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NIOSH
Fire Fighter Fatality Investigation and Prevention Program

Death in the line of duty...

A summary of a NIOSH fire fighter fatality investigation *March 20, 2009*

Two Volunteer Fire Fighters Die in a Tanker Rollover – North Carolina

SUMMARY

On March 24, 2007, a 45-year-old male volunteer fire fighter (victim #1) and a 19-year old male volunteer fire fighter (victim #2) died while they were responding in a tanker to a structure fire. The tanker crossed the double-yellow center-line of a two-lane state roadway, and as victim #1 steered to the right, the tanker began skidding sideways. The tanker ran off the road, then skidded back onto the roadway and overturned several times before coming to rest sitting upside-down on the roadway and the shoulder of the road. Victim #1 was ejected and victim #2 was partially ejected from the cab of the tanker. Both of the victims were found unresponsive, and were pronounced dead at the scene by Emergency Medical Services (EMS). Key contributing factors identified in this investigation include: Unsafe speed of the tanker for the roadway, the driver's inability to control the vehicle once it started to skid, and seat belts not being worn by the fire fighters.

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

- ***develop and enforce standard operating procedures (SOPs) that require mandatory use of seat belts in all moving vehicles***
- ***ensure that all drivers of fire department vehicles receive guidance on the safe and prudent operation of the vehicles under all conditions***
- ***consider requiring that emergency vehicle operators/drivers receive driver training from a State or other nationally recognized training program, in addition to specific departmental driver training***
- ***consider encouraging all members to sign the "National Fire Service Seat Belt Pledge" to reinforce the importance of wearing seat belts***

Two Volunteer Fire Fighters Die in a Tanker Rollover – North Carolina

INTRODUCTION

On March 24, 2007, two volunteer fire fighters, a 45-year-old male volunteer fire fighter (victim #1), the driver, and a 19-year-old male passenger (victim #2) were responding in a tanker to a structure fire when the driver lost control of the tanker that overturned and both victims were fatally injured. On March 26, 2007, the National Institute for Occupational Safety and Health (NIOSH) was notified of this incident by the U. S. Fire Administration (USFA). On July 26, 2007, an investigation of this incident was conducted by a NIOSH Safety and Occupational Health Specialist. Meetings and interviews were conducted with the County Fire Marshal and the Chief from the volunteer fire department. The incident site was visited. Copies of the department's Standard Operating Procedures (SOPs), vehicle maintenance records, the North Carolina State Highway Patrol report, medical examiner's report and photographs of the incident scene were reviewed. On August 7, 2007, a telephone interview was conducted with the investigating North Carolina State Highway Patrolman.

FIRE DEPARTMENT

At the time of the incident, the volunteer fire department involved in this incident served a population of 6,000 in a geographical area of 35 square miles and was comprised of 42 volunteer fire fighters. The department had two pumpers, one service truck and two water tanker trucks. Repair and service of all the apparatus was typically provided by an area vehicle repair shop.

TRAINING AND EXPERIENCE

Victim #1 had been a member of the volunteer department for approximately 4.5 years. He had been a driver for the department for 2 years and he held a Regular Class C state driver's license. Victim #1 had completed 87 hours of various training at the department in 2006 and had completed 11 hours in 2007. Victim #1 had completed a 3-hour refresher tanker driving and dump tank training on January 15, 2007. In addition to attending driving training at the department, it was reported that victim #1 had also attended an additional driving course in September 2006 at a regional training school. Victim #1 was an engine service mechanic and tow operator by occupation, and worked in a vehicle repair and towing business.

Victim #2 had been a member of the volunteer department for approximately 6 years; 4 of those years, as a junior fire fighter. Victim # 2 completed 72 hours of various training at the department in 2006 and had completed 23 hours in 2007. He worked in the grocery industry.

The state of North Carolina has no minimum state training requirements for volunteer fire fighters. The department requires that a fire fighter be 18-years old and complete a 90-day probationary period. Prior to a fire fighter participating on a structure fire, they are required to attend live fire training that compiles with NFPA 1403[1]. To remain a fire fighter in good standing, the department

requires that each fire fighter attend a minimum of 36 hours of training each year from the department or the state.

As part of its administrative policies, the fire department had standard operating procedures (SOPs) for self contained breathing apparatus (SCBA) use, full bunker gear, PASS devices, communications equipment, emergency vehicle operations, emergency operations, and incident command. At the time of the incident, the department did not have SOPs for seat belt use, and seat belt use was not mandated by the department. Since the incident, the department has developed an SOP that requires that a seat belt be used at all times while riding in or driving a fire apparatus. Additionally, the department currently enforces the seat belt usage and has disciplinary measures in place for fire fighters and their officers if the procedure is not followed.

To be designated as a driver, the department requires that the fire fighter be a member for a minimum of three years and be 21 years of age. A driver must provide a demonstration of their driving skills and must be approved by two of the three department officers. Driver training at the department [which includes NFPA 1451[2] Standard for a Fire Service Vehicle Operations Training Program standard protocols] consists of classroom training and a minimum of six hours of hands-on driving with the Chief and a designated training officer. The department required a minimum of 26 hours of driving and operation time before being approved to drive the tanker involved in this incident. After receiving the initial driving training, a fire fighter designated to be a driver needed final approval from the Chief. The department provided refresher driver training two times per year, and drivers were required to complete 3-hours of refresher driving training every 6 months. The victim meet all of these department requirements. A written policy and procedures were established at the fire department to report any unsafe operations of an emergency vehicle; once such action was reported, it was subject to disciplinary action by the fire department board.

The department had not experienced any other fatalities or vehicle related incidents prior to this incident.

EQUIPMENT

The vehicle involved in this incident was a 1988 water tanker with a 4-speed manual transmission and an air-over-hydraulic brake system. The tanker's gross vehicle weight rating was 30,200 lbs. The tanker had two axles with 6 wheels (two in the front and four in the rear). The 1,200-gallon baffled[a] rectangular-shaped water tank was filled to capacity at the time of the incident. The tanker was equipped with driver and passenger lap-type belts. The department required that each fire apparatus receive a visual safety inspection and inventory check, following each call and on a weekly basis, to document the safety inspection. A check-off sheet (e.g., brakes, tires, engine, lights and

[a] A baffle (swash partition, swash plate) is a divider within a liquid tank that is designed to prevent liquid surges from occurring.

siren) was utilized and documentation was retained. Documentation existed for the week of this incident.

Although not a requirement by the state of North Carolina, the tanker had passed a safety inspection on May 31, 2006 that was conducted at an area mechanical garage. In addition, due to a requirement by the department's insurance carrier, the tanker received an annual weight ticket on September 25, 2006, which indicated that the tanker with all on-board equipment and the water tank filled to capacity weighed 26,240 lbs. The tanker was purchased new by the department. Following the incident, the tanker was inspected by the North Carolina State Highway Patrol and the department's insurance company, and no mechanical issues or problems were identified.

CLOTHING/GEAR

When the incident occurred, victim #1 was driving the tanker. He was wearing civilian type clothing and tennis shoes. His bunker gear was stored on-board. Victim #2 was wearing his bunker gear and boots.

WEATHER / ROAD CONDITIONS

The incident occurred on a clear day with no precipitation present in the area. The road where the incident occurred is a rural, two lane state roadway that has several curves. The road is comprised of asphalt pavement. The shoulder of the road where the incident occurred was a combination of sparse grass with a mixture of dirt and sand. The posted speed limit on the road was 45 miles-per-hour (mph).

INVESTIGATION

At approximately 1139 hours, a tanker from a volunteer department returned back to the station with victim #1 and victim #2 on board. They were returning from the scene of a garage fire that they had been dispatched to approximately one-hour prior. Once back at the station, victim #1 and victim #2 replenished the 1,200 gallon water tank on the truck.

At approximately 1146 hours, the department was dispatched to a structure fire for an automatic aid call. At approximately 1150 hours, the tanker departed the station with victim #1 driving and victim #2 riding as a passenger, with the lights and siren activated. Two fire fighters and a junior fire fighter riding in a privately owned vehicle (POV) responded behind the tanker. The route to the fire was a two-lane state road, with a posted speed limit of 45 mph (Photo 1). The tanker was travelling westbound.

After traveling approximately two miles and completing a slight right curve, victim #1 braked and steered the tanker towards the left side of the roadway. The tanker crossed over the double yellow center-line, and victim #1 attempted to steer the tanker back towards the right side of the road. According to the state highway patrol, victim #1 overcorrected and the tanker began to skid sideways across the roadway. The tanker temporally ran off the right-side of the roadway, then proceeded to skid back onto the road and began overturning. According to witness statements, the tanker rolled over three to four times onto the roadway.

The state highway patrol estimated that the tanker continued to travel 55 feet before it came to rest sitting upside-down and lying across the roadway and partially on the westbound shoulder of the road (Photo 2). The state highway patrol estimated that the tanker was traveling approximately 50 mph at the time of the incident, and concluded that neither of the victims were wearing a seat belt.

The fire fighters following the tanker in the POV ran to check on the occupants of the tanker. At approximately 1155 hours, one of the fire fighters from the POV called 911 for help on his mobile telephone, then called the fire department to report the incident. Victim #1 was ejected, and he was found lying in a prone position, approximately ten feet from the tanker. Victim #2 was found to be partially ejected and was pinned under the cab area of the tanker on the passenger side. The fire fighters from the POV used a fire extinguisher to extinguish a small engine fire that had ignited under the tanker. The Chief of the department was monitoring his radio while at work, and after hearing the dispatch, responded to the incident scene.

At approximately 1200 hours, the state highway patrol and emergency medical services arrived on the scene. At 1211 hours, EMS pronounced victim #1 and victim #2 dead on the scene. At approximately 1248 hours, both of the victims were transported to the hospital.

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 identifies the following items as key contributing factors in this incident that ultimately led to the deaths of 2 fire fighters.

- unsafe operation of the tanker for the roadway.
- Driver's inability to control the vehicle once it started to skid.
- Seat belts not being worn by the fire fighters.

CAUSE OF DEATH

The medical examiner listed the cause of death for both of the victims as blunt force trauma due to a motor vehicle accident.

RECOMMENDATIONS

Recommendation #1: Fire departments should develop and enforce standard operating procedures (SOPs) that require mandatory use of seat belts in all moving vehicles.

Discussion: Fire departments should develop, implement and enforce SOPs on the use of seat belts.[3] The SOPs should apply at all times to all persons riding in all moving emergency vehicles.[4] All occupants of an emergency apparatus must be seated within the cab or body and wearing their seat belts before the apparatus is put in motion.[5] Fire department apparatus operators should be trained to understand that a driver who is properly secured by a seat belt has a better chance of maintaining control of the vehicle and possibly avoiding a crash, as well as a greater probability of survival, should a traffic incident occur. According to the Volunteer Firemen's Insurance Services, Inc. (VFIS) "motor vehicle incidents are responsible for nearly a quarter of fire fighters injuries each year. Fire fighters are being injured and killed in vehicle incidents because they were not wearing seat belts."[6] The International Association of Fire Chiefs (IAFC) board of directors adopted a position statement on seat belt use.[7] The statement establishes that all emergency-response agencies must have and strictly enforce a seat belt usage policy with effective disciplinary guidance that applies to all vehicles on department business, including personally owned vehicles. This policy statement includes a suggested model policy that can be adapted to the needs of individual fire departments.[8] The suggested model seat belt policy recommends that a department utilize a progressive disciplinary system holding the violator and the supervisor responsible to ensure compliance with the seat belt policy, reflecting the serious and potential life threatening consequences of failure to comply.

In its publication *Safe Operation of Fire Tankers*,[9] the United States Fire Administration (USFA) cites a Department of Transportation (DOT) study of seat belt use which revealed the following statistics: 1) 75 percent of 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. In addition to increasing the chance of surviving a crash, an operator who is properly secured by a seatbelt has a better chance of maintaining control of the vehicle in an emergency situation.

Seat belts must be worn whenever the apparatus is in motion. A significant percentage of tanker incidents involve the vehicle rolling over and the driver and/or passenger(s) being thrown from the vehicle. The chance of serious injury or death is greatly multiplied when the occupant is thrown from the apparatus.[8] Wearing seat belts will prevent nearly all ejections from the apparatus. At the time of the incident, the fire department had an SOP on emergency driving, but did not have written SOPs

regarding the use of seat belts. Since this incident, the fire department has developed written SOPs that mandate and enforce the use of seat belts.

Recommendation #2 : Fire departments should ensure that all drivers of fire department vehicles receive guidance on the safe and prudent operation of the vehicles under all conditions.

Discussion: The posted speed limit on the road where the incident occurred is 45 mph. The North Carolina Highway Patrol uniform traffic accident report estimated the speed of the tanker at 50 mph at the time of the incident. In many cases, tankers should be driven at a much slower speed through curves than what is posted. Tankers should never be driven at a speed at which the vehicle cannot be fully controlled.[3,9] Tankers tend to be heavier and have a higher center of gravity than other fire vehicles.[3,9] Both of these factors affect the driver's ability to control a tanker. Based on physics, a top-heavy vehicle is inclined to tip or roll over if driven through a curve at an unsafe speed.[8] NFPA 1500 Section 6.2.4: Drivers/Operators of Fire Department Apparatus, states that "Drivers of fire apparatus shall be directly responsible for the safe and prudent operation of fire department vehicles."[10]

When a department conducts initial driving and refresher driver training, it is imperative that fire fighters that are designated as drivers understand all the principals and the myriad of the potential problems that can occur while driving a fire apparatus. According to the USFA publication *Safe Operation of Fire Tankers*,[9] one of the most common causes for serious fire department crashes is overcorrection by the driver when the vehicle's tires leave the roadway. Roadways that are not accompanied by paved shoulders outside of the driving lanes, as in this incident, typically have a slight drop-off of several inches at the pavement edge. Avoiding conditions that lead to skidding is as important as knowing how to correct skids once they occur.

The most common causes of skids include:

- Driving too fast for road conditions
- Failing to properly appreciate weight shifts of heavy apparatus
- Failing to anticipate obstacles (these range from other vehicles to animals)
- Improper use of auxiliary braking devices
- Improper maintenance of tire air pressure and adequate tread depth.[5]

According to *Safe Operation of Fire Tankers*,[9] a fire apparatus driver often gets into trouble when attempting to return the vehicle onto the paved surface by quickly turning the steering wheel toward the left, while maintaining speed. Often the result of this action is the apparatus lurching severely towards the left when the right side wheels jump back onto the paved surface. This may cause the tanker to travel into oncoming lanes of traffic, travel completely over to the opposite side of the roadway, or to simply over-turn. If the right-side wheels go off the edge of the road, the apparatus should not be brought back onto the road surface while attempting to maintain speed. According to *Safe Operation of Fire Tankers*,[9] apparatuses should be slowed to an appropriate speed to remount

the paved surface before attempting to bring the wheels back onto the road surface. Fire departments can help ensure prudent operation of fire department vehicles by having written guidelines and SOPs, encouraging reporting of any unsafe driving, and following up by taking necessary corrective actions.

Recommendation #3: Fire departments should consider requiring that emergency vehicle operators/drivers receive driver training from a State or other nationally recognized training program, in addition to specific departmental driver training.

Discussion: Establishing an effective fire apparatus driver training program is not a quick and simple process. There are multiple components of a properly designed driver training program, including classroom (theoretical) and practical (hands-on) training sessions. Fire departments should consider requiring their emergency vehicle operators/drivers to receive driver training from a State or other nationally recognized training program in addition to specific departmental driver training. Requiring that an emergency vehicle operator/driver successfully complete an accredited emergency vehicle driver training program in addition to specific departmental driver training helps ensure quality training based on current and state-of-the-art knowledge, and a consistent foundation for driving a fire apparatus in emergency and nonemergency situations. The accredited emergency driving program would provide consistent instructor qualifications, classroom (theoretical) instruction (i.e., applicable laws and liabilities, vehicle dynamics, emergency and nonemergency driving procedures, crash and injury prevention measures and vehicle and apparatus care procedures), practical (hands-on) driving with an evaluation, and written examination.[9]

The State of North Carolina where this incident occurred has an "*Emergency Vehicle Driver Certification*" program, which is considered to be a minimum standard with the intent, that through a voluntary program, personnel who drive emergency vehicles in the State of North Carolina will meet or exceed this certification.[11] The North Carolina certification program consists of entrance requirements, program requirements, student evaluations, and a practical examination.

Recommendation #4: Fire departments should consider encouraging all members to sign the "National Fire Service Seat Belt Pledge" to reinforce the importance of wearing seat belts.

Discussion: Fire departments should consider encouraging all members to sign the "National Fire Service Seat Belt Pledge" [12] to reinforce the importance of wearing seat belts. The National Fallen Fire Fighter Foundation has established the following pledge:

"I pledge to wear my seat belt whenever I am riding in a Fire Department vehicle. I further pledge to insure that all my brother and sister fire fighters riding with me wear their seatbelts. I am making this pledge willingly; to honor Brian Hunton, my brother fire fighter, because wearing seat belts is the right thing to do."

The International Association of Fire Chiefs (IAFC), the U.S. Fire Administration, the National Volunteer Fire Council, the National Fire Protection Association, the National Institute for Occupational Safety and Health, and the National Fallen Firefighters Foundation are committed to

promoting firefighter seat belt use and are supportive of this pledge. This program was created because vehicle crashes are the second leading cause of firefighter line-of-duty deaths, and not wearing seat belts is the number one vehicle related safety concern in the fire service. This seat belt campaign supports the Everyone Goes Home®[11] firefighter life safety initiatives www.everyonegoeshome.com. Fire departments that achieve 100% of their members signatures on the seat belt pledge will receive a National Certificate recognizing their commitment to firefighter safety and the use of seat belts.

This pledge was created to honor fire fighter Christopher Brian Hunton, age 27, of the Amarillo (Texas) Fire Department. In 2005, he fell out of his fire truck responding to an alarm. He died two days later from his injuries. Brian was not wearing his seat belt. To download the Seat Belt Pledge for your department and to watch the progress of this initiative across the country, go to http://www.everyonegoeshome.com/resources/pledge.pdf .

To date, over 70,000 firefighters have taken the pledge and approximately 300 fire departments have received a 100% Certificate for their accomplishment in getting all personnel to sign the pledge. The goal of this program is 1,000,000 firefighter signatures and 30,000 fire departments with 100% participation.

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INVESTIGATOR INFORMATION

This incident was investigated by Nancy T. Romano, Safety and Occupational Health Specialist, NIOSH, Division of Safety Research, Surveillance and Field Investigation Branch.

Photo 1. Westbound view of the road the tanker was traveling.
(Photo courtesy of the NC State Highway Patrol)

Photo 2. Incident scene
(Photo courtesy of the NC State Highway Patrol)