



F A C E

Fatality Assessment and Control Evaluation Program

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Traffic Control Supervisor Dies When Struck By An Asphalt Dump Truck While Picking Up Cones on a Roadway Work Zone - Tennessee

SUMMARY

On May 11, 2005, a 52-year-old male traffic control supervisor (the victim) was backed over in a roadway work zone by a dump truck hauling asphalt. The victim was part of a sub-contracted crew providing traffic control on a city street while paving was being done. The traffic control crew had re-arranged the work zone for a new paving operation, and the victim was picking up some extra cones in the work zone. The victim was facing away from an asphalt dump truck that was traveling in reverse towards the paver. The driver felt a “bump” and saw some cones tumbling into the road. He stopped, pulled forward and parked the truck. The driver and a traffic control worker found the victim lying face down on the ground moaning while clutching some traffic cones. They yelled for someone to call 911.

Approximately 4 minutes later, Emergency Medical Services (EMS) arrived on scene, assessed the victim and found he had multiple injuries. The victim was transported via ambulance to an area hospital, where he was later pronounced dead.

NIOSH investigators concluded that, to help prevent similar occurrences, employers should:

- *ensure that backing procedures are in place for the use of mobile construction vehicles, a spotter is designated to direct backing, and drivers are in communication with workers on foot*
- *develop, implement and enforce procedures that minimize exposure of workers on foot to moving construction vehicles and equipment*

Fatality Assessment and Control Evaluation (FACE) Program

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatality Assessment and Control Evaluation (FACE) investigations when notified by participating states (Maryland, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia); by the Wage and Hour Division, Department of Labor; or when a request for technical assistance is received from NIOSH-funded state-level FACE programs in California, Iowa, Kentucky, Massachusetts, Michigan, New Jersey, New York, Oregon and Washington. The goal of FACE is to prevent fatal work injuries by studying the work environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact. FACE investigators evaluate information from multiple sources that may include interviews of employers, workers and other investigators; examination and measurement of the fatality site, and related equipment; and review of records such as OSHA, police, medical examiner reports, and employer safety procedures and training records. The FACE program does not seek to determine fault or place blame on companies or individual workers. Findings are summarized in narrative reports that include recommendations for preventing similar events in the future. For further information visit the FACE website www.cdc.gov/niosh/face or call toll free 1-800-35-NIOSH.

- *develop and implement specific training on equipment blind areas for mobile equipment operators and workers on foot*
- *consider installing after market devices (i.e., camera, radar, and sonar) on construction vehicles and equipment to help monitor the presence of workers on foot in blind areas*

Additionally,

- *employers and companies performing any type of final assembly on construction vehicles should ensure that safety equipment is installed in accordance with the manufacturer's specifications and operates as intended*
- *Manufacturers of heavy construction equipment, such as dump trucks, should explore the possibility of incorporating new monitoring technology (e.g., radio frequency identification (RFID) tags and tag readers) on their equipment to help monitor the presence of workers on foot in blind areas*
- *The U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) and State OSHA Plans should consider a rulemaking effort to improve the safety regulations and require new safeguards for employees on roadway construction worksites*

INTRODUCTION

On May 11, 2005, a 52-year-old male traffic control supervisor (the victim) died from injuries received when he was struck and backed over by an asphalt dump truck while picking up cones in a roadway work zone. On May 12, 2005, officials of the Tennessee Occupational Safety and Health Administration (TOSHA) notified the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), of the incident.

On September 15, 2005, a DSR safety and occupational health specialist conducted an investigation of the incident and reviewed incident circumstances with the investigating TOSHA safety compliance officer and his manager. Photographs of the incident site and witness statements taken by TOSHA shortly after the incident were reviewed. The city police report was reviewed. On September 15, 2005, the victim's employer was interviewed. No site visit was conducted because the job had been completed. The medical examiner's report and death certificate were reviewed.

Employer. The victim's employer was a subcontractor providing work zone traffic control. The company had been in business for approximately 3 years, and primarily worked in the state of Tennessee. The company employed 3 full-time and 100 part-time workers, primarily hiring off-duty fire fighters as part-time workers.

The employer was subcontracted one week prior to the incident to provide traffic control services for a paving subcontractor. The employer had been previously subcontracted by this paving subcontractor several times a month throughout the year. Two days prior to this incident, the

paving subcontractor used this employer to provide traffic control at another work site, however the victim was not assigned to that job.

On the day of the incident, the employer sent a crew of three workers consisting of a traffic control operator, an uniformed off-duty police patrol officer, and a work zone traffic control supervisor (the victim). The traffic control operator and the uniformed off-duty police patrol officer had worked part-time for approximately one year. This was the company's first workplace fatality.

Victim. The 52-year-old male victim had been working part-time for the company for 2 years. On the day of the incident, the victim was working as a traffic control supervisor, and he was wearing a Class II^a lime safety vest and work boots. To be a supervisor, the victim completed the American Traffic Safety Services Association (ATSSA) traffic control supervisor 2-day training course.¹ This training covered responsibly for the installation, maintenance and removal of traffic control devices. Prior to becoming a supervisor, the victim was a traffic control operator for one year. The victim's full-time occupation was as a district fire chief; he was a 30-year veteran with a career fire department.

Training. The company had a written safety program. The employer attended the ATSSA flagger instructor one-day training course, which has pre-requisites that the traffic control technician and traffic control supervisor courses be completed. The employer provides all traffic control training when new employees are hired to provide traffic control services. All new traffic control employees are required to receive a safety orientation and the ATSSA traffic technician one-day course, which teaches concepts, techniques and practices in the installation and maintenance of traffic control devices. Additionally, on-the-job training was provided for new workers by going out to various jobsites with a supervisor for several days. In addition to having prior experience as a technician, the employer requires that supervisors attend the ATSSA supervisor traffic control two-day course.

The traffic control operator and the uniformed off-duty police patrol officer had completed the ATSSA traffic technician course. Additionally, the uniformed off-duty police patrol officer was a certified flagger. All training was documented by the company.

According to TOSHA, the driver of the truck worked for the paving subcontractor for approximately 22 years and received yearly refresher driver training.

Incident Scene. There was an original contract for road work on an interstate that was awarded to a general contractor by the State of Tennessee, Department of Transportation. The contract required that any damage to city streets caused by construction equipment be repaired. Some of the streets in the vicinity were damaged; therefore some paving and repair work was needed. For the paving and repair work, the victim's employer was subcontracted by a paving subcontractor

^a A high visibility safety garment. The American National Standards Institute (ANSI) and the International Safety Equipment Association (ISEA) recommend a Class II garment for workers who require greater visibility under inclement weather conditions, when backgrounds are complex, or when tasks divert attention from approaching vehicle traffic moving in excess of 25 miles per hour.

to provide traffic control services, which consisted of stopping and releasing public traffic. The paving subcontractor was responsible for directing all the construction vehicles and equipment within the roadway work zone. Each of the traffic control workers had a radio to communicate between themselves and they would monitor the progress of the paving operation to determine what needed to be done.

The paving subcontractor was contracted to pave four traffic lanes and a turning lane on a city street. The paving to be performed was between two intersections and was approximately one block in length. Two traffic lanes and a turning lane ran south, while two other traffic lanes headed north (Diagram). There was an interstate overpass that ran above the incident site. The day of the incident was the workers' first time working together at this location.

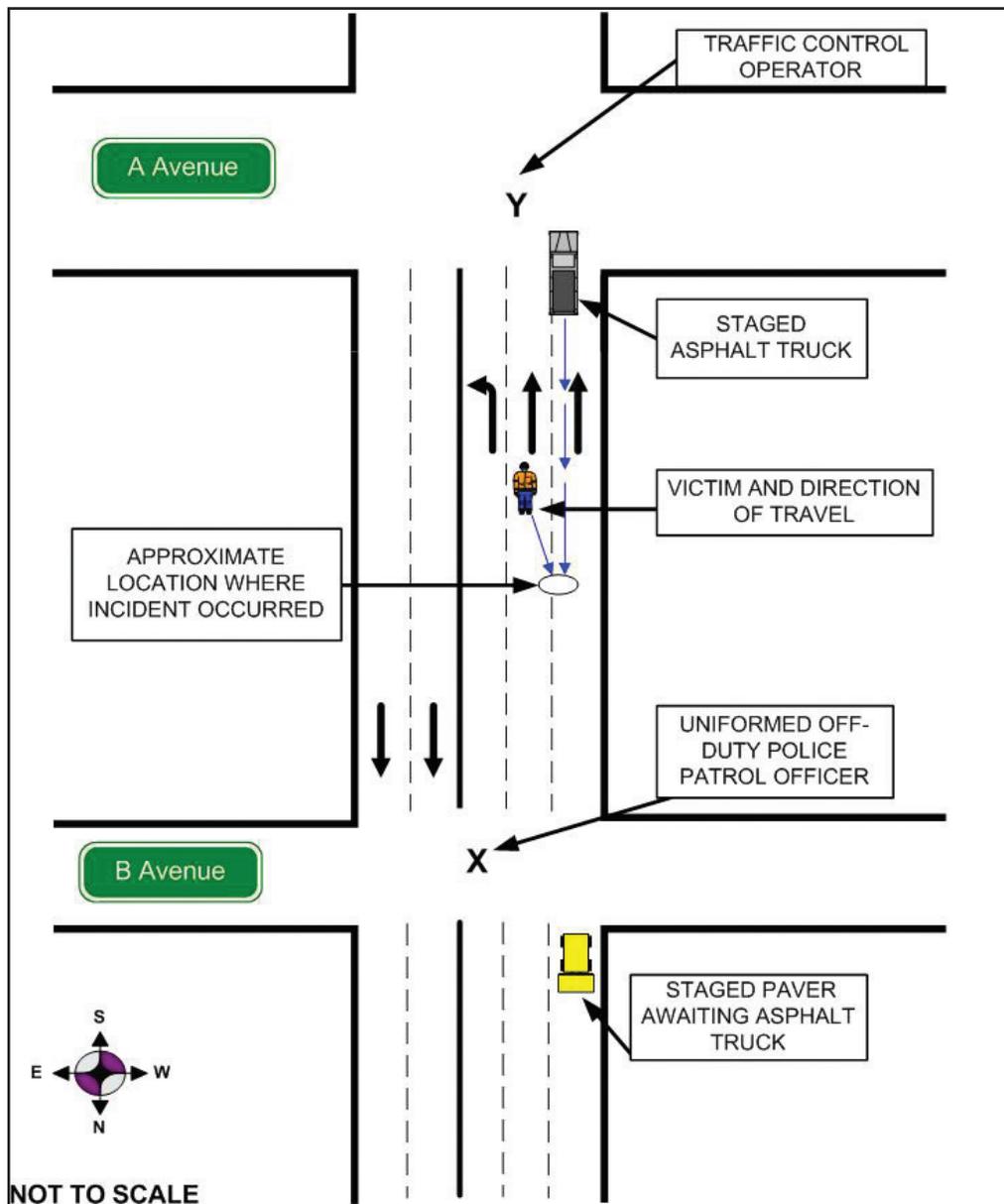


Diagram. Aerial view of incident scene

During the paving operation, the paver with an asphalt dump truck positioned in front moved slowly forward as the truck dumped asphalt into the paver, which laid the asphalt onto the road surface. Once a dump truck was emptied, the driver would leave to pick-up another load, and radio and tell the next staged asphalt dump truck to bring asphalt to the paver.

The traffic control operator used a STOP/GO paddle to control traffic. The uniformed off-duty police patrol officer could control the traffic lights. Orange traffic cones were used as channelizing devices to warn and guide the public drivers. Road work signage consisted of a warning of “Road Work Ahead” and one stating “One Lane Ahead.”

Equipment. The asphalt dump truck involved in this incident was owned and operated by the paving subcontractor. The diesel 5-ton tandem-axle truck was purchased new in 2004, and had a gross vehicle weight rating (GVWR) of 72,000 pounds (Photo 1).



Photo 1. Photo of the dump truck. [Photograph courtesy of the TOSHA].

The truck was equipped with dump cylinders and the bed was approximately 16 feet in length and 8 feet in width. The sides and tailgate of the truck bed were approximately 6 feet in height, and the rear of the truck bed was approximately 42-inches above the ground. Mounted on each door of the truck was a mirror equipped with a round spot (convex) mirror. In addition, on each side of the front fenders of the truck was a convex spot mirror. Due to the dump bed, the vision out of the rear view window of the truck was completely obstructed. On each side in the rear on the dump bed, there was a red light that flashed when the truck was placed into reverse. Additionally, under the rear dump bed tailgate there were three lights (a red, white, and a flashing red) that lit when the truck was in reverse gear.

Following the purchase of the truck, a local vehicle dealer sent the chassis to an out-of-state company for the installation of the dump bed and to complete final assembly. Included in the installation and final assembly was the installment of an audible reverse alarm to the frame of the dump body (Photo 2 and Photo 3).



Photo 2. Photo shows a view of the rear of the truck. The reverse signal alarm is mounted behind the frame which is indicated by an arrow. [Photograph courtesy of the TOSHA].



Photo 3. Photo shows the view under the raised dump bed. Note the grill of the reverse signal alarm which is facing towards the front of the truck. [Photograph courtesy of the TOSHA].

At the time of the incident, the paving subcontractor required that the truck be inspected daily by using an equipment checklist that the driver completed and documented prior to each shift (e.g., brakes, horn, lights, wipers, reverse alarm, and safety equipment). The documented checklist was completed by the driver on the morning of the incident.

Weather. It was daylight at the time of the incident. Conditions were clear, sunny, and the temperature was in the 50's.

INVESTIGATION

On May 11, 2005, at approximately 7:00 a.m., the crew of three workers, a traffic control operator, a uniformed off-duty police patrol officer, and a traffic control supervisor (victim), began providing traffic control services for a paving subcontractor. The paving subcontractor had nine workers on the site including two asphalt truck drivers, a project representative, and an asphalt foreman.

At approximately 9:45 a.m., following the completion of some paving and patching work, the paving and traffic control workers relocated to another street to perform paving activities (Diagram). The traffic control crew set up a roadway work zone by placing cones to show the traffic boundaries and placing signage to warn the public traffic. The northbound lanes were paved first. The uniformed off-duty police patrol officer was positioned at the “B” Avenue (North) intersection, while the traffic control operator was detailed to the “A” Avenue (South) intersection. While standing near the intersection with the uniformed off-duty police patrol officer, the victim monitored the progress of the paving activities and assisted with the placement of traffic cones in the work zone.

Work progressed until paving was completed on both northbound traffic lanes. The next section to be done were the southbound traffic lanes and the turning lane. Because the paver was positioned near the north intersection, the paving subcontractor decided to start the paving with the turning lane and progress from north to south. The traffic control crew stopped traffic momentarily and re-positioned the cones to establish the new work zone. The new traffic control zone routed northbound traffic into one lane onto the easternmost newly paved lane that was normally opened to northbound traffic. A driver staged his dump truck loaded with asphalt facing the “A” Avenue (south) intersection to reverse back towards the paver located in the southbound lanes.

While at the south intersection, the traffic control operator observed the victim walking toward him picking up a few cones. As the traffic control operator began walking to assist the victim, the victim waved and yelled that he had them. It is theorized that three to five cones were remaining from the previously established work zone, and while they were not impeding the job, it is believed the victim was picking them up as a precaution so they would not be too close to the paver when paving of the turning lane began.

The driver of the staged asphalt dump truck received a call on the radio from the other dump truck driver that had been supplying the asphalt to the paver, that the paver was staged for more asphalt and was waiting for asphalt just north of the “B” Avenue intersection. As the traffic control operator walked back to the south intersection, he observed the staged asphalt dump truck backing through the work zone toward the north intersection and paver. Once he returned to his intersection, the traffic control operator turned and saw the asphalt dump truck continuing to travel in reverse. He could see further down the work zone, where the victim was walking with his back towards the reversing asphalt dump truck while carrying the cones and making his way back to the “B” Avenue intersection.

The asphalt dump truck driver continued backing, and after traveling approximately 172 feet, he felt a “bump.” Looking in his mirror, he saw some traffic cones tumbling in the roadway. Thinking he had struck something, he stopped, then pulled forward and parked. After hearing the truck come to a hard stop, the traffic control operator looked back at the driver sitting in the truck. He raised his arms and shrugged, as to say what is going on, and the driver motioned towards the rear of his truck. The traffic control operator ran back to see what occurred as the driver was getting out. They found the victim lying behind the truck, face down on the ground, moaning and clutching some cones. They yelled for someone to call 911.

At approximately 11:22 a.m., Emergency Medical Services (EMS), the city police, and fire department were dispatched to the incident scene. EMS arrived on the scene at approximately 11:26 a.m., assessed the victim, and found he had multiple injuries. The victim was transported via ambulance to an area hospital where he was pronounced dead at 3:55 p.m.

According to the city police report, the pants of the victim showed tire prints that began at the bottom of the leg area and continued to the waist area. Additionally, a post inspection of the truck by the city police found physical evidence on the driver's side rear outside tandem tire that indicated the tire had struck the victim. The police report indicated that the reverse alarm and all the flashing lights were operable following the incident.

On May 17, 2005, at the paving contractor's office, TOSHA conducted an investigation of the truck and found that the reverse alarm was mounted on the frame panel with the sound grill opening facing the front of the truck (Photo 3). The reverse alarm manufacturer's installation instructions clearly stated that the sound opening grill should be mounted to face the target hazard area, which would be the rear of the truck. The TOSHA compliance officer conducted a sound level meter evaluation of the reverse alarm with the truck running. Sound pressure was measured at 82dB(a) at the rear of the truck, 74dB(a) approximately 10 feet from the rear of the truck, and 72 dB(a) 20 feet from the rear of the truck. TOSHA determined that the audible reverse alarm was functioning below the alarm manufacturer's rating level of 97 dB(a). It should be noted that TOSHA could not determine what the actual surrounding noise level was at the time of the incident.

CAUSE OF DEATH

The medical examiner's report stated that the cause of death was multiple blunt force injuries.

RECOMMENDATIONS /DISCUSSION

Recommendation #1: Employers should ensure that backing procedures are in place for the use of mobile construction vehicles, a spotter is designated to direct backing, and drivers are in communication with workers on foot.

Discussion: Backing procedures should be developed and implemented for each roadway construction job. In this case, there was not an established backing protocol or designated backing spotters. Backing protocols should include, but not be limited to, an assigned backing spotter, and policies that backing will not begin without an understandable signal from the spotter that it is safe to start backing.² In addition, operators of construction vehicles and equipment must come to a complete stop if contact with a spotter is lost, and backing should not resume until contact is re-established. All equipment operators and truck drivers, upon entering the construction site, should be aware of who the spotters are, and the established backing protocol. To assist with making themselves visible to the operators, all workers on foot (e.g., spotters, flaggers) should be required to wear a high visibility safety garment.²

Employers must ensure adequate communication among all workers on the construction roadway work zone site. Communication of any changes to scheduled tasks is critical, especially between mobile equipment operators and workers on foot. This can be accomplished by personal one-on-

one communication, hand signaling, or with two-way radios. In this incident, when a driver was out of asphalt, he would call on the radio to the next staged dump truck and instruct it to report to the paver while providing the staging location, without explicit communication to workers on foot.

Recommendation #2: Employers should develop, implement and enforce procedures that minimize exposure of workers on foot to moving construction vehicles and equipment.

Discussion: According to a December 2004 article in the Bureau of Labor Statistics Monthly Labor Review, of the 844 fatal workplace injuries on road construction sites identified by the Census of Fatal Occupational Injuries (CFOI) from 1995 to 2002, about 60 percent were the result of a worker being struck by a vehicle or some kind of mobile equipment. Two-hundred and seventy-four workers were struck by trucks (including 100 dump trucks), 172 were struck by automobiles or other vehicles, and 63 workers were struck by machinery.³ It is critical that employers develop procedures to minimize exposure of workers on foot to moving vehicles and equipment in the tight confines of roadway construction work zones. In this incident, the traffic control crew were designated to provide traffic control for the public traffic, while the paving subcontractor controlled all construction vehicles and equipment within the work zone. Each employer on a multi-employer roadway work site needs to work together cohesively. Construction vehicle and equipment operators, and workers on foot, need to be made aware of the potential for exposure and steps to minimize hazards for workers on foot.

Internal traffic control plans (ITCP) are a promising tool for protecting workers on foot from moving vehicles and equipment.⁴ ITCPs are site-specific plans that coordinate the flow of construction vehicles, equipment, and workers on foot. ITCPs identify directions and pathways for moving vehicles and equipment, and should be developed by employers to minimize the backing of vehicles and equipment, to the extent possible. ITCPs may also include designated walkways for workers on foot that are clear of operating construction vehicles and equipment, and should be developed to minimize the backing distance of vehicles and equipment and to designate areas of a work zone that are prohibited for workers on foot. For small recurrent operations such as filling potholes, routine maintenance, and mowing work zones, a checklist could be used in place of a complete ITCP.^{2,4} An ITCP used in combination with communication and a site specific backing protocol could reduce the likelihood of workers on foot being struck by backing vehicles.

Additional information and recommendations for protecting roadway construction workers can be obtained from the NIOSH document entitled “Building Safer Roadway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment,”² and the Roadway Work Zone Safety and Health Coalition Alliance document entitled “Internal Traffic Control Plans.”⁴

Recommendation #3: Employers should develop and implement specific training on equipment blind areas for mobile equipment operators and workers on foot.

Discussion: OSHA regulations require employers to train workers to recognize and avoid unsafe conditions that may be present in their work environments, and to provide training on the regulations

applicable to their work.⁵ Training should be an essential part of a roadway construction company's safety program and should address, at a minimum, all known and anticipated hazards. Roadway construction workers and mobile equipment operators should be made aware that blind areas exist around construction vehicles and they should receive specific training in the identification of these blind areas. A blind area (or blind spot) is the area around a vehicle or piece of construction equipment that is not visible to the operator, either by direct line-of-sight or indirectly by the use of internal and external mirrors. Training is important for both construction vehicle operators and workers on foot in proximity to vehicles and equipment. As part of a research project evaluating different strategies to prevent worker injuries in construction work zones, NIOSH contracted with Caterpillar to provide blind area diagrams for 38 different vehicles or machines used in the construction industry.^{6,7} These diagrams may be useful in worker training.

Recommendation #4: Employers should consider installing after market devices (i.e., camera, radar, and sonar) on construction vehicles and equipment to help monitor the presence of workers on foot in blind areas.

Discussion: Rear-view cameras and sensors based on radar, sonar, and infrared technology are available to help monitor equipment blind spots.^{8,9} Although improvements may be needed to make this technology more durable in the rough physical environment of a construction site, this equipment shows promise as a tool for worker safety. A camera mounted on the rear of the equipment provides a view of the obstructed area on a video monitor in the cab. Sensor systems provide an alarm in the cab when a person or other obstacle is detected at the rear of the equipment. A combination of a camera and a sensor system may offer the best protection, especially in congested work areas.

Recommendation #5: Employers and companies performing any type of final assembly on construction vehicles should ensure that safety equipment is installed in accordance with the manufacturer's specifications and operates as intended.

Discussion: Following the employer's purchase of the new truck in this incident, the truck dealer sent it out of state for installation of the dump body and the audible reverse alarm. According to the manufacturer's installation instructions for the reverse alarm,¹⁰ for proper sound dispersion, the sound opening grill should be installed facing the targeted hazard area, which in this case would be the rear of the truck facing outward. According to the investigating TOSHA compliance officer, the alarm was functioning when it was tested after the incident; however, following further inspection, it was determined that the placement of the alarm did not follow the manufacturer's installation instructions. TOSHA determined that the reverse alarm was functioning below the alarm manufacturer's rating level of 97 dB(a).

When installing safety equipment on any construction vehicle or equipment, it is important to ensure that it is installed according to the manufacturer's installation specifications and is working to its optimal level as designed. It is imperative that an employer, prior to placing a new construction vehicle or equipment into service, completely inspect the vehicle to ensure that all safety features are installed correctly and are functioning at their optimal level. On this dump truck, the warning

alarm grill was visible when the dump bed was in the raised position. A visual inspection could identify an incorrect position installation. The reverse alarm sound level could also be checked by using a sound level meter, which would confirm the level at which the alarm is functioning.

Recommendation #6: Manufacturers of heavy construction equipment, such as dump trucks, should explore the possibility of incorporating new monitoring technology (e.g., radio frequency identification (RFID) tags and tag readers) to help monitor the presence of workers on foot in blind areas.

Discussion: In this incident, the police reported that the driver stated he did not see the victim behind the truck. Emerging technology, such as sensor-based systems, rear-view cameras, and radio frequency identification (RFID) tags and tag readers are becoming available for construction equipment, though testing and demonstration at construction projects are still needed.^{2,8,9} Collisions between construction vehicles, equipment and workers have been attributed, in part, to limited visibility around the equipment. As new or existing monitoring technologies are proven to be effective on work sites, equipment manufacturers should offer these systems on new equipment.

Recommendation #7: The U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) and State OSHA Plans should consider a rulemaking effort to improve the safety regulations and require new safeguards for employees on roadway construction worksites.

Discussion: The State of Washington is the first jurisdiction in the United States to enact specific legislation to protect roadway construction workers. Between 1998 to 2003 there were seventeen fatalities in roadway construction work zones in Washington. Of the seventeen fatalities, dump trucks were involved in eight of the fatalities. “Of those eight fatalities, six were the result of an employee being backed over by the dump truck.”¹¹

The State of Washington, with input from stakeholders, adopted an emergency rule in May 2004.¹¹ The rule included significant new requirements for dump truck drivers backing their vehicles inside roadway worksites. This rule, Washington Administrative Code (WAC) 296-155-610 (2)(f), was permanently adopted in December 2004, and became effective in January 2005.¹² It affects all construction companies that operate dump trucks in reverse while on the jobsite. The Washington State rule states that if you operate a dump truck^b in reverse within 50 feet of workers on the jobsite, that in addition to an audible warning device, the driver must use an observer to signal that it is safe to back up. If an observer is not used, the truck must have an operable mechanical device that provides a full view behind the truck, such as a video camera. More information about the Washington State regulation is available at: <http://www.lni.wa.gov/wisha/rules/construction/HTML/296-155m.htm#WAC296-155-610>.

^b The term “dump truck” includes both belly and rear dump trucks with a minimum pay load of four yards.

Additional Information. The NIOSH Safety and Health Topic Page on Highway Work Zones is available at: <http://www.cdc.gov/niosh/injury/traumazone.html>.

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INVESTIGATOR INFORMATION

This investigation was conducted by Nancy T. Romano, Safety and Occupational Health Specialist, Fatality Investigations Team, Surveillance and Field Investigations Branch, Division of Safety Research.

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