by the cab of Engine 2 during the rollover.
(NIOSH photo.)**

The water tank was a T-shaped “wet-side” design meaning the tank had no protective walls and appeared as part of the apparatus body. The tank had a ½-inch-thick floor and ¾-inch sidewalls and top. The interior baffles were ½-inch thick. The tank was constructed with non-corrosive stress-relieved thermoplastic. The transverse and longitudinal swash partitions were manufactured with polypropylene materials with all partitions equipped with vent and air holes to permit movement of air and water between compartments (see Photo 3). The partitions interlocked with one another and were welded to each other as well as to the walls and floor of the tank (see Photo 4). The tank was then mounted to the apparatus with a heavy duty rubber cushion between the tank subframe and the tank. Additionally, a raised hose bed constructed of poly-type material was mounted on top of the water tank and contained 1,500 feet of 5-inch supply hose.

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Photo 3. Aerial view looking down on the transverse and longitudinal swash partitions and vent/air holes.
(NIOSH photo.)

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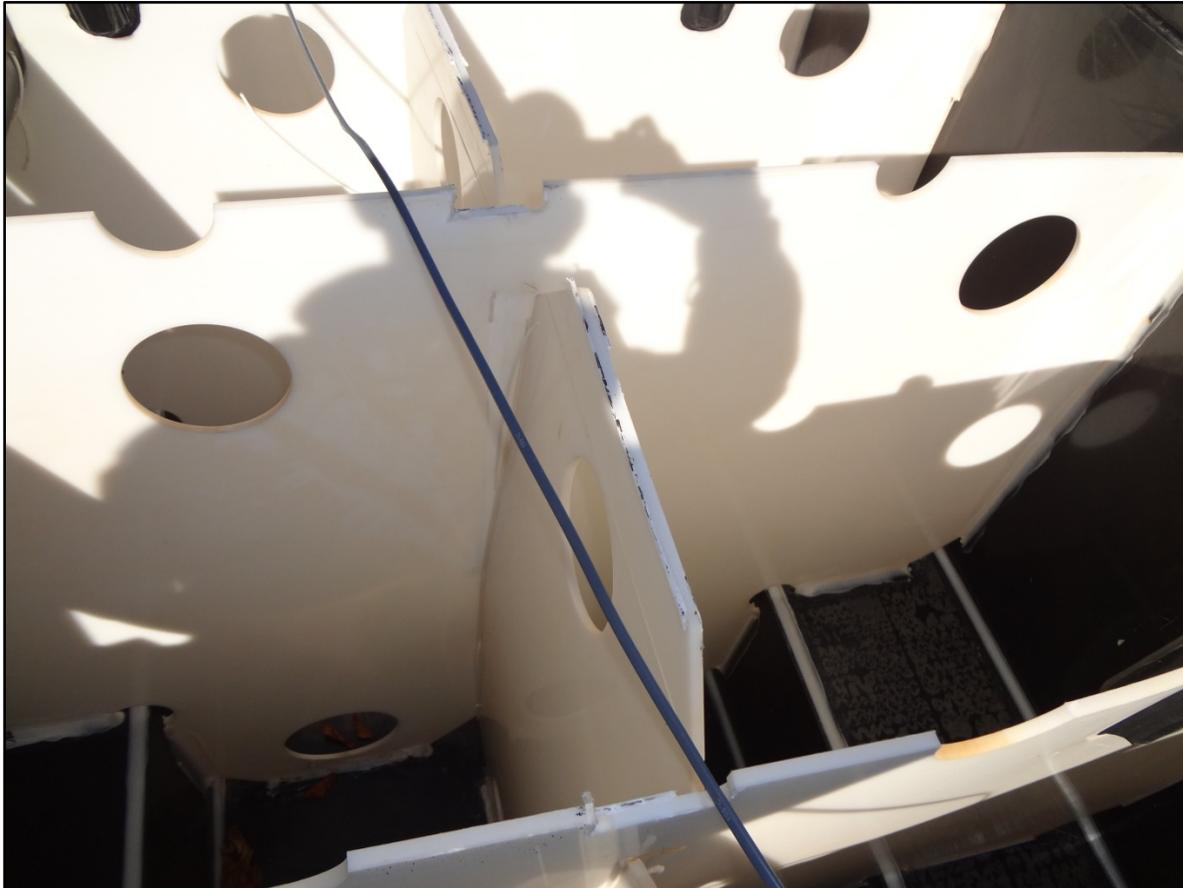


Photo 4. Aerial view looking down on the T-shaped tank showing how the swash partitions connected.
(NIOSH photo.)

Timeline

This timeline is provided to set out, to the extent possible, the sequence of events according to recorded radio transmissions. Times are approximate and were obtained from review of the dispatch records, witness interviews, and other available information. Times have been rounded to the nearest minute. This timeline is not intended, nor should it be used, as a formal record of events.

- **1409 Hours**
The probationary member called 9-1-1 to report a structure fire behind his house.
- **1411 Hours**
The probationary member requested dispatch to notify the fire marshal of the structure fire.
- **1412 Hours**
Engine 1 from the probationary member's department marked en route.

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Mutual aid department dispatched to assist with structure fire.

- **1414 Hours**

Mutual aid department marks en route to structure fire.

- **1420 Hours**

Engine 1 arrived on scene at the structure fire.

- **1433 Hours**

Mutual aid department arrived on scene at the structure fire.

Note: Following their arrival, the mutual aid fire fighters reported seeing the victim leaving his residence in his personal vehicle.

- **1437 Hours**

The probationary member en route to scene in Engine 2.

- **1439 Hours**

9-1-1 center received a call for a fire truck crash.

Dispatch contacted units on scene at the structure fire to confirm if there had been a crash involving a fire truck.

- **1440 Hours**

Mutual aid department dispatched for a wreck with entrapment.

Mutual aid unit at structure fire responded to the reported fire truck incident.

- **1444 Hours**

Mutual aid department and ambulance arrived on scene of vehicle incident and confirmed the death of the member.

Personal Protective Equipment

The fire chief and personnel from his department reported to the NIOSH investigator that the probationary member was wearing his issued structural firefighting coat, pants, and fire boots (see Photo 5) when he left the fire scene in his personal vehicle. According to the fire chief, he was still wearing these items when he was discovered at the rollover incident. The NIOSH investigator was not able to inspect the personal protective equipment worn that day.

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Photo 5. Similar set of boots that were worn by the member.
(NIOSH photo.)

Weather and Road Conditions

On the day of the incident, the probationary member was traveling east on a two-lane, paved asphalt state roadway with a posted speed limit of 45 mph (see Photo 6). The incident occurred as he was exiting a left curve on this roadway (see Photo 7). Engine 2's right front wheel exited the paved road onto the narrow soft shoulder before continuing into a downward-sloping culvert. Engine 2 eventually overturned after hitting the culvert headwall and came to rest on its wheels (see Photo 8). Weather this day was overcast with temperatures in the low 60s. The weather was not considered to be a contributing factor.

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In 2011, the fire department had suffered an incident on the same road but coming from the opposite direction. The driver was 18 years old and had not received driver training on the apparatus he was driving. After leaving the roadway, he over-corrected, crossed the roadway, and struck a structure.



Photo 6. Looking east, toward the curve in the roadway where the probationary member lost control of Engine 2.
(NIOSH photo.)

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Photo 7. Looking west, another view of the roadway coming out of the curve. Note the downward-sloping shoulder and culvert just left of the paved roadway.

(NIOSH photo.)

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**Photo 8. Looking west and standing at the final resting position of Engine 2.
(NIOSH photo.)**

Investigation

On October 17, 2013, a 28-year-old male volunteer probationary member lost his life after the pumper/tanker he was operating left the roadway and overturned. On the day of the incident, the probationary member was at his home and observed smoke coming from a double-wide mobile home located behind his house (see Photo 9).

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Photo 9. Double-wide mobile home that was on fire behind the probationary member's house.
(NIOSH photo.)

He immediately called 9-1-1 and advised the dispatcher of the possible fire. The department was dispatched to the structure fire along with neighboring mutual aid departments. The probationary member donned his structural firefighting ensemble that he had in his personal vehicle and waited for his department to arrive. It is unknown what his actions were while on the fireground before the arrival of his department. The department arrived on scene in Engine 1 with a crew of two, followed shortly by a mutual aid fire fighter in his personal vehicle. Only smoke was visible from the roof line as the responding crews arrived, and they believed they had an attic fire. Arriving crews operated independently without incident command. A single 1¾-inch cross lay was stretched from Engine 1 to the front door of the structure. One fire fighter from Engine 1 remained at the engine as the pump operator while the other joined the probationary member and the mutual aid fire fighter. The hoseline was charged and entry was made through the front door of the structure while on air. Pike poles were initially used to drop the interior ceiling just inside the doorway where they were met with high heat. All three backed out to the front steps and sprayed water into the ceiling/attic area. Additionally, an exterior ridge vent was opened above the front door by this crew to ventilate the attic space. A ladder was placed near this opening so that the crew could spray water into the attic.

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After this initial attack, the probationary member's low-air alarm sounded, alerting him to go and change his bottle. He advised the other two fire fighters on the hoseline with him before he left. He walked a short distance to Engine 1 and asked the pump operator where the extra air bottles were. She stated she wasn't sure. He then advised her that he was going to get Engine 2; he did not advise the hose crew of this. It is unknown whether he searched for air bottles on Engine 1, but an extra SCBA pack and four additional spare bottles were on the engine. He was observed leaving the scene by the mutual aid department fire fighters who were hooking Engine 1 to the hydrant across the street from the fire. Engine 1 carried 1,000 gallons of water and had not run out of water at the time the probationary member left the scene.

The probationary member traveled approximately 1.2 miles to his department's substation in his POV. He then drove Engine 2 approximately 0.5 miles from the substation before the crash occurred. He responded in emergency mode with lights and siren. The mutual aid department recalled hearing a siren coming toward the fire scene, but then all of a sudden it stopped getting louder but continued to sound. Dispatch came over the radio and asked personnel on the fire scene if anyone had been involved in a motor vehicle incident, stating that they had received a 9-1-1 call for an overturned fire truck. The mutual aid department advised they would respond to the address that 9-1-1 had provided. It was then confirmed that the probationary member had been involved in a crash while operating Engine 2. The probationary member received fatal injuries during the rollover and was pronounced dead on the scene. He was not wearing a seat belt.

Crash Reconstruction

The state uniform traffic crash report stated that the tanker was traveling eastbound toward the direction of the structure fire. The tanker left the right side of the roadway when exiting a curve, then overturned, striking a culvert headwall before finally resting upright. A power pole was also knocked down during the rollover. The tanker came to rest approximately 270 feet from where it had left the roadway (see Photos 10 and 11 and Diagram). The investigating officer stated in his report that he did not believe the probationary member had exceeded the posted speed limit, but did believe a shift of water within the tanker to be the reason for the loss of control when exiting the curve.

NIOSH could not confirm whether the water tank was completely full at the time of the incident but individuals on scene stated that the tank's containment lid came off during the incident and cracks were present on both sides of the tank after the incident (see Photo 12 and Photo 13). The fire chief advised the NIOSH investigator that he had filled the tank a week before the incident at his main station and then drove it approximately 3.5 miles to the substation, where he then backed Engine 2 into the station. He stated that at that time the tank-fill lights read full on the pump panel (see Photo 14). *Note: It is important to ensure that a tank is either completely full or completely empty because the sloshing effects of water during vehicle operation may cause the vehicle to become dangerously unstable when changing lanes or negotiating curves.*

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Photo 10. Engine 2's resting position following the rollover.
(Photo courtesy of the insurance company.)

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Photo 11. Looking west, another view of the final resting position and incident scene.
(Photo courtesy of the insurance company.)

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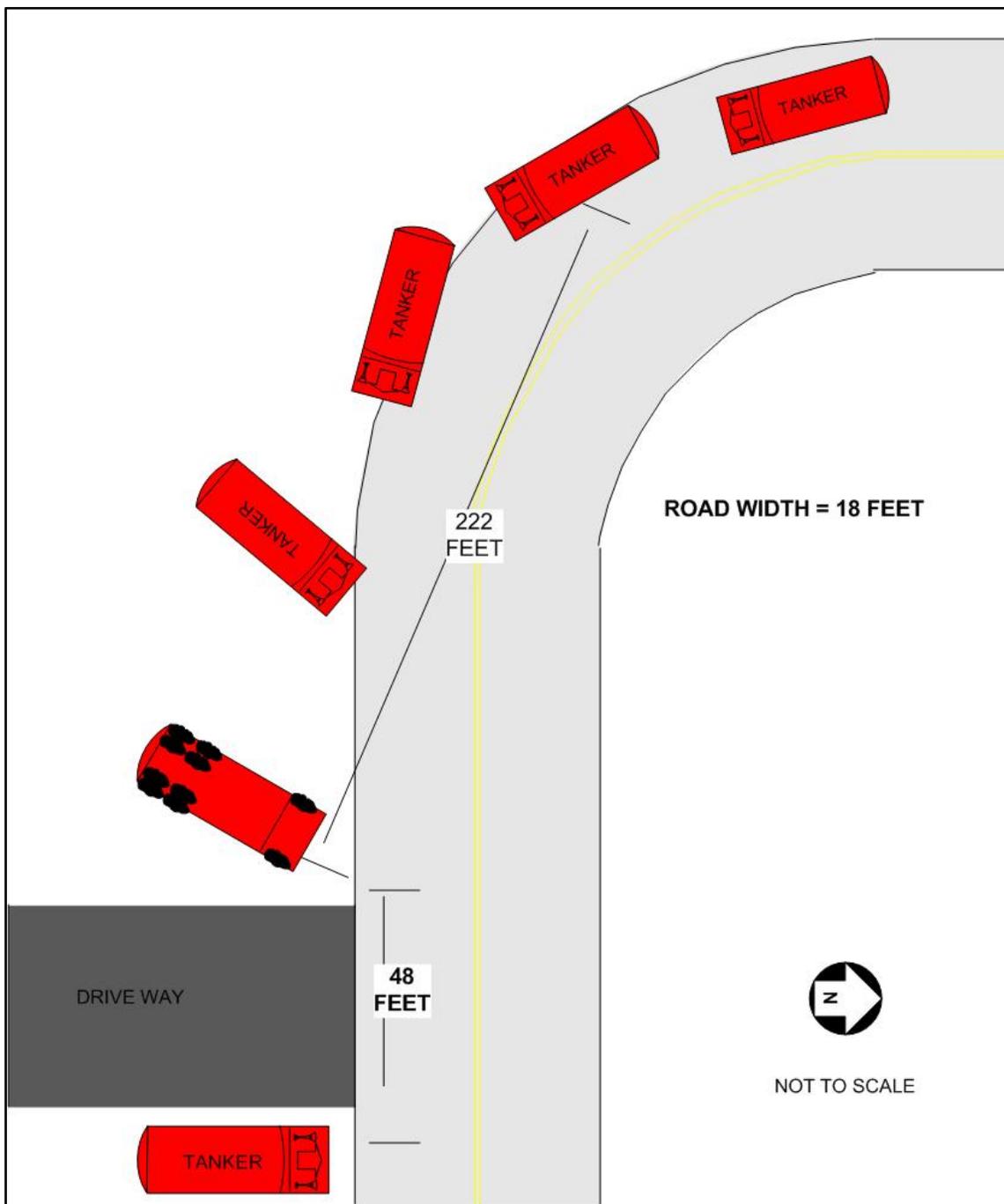


Diagram. Recreation of the path of travel taken by Engine 2 during the incident, based on information taken from the state uniform traffic crash report. (NIOSH diagram.)

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**Photo 12. Officer side of Engine 2, showing a crack in the tank.
(NIOSH photo.)**

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**Photo 13. Driver side of the tanker, showing a crack in the tank.
(NIOSH photo.)**

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Photo 14. Tank fill gauge.
(NIOSH photo.)

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 led to the fatality:

- No department- or state-required driver training program
- Inexperienced driver
- Not wearing a seat belt
- Driving or entering a curve at a speed not negotiable for a large vehicle such as a pumper/tanker
- Exiting a curve on a narrow roadway with a minimal shoulder
- Vehicle overturned
- Incident management system not implemented at the fire scene

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Cause of Death

According to the coroner, the death was due to head trauma.

Recommendations

Recommendation #1: Fire departments and authorities having jurisdiction should ensure that all drivers complete a comprehensive driver training program, such as NFPA 1451 Standard for a Fire and Emergency Services Vehicle Operations Training Program, and NFPA 1002 Standard for Fire Apparatus Driver/Operator Professional Qualifications before allowing a member to operate a fire department apparatus.

Discussion: Fire departments should provide adequate resources and training to ensure the safe arrival to and return of members from an emergency scene. Fire departments should develop, implement, and enforce written standard operating procedures for emergency vehicle driving and ensure fire fighters are thoroughly trained and qualified before being allowed to drive and operate emergency vehicles. The minimum requirements for a fire service vehicle operations training program are contained in NFPA 1451 *Standard for a Fire and Emergency Services Vehicle Operations Training Program*.² The objective of the program is to prevent crashes, injuries, and fatalities, both civilian and fire service. Fire departments must also ensure that fire fighters are familiar with the different models of fire apparatus that they may be expected to operate. The members should be trained to operate specific vehicles or classes of vehicles before being authorized to drive or operate such vehicles.²⁻⁴

SOGs for driving fire department vehicles should include the principles of skid avoidance and the effects of liquid surge, load factors, general steering reactions, recognizing the hazards of entering and negotiating curves in the roadway at an excessive speed, and speed on vehicle control. Training in accordance with NFPA 1002 should be included. Common causes for loss of control are driving too fast for road conditions, failing to properly react to weight shifts of heavy emergency vehicles/apparatus, driver distraction, and failing to anticipate obstacles.

Prior to this incident, the probationary member's department did not have a written comprehensive driver training program. New drivers operating a fire department vehicle would be supervised by the fire chief until both were comfortable that the member could operate the vehicle safely. The probationary member had only driven Engine 2 3–5 times under nonemergency conditions and had not been released to drive this apparatus on his own.

Recommendation #2: Fire departments should ensure that department drivers/operators are trained in the unique characteristics of driving a tanker and maintaining control.

Discussion: Fire apparatus driver/operators are responsible for safely transporting fire fighters, apparatus, and equipment to and from the scene of an emergency or other call for service. Crashes are second only to cardiac events as the cause of on-duty deaths of fire fighters.⁵ Under all circumstances, the fire apparatus driver/operator must exercise care for the safety of others and must maintain complete control of the vehicle.⁶ NFPA 1500 *Standard on Fire Department Occupational Safety and*

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Health Program, Chapter 6.2.4, states, "Drivers of fire apparatus shall be directly responsible for the safe and prudent operation of the vehicles under all conditions."^{2,4} The International Association of Fire Chiefs (IAFC) provides a *Guide to IAFC Model Policies and Procedures for Emergency Vehicle Safety*.⁷ Many human elements are involved in failing to maintain the safe control of fire apparatus while responding to an alarm. Insufficient training, excessive speed, inexperience with the apparatus, failure to recognize a dangerous situation, overconfidence in one's driving ability, sense of urgency, and poor driving habits are some of the human elements that fire fighters and officers have a shared responsibility to understand and train to avoid.^{4,8} According to the United States Fire Administration's *Safe Operation of Fire Tankers*,⁸ a significant percentage of crashes involving fire department tankers is attributed to the vehicle being driven at a speed that is excessive for the given conditions.

The United States Department of Transportation, National Highway Traffic Safety Administration, describes these types of events: "A vehicle in transport sometimes leaves the travel lane and encroaches onto the shoulder, median, roadside, parking lane, gore, or a separator and hits one or more natural or artificial objects. This event usually involves a single vehicle and is referred to as a run-off-road crash (ROR)."⁹ ROR crashes account for a significant percentage (around 70%) of all fatal single-vehicle crashes. Curved road segments, rural roads, high-speed-limit roadways and roadways with fewer lanes are found to be more likely to be involved in fatal single-vehicle ROR crashes."⁹

During this incident, the probationary member had limited experience operating this apparatus and no experience operating it during an emergency response. According to the state uniform traffic crash report, the apparatus left the right side of the roadway when exiting a curve. This roadway was narrow with a minimal shoulder that sloped down toward a shallow culvert. There was no indication of skid marks prior to the curve. NIOSH cannot confirm whether the tanker was completely full or not. The fire chief advised the NIOSH investigator that he had filled Engine 2 a week before this incident at his main station and then drove it approximately 3.5 miles to the substation where he backed the apparatus into this station. He stated that the tank-fill lights read full on the pump panel and Engine 2 did not respond on any calls after it was parked in the substation.

Recommendation #3: Fire departments should ensure that seatbelts are properly worn at all times by apparatus drivers and occupants.

Discussion: NFPA 1500 *Standard on Fire Department Occupational Safety and Health Program* states that all persons riding in fire apparatus shall be seated and belted securely by seat belts in approved riding positions at any time the vehicle is in motion. The standard further states that seat belts shall not be released or loosened for any purpose while the vehicle is in motion.⁴ Numerous nationally recognized fire service entities have guidance available on implementing a seat belt policy. The IAFC, *Guide to IAFC Model Policies and Procedures for Emergency Vehicle Safety*, offers the following guidelines: "The driver shall not begin to move the vehicle until all passengers are seated and properly secured. All passengers shall remain seated and secured as long as the vehicle is in motion."⁷

Vehicle crashes are historically the second leading cause of fire fighter line of duty deaths. Seat belts are not only important for protecting occupants in the event of a crash, but they may be useful in helping to avoid crashes. The U.S. Fire Administration's (USFA) *Safe Operation of Fire Tankers*

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states, "Some crash reconstruction specialists have speculated that particular incidents may have occurred after the unrestrained driver of a truck was bounced out of an effective driving position following the initial contact with a bump in the road or another object."⁸ In the same publication, the USFA also cites a Department of Transportation study of seat belt use that revealed the following statistics: (1) 75 percent of the people ejected from vehicles suffer fatal injuries; (2) 80 percent of fatalities in rollover incidents involve occupants being ejected from the vehicle; and (3) in a rollover incident, occupants are 22 times more likely to be thrown from the vehicle if they are not wearing their seat belts.⁸

To increase the use of seat belts by fire fighters, the National Fire Service Seat Belt Pledge campaign was created.¹⁰ The United States Fire Administration, National Fallen Fire Fighters Foundation, National Institute for Occupational Safety and Health, International Association of Fire Chiefs, National Volunteer Fire Council, and the National Fire Protection Association support the campaign as a method of raising awareness of the importance of mandatory use of seat belts by all fire fighters.¹¹ Fire fighters who take the pledge and fire departments who achieve 100% pledge participation show their individual and organizational commitment to fire fighter safety.¹²

During this incident, the probationary member was not wearing his seat belt. According to the fire chief, his department had a verbal policy requiring all drivers and occupants to wear a seat belt in department apparatus when in motion. The department did not have a written SOG requiring seat belt use. Fire departments should develop, implement, train, and enforce SOGs on the use of seat belts. Training and enforcement should include all levels of the organization, from the apparatus driver and fire fighters riding in the apparatus to the officer on the apparatus and chief officer levels. The SOGs should apply to all persons driving or riding in all emergency vehicles, and they should state that all persons should be seated and secured in an approved riding position before the vehicle is put in motion.

Recommendation #4: Fire departments should consider using a risk benefit analysis to prioritize emergency vehicle response by auxiliary or fire support vehicles.

The following are excerpts taken from the *IAFC Guide to Model Policies and Procedures for Emergency Vehicle Safety* and provide guidance in developing an SOP for responding to incidents.

"Fire department vehicle operations are classified as either emergency or non-emergency. During non-emergency operations, fire department vehicles shall comply with all of the traffic laws and rules of the road that apply to all other vehicles. The specific exceptions to traffic laws that apply to emergency vehicles shall only be exercised during authorized emergency operations. Emergency response creates an increased risk to fire fighters and to other users of the roadways. The increased risk must be balanced against the potential benefits of faster response in situations where lives and/or property are at risk. Emergency response shall be limited to situations where prompt response is likely to reduce the risk of death, serious injury or disability, or preventable damage to property."⁷

Each response to an incident shall be classified as either emergency or non-emergency at the time of dispatch, based on the nature of the reported situation. The response classification shall be assigned

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according to pre-established criteria. The response classification may be changed by the communications center at the time of dispatch or while units are en route, based on the receipt of additional information. The change of response classification may apply to all units or only to specified units. The officer in charge of a company or unit that is en route to an incident is also authorized to change the response classification, based on reliable information that the change is appropriate. The communications center and all other responding units will be advised immediately of a change in response classification.

When multiple units are responding in emergency mode, the officer arriving at the scene and assuming command of the incident shall determine if it is appropriate to downgrade the response of any units that are still en route. The additional units shall be directed to continue "at reduced speed" or non-emergency when the situation does not urgently require their presence at the scene.

The fire department should adopt a written policy to define the specific types of incidents and situations for which emergency response is authorized. The state traffic laws should be consulted to determine the legal definitions that apply to authorized emergency response. The determination of which types of calls justify emergency response must consider local factors and traffic conditions. In some cases, the difference between emergency response and non-emergency response could be measured in seconds, while in other cases the difference could be several minutes. In jurisdictions where traffic congestion is a major problem, a "reduced speed policy" could be implemented to reduce the risks of emergency response, while maintaining the ability to move through traffic.

Examples of incident classifications are provided below:

Emergency Response Classifications

- Smoke or fire in a building
- Outside fire with exposures
- Gas leak inside a building
- Hazardous materials release with persons in distress
- Critical medical incident

Non-emergency Response Classifications

- Automatic fire alarm system activation—no human report of smoke or fire
- Residential smoke alarm sounding—no indication of smoke or fire
- Carbon monoxide alarm—no indication of person(s) in distress
- Outside fire without exposures
- Smoke in the area—no indication of source
- Outside gas leak
- Electrical wires arcing
- Hazardous materials release—no indication of person(s) in distress
- Water leak
- Unknown odor—no symptoms or persons in distress

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- Relieve units at the scene of an incident that is under control

Fire departments should also consider the adoption of policies to limit certain vehicles, such as tankers (water tenders), support units, and other large and/or heavy vehicles to non-emergency response mode.

In this incident, the probationary member left the fire scene in his personal vehicle to get Engine 2. He responded back to the fire scene in Engine 2 with lights and siren and lost control approximately one half mile from the fire scene. Fire department members are unsure why he left because an engine from his department was on scene and was being supplied by a mutual aid engine that had a viable water supply. Additionally, if he was searching for air bottles, Engine 1 from his department had an additional SCBA pack and several spare bottles.

Recommendation #5: Fire departments should consider developing and implementing a policy prohibiting the wearing of rubber fire boots while operating a vehicle.

Discussion: The NIOSH investigator cannot confirm that wearing of structural firefighting boots contributed to this incident but the use of proper footwear while driving is important for safe vehicle operation. Wearing shoes not suitable for driving, especially shoes that are thick-soled and irregularly shaped, can impact a driver's ability to safely operate vehicle braking and acceleration pedals and may lead to vehicle crashes. Shoe characteristics that should be avoided include soles thicker than 10 cm, worn sole treads, and heaviness.¹³

Recommendation #6: Fire departments should establish the incident management system at all incidents.

Discussion: Most incidents are considered routine and involve a small commitment of resources (high-frequency/low-risk), while few incidents involve large commitments of resources and complex situations (low-frequency/high-risk). An incident management system is intended to provide a standard approach to the management of emergency incidents. The NFPA 1500 *Standard on Fire Department Occupational Safety and Health Program*⁴ and NFPA 1561 *Standard on Emergency Services Incident Management System*¹⁴ both state that an incident management system shall be utilized at all emergency incidents. Most often, this system is commonly known as, or referred to as, the Incident Command System, or ICS. The many different and complex situations encountered by fire fighters require a considerable amount of judgment in the application of an ICS. The primary objective is to always manage the incident. The incident commander (IC) should be able to apply ICS in a manner that supports effective and efficient management of the incident and responders on scene. The use of ICS should not create additional challenges for the IC, but rather provide a systems approach to ensuring a successful outcome of the incident.¹⁴

NFPA 1561, Chapter 3.3.29, defines an incident management system as "a system that defines the roles and responsibilities to be assumed by responders and the standard operating procedures to be used in the management and direction of emergency incidents and other functions."¹⁴ Chapter 4.1 states, "The incident management system shall provide structure and coordination to the management

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of emergency incident operations to provide for the safety and health of emergency services organization responders and other persons involved in those activities."¹⁴ Chapter 4.2 states, "The incident management system shall integrate risk management into the regular functions of incident command."¹⁴

The incident management system covers more than just fireground operations. The incident management system must ensure for command/control and fire fighter safety, which includes situational evaluation, strategy and the incident action plan, personnel accountability, risk assessment and continuous evaluation, communications, rapid intervention crews, roles and responsibilities of the incident safety officer, and interoperability between multiple agencies (e.g., mutual aid departments, law enforcement, emergency medical services, state and federal government agencies and officials) and surrounding jurisdictions (automatic aid or mutual aid responders).

One of the most critical components of this system is the development and implementation of an incident action plan (IAP).¹⁴ For the fire service, the IAP is communicated verbally for the majority of times. The IAP is based on the resources immediately available and those responding. The goal is determined in accordance with the incident priority from which a strategy must emerge; tactical objectives that are aimed at meeting the strategy are determined and specific assignments are made. As assignments are made, a personnel accountability system should be established. Most importantly, the overall IC communicates the IAP to tactical- and task-level supervisors.

During this incident, arriving units and responders operated on their own initiative without incident command, which did not allow for the ICS to be implemented on the fireground. Responders on scene relied upon their individual knowledge and experience to make individual decisions on what they believed was needed to bring the incident under control. This may have encouraged the probationary member to take it upon himself to leave the scene and retrieve Engine 2. He had not been cleared by his department to operate this apparatus in any level of response. The establishment of the ICS with an IC may have prevented the probationary member from leaving the fireground.

Recommendation #7: Fire departments should ensure that members do not freelance at any time at incident scenes.

Discussion: It is paramount that fire departments ensure that members understand how dangerous freelancing can be on any incident scene. Fire departments should ensure that procedures are in place to prohibit freelancing and provide information on the hazards of acting independently without receiving authorization and clearly defined task assignments from command. Members should maintain communications at all times with their crew, their officer, and/or the IC to ensure that tasks are appropriately delegated and carried out. Performing unnecessary tasks that have not been identified in the IAP or are outside your training could lead to a dangerous situation. Of utmost concern, responders should not leave the scene of an incident without communicating the reason for leaving and obtaining approval from their officer or IC. This can lead to loss of accountability of responders on scene, which could place fire fighters or a rapid intervention crew in harm's way.

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During this incident, the probationary member advised the pump operator that he was leaving to get Engine 2. Members on scene of the fire incident did not understand why he left the scene to retrieve an additional apparatus. Additionally, he had not been cleared to operate Engine 2 in any response mode.

Recommendation #8: Fire departments should develop emergency response deployment protocols to prevent resources from unnecessarily responding, unplanned or unknown, to an emergency scene.¹⁵

Discussion: The International Association of Fire Chiefs and the National Volunteer Fire Council discourage the practice of self-dispatch among emergency response personnel to emergency incidents without notification or request. They have issued a joint policy statement stating that, “Uncontrolled and uncoordinated arrival of resources at emergencies cause significant accountability issues as a result of personnel freelancing and creating additional safety risks to fire fighters, civilians and others who are operating within the parameters of the incident action plan. Chaos at the scene occurs, creating additional safety risks because these companies or individuals are not aware of the overall strategic plan. Further, unrequested emergency units and emergency personnel at incidents disrupt the accountability and incident management system. An incident management system requires that a formal structure is utilized to determine the needs of an incident. The needs of the incident are in most cases directly related to personnel and equipment. When unrequested resources show up, the incident management system fails. Unplanned resources in many cases block roads, create traffic jams, restrict access and ultimately affect the safety of those fire fighters who are operating at the scene by denying them needed resources. Freelancing of personnel and fire companies adversely impact incident management systems and require that the incident commander assign more personnel to control and coordinate these resources that were not requested.”¹⁶

During this incident, the probationary member advised his pump operator that he was leaving to get Engine 2. Members on scene of the fire incident did not understand why he left the scene to retrieve an additional apparatus. Additionally, he had not been cleared to operate Engine 2 in any response mode.

Recommendation #9: Fire departments should develop policies and procedures, mission and vision statements, and training programs, which promote an institutional safety culture that ensures that all members are empowered to report unsafe practices or actions.

Discussion: *Everyone Goes Home, Firefighter Life Safety Initiative #4 Empowerment* states, “All Firefighters must be empowered to stop unsafe practices,” which means allowing the members of each department to speak up with regard to personal and organizational safety, without negative consequences for doing so (within a prescribed context), and without decentralizing the authority of the formal leader.¹⁷ The resources needed for all fire service organizations to institute *Initiative #4 Empowerment*, regardless of type or size, are already available to them, and are free. All that is required is for departments to develop policies and procedures that officers encourage and enforce, and fire fighters have the courage to help each other by speaking up.

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In this incident, there was no incident management system or incident commander established on scene and the probationary member left the scene during fireground operations to retrieve Engine 2. Members of his department do not understand why he left the scene to retrieve Engine 2.

Recommendation #10: Fire departments should consider rollover protection for the crew areas of fire apparatus when upgrading or purchasing new apparatus.

Discussion: Fire departments should consider rollover and crash avoidance/protection systems when upgrading or purchasing new fire apparatus. Many features are available that can add to the safety of fire fighters involved in crashes. Many of the new rollover protection components are integrated systems designed to increase protection for the fire fighters riding inside the apparatus. Strengthened cabs, combined with roll protection systems that sense the moment a vehicle is in a side roll, provide passenger protection through air bag systems and automatic seat belt pre-tensioners that retract the seat downward to increase the clearance between the fire fighter's head and the ceiling of the apparatus and therefore improve survivability.

Recommendation #11: Fire apparatus manufacturers, researchers, and standard setting bodies should continue to improve fire truck safety standards and designs for increased crashworthiness of compartments for fire fighter survivability in rollover crashes.

Discussion: The minimum requirements for crashworthiness in rollover incidents should be improved to increase the survivability of fire fighters involved in rollover crashes. Minimum cab roof strength should be reviewed and evaluated with other protection systems to prevent cab intrusion into the passenger compartments (see Photo 15). Rollover fatalities and injuries in the fire service may be reduced by increasing the crashworthiness of fire apparatus. NFPA 1901, annex A, ¹⁸ section A.14.3.2, notes, "The U.S. standards developed by SAE and the United Nations ECE regulation mirror each other except that SAE J2422 requires a roof preload impact prior to the roof crush. The ECE standard was established in 1958, while the SAE standards did not add performance criteria until 2003. Both the SAE and ECE standards are viable minimum measures of cab integrity. Manufacturers may test in excess of the standards."

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**Photo 15. Cab intrusion sustained during the rollover.
(NIOSH photo.)**

Section A.4.13.1 of NFPA 1901, annex A, ¹⁸ notes, “Several features and factors affect vehicle safety in a rollover.” The features and factors are listed below:

- “*Custom Fire Apparatus Cab.* The nature of the custom fire apparatus cab makes it much stronger in rollover than typical conventional commercial cabs. There is much anecdotal evidence to indicate that the crashworthiness of a typical custom fire apparatus cab is significantly greater than a typical commercial cab, and most custom chassis manufacturers can provide test data on cab integrity.
- “*Lateral Acceleration Alert Device.* There are both mechanical and electronic devices available that will measure the lateral acceleration of a vehicle. Although these devices will not prevent rollover, they can be used effectively as a driver training tool to indicate when the vehicle is approaching the roll threshold and as a reminder to the driver that excessive lateral acceleration

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can lead to a rollover event.

- “*Side Roll Protection*. Many custom fire apparatus manufacturers offer side air bags or curtains that inflate during a roll event and that are usually combined with seat belt pre-tensioning devices and suspension seat pull-down devices. This option can reduce injury during a rollover as long as the occupants are seated and belted.
- “*Roll Stability Control*. This technology electronically senses the lateral acceleration of the vehicle and takes action by depowering the engine and applying the brakes if the vehicle approaches a roll threshold. The effectiveness of this product is limited to events on relatively flat pavement, since it cannot do much to help the situation once a vehicle is off the road and leaning into a ditch.
- “*Electronic Stability Control (ESC)*. ESC uses a steering wheel position sensor, a vehicle yaw sensor, a lateral accelerometer, and individual wheel brake controls in conjunction with the antilock brake system (ABS). The system tracks the direction that the driver intends to steer and uses brake application at individual wheels to help straighten out the vehicle.
- “*Driver Skill and Experience*. While the design and features of the vehicle are important to safe driving, the most important aspect of crash prevention is the skill and experience of the operator. The operator’s attitude, training, experience, qualifications, and the application of those qualities are the most important elements in crash prevention. The operator must ensure that the physical limits of the vehicle are not exceeded. Driver skill is developed only through training and practice.”

During this incident, cab intrusion occurred during the rollover.

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Investigator Information

This incident was investigated by Stacy C. Wertman, safety and occupational health specialist with the Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH, located in Morgantown, West Virginia. An expert technical review was provided by Mike Wieder, Associate Director Fire Protection Publications and Executive Director, IFSTA. A technical review was also provided by the National Fire Protection Association, Public Fire Protection Division.

Additional Information

The NIOSH Fire Fighter Fatality Investigation and Prevention Program has conducted numerous investigations of line-of-duty deaths involving tanker rollovers. Published investigative reports for the incidents below can be found at http://www2a.cdc.gov/NIOSH-fire-fighter-face/state.asp?state=ALL&Incident_Year=ALL&Medical_Related=ALL&Trauma_Related=0019&Submit=Submit.

- F2000-06 Tanker Rollover Results in the Death of One Volunteer Fire Fighter—Texas
- F2000-10 A Captain and a Fire Fighter Die From Injuries in a Tanker Rollover—Indiana
- F2000-18 Tanker Rollover Claims Life of Volunteer Fire Chief—Missouri
- F2001-01 Volunteer Fire Fighter Dies and Junior Fire Fighter is Injured After Tanker Rollover During Water Shuttle Training Exercise—Kentucky
- F2001-06 Fire Fighter Dies After the Tanker Truck He was Driving Strikes a Utility Pole and OvertURNS While Responding to a Grass Fire—Kentucky
- F2001-39 Volunteer Fire Fighter Killed and an Assistant Chief Injured in Tanker Truck Crash—West Virginia
- F2002-39 Junior Volunteer Fire Fighter Dies in Tanker Rollover—Tennessee
- F2002-41 Career Fire Fighter Dies in Tanker Rollover—North Carolina
- F2003-15 Volunteer Fire Fighter Dies in Tanker Rollover—Ohio
- F2003-20 Junior Volunteer Fire Fighter is Killed While Responding to a Brush Fire With an Intoxicated Driver—Wyoming
- F2003-23 Volunteer Assistant Chief Dies in Tanker Rollover—New Mexico
- F2005-27 Volunteer Fire Chief Dies From Injuries Sustained During a Tanker Rollover—Utah

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- F2006-06 Volunteer Fire Fighter Dies in Tanker Rollover Crash—Texas
- F2006-25 Junior Volunteer Fire Fighter Dies and Three Volunteer Fire Fighters are Injured in a Tanker Crash—Alabama
- F2007-25 Two Volunteer Fire Fighters Die in a Tanker Rollover—North Carolina
- F2008-05 Volunteer Captain Dies in Engine Rollover—Colorado
- F2008-10 Volunteer Fire Fighter Dies in a Tanker Crash—Louisiana
- F2012-30 Volunteer Fire Fighter Dies in Tanker Crash En Route to Grass Fire—Indiana

National Volunteer Fire Council: Emergency Vehicle Safe Operations for Volunteer and Small Combination Emergency Service Organizations. http://www.nvfc.org/files/documents/EVSO_2009.pdf

National Safety Council: Coaching the Emergency Vehicle Operator II™: Fire Apparatus Defensive Driving Course. http://www.nsc.org/products_training/training/pages/onlinetraining.aspx

NIOSH Hazard ID: Fire Fighter Deaths From Tanker Truck Rollovers. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2002-111. <http://www.cdc.gov/niosh/docs/2002-111/>

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