

Highway Accident Report

**Work Zone Collision Between
a Tractor-Semitrailer and
a Tennessee Highway Patrol Vehicle
Jackson, Tennessee, July 26, 2000**



**National
Transportation
Safety Board**
Washington, D.C.

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Abstract: About 8:52 a.m. on July 26, 2000, an eastbound 1999 International truck tractor pulling a loaded semitrailer, and traveling at a driver-estimated speed of 65 mph in a 55-mph work zone, collided with a Tennessee Highway Patrol (THP) vehicle trailing construction vehicles. Witnesses reported that the patrol car exploded and caught fire at impact. The patrol car was pushed approximately 192 feet before it came to rest in the median. The tractor-semitrailer continued through a 61-foot depressed earthen median and into the westbound lanes, where it collided with a 1997 Chevrolet Blazer. The tractor-semitrailer then continued across the travel lanes and came to rest in a wooded area on the north side of I-40. The State trooper in the THP vehicle was killed, and the Chevrolet driver was seriously injured.

The following major safety issues were identified in this accident:

- Lack of communication between the Tennessee Department of Transportation, its contractors, and the Tennessee Highway Patrol.
- Inadequate planning and coordinating of traffic control responsibilities between highway construction personnel and law enforcement officers before engaging in work zone activities.
- Need to train officers in safe traffic control procedures within highway work zones.

As a result of this accident investigation, the Safety Board makes recommendations to the Federal Highway Administration, the National Highway Traffic Safety Administration, the Tennessee Department of Transportation, the National Sheriffs' Association, the International Association of Chiefs of Police, and the American Association of State Highway and Transportation Officials.

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Acronyms and Abbreviations

AAMVA	American Association of Motor Vehicle Administrators
AASHTO	American Association of State Highway and Transportation Officials
ANPRM	advance notice of proposed rulemaking
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
I-40	Interstate Highway 40
MMUCC	Model Minimum Uniform Crash Criteria
MUTCD	<i>Manual on Uniform Traffic Control Devices</i>
NHTSA	National Highway Traffic Safety Administration
NIOSH	National Institute for Occupational Safety and Health
OCPS	Office of Capital Project Safety
Project CAR	Construction Accident Reduction Project
TDOT	Tennessee Department of Transportation
THP	Tennessee Highway Patrol
TMA	truck-mounted attenuator

Executive Summary

About 8 a.m. on July 26, 2000, a work zone project began near milepost 85.6 on eastbound Interstate Highway 40 (I-40) in Jackson, Tennessee. This was the third day of an operation that consisted of milling rumble strips into the shoulder pavement. The three construction vehicles that were involved were positioned along the outside shoulder of the interstate. Two Tennessee Highway Patrol vehicles, with their emergency lights flashing, were also present to assist with enforcement and traffic control. The THP vehicles were stopped 450 feet and 950 feet, respectively, behind the construction vehicles along the right lane.

About 8:52 a.m., an eastbound 1999 International truck tractor pulling a loaded semitrailer, and traveling at a driver-estimated speed of 65 mph in a 55-mph work zone, collided with the trailing Tennessee Highway Patrol vehicle. Witnesses reported that the patrol car exploded and caught fire at impact. The patrol car was pushed approximately 192 feet before it came to rest in the median. The tractor-semitrailer continued through a 61-foot depressed earthen median and into the westbound lanes, where it collided with a 1997 Chevrolet Blazer. The tractor-semitrailer then continued across the travel lanes and came to rest in a wooded area on the north side of I-40. The State trooper in the Tennessee Highway Patrol vehicle was killed, and the Chevrolet driver was seriously injured.

The National Transportation Safety Board determines that the probable cause of this accident was the driver's incapacitation, owing to the failure of the medical certification process to detect and remove a medically unfit driver from service. Contributing to this accident were the lack of planning and coordination between the Tennessee Department of Transportation, its contractors, and the Tennessee Highway Patrol regarding work zone projects; the lack of traffic control training, specific to highway work zone operations, provided to Tennessee Highway Patrol officers; and the failure of the Tennessee Department of Transportation and its contractors to protect all work zone personnel and road users.

The following safety issues were identified in this accident:

- Lack of communication between the Tennessee Department of Transportation, its contractors, and the Tennessee Highway Patrol.
- Inadequate planning and coordinating of traffic control responsibilities between highway construction personnel and law enforcement officers before engaging in work zone activities.
- Need to train officers in safe traffic control procedures within highway work zones.

As a result of this accident investigation, the Safety Board makes recommendations to the Federal Highway Administration, the National Highway Traffic Safety Administration, the Tennessee Department of Transportation, the National Sheriffs' Association, the International Association of Chiefs of Police, and the American Association of State Highway and Transportation Officials.

Factual Information

Accident Narrative

About 8 a.m. on July 26, 2000, a work zone project began near milepost 85.6 on eastbound Interstate Highway 40 (I-40) in Jackson, Tennessee. This was the third day of an operation that consisted of milling rumble strips¹ into the shoulder pavement. The three construction vehicles that were involved were positioned along the outside shoulder of the interstate. Two Tennessee Highway Patrol (THP) vehicles, with their emergency lights flashing, were also present to assist with traffic control. The THP vehicles were stopped 450 feet and 950 feet, respectively, behind the construction vehicles along the right lane.

About 8:52 a.m., an eastbound 1999 International truck tractor pulling a loaded semitrailer and traveling at a driver-estimated speed of 65 mph in a 55-mph work zone, collided with the trailing THP vehicle. Witnesses reported that the patrol car exploded and caught fire at impact. The patrol car was pushed approximately 192 feet before it came to rest in the median. The tractor-semitrailer continued through a 61-foot depressed earthen median and into the westbound lanes, where it collided with a 1997 Chevrolet Blazer. The tractor-semitrailer then continued across the travel lanes and came to rest in a wooded area on the north side of I-40. (See figures 1 through 4.) The State trooper in the THP vehicle was killed, and the Chevrolet driver received serious injuries.² The officer in the lead THP vehicle tried to extinguish the flames from the burning THP vehicle with a fire extinguisher but was unable to do so. A witness reported an attempt was made to extricate the officer from the burning vehicle, but that the heat from the fire was too intense.

At the time of the accident, the weather was clear and the temperature was 78 degrees.

¹ Rumble strips or “audible roadway delineators” are incorporated into shoulders to help prevent drift-off-the-road accidents. Rumble strips may be created by either rolling indentations into the pavement surface or by milling (grinding) depressions into the pavement.

² The Chevrolet driver’s serious injuries included a fractured arm and multiple lacerations, abrasions, and contusions. She was belted, and the vehicle air bags deployed, during the accident.

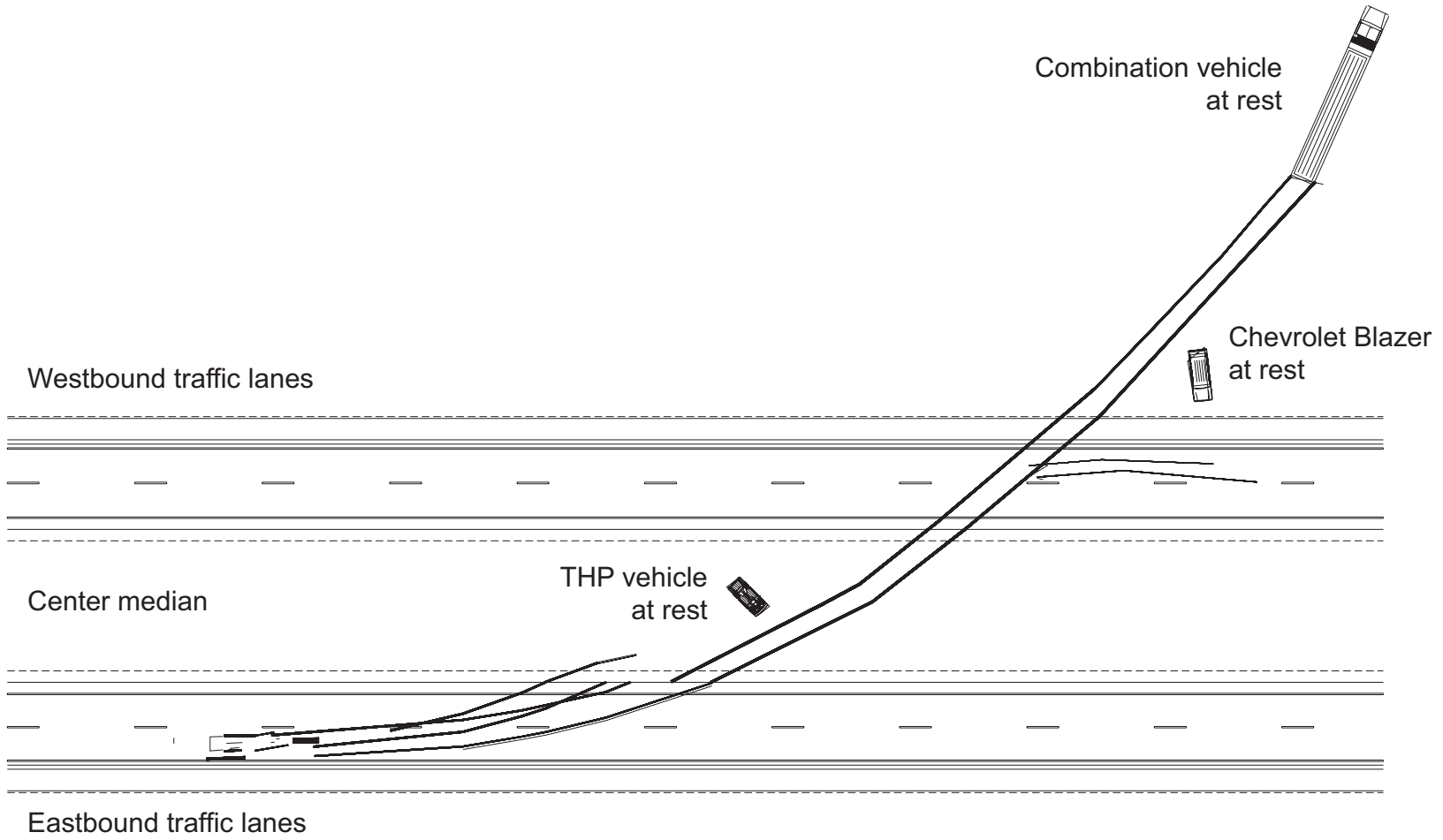


Figure 1. Accident diagram.



Figure 2. Accident scene.



Figure 3. Wreckage of patrol car.



Figure 4. Wreckage of trailer and Chevrolet Blazer.

Preaccident Events

Driver

According to the driver's logs and to statements made to the THP after the accident,³ the driver departed Long Beach, California, with a load of computer supplies on July 20, 2000. He reached Moriarty, New Mexico, on July 23 and rested in the tractor-semitrailer's sleeper berth from 10:00 p.m. to 7:00 a.m. On July 24, he drove for 9 hours and 30 minutes, performing an additional 45 minutes of on-duty activities upon arriving in Oklahoma City, Oklahoma. He entered the tractor-semitrailer's sleeper berth at 10:00 p.m. On July 25, he logged in as "on duty" at 7:00 a.m. He drove 9 hours and 15 minutes, performing an additional 30 minutes of on-duty activities upon arriving in West Memphis, Arkansas. He entered the sleeper berth at 11:00 p.m. The driver stated to the THP that he had "a pretty good night's sleep" that night. His last log entry indicated that he returned to duty on July 26, the day of the accident, at 7:00 a.m.

The driver told the THP that this was the second time he had driven through the construction area near Jackson, Tennessee, in the last 2 months and that he recalled seeing

³ The driver declined to speak to Safety Board investigators.

signs about the construction before reaching Jackson. He also recalled that the eastbound traffic was moderate and that the westbound traffic was heavier. The driver did not remember seeing the patrol car or its flashing blue light until immediately before hitting it. He stated that he may have tried to swerve, but he did not remember whether he had time to apply the brakes.

Witnesses driving behind the tractor-semitrailer before the accident stated that they observed the tractor-semitrailer drifting to the right of the roadway. One witness stated that he had observed the accident driver drift off the road twice. Another witness stated that the accident driver drifted off the road several times within a 5-mile span, and that, on one occasion, the driver ran completely off the road. This witness said he tried to contact the accident driver on his citizen band radio but could not reach him. He stated that before the collision, the accident driver had hit his brakes and veered to the left, as if someone had stopped in front of his vehicle.

Construction Project

The milling of rumble strips on the south shoulder of eastbound I-40 began on July 25th and was scheduled to be completed the next day. The construction vehicles involved were a milling machine, a sweeper with flashing yellow lights, and a protection vehicle with flashing yellow lights and a towed arrow board (see figure 5).⁴

⁴ The arrow display was a panel type C, which is defined in the *Manual on Uniform Traffic Control Devices* as having a minimum panel dimension of 96 by 48 inches, a minimum legibility distance of 1 mile, and a minimum of 15 lighting elements. Such displays are intended for use on high-speed, high-volume traffic control projects.

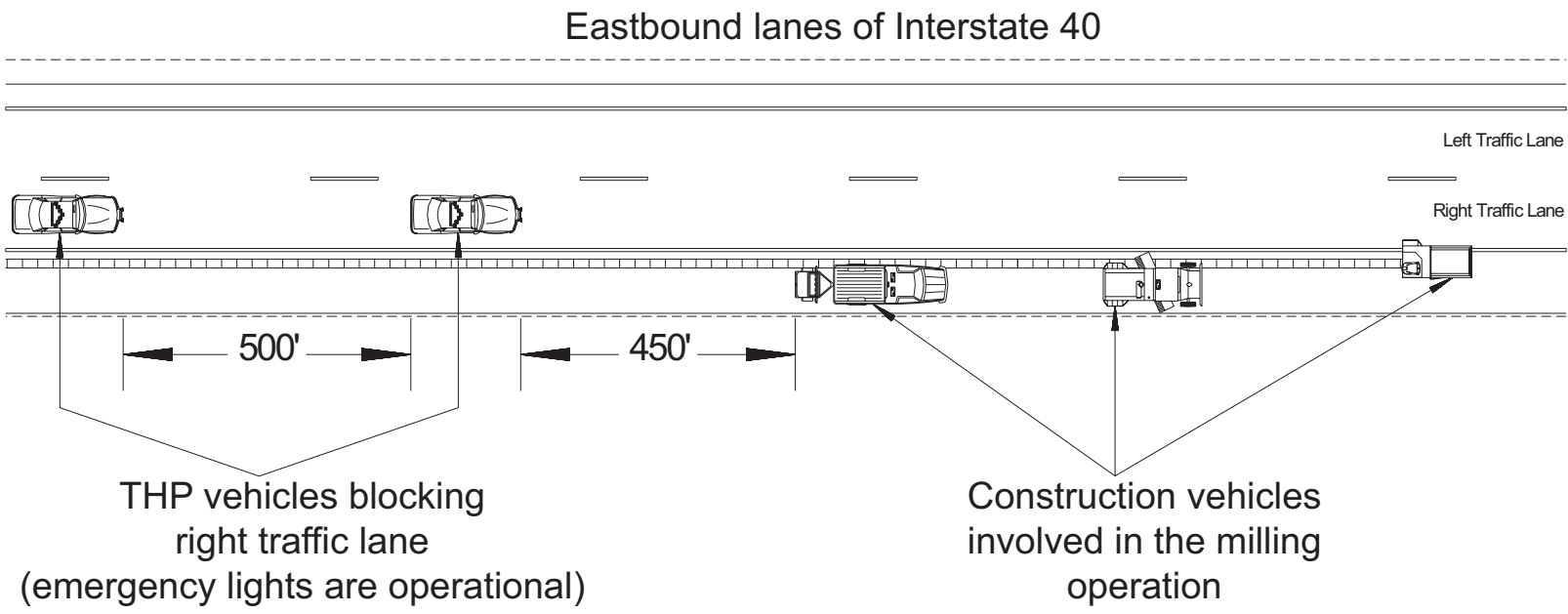


Figure 5. General configuration of THP vehicles and milling operations work caravan based on THP statements and evidence at accident scene.

Under the terms of the construction contract, Dement Construction Company was responsible for maintaining traffic control during the milling operation. Dement used two variable message signs, truck-mounted flashing yellow lights, a single portable arrow direction board, and two marked THP vehicles to accomplish traffic control. The two variable message signs had been placed east of the project in the center median—one at milepost 82 and the other near exit 85. (See figure 6.) The signs had been configured to alternate between three messages: 1) *USE CAUTION*, 2) *ONE LANE TRAFFIC AHEAD*, and 3) *WORKERS IN ROAD AHEAD*. The variable message signs did not specify which traffic lane was closed.

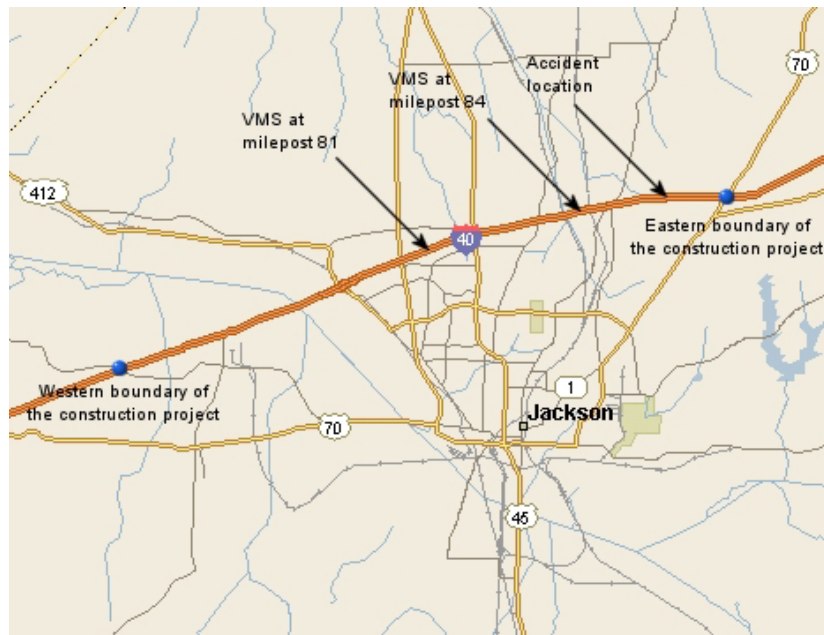


Figure 6. Map of work zone and accident location.

The THP assigned two officers to the work zone site to provide enforcement and traffic control support in accordance with the Construction Accident Reduction Project (Project CAR).⁵ Each officer drove a marked patrol vehicle with flashing lights to assist with traffic control duties. Both vehicles were positioned in the right traffic lane behind the milling operation. The first vehicle attempted to maintain a distance of about 500 feet from the rear of the operation, while the second vehicle attempted to maintain a separation of about 500 feet from the first marked patrol vehicle, or about 1,000 feet from the rear of the operation.

All of the construction vehicles were positioned on the roadway shoulder. According to the construction foreman, the only construction vehicle that encroached into

⁵ The Tennessee Department of Transportation and the THP created Project CAR in 1998 to increase motorist compliance with work zone traffic control devices. For further information, see the *Work Zone Safety* section later in this report.

the traffic lanes of the interstate was the milling machine, which extended approximately 1 to 1.5 feet into the traffic lane and left 10.5 to 11 feet of the lane available for the passage of traffic. He stated that he believed that the amount of construction vehicle encroachment into the traffic lane did not warrant a lane closure and that the operation complied with the guidance provided by the *Manual on Uniform Traffic Control Devices* (MUTCD).⁶ The foreman also stated that he believed the THP presence in the traffic lane was unsafe but assumed that the officers were familiar with traffic control operations and did not need his advice. According to the THP, the sweeper that trailed the milling machine also encroached into the traffic lane by 2 to 3 feet and generated a considerable amount of dust as it performed its operation.

The Tennessee Department of Transportation (TDOT) Regional Safety Coordinator stated that he received complaints throughout the day of July 25th that the messages displayed on the two variable message signs were confusing because motorists did not know which traffic lane was closed ahead.⁷ Additionally, TDOT personnel had also complained on the previous day to the Regional Safety Coordinator regarding the unprotected THP vehicles being positioned within the traffic lane. Based on the complaints he had received, the TDOT Regional Safety Coordinator stated that he planned to inspect the operation on the following day. The accident occurred before he reached the work zone.

During a postaccident interview, the construction foreman told Safety Board investigators that when the milling operation began, he had advised the THP officers who were assisting with traffic control that the operation would involve a “mobile lane closure.” By his definition, a mobile lane closure meant that all of the construction vehicles would be positioned on the shoulder of the highway and that traffic control efforts would be directed toward informing motorists ahead of time of the operation and keeping them away from the shoulder and a safe distance from the milling operation. He stated that despite the minor encroachment of the construction vehicles into the right traffic lane, he intended to keep both eastbound traffic lanes open. When the foreman observed the THP vehicles in the roadway blocking the right traffic lane, he said it made him extremely nervous. However, he stated that he felt too intimidated to advise the officers that it was not his intent to have the traffic lane blocked, and he also believed that the officers knew what they were doing.

The construction foreman further stated that he believed an additional arrow board, used in conjunction with the existing one, would have enhanced the safety of the operation. He had intended to include the additional arrow board on the morning of the accident, but at the time of the accident had not yet incorporated it. The construction diary for the day before the accident indicated that it was a State work zone inspector who had suggested incorporating a second arrow board.

⁶ Federal Highway Administration, Part VI of *Standards and Guides for Traffic Controls for Street and Highway Construction, Maintenance, Utility, and Incident Management Operations. Manual on Uniform Traffic Control Devices*, 1988 edition, revision 3 (Washington, DC: FHWA, 1993).

⁷ The number of complaints was not tabulated.

According to Part VI of the MUTCD,⁸ routine inspection of traffic control elements should be performed to ensure acceptable levels of operation. Individuals trained in the principles of safe traffic control should be assigned responsibility for the safety of the work sites to ensure that the traffic control measures in use are necessary, that they conform to the traffic control plan, and that they provide safe conditions to motorists, pedestrians, and workers alike.

The THP sergeant responsible for scheduling Project CAR officers informed investigators that when the construction foreman told him that he wanted a mobile lane closure, the sergeant and his officers understood this to mean that the lane next to the shoulder was to be closed off. To accomplish this closure, they positioned their marked THP vehicles within the lane and proceeded to pace the work operation, maintaining a distance of about 500 feet behind the last vehicle, which was the truck towing the arrow board.

Driver Medical Information

The investigation revealed that the 50-year-old tractor-semitrailer driver was involved in a similar accident in July 1997, when he struck a stopped highway patrol car in Utah, seriously injuring two troopers. The patrol car had been parked on the roadway to prevent other vehicles from running into a load of spilled gravel.⁹ After the Jackson, Tennessee, accident, the driver stated to the THP that he might have fallen asleep immediately before the accident.

The tractor-semitrailer driver's medical records from a Denver Veteran's Administration hospital indicated that in December 1996, during in-patient treatment for a severe infection of his legs, he was evaluated as possibly having obstructive sleep apnea. His physician recommended that he take part in a formal sleep study; the driver stated that he needed to return to work and would follow up promptly when he returned to Boise, Idaho. He did not formally undergo a sleep study until August 1997, the month following his involvement in the motor vehicle accident that seriously injured two troopers. He was diagnosed with obstructive sleep apnea and given a device¹⁰ to treat his condition. He was not able to tolerate the device and, in September 1997, underwent surgery to try to correct the disorder. His hospital records indicated that he suffered complications¹¹ from the surgery. He failed to keep a postsurgery appointment in the pulmonary clinic and never scheduled a followup sleep study. The driver did not indicate that he had been diagnosed or treated for obstructive sleep apnea on any of his commercial driver medical examination forms.

⁸ MUTCD, Part VI, 1988 edition, revision 3 (1993).

⁹ The driver was charged with a misdemeanor and fined.

¹⁰ A continuous positive air pressure mask that holds the airway open and keeps oxygen flowing freely during sleep.

¹¹ Postoperative swelling of the neck, resulting in difficulty swallowing and anxiety.

In September 1998, the driver was diagnosed with hypothyroidism¹² and placed on replacement thyroid hormone. He noted this condition on his October 1998 commercial driver medical examination form and was found by the physician performing the examination to have markedly diminished deep tendon reflexes.¹³ The physician noted that the driver had just begun replacement therapy but did not limit or deny the medical certificate.

On his August 1999 commercial driver medical examination form, the driver made no mention of hypothyroidism or his history of sleep apnea. Although he had been prescribed medication for his hypothyroidism, he indicated that he was not on any medication.

Following the accident, a pill bottle was found in the driver's truck cab. The bottle contained 85 of 90 pills of levothyroxine, a thyroid hormone replacement. The prescription date was 1998, with an expiration date of December 1999. The labeling noted that the prescription was the first of four available for refill of the medication. A blood test performed by the THP following this accident indicated that his thyroid hormone level was markedly low. Symptoms of untreated hypothyroidism may include fatigue, lethargy, constipation, cold intolerance, stiffness and cramping of the muscles, carpal tunnel syndrome, and, over time, a slowing of intellectual and motor activity, a decrease in appetite, and an increase in weight. Obstructive sleep apnea is also associated with untreated hypothyroidism.¹⁴

Neither obstructive sleep apnea nor hypothyroidism is specifically disqualifying for commercial drivers, although nonbinding Federal Motor Carrier Safety Administration (FMCSA) advisory criteria note that "there are many conditions that interfere with oxygen exchange ... including ... sleep apnea. If the medical examiner detects a respiratory dysfunction that in any way is likely to interfere with the driver's ability to safely control and drive a commercial motor vehicle, the driver must be referred to a specialist for further evaluation or therapy."¹⁵ No FMCSA guidelines address hypothyroidism.

TDOT Construction Project

The work zone project underway at the accident site was part of a TDOT rehabilitation construction project along a portion of I-40 traversing the city limits of Jackson, Tennessee. This section of I-40 consists of a four-lane divided highway, with the eastbound and westbound lanes separated by a 61-foot depressed grassy median. Heavy vehicles (over 10,000 pounds) constitute approximately 37 percent of the vehicle traffic.

¹² A condition of decreased activity of the thyroid gland.

¹³ Diminished cognitive and motor functions are typical symptoms of hypothyroidism.

¹⁴ Leonard Wartofsky, "Diseases of the Thyroid," eds. Kurt J. Isselbacher, Eugene Braunwald, and Jean D. Wilson, et. al., *Harrison's Principles of Internal Medicine*, 13th edition (New York: McGraw Hill, Inc., 1994) 1931-1953.

¹⁵ For further information, see <<http://www.fmcsa.dot.gov/rulesregs/fmcsr/medical.htm>>.

When no construction is being performed on this section of I-40, 85 percent of the vehicles travel at speeds of up to 76 mph. The project, which began on May 11, 2000, was located within Madison County, encompassing the section of I-40 beginning at Lower Brownsville Road and continuing east to State Highway 70.¹⁶ The project comprised three phases: pavement resurfacing and the installation of snowplowable reflective markers and guardrails (phase I), the milling of rumble strips (phase II), and the placement of lane markings (phase III).

Preconstruction Conference

On February 14, 2000, TDOT held a preconstruction conference. Personnel from TDOT, Dement Construction,¹⁷ and Traf-Mark¹⁸ attended the meeting. The attendees' list did not show that any THP personnel had attended the conference. In a postaccident interview, a TDOT representative¹⁹ explained to investigators that TDOT had not invited the THP to its preconstruction meetings because it assumed that the THP did not have the manpower to participate, given the extensive amount of roadway construction being performed within the State.

Contract Provisions

The TDOT construction contract included the following traffic control plans:

- Advance Road Work Signing on Divided Highways and Freeways
- Traffic Control for One Lane Closure on Multi-Lane Divided Highway (No Portable Barrier Rail Setup)
- Traffic Control for Two Right (or Two Left Inside) Outside Lane Closure on Freeway or Expressway
- Traffic Control for Two Right Outside (or Two Left Inside) Lane Closure on Freeway or Expressway (With Interconnected Portable Barrier Rail)

Although the contract contained traffic control plans for lane closure operations, it did not contain traffic control plans applicable to mobile operations or to shoulder work with minor encroachment, such as milling rumble strips, pavement striping, and other lane marking operations. The contract did not specify THP duties with regard to traffic control within the work zone.

¹⁶ Project number 57201-8111-44 comprised 6.13 miles of I-40; project number 57201-8110-44, 6.26 miles.

¹⁷ The primary contractor.

¹⁸ Subcontractor responsible for placing lane markers and performing pavement scoring operations within the construction project.

¹⁹ Regional Safety Coordinator, Tennessee Department of Transportation, Region 4, telephone conversation, February 2002.

Work Zone Standards

Tennessee used the MUTCD as its standard when creating traffic control plans. At the time of the accident, the 1988 MUTCD was the most recent edition.²⁰ It was supplemented by a 1993 revision to one of its chapters (Part VI),²¹ which provided additional traffic control guidelines for different types of construction projects. Two such guidelines pertained to the operational circumstances at the time of the accident: (1) shoulder work with minor encroachment²² and (2) lane closure on a divided highway.²³

The milling operation in Jackson, Tennessee, required at least one construction vehicle to encroach upon the 12-foot-wide right lane. Under circumstances such as this, Part VI of the MUTCD allows the encroached lane to stay open as long as there is at least 10 feet of travel space. A traffic sign reading “road work ahead” should be placed in advance of the construction, and additional signs, with a message such as “road narrows,” may also be appropriate. Channelizing devices, such as traffic cones, are optional if the protection vehicle²⁴ used is equipped with an activated flashing yellow light. Truck-mounted attenuators (TMAs), which are compact crash cushions attached to the rear of protection vehicles, are also optional. Part VI states that for high-speed traffic conditions, a lane closure should be considered.

The variable message signs in advance of the milling operation alternated between three messages: (1) *USE CAUTION*, (2) *ONE LANE TRAFFIC AHEAD*, and (3) *WORKERS IN ROAD AHEAD*. In the case of a lane closure on a divided highway, Part VI states that the work zone should include advance road signs that indicate which lane is closed, accompanied by a corresponding lane reduction symbol sign. Furthermore, channelizing devices and a protection vehicle with an activated flashing yellow light should be used to separate the work zone from the through traffic. TMAs are not required, but recommended.

The purpose of TMAs is to reduce the acceleration forces experienced by occupants of striking and struck vehicles. They are designed to decelerate and stop vehicles weighing as much as 4,400 pounds during head-on impacts up to a differential velocity of 62 mph.²⁵ The American Association of State Highway and Transportation Officials (AASHTO) *Roadside Design Guide* provides standards on the proper use of

²⁰ A newer version of the MUTCD (*Millennium Edition*) was published in December 2000. States have until January 17, 2003, to reach substantial conformance with the *Millennium Edition* of the MUTCD.

²¹ MUTCD, Part VI, 1988 edition, revision 3 (1993).

²² MUTCD, Part VI, 1988 edition, revision 3 (1993) 18-19.

²³ MUTCD, Part VI, 1988 edition, revision 3 (1993) 172-173.

²⁴ Protection vehicles include shadow vehicles, barrier vehicles, and advance warning trucks weighing at least 18,000 pounds.

²⁵ See *Recommended Procedures for the Safety Performance Evaluation of Highway Features* for more detailed information on attenuator testing requirements. Transportation Research Board, National Research Council, *Recommended Procedures for the Safety Performance Evaluation of Highway Features*, National Cooperative Highway Research Program Report 350, research sponsored by the American Association of State Highway and Transportation Officials in cooperation with the Federal Highway Administration (Washington, DC: National Academy Press, 1993).

TMA. The *Roadside Design Guide* “very highly” recommends that TMAs be used in mobile lane operations having no formal lane closure. It also “highly” recommends that TMAs be used in mobile shoulder operations and in formal lane closures that involve exposed personnel working in high-speed environments.

In 2001, the National Institute for Occupational Safety and Health (NIOSH) issued a report on work zone safety that discussed the use of TMAs.²⁶ It recommends that when worker exposure cannot completely be eliminated, positive protective barriers, such as TMAs, should be used to shield workers from traffic vehicles. The report adds that TMAs may be particularly useful in mobile work zones, where they can move forward as work progresses to protect workers from being struck from behind by traffic vehicles.

TMAs are not designed to stop heavy vehicles, such as trucks and motorcoaches, although anecdotal evidence exists that, in a few instances, TMAs have reduced the severity of injuries suffered by construction workers and heavy truck occupants.^{27,28} Typical TMAs are approximately 12 feet long and are mounted on the back of protection vehicles. To effectively stop a heavy truck without injuring the occupants of either vehicle, a TMA would have to be roughly twice as long, leading to weight and transport issues.²⁹ No federally funded research is currently underway on developing TMAs that would decelerate and stop heavy commercial vehicles.

Work Zone Safety

In late 1997, the Federal Highway Administration (FHWA), in conjunction with TDOT and the THP, began an assessment project to promote motorist compliance with traffic control devices and speed limits in and around work zones. Issues identified during this project included the utilization of police for traffic control and enforcement within work zones and the ability of law enforcement agencies to gather and report accurate work zone accident data.

Project CAR

Between 1995 and 1996, 5,140 vehicles were involved in accidents in Tennessee work zones. With extensive roadway renovations underway near Nashville, Chattanooga, Memphis, and Knoxville, construction worker fatalities increased 52 percent, from 19 to 29, during that period. In response to the hazardous conditions being experienced at these and other sites throughout the State, and in order to increase motorist compliance with

²⁶ National Institute for Occupational Safety and Health, *Building Safer Highway Work Zones: Measures to Prevent Worker Injuries From Vehicles and Equipment*, DHHS/NIOSH Publication No. 2001-128 (Washington, DC: DHHS/NIOSH, 2001).

²⁷ National Transportation Safety Board, *Highway Work Zone Safety*, Safety Study NTSB/SS-92/02 (Washington, DC: NTSB, 1992).

²⁸ Project Engineer, Exodyne Technologies, Incorporated, telephone conversation, February 2002.

²⁹ Safety and Structural Systems Associate Research Engineer, Texas Transportation Institute, telephone conversation, February 2002, and e-mail correspondence, March 2002.

work zone traffic control devices, TDOT and the THP formed a partnership in 1998 known as Project CAR. This initiative provides funds for TDOT to contract with the THP to station State troopers at work zones experiencing hazardous driving behavior. Project CAR's stated objectives are to:³⁰

- Reduce work zone fatalities.
- Encourage State troopers to maintain a goal of two hazardous moving violations for each hour worked.
- Ensure that disabled vehicles are expeditiously removed from work zones.
- Ensure that, upon request, State troopers assist TDOT workers in routing and directing traffic.

Project CAR does not specify lines of authority or how enforcement and traffic control are to be conducted. In addition, it does not provide THP officers with training or guidance on traffic control procedures for work zone operations.

THP Training

The THP's General Order 405 establishes the department's policies and procedures for traffic direction and control. The four pages of guidance contained in the General Order are presented to THP recruits while attending basic academy training. General Order 405 provides instruction for departmental procedures, the use of emergency lighting, and the use of hand signals during the manual direction of traffic. It does not contain procedures or terminology specific to work zone operations.

Postaccident Training Initiatives

Following this accident, the THP reassessed its training on traffic control procedures and identified the need to better train its personnel. The THP developed a 1-hour pilot class that was presented to supervisors from January through April 2001. In addition, from April through August 2001, a 2-hour course was presented to THP officers as part of their in-service training. The THP plans to incorporate this training into its academy curriculum by August 2002.³¹

The FHWA Tennessee Division office in Nashville provided engineering input into the incident management training that the THP adopted. Building on the THP's program and working in conjunction with the University of Tennessee Center for Transportation Research, the FHWA began a project entitled *Temporary Traffic Control During Law Enforcement Incident Management*. This project is designed to supplement existing law enforcement training by incorporating and adapting MUTCD work zone temporary traffic control elements, safe roadside design practices, and accident reporting procedures. The initial target group for the training is the THP, but it may be expanded to include other law

³⁰ <<http://www.nhtsa.dot.gov/people/outreach/safedige/Fall1999/fall-1499.html>>.

³¹ Office of Planning and Research, Tennessee Highway Patrol, telephone conversation, March 2002.

enforcement agencies within the State if successful.³² The FHWA Tennessee Division office scheduled a pilot training course for May 9, 2002.

Training Programs in Other States

The Safety Board contacted the State police departments of Maryland, Delaware, Connecticut, and New Jersey to determine whether any of these States train their officers in work zone safety strategies. Like Tennessee, these States utilize police officers to increase motorist compliance with work zone traffic laws. Connecticut has a 4-hour-long work zone training program but does not use it because the State has not recently had a work zone accident involving a State trooper.³³ Delaware³⁴ and Maryland³⁵ do not offer training specific to work zone safety. In the last three police academy classes, the Maryland State Police briefly addressed work zone safety as part of a 3-hour incident management training block.

Since 1994, the New Jersey State Police have specifically trained officers in work zone safety and traffic control for highway construction areas. Officers in its construction unit are required to attend a 4-day workshop that teaches MUTCD work zone principles and procedures. The course also includes Occupational Safety and Health Administration training about on-the-job risks associated with roadway construction. This training course is a collaborative effort between the New Jersey State Police, international and local labor unions, the Utilities and Transportation Contractors' Association, Rutgers University, local and county police, and the New Jersey Department of Labor. According to the New Jersey State Police Web site,³⁶ once training is completed, construction unit officers work to enforce the rules and regulations governing traffic control and safety in highway work areas. The officers may inspect construction sites to ensure contractors comply with the traffic control plans established for their project. The officers may also provide work zone safety training for local police agencies and for other governmental and private organizations. New Jersey also provides a 4-hour basic work zone safety course for officers not assigned to the construction unit.

New Jersey established the construction unit in 1994 to increase the level of performance of law enforcement personnel in work zones and to provide enforcement consistency statewide. Among the benefits of the construction unit are more uniform implementation of approved traffic control plans, better control of the construction project, and increased safety for workers and the traveling public.^{37,38} From 1984 to 1993, New Jersey averaged almost 21 work zone-related fatalities per year.³⁹

³² Safety and Operations Research Team, Federal Highway Administration, Tennessee Division office, telephone conversation, February 2002.

³³ Connecticut State Police, telephone conversation, March 2002.

³⁴ Delaware State Police, telephone conversation, March 2002.

³⁵ Maryland State Police, telephone conversation, March 2002.

³⁶ <<http://www.njsp.org/about/traffic.html>>.

³⁷ Work Zone Safety Information Clearinghouse, Texas Transportation Institute, in cooperation with the American Road and Transportation Builders Association <<http://wzsafety.tamu.edu>>.

³⁸ Supervising Engineer, NJDOT Office of Capitol Project Safety, telephone conversation, March 2002.

Since 1994, the State has averaged 12 work zone-related fatalities per year.⁴⁰ Because work zone data on the frequency, type, length, duration, and location of work zone projects in New Jersey are not available, it is not possible to determine whether the reduction in work-zone fatalities can be attributed to the training program.

In addition, New Jersey recently established an Office of Capital Project Safety (OCPS) to enhance safety in construction work zones and improve the safety awareness of contractors, construction workers, motorists, and New Jersey Department of Transportation employees. As problems are identified in work zones, the OCPS plans to evaluate and resolve the problems and then develop a process to prevent them from recurring.⁴¹

FHWA Report on Police Use in Work Zones

In October 2001, the FHWA published a report summarizing the results of a survey that it conducted with AASHTO on the use of uniformed police officers for federally funded highway construction projects.⁴² Forty-six State transportation agencies responded to the survey, along with a number of law enforcement agencies and organizations, highway industry associations, State legislators, and contractors. About two-thirds of the States responding indicated that they use uniformed police officers in at least some work zones, most often where particular traffic safety concerns exist, such as in work zones with high speed and high traffic volume and in work zones with lane closure or nighttime operations unprotected by a concrete barrier.

Funds to pay for the police presence are generally factored into the overall construction costs by the State transportation agencies. As with Project CAR in Tennessee, police funding for work zone projects is generally administered through an interagency agreement or a memorandum of understanding between the State transportation agency and the State police.

The FHWA report states that it is not clear from the responses gathered whether police officers are always familiar with MUTCD procedures. Roughly a quarter of respondents indicated that their State had a program in place or under development to train uniformed police officers working in construction projects. One-fifth of the respondents indicated that officers are trained in traffic operations and traffic management as part of basic training but are not given specific training on traffic management in work zones. The responses also suggested that officer supervision arrangements vary; officers are sometimes supervised by the State department of transportation project engineer,

³⁹ 1984 through 1993 data requested from the National Highway Transportation Administration.

⁴⁰ 1994 through 2000 data obtained from the Work Zone Safety Information Clearinghouse Web site <<http://wzsafety.tamu.edu>>.

⁴¹ Supervising engineer, OCPS, New Jersey Department of Transportation, telephone conversation, February 2002.

⁴² Federal Highway Administration, *A Study on the Use of Uniformed Police Officers on Federal-Aid Highway Construction Projects*, docket number FHWA-1999-5387 (Washington, DC: FHWA, 2001).

sometimes by the contractor, and other times by the law enforcement agency supervisor on duty.

In response to these findings, the FHWA made the following recommendations to State agencies that use Federal highway funds to assign uniformed police officers to highway work zones:

- Develop guidelines addressing (a) when to use uniformed police officers, (b) the traffic control planning process, and (c) officer pay, work procedures, and supervision.
- Provide training in MUTCD requirements to police officers assigned to federally funded highway work zones. (Note: Federal regulations require the use of MUTCD signing and flagging procedures in federally funded highway work zones.)
- Gather data on traffic safety incidents occurring in federally funded highway work zones to better assess the effectiveness of traffic control techniques.
- Consider using new traffic control technologies, such as automated enforcement and intrusion alarms.

FHWA Rulemaking

On February 6, 2002, the FHWA released an advance notice of proposed rulemaking (ANPRM) regarding improvements to its regulations on Traffic Safety in Highway and Street Work Zones.⁴³ In the ANPRM, the FHWA identified a set of issues that may be addressed, including general policy and regulatory considerations, transportation planning and programming, project design for construction and maintenance, managing for mobility and safety in and around work zones, public outreach and communications, and analyzing work zone performance. The ANPRM does not address the need for training for law enforcement officers involved in work zone operations.

Work Zone Accident Statistics

In the past 5 years, the number of traffic fatalities occurring in work zones has risen. In 1996, 717 individuals were killed in work zone-related accidents; by 2000, that number had increased to 1,093. (See figure 7.) The number killed in work zones located in principal arterials, where travel speeds are normally higher, also increased from 483 in 1996 to 641 in 2000. During that 5-year period, the number of work zone fatalities in which heavy vehicles were involved increased from 153 to 219.⁴⁴ Commercial vehicles account for 7 percent of all vehicle miles driven per year. They are involved in 3 percent of

⁴³ *Work Zone Safety*, 67 *Federal Register* (FR) 5532.

⁴⁴ Data obtained via the Fatality Analysis Reporting System (FARS) Web-based Encyclopedia <<http://www-fars.nhtsa.dot.gov>>.

all injury accidents, 9 percent of all fatal accidents, and 20 percent of all fatal work zone accidents.⁴⁵

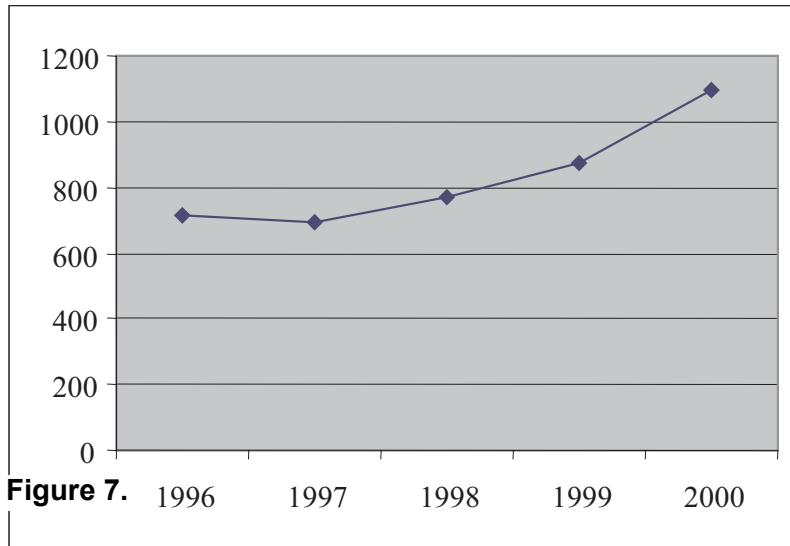


Figure 5. Annual work zone fatalities (1996-2000).

The number of work zone projects is increasing due to maintenance required on the Nation's aging roadway infrastructure.⁴⁶ Exposure data on the frequency, type, length, duration, and location of work zone projects are not available, and the extent to which the rise in fatalities may be due to the increase in driver exposure to work zones is not known.⁴⁷ What is known is that vehicle miles traveled have steadily increased,⁴⁸ as have capital outlays for highway maintenance projects.⁴⁹

⁴⁵ Federal Motor Carrier Safety Administration, *Large Truck Crash Overview*, 1998 and 1999 editions, <<http://www.fmcsa.dot.gov/factsfigs/formspubs.htm>> (Washington, DC: FMCSA, 1998 and 1999).

⁴⁶ Safety Study NTSB/SS-92/02.

⁴⁷ Recently published research on a limited dataset of California interstate work zones indicates that accidents increase significantly on roadways where work zones are present. Additionally, there is a positive correlation between work zone lengths and accident frequencies. See Asad J. Khattak, Aemal J. Khattak, and Forrest M. Council, "Effects of Work Zone Presence on Injury and Non-injury Crashes," *Accident Analysis and Prevention*, Vol. 34 (1) (2002) 19-29.

⁴⁸ <<http://www-fars.nhtsa.dot.gov>>.

⁴⁹ Federal Highway Administration, *Highway Statistics 2000*, <<http://www.fhwa.dot.gov/ohim/hs00/index.htm>> (Washington, DC: FHWA, 2000).

Analysis

This analysis recounts the events leading to the Jackson, Tennessee, accident, examines related medical certification issues and then focuses upon the factors that led to the unsafe conditions for both motorists and workers: (1) the planning and coordination between TDOT, its contractors, and the THP regarding the work zone operation underway at the time of the accident and (2) the degree of traffic control training in highway work zone operations received by THP officers. Finally, the analysis examines whether TMAs might have ameliorated the severity of this accident.

The Accident

About 8 a.m. on July 26, 2000, two THP officers positioned their vehicles, with their emergency lights flashing, within the right eastbound lane of a high-speed roadway in order to warn motorists away from the milling machine and the sweeper on the roadway shoulder. Although variable message signs warned motorists of the roadwork ahead and of a lane closure, the signs failed to specify which lane was closed. No channeling devices were positioned behind the officers to direct motorists to the left lane. In addition, the protection vehicle towing the flashing arrow board was positioned behind the sweeping machine, 950 feet ahead of the trailing police vehicle.

Less than an hour after the work zone project began, a loaded tractor-semitrailer entered the 55-mph work zone, traveling in the right lane at a driver-estimated speed of 65 mph. The tractor-semitrailer collided with the trailing THP vehicle, causing the smaller vehicle to explode upon impact and to be dragged approximately 192 feet before coming to rest in the highway median. The tractor-semitrailer continued through the highway median into the westbound lanes, collided with a 1997 Chevrolet Blazer, and finally came to rest in a wooded area on the north side of I-40.

After the accident, a THP officer and a witness attempted to extinguish the flames from the burning THP vehicle and extricate the officer inside, but were unable to do so because of the intense heat. The Safety Board concludes that the severity of the tractor-semitrailer's impact with the trailing police car and the subsequent explosion and fire made this accident unsurvivable for the officer in the trailing THP vehicle.

The situation that confronted motorists as they entered the work zone was challenging. On the previous day, vague messages displayed on the variable message signs had prompted motorists to complain to TDOT that they could not tell which lane was closed. The unprotected positions of the THP vehicles had generated sufficient complaints by TDOT personnel to the Regional Safety Director to merit an inspection of the work zone operation. The accident occurred before this inspection could take place.

The tractor-semitrailer driver, who had been diagnosed with obstructive sleep apnea in 1997 and hypothyroidism in 1998, had continued to drive after the diagnoses. A subsequent investigation revealed that it was unclear whether the driver's chronic and potentially incapacitating medical conditions had been treated successfully. Witnesses reported that before the collision, the driver had drifted off the road at least twice. The driver himself told the THP that he might have fallen asleep at the time of the accident.

Medical Certification Issues

Driver Factors

The tractor-semitrailer driver's medical records indicate that in August 1997, he was formally diagnosed with sleep apnea, 1 month after colliding with a police vehicle and injuring two officers. Although he underwent surgery for his condition, he failed to keep postsurgical appointments. He did not schedule a followup sleep study, making it difficult to assess the success of the surgery.

The driver also suffered from hypothyroidism, but he did not mention this or his history with obstructive sleep apnea to the examiner during his August 1999 commercial driver medical examination. Moreover, he had been prescribed medication for his hypothyroidism, but indicated that he was not on any medication. Following the accident, a pill bottle nearly full of thyroid hormone medication was found in the truck cab. A postaccident blood test performed by the THP indicated that his thyroid hormone level was markedly low. Apparently, the driver took only a few pills of the last prescription filled in 1998 for thyroid hormone and never followed up on his thyroid condition. The Safety Board concludes that the driver's obstructive sleep apnea, his untreated hypothyroidism, or complications from either or both conditions predisposed him to impairment or incapacitation, including falling asleep at the wheel, while driving.

Past Recommendations

This accident investigation raises many of the same medical certification issues that the Safety Board addressed in its report⁵⁰ on a 1999 motorcoach accident in New Orleans that killed 22 passengers and injured 22 others. The motorcoach driver involved was able to renew his commercial driver medical certificate, and thereby retain his commercial driver's license, despite suffering from several life-threatening medical conditions of the kidneys and heart that affected his ability to perform his duties and required him to undergo 3- to 4-hour-long clinical treatments 6 days a week. The New Orleans report details several factors that contributed to the failure of the medical certification process to prevent unfit drivers from operating a commercial vehicle. As a result of its investigation, the Safety Board made recommendations to the FMCSA and

⁵⁰ National Transportation Safety Board, *Motorcoach Run-off-the-Road Accident, New Orleans, Louisiana May 9, 1999*, Highway Accident Report NTSB/HAR-01/01 (Washington, DC: NTSB, 2001).

other organizations to develop a comprehensive medical oversight program for interstate commercial drivers that contains the following program elements:

H-01-17

Individuals performing medical examinations for drivers are qualified to do so and are educated about occupational issues for drivers.

H-01-18

A tracking mechanism is established that ensures that every prior application by an individual for medical certification is recorded and reviewed.

H-01-19

Medical certification regulations are updated periodically to permit trained examiners to clearly determine whether drivers with common medical conditions should be issued a medical certificate.

H-01-20

Individuals performing examinations have specific guidance and a readily identifiable source of information for questions on such examinations.

H-01-21

The review process prevents, or identifies and corrects, the inappropriate issuance of medical certification.

H-01-22

Enforcement authorities can identify invalid medical certification during safety inspections and routine stops.

H-01-23

Enforcement authorities can prevent an uncertified driver from driving until an appropriate medical examination takes place.

H-01-24

Mechanisms for reporting medical conditions to the medical certification and reviewing authority and for evaluating these conditions between medical certification exams are in place; individuals, health care providers, and employers are aware of these mechanisms.

The Safety Board also issued Safety Recommendation H-01-26 to the American Association of Motor Vehicle Administrators (AAMVA) to urge its member States to develop a comprehensive medical oversight program for intrastate commercial drivers that contains the same elements. The FMCSA responded to Safety Recommendations H-01-17 through -24 in an April 11, 2002, letter; that response was under review at the

time this report went to publication. The AAMVA has not yet responded to Safety Recommendation H-01-26.

Considerable effort will be required to create a comprehensive medical oversight program that is both effective and feasible. However, the Jackson, Tennessee, accident again demonstrates how easily unfit drivers are able to take advantage of the inadequacies of the current medical system, resulting in potentially fatal consequences. The Safety Board therefore concludes that had a comprehensive medical oversight program been in place at the time of the accident, this driver, who had known and potentially incapacitating medical conditions, would have been considerably less likely to be operating a commercial vehicle. The Safety Board urges both the FMCSA and AAMVA to act quickly to develop a comprehensive medical oversight plan for commercial drivers.

Communication, Planning, and Coordination Between TDOT and the THP

Project CAR was a mechanism for TDOT to contract with the THP to provide enforcement and traffic control assistance on this construction project. Despite the THP's role in the project, it was not invited to attend the TDOT preconstruction conference meetings. Typically, participants in a preconstruction conference discuss the scope of a construction project; the time, resources, and procedures needed to complete it; and the traffic control plan that best suits each phase of the project. Large projects, such as the one in Jackson, Tennessee, usually involve the State's department of transportation and several contractors and subcontractors. Because of the number of parties involved, communication and coordination are vital in establishing a work zone strategy that is both effective and safe.

Not seeking THP representation resulted in a lost opportunity for Dement Construction and THP representatives to coordinate traffic control duties. It also meant that TDOT could not clarify to all involved who was in charge of traffic control in the work zone. This clarification would have been helpful, given the natural assumption that police officers are in charge of traffic control. The end result was a disjointed traffic control effort between the TDOT contractor and the THP that was inherently unsafe. The Safety Board concludes that had TDOT invited the THP to the preconstruction conferences, lines of communication may have been established, enabling the parties to agree upon traffic control responsibilities and clarify the manner in which they should be performed.

At the time of the accident, TDOT was employing a traffic control strategy that was not covered in the construction contract. In fact, the contract did not contain a traffic control plan that was applicable to mobile operations such as milling rumble strips or performing pavement striping and other lane marking operations. Furthermore, the contract did not specify the THP's duties with regard to traffic control within the work zone.

The failure to define a specific traffic control plan for the milling operation suggests that too little planning had been devoted to that operation, which may have led to the ambiguous information displayed on variable message signs and to other questionable safety practices discussed below. The lack of a specific traffic control plan, in conjunction with the absence of the THP in the preconstruction conferences, quite likely added to the contractor's uncertainty with regard to the THP's role in the milling project. These circumstances may have fostered the misconception that the THP officers did not need additional guidance on work zone operations. The Safety Board concludes that the traffic control and safety aspects of the work zone operation would have been improved had the construction contract incorporated traffic control plans for all aspects of the work zone operation and assigned specific responsibilities to each party. The Safety Board believes that the Tennessee Department of Transportation should conduct preconstruction conferences with all parties involved in a work zone project. Further, as a result of such conferences, TDOT should produce a written traffic control plan or project plan agreed to by all parties that defines the lines of authority and how traffic control and enforcement will be performed for all types of work zone configurations to be utilized.

According to the FHWA's 2001 study on the *Use of Uniformed Police Officers on Federal-Aid Highway Construction Projects*, a majority of the States use uniformed police officers in at least some work zones, most often where particular traffic safety concerns exist, such as in work zones with high speed and high traffic volume and in work zones with lane closure or nighttime operations unprotected by a concrete barrier. Part VI of the MUTCD encourages the use of police officers in work zone operations, stating that the "use of police in vulnerable work situations, particularly those of relatively short duration, heightens the awareness of passing traffic and will likely cause a reduction in travel speed."

Although the use of police officers is promoted as a way to increase work zone safety, no specific guidance exists that addresses the need to coordinate traffic control and enforcement activities with the officers. The MUTCD, which codifies the principles and procedures used by all States when designing and implementing work zones, does not provide guidance on this issue. The accident in Jackson, Tennessee, illustrates the importance of a coordinated effort in creating a safe work zone environment for workers and the traveling public. The Safety Board concludes that the widespread use of police officers at highway work zones underscores the need for standard guidance to assist construction and maintenance workers in coordinating traffic control, enforcement, and other safety-related tasks with police officers assigned to work zones. The Safety Board believes that the Federal Highway Administration should review and revise the *Manual on Uniform Traffic Control Devices* to provide guidance on coordination with law enforcement personnel used in traffic control strategies at highway work zones.

Training Issues

Role of Law Enforcement

Law enforcement personnel typically perform short-term traffic control functions for specific events. These functions include providing enforcement and traffic control support at accident scenes, at intersections with malfunctioning or missing traffic control devices, in work zones, when escorting permitted (oversize) vehicles, and during special events that generate heavy traffic. However, THP General Order 405, which governs traffic direction and control, does not provide guidance for the unique situations found in long-term work zone environments. For this reason, the THP officers lacked the guidance and training necessary to provide safe and effective traffic control for work zone operations.

As part of its investigation, the Safety Board conducted a limited survey of the police work zone training practices in Maryland, Delaware, Connecticut, and New Jersey. Among those surveyed, only New Jersey had officers who are trained in Part VI of the MUTCD and other traffic control safety standards. New Jersey State Police assigned to the construction unit are authorized to enforce the rules and regulations governing traffic control and safety in highway work areas. The officers may even inspect construction sites to ensure that contractors comply with the traffic control plans established for their projects. According to the supervising engineer of the New Jersey Department of Transportation Office of Capitol Project Safety, having trained officers patrolling New Jersey work zones has resulted in more uniform implementation of traffic control plans, better control of construction projects, and increased safety for workers and the traveling public.

Instruction and training similar to that given to the New Jersey construction unit would have benefited the THP officers assigned to the milling operation in Jackson, Tennessee. Prior to the milling operation, the Dement construction foreman advised the THP officers that the operation would involve a “mobile lane closure.” By this, he meant that all of the construction vehicles would be positioned on the shoulder of the highway and that traffic control efforts would be directed toward informing motorists ahead of time of the operation and keeping them away from the shoulder and a safe distance from the milling operation. Although the construction foreman indicated that he did not intend that the THP close the right lane, the phrase “mobile lane closure” could easily be construed to mean “close the lane.” “Mobile lane closure” is not a term used in the MUTCD, nor was a mobile operation mentioned in the Jackson traffic control plan. Yet, the THP did not ask for clarification and proceeded to position their vehicles behind the construction vehicles in an unsafe manner. The Safety Board concludes that had the THP officers received work zone traffic control training, they may have asked the construction foreman for clarification on the traffic control strategy to be used that day. The Safety Board further concludes had the THP officers received work zone traffic control training, they would have realized the hazards of positioning their vehicles in the lane behind the highway construction vehicles.

Since the Jackson, Tennessee, accident, the THP has worked with the FHWA to develop training programs on MUTCD traffic control strategies for its supervisors and officers. The Safety Board supports the efforts of the THP and the FHWA to reduce work zone-related accidents through training. This effort places Tennessee in the forefront on the work zone training issue because, as the FHWA's survey on the use of uniformed police officers indicates, three-fourths of responding State agencies do not have a program in place or under development to train police officers on work zone safety standards. New Jersey has adopted such a training program and believes that it has contributed to the implementation of more uniform traffic control plans and better controlled construction projects and has also led to a significant reduction in work zone-related fatalities. Therefore, the Safety Board believes that the FHWA, in cooperation and consultation with the National Highway Traffic Safety Administration (NHTSA), the International Association of Chiefs of Police, the National Sheriffs' Association, and AASHTO should develop a model training program for law enforcement personnel that addresses traffic control strategies at highway work zones, and encourage the States to adopt it. At a minimum, the training program should incorporate material from Part VI of the MUTCD and information concerning procedures and terminology typically used by highway engineers in establishing and evaluating work zone operations.

Past Recommendations

Other recent accident investigations have raised concerns that law enforcement officers sometimes lack the training to conduct activities that are not a part of their normal duties. In December 2001, the Safety Board adopted a report⁵¹ that described the events leading to the collision between a commuter train and a tractor combination vehicle carrying an oversized/overweight load. As a result of its investigation, the Safety Board recommended that the International Association of Chiefs of Police and the National Sheriffs' Association:

H-01-36

Notify your members of the circumstances of the Glendale, California, accident and encourage them to train their officers to make sure (1) that documentation regarding permits is reviewed and verified; (2) that safety briefings to discuss routings and special conditions, including the hazards associated with moving oversize/overweight vehicles over grade crossings, are conducted; (3) that provisions for handling off-route loads are in place; and (4) that necessary notification to the railroads is made before an oversize/overweight vehicle is escorted across a highway-railroad grade crossing.

⁵¹ National Transportation Safety Board, *Collision Between Metrolink Train 901 and Mercury Transportation, Inc., Tractor-Combination Vehicle at Highway-Railroad Grade Crossing in Glendale, California, on January 28, 2000*, Highway Accident Report NTSB/HAR-01/02 (Washington, DC: NTSB, 2001).

The report also recommended that the FHWA, in cooperation and consultation with the FMCSA and trade associations.⁵²

H-01-31

Develop model oversize/overweight vehicle movement guidelines. The guidelines should address, at a minimum, issues such as (1) when pilot cars and police escorts are required; (2) the training, testing, and certification of pilot car operators, police officers, and truck drivers in the movement of oversize/overweight loads; (3) the use of height poles and traffic controls; (4) how to conduct route surveys; (5) the maneuvering limitations of heavy-haul vehicles; (6) the effects of fatigue on performance; (7) the need to assess the dangers at railroad crossings, particularly for low-clearance vehicles; and (8) the need and requirements to notify the railroads before an oversize/overweight vehicle is escorted across a highway-railroad grade crossing.

In addition, the Safety Board issued a companion recommendation (H-01-33) urging the FMCSA and trade associations to work with the FHWA to accomplish Safety Recommendation H-01-31. Owing to the relatively short time since these recommendations were issued, as of April 2002, they are classified “Open—Await Response.” The Safety Board looks forward to learning about the results of joint Government, industry, and law enforcement initiatives to ensure the safety of vehicles in unique traffic situations.

Work Zone Safety

Configuration Criteria

The construction foreman stated to Safety Board investigators that he had advised the THP officers who were assisting with traffic control that the operation would involve a mobile lane closure. The construction foreman further stated to Safety Board investigators that when he advised the THP officers who were assisting with traffic control that the operation would involve a mobile lane closure, his intent was to keep both traffic lanes open. The foreman noted that the configuration used in the work zone met MUTCD requirements.⁵³

Some disagreement exists regarding the extent to which the construction vehicles encroached upon the roadway. Nonetheless, the presence of the THP vehicles in the right lane effectively made this a lane closure operation. TDOT contracted with the THP to assist with traffic enforcement and traffic control during the construction project. As such, the THP officers were part of the construction crew. The 1993 Part VI revision of the MUTCD indicates that certain traffic control elements should be present for a lane closure

⁵² AASHTO, the AAMVA, the Commercial Vehicle Safety Alliance, the Specialized Carriers and Rigging Association, the California Professional Escort Car Association, the Texas Pilot Car Association, and the United Safety Car Association.

⁵³ MUTCD, Part VI, 1988 edition, revision 3 (1993).

on a divided highway, including advance road signs indicating that the appropriate lane is closed, a corresponding lane reduction symbol sign, a protection vehicle with an activated flashing yellow light, and channelizing devices to separate the work zone from the through traffic.

Several of these traffic control elements were missing in the Jackson work zone. The variable message signs used did not specify which lane ahead was closed, and they were not accompanied by a corresponding lane reduction symbol sign. Channelizing devices to separate the work zone from the through traffic were not used. Although a protection vehicle with a flashing arrow board was present, it was not positioned to warn vehicles away from the THP vehicles. Therefore, the Safety Board concludes that the traffic control configuration used by TDOT and its contractors did not meet MUTCD requirements for a lane closure on a divided highway.

The precautions taken by TDOT, its contractors, and the THP were insufficient to protect the officers, construction workers, and road users. The most obvious problem was the unprotected position of the patrol cars on the roadway. Although lines of communication had not been established for this project, and although the foreman's statements suggest that he had some trepidation in advising the officers on traffic control, these factors do not relieve TDOT or its contractors of their responsibility to clarify their traffic control intent to the officers, to voice their concerns regarding the officers' presence in the travel lane, and to follow the prescribed traffic control plans. These factors also should not have kept the THP from recognizing that, as members of the construction crew, they have a responsibility to coordinate activities with TDOT and its contractors.

Had the THP vehicles not been positioned in an active lane during the milling operation, TDOT and its contractor would not have been required, under the MUTCD, to close a traffic lane. However, the presence of the THP vehicles in the right lane obligated TDOT and its contractors to adopt a lane closure strategy to protect the exposed vehicles. This strategy should have included changing the variable message signs to indicate that the right lane was closed ahead and accompanying them with corresponding lane reduction symbol signs. In addition, channelizing devices should have been put in place to separate the construction and police vehicles from the through traffic, and a protection vehicle with an arrow board and a TMA should have been positioned to trail the police vehicles within the channelizing devices. Therefore, the Safety Board concludes that TDOT, its contractors, and the THP failed to take the precautions necessary to protect all workers and road users within the work zone.

Use of TMAs

In the Jackson accident, the police vehicles were, in effect, acting as protective barriers for the construction workers in the milling operation, a practice not sanctioned by either the MUTCD or the AASHTO *Roadside Design Guide*. Given the hazardous nature of this practice, the Safety Board examined whether having a TMA positioned behind the THP vehicles would have reduced the severity of this accident. As mentioned previously, TMAs are compact crash cushions attached to the rear of protection vehicles that are intended to protect construction workers and the occupants of a striking vehicle. They are

designed to decelerate and stop vehicles as heavy as 4,400 pounds, traveling at speeds of up to 62 mph. In the Jackson accident, the weight (48,000 pounds)⁵⁴ and speed (65 mph) of the striking tractor-semitrailer far exceeded the design parameters of a TMA. Had a TMA-equipped protection vehicle been positioned behind the police vehicles, it would quite likely have been destroyed and its driver killed or seriously injured.

The protection offered by TMAs has improved since the Safety Board published its 1992 safety study⁵⁵ on highway work zone safety. At that time, TMAs were designed for an impact speed of up to 45 mph. In the 1992 study, the Safety Board evaluated several accidents involving both cars and heavy trucks in which TMAs were used and concluded, “Truck-mounted attenuators used on vehicles in moving maintenance operations and on barrier vehicles at stationary work zone sites can substantially reduce the severity of accidents in these work zones.” The Safety Board recommended that the FHWA:

H-92-36

Conduct research, in conjunction with industry, to determine the effectiveness of truck-mounted attenuators when struck at various angles and offsets and at speeds in excess of 45 mph, and analyze the safety benefits and shortcomings of using truck-mounted attenuators in such high-speed environments.

Since receiving this recommendation, the FHWA has published a report defining the testing parameters for TMAs,⁵⁶ including crash tests at speeds up to 62 mph. The report also defines the parameters for 10-degree-offset crash tests, but considers these types of tests to be optional, noting “there is no assurance that new TMA designs can be made to meet these test requirements without significant increases in cost or without detrimental effects on truck handling.” Nonetheless, the report encourages manufacturers to design with this goal in mind. Consequently, on September 16, 1994, the Safety Board classified Safety Recommendation H-92-36 “Closed—Acceptable Alternate Action.”

Approximately 80 percent of work zone accidents involve smaller passenger vehicles, and TMAs are designed to dissipate the energy of impacts involving such vehicles. In the absence of more definitive data, the recent increase in overall work zone fatalities suggests that greater use of work zone TMAs may be warranted. The Safety Board concurs with NIOSH that when worker exposure cannot be eliminated completely, positive protective barriers, such as TMAs, should be used to shield workers from traffic.

Work Zone Data

During its investigation, the Safety Board attempted to find exposure data⁵⁷ that would help clarify the increase in work zone fatalities. Exposure data are necessary

⁵⁴ The tractor-semitrailer was fully loaded with computers and computer supplies at the time of the accident. The average weight of such vehicles, when fully loaded, is between 70,000 and 75,000 pounds; they can weigh as much as 80,000 pounds without having to be permitted.

⁵⁵ Safety Study NTSB/SS-92/02.

⁵⁶ *Recommended Procedures for the Safety Performance Evaluation of Highway Features*, National Cooperative Highway Research Program Report 350, 1993.

because risk cannot be fully determined using fatality data alone, since fatality data do not account for changes in the frequency, duration, and length of work zones, nor do they account for the location and type of construction being performed. Exposure data might also have helped the Board determine whether the issues identified in the Jackson, Tennessee, collision were isolated to this accident or were more far reaching. However, investigators found that work zone-related exposure data are not gathered nationally.

In its 1992 study on work zone safety,⁵⁸ the Safety Board concluded that the lack of exposure data for work zone accidents makes it difficult to compare accident rates in work zones with accident rates on roads elsewhere. Therefore, the Safety Board issued the following recommendations to NHTSA and the FHWA:

H-92-33

Review, in conjunction with the Federal Highway Administration, all State accident report forms, select the data elements that comprehensively document work zone accidents, and encourage the States to incorporate these data elements into their accident report forms.

H-92-34

Review, in conjunction with the National Highway Traffic Safety Administration, all State accident report forms, select the data elements that comprehensively document work zone accidents, and encourage the States to incorporate these data elements into their accident report forms.

NHTSA created the Model Minimum Uniform Crash Criteria (MMUCC) in response to Safety Recommendation H-92-33. The MMUCC is a voluntary set of guidelines that help States collect consistent, reliable accident data that are more effective for identifying traffic safety problems, establishing goals and performance measures, and monitoring the progress of programs. These guidelines include a data element for work zone accidents, which allows police officers to specify where in a work zone an accident occurred. Officers can also specify the work zone type and whether construction workers were present at the time of the accident. NHTSA has encouraged the States to adopt the MMUCC through training and educational programs in conjunction with the FHWA, the National Association of Governors' Highway Safety Representatives, and others. Consequently, the Safety Board classified this recommendation "Closed—Acceptable Action" on April 5, 2001.

Although NHTSA does not track the number of States that have adopted all or part of the MMUCC, it believes that about 40 percent of the States have altered their accident reports to incorporate MMUCC data elements. NHTSA is currently hosting a State compatibility working group to address general concerns with the MMUCC and plans to

⁵⁷ Data with a common characteristic, such as vehicle miles traveled, that enable better comparison of data from disparate sources.

⁵⁸ Safety Study NTSB/SS-92/02.

hold a workshop for State representatives in August 2002. NHTSA expects to publish an updated version of the MMUCC by 2003.⁵⁹

In response to Safety Recommendation H-92-34, the FHWA determined that a standard definition for a work zone had to be developed first. In December 2000, the FHWA revised the Millennium edition, Section 6C.02, of the MUTCD to include the following definition:

A work zone is an area of a highway with construction, maintenance, or utility work activities. A work zone is typically marked by signs, channelizing devices, barriers, pavement markings, and/or work vehicles. It extends from the first warning sign or rotating/strobe lights on a vehicle to the END ROAD WORK sign or the last temporary traffic control device.

This definition provides public safety personnel with a baseline for recording accidents in and around work zones, and the FHWA has requested that the States include specific data elements on their accident reporting forms that account for work zones.⁶⁰ As a result of these efforts, the Safety Board classified this recommendation “Closed—Acceptable Action.”

In addition to pointing out the lack of exposure data available on work zone accidents, the Board’s 1992 study noted deficiencies in its collection. Therefore, the Safety Board recommended that the FHWA:

H-92-35

Develop a program to collect exposure data for construction work zones on the interstate system.

The FHWA has two research efforts underway to determine the influence of work zones on crash rates, the sources of information now available to generate exposure data, and the availability of other types of exposure data that might further benefit the safety and performance assessment of work zones. Exposure data are being gathered on a limited basis for these efforts; those data include the annual percentage of the Nation’s highways with at least 1 day of work zone activity, the number of vehicles that traverse work zones annually, the total worker-hour exposure in work zones, traffic density, and work zone length, type, and duration. Current work zone crash and fatality statistics will also be assessed with respect to the exposure measures developed for this task. The results from one of these research efforts are expected in spring 2002 and the other in fall 2002.

While the MMUCC provides a mechanism for the States to collect more accurate and detailed information on work zone accidents, little can be learned from the number of work zone injuries and fatalities without first knowing more about the conditions in which

⁵⁹ Team Leader, State Data and Quality Assurance Branch, National Center for Statistics and Analysis, NHTSA, telephone conversation, April 16, 2002.

⁶⁰ Transportation Specialist, Safety Core Business Unit, Federal Highway Administration, e-mail correspondence, April 2002.

they occurred. An accounting of work zone characteristics, including types, frequency, duration, length, and location of operations, is needed to permit researchers to determine accident rates under differing conditions, thereby allowing for better assessments of safety procedures and equipment. Therefore, the Safety Board expects that the FHWA report will allow the agency to quickly act upon the Board's decade-old recommendation to collect work zone exposure data. In the meantime, this recommendation remains "Open—Acceptable Response."

Conclusions

Findings

1. The severity of the tractor-semitrailer's impact with the trailing police car and the subsequent explosion and fire made this accident unsurvivable for the officer in the trailing Tennessee Highway Patrol vehicle.
2. The driver's obstructive sleep apnea, his untreated hypothyroidism, or complications from either or both conditions predisposed him to impairment or incapacitation, including falling asleep at the wheel, while driving.
3. Had a comprehensive medical oversight program been in place at the time of the accident, this driver, who had known and potentially incapacitating medical conditions, would have been considerably less likely to be operating a commercial vehicle.
4. Had the Tennessee Department of Transportation invited the Tennessee Highway Patrol to the preconstruction conferences, lines of communication may have been established, enabling the parties to agree upon traffic control responsibilities and clarify the manner in which they should be performed.
5. The traffic control and safety aspects of the work zone operation would have been improved had the construction contract incorporated traffic control plans for all aspects of the work zone operation and assigned specific responsibilities to each party.
6. The widespread use of police officers at highway work zones underscores the need for standard guidance to assist construction and maintenance workers in coordinating traffic control, enforcement, and other safety-related tasks with police officers assigned to work zones.
7. Had the Tennessee Highway Patrol officers received work zone traffic control training, they may have asked the construction foreman for clarification on the traffic control strategy to be used that day.
8. Had the Tennessee Highway Patrol officers received work zone traffic control training, they would have realized the hazards of positioning their vehicles in the lane behind the highway construction vehicles.
9. The traffic control configuration used by the Tennessee Department of Transportation and its contractors did not meet *Manual on Uniform Traffic Control Devices* requirements for a lane closure on a divided highway.

10. The Tennessee Department of Transportation, its contractors, and the Tennessee Highway Patrol did not take the precautions necessary to protect all workers and road users within the work zone.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the driver's incapacitation, owing to the failure of the medical certification process to detect and remove a medically unfit driver from service. Contributing to this accident were the lack of planning and coordination between the Tennessee Department of Transportation, its contractors, and the Tennessee Highway Patrol regarding work zone projects; the lack of traffic control training, specific to highway work zone operations, provided to Tennessee Highway Patrol officers; and the failure of the Tennessee Department of Transportation and its contractors to protect all work zone personnel and road users.

Recommendations

To the Federal Highway Administration:

Review and revise the *Manual on Uniform Traffic Control Devices* to provide guidance on coordination with law enforcement personnel used in traffic control strategies at highway work zones. (H-02-02)

In cooperation and consultation with the National Highway Traffic Safety Administration, the International Association of Chiefs of Police, the National Sheriffs' Association, and the American Association of State Highway and Transportation Officials, develop a model training program for law enforcement personnel that addresses traffic control strategies at highway work zones, and encourage the States to adopt it. At a minimum, the training program should incorporate material from Part VI of the *Manual on Uniform Traffic Control Devices* and information concerning procedures and terminology typically used by highway engineers in establishing and evaluating work zone operations. (H-02-03)

To the National Highway Traffic Safety Administration:

Work with the Federal Highway Administration to develop a model training program for law enforcement personnel that addresses traffic control strategies at highway work zones. At a minimum, the training program should incorporate material from Part VI of the *Manual on Uniform Traffic Control Devices* and information concerning procedures and terminology typically used by highway engineers in establishing and evaluating work zone operations. (H-02-04)

To the Tennessee Department of Transportation:

Conduct preconstruction conferences with all parties involved in a work zone project. As a result of such conferences, produce a written traffic control plan or project plan agreed to by all parties that defines the lines of authority and how traffic control and enforcement will be performed for all types of work zone configurations to be utilized. (H-02-05)

To the National Sheriffs' Association, the International Association of Chiefs of Police, and the American Association of State Highway and Transportation Officials:

Work with the Federal Highway Administration to develop a model training program for law enforcement personnel that addresses traffic control strategies at highway work zones. At a minimum, the training program should incorporate material from Part VI of the *Manual on Uniform Traffic Control Devices* and information concerning procedures and terminology typically used by highway engineers in establishing and evaluating work zone operations. (H-02-06)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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Adopted: May 14, 2002

Appendix A

Investigation

The National Transportation Safety Board was notified of the Jackson, Tennessee, accident on July 27, 2000. Investigators were dispatched from the Parsippany, New Jersey, and Arlington, Texas, offices. Groups were established to investigate highway factors and motor carrier operations.

Participating in the investigation were representatives of the Tennessee Highway Patrol and Tennessee Department of Transportation. No public hearing was held; no depositions were taken.

Appendix B

Jackson, Tennessee, Driver Medical Information

Table 1. Information extracted from the driver's medical records by the Medical Officer, National Transportation Safety Board.

Date	Information	Source
10/8/96	A form titled "Physical Examination Form" indicates "No" for the health history categories "Seizures, fits, convulsions, or fainting," "Extensive confinement by illness or injury," and "Permanent defect from illness, disease, or injury." The form indicates "Yes" for "Suffering from any other disease" and notes "Crohn's disease – no recent problem." The form notes no abnormalities and is signed by a physician indicating that the driver is "qualified only when wearing corrective lenses."	Driver's employer
11/26/96	Admission history notes "...truck driver admitted for recent onset left lower swelling, pain, and erythema after driving 10 hours/day for 10 days. ... 2 nights ago patient was napping, woke up – when got up to stand noted pain in left groin all the way down to the left foot – along with left lower extremity swelling (pants were very tight around left lower extremity – tight and painful enough that patient didn't change his pants for last 2 days, and didn't stop to eat anywhere because it hurt too much to put weight onto his lower extremity – also left foot swelling to point couldn't wear shoes) continued to drive 10 hours/day over last 2 days with intermittent stops every couple of hours to elevate leg and rest...." Past medical history notes "Crohn's disease – treated with meds in past none currently, intermittent diarrhea about once per month." Temperature was noted as 101.8, weight as 358, and height as 5'11".	Denver VA Medical Center
11/30/96	Interim summary notes admission diagnoses of "1. Left lower extremity cellulitis. 2. History of Crohn's disease. 3. Possible obstructive sleep apnea...." History notes that the driver "...presented to the Denver VA emergency room (ER) with a 2-day history of left lower extremity swelling, fever to 100.7 in the ER, and positive cough with yellow sputum. The patient notes pain in his left lower extremity beginning 2 days before and then swelling. He did continue to drive his truck for 2 days but would pull off to the side of the road because he would have such pain. He did not stop to eat during those 2 days because it was too painful to leave his truck. He noted subjective fevers...."	Denver VA Medical Center

12/2/96	Addendum notes indicate that the driver "...on admission, gave a history consistent with potential obstructive sleep apnea with the presence of snoring as well as some daytime somnolence and had obesity as well as hypertension...underwent a nighttime pulse oximetry study which showed significant desaturations. The patient was to have a formal sleep study; however, he reported that he is in need of returning to his home in Boise so that he can return to his employment. We would have preferred that the patient remain an inpatient to complete this evaluation; he stated that he needed to be discharged for financial reasons and that he would follow up promptly in Boise..."	Denver VA Medical Center
12/2/96	Discharge instructions note diagnoses of "(1) left lower extremity cellulitis (2) suspected obstructive sleep apnea with documented nocturnal desaturations," discharge medication of "Augmentin 500 mg by mouth 3 times a day for 10 days," and employment status of "No work for 1 week secondary to need to elevate left leg."	Denver VA Medical Center
12/4/96	Emergency clinic notes indicate that the driver "...presents after admit to Denver VA for left lower extremity cellulitis...night time desats by pulse ox? sleep apnea...resents to re-establish care at BVAMC and secondary rash from Augmentin" and that he "... needs followup for sleep apnea diagnosis (sleep study)." He was prescribed azithromycin and "Benadryl for rash."	Boise VA Medical Center
12/10/96	Emergency clinic notes indicate that the driver's "leg is getting worse...Assessment: cellulitis – improved, but with continuing symptomatology...Plan: azithromycin...return tomorrow..."	Boise VA Medical Center
12/11/96	Emergency clinic notes indicate "...cellulitis – resolving well on azithromycin...continue azithromycin...whirlpool...doppler study...followup...12/18..."	Boise VA Medical Center
12/18/96	Physician note indicates "...schedule pulmonary consult – sleep apnea...schedule...clinic 4 months."	Boise VA Medical Center
4/30/97	Physician note indicates "...resolved cellulitis...return to clinic 5 months."	Boise VA Medical Center
7/16/97	Physician note indicates "truck driver – status post motor vehicle accident after 'blackout' 1 week ago...had motor vehicle accident while driving his truck on 7/14/97. Can't remember a 1 mile distance just before accident. Doesn't know whether blacked out or fell asleep...was told he might have sleep apnea...Plan...consult for sleep apnea...follow up in 2 weeks."	Boise VA Medical Center
7/24/97	Pulmonary clinic note indicates "...patient is a truck driver...history of very loud snoring for all of his adult life. Patient's brother has witnessed apneas in past....does have daytime sleepiness...Assessment: Probable obstructive sleep apnea syndrome...his profession makes him high risk for disease-related mortality. Plan 1) I will schedule sleep study as high priority...2) No driving until sleep study is done and treatment started...return to clinic with me in pulmonary clinic in 3 months."	Boise VA Medical Center

8/13/97	Sleep study results indicate "Severe obstructive sleep apnea. During second half of this study, patient was placed on CPAP mask and titrated up to maximum of 10 cm H20. This was associated with no significant improvement and complaints by the patient of the mask causing complete obstruction of the airway. BiPAP mask was attempted and titrated up to 12/5, with similar results. Recommendations: Referral to ENT to consider surgical therapy for this patient's sleep apnea."	Boise VA Medical Center
8/21/97	Pulmonary clinic note indicates "please refer to ENT clinic ASAP – patient with severe obstructive sleep apnea. Unable to tolerate CPAP mask. Please evaluate for uvulopalatopharyngoplasty."	Boise VA Medical Center
9/4/97	A note signed by the same physician who signed the 10/8/96 physical examination form indicates that the driver "was examined and found to be free of any disability. He is physically and mentally fit for safe operation of a commercial transportation vehicle."	Driver's employer
9/19/97	Discharge note following surgery 9/16/97 for obstructive sleep apnea (uvulopalatopharyngoplasty, genioglossus advancement, hyoidpexy) notes: "Discharge diagnoses: 1. Obstructive sleep apnea. 2. Obesity." and indicates "On postoperative day number one...He complained of difficulty swallowing...he reported complaints of food getting stuck in his throat...On 9-19-97...it was found that the patient had inadequate laryngeal elevation...this left him unable to protect his airway...he...was then taught to use a modification of a supraglottic texture...could tolerate liquids...had some moderate problems with pureed texture ... discharged home ... scheduled followup to the Boise Fly-In Clinic on 9-23-97.... should he have difficulties maintaining...hydration level he was instructed to report to the Boise VA...Discharge Medications: Tylenol No. 3 elixir...instructed to avoid heavy lifting...for the next 2 weeks...instructed to avoid driving while taking narcotics..." Social Work note on 9/18/97 indicates "...Patient may be discharged tomorrow. His brother will drive him home...."	Salt Lake City VA Medical Center
9/19/97	Emergency Department note indicates "3 days ago had surgical procedure for sleep apnea – discharged from hospital 5:00 – driving back to Boise and at about 6:30 pm developed pain in anterior neck and throat, feeling of swelling in anterior neck and difficulty swallowing secretion...diagnostic impression: postoperative swelling...transferred to 3E to lodge..." ENT note indicates "...breathing easily, incision intact, airway widely patent, incisions clean dry intact with steristrips – no hematoma...admit as lodging status...recheck in AM."	Salt Lake City VA Medical Center
9/21/97	Emergency Notes indicate that driver is "unable to take antibiotics, feels like he's choking....discharged 9/19. Readmitted 9/19 with difficulty swallowing/anxiety. Discharged 9/20. Doing well yesterday morning drank water without difficulties.... During the day it became more difficult to drink water.... Plan – prop head of bed, sit in Lazyboy recliner. Liquid Tylenol #3 or Tylenol Elixer....Follow-up appointment already scheduled 9/23."	Boise VA Medical Center

9/23/97	ENT follow-up note indicates that driver is "starting to feel better. Swallowing improved but still only taking liquids....still poor laryngeal elevation...able to clear secretions...."	Boise VA Medical Center
11/24/97	Pulmonary clinic note indicates that the driver "failed to follow up with me. Still needs repeat sleep study..."	Boise VA Medical Center
8/10/98	Physician note indicates the driver complained of "malaise and fatigue...fatigue for 1 month. Diarrhea for 18 years unchanged....history of apnea but after surgery in Salt Lake City Utah VA, he is sleeping better and feeling rested.... Assessment: low energy, fatigue etiology unclear..."	Boise VA Medical Center
9/16/98	Physician note indicates the driver "has increased TSH slightly. He has increased weight. He has had increased sensitivity of heat. He has diarrhea (Crohn's disease)...weight 358...deep tendon reflexes sluggish...also has pseudomyotonia....Assessment: Probable mild hypothyroidism, sleep apnea, resolved status post ENT surgery. Plan: begin L-thyroxine 0.025 mg...return to clinic ...in 3 months...TSH in 2 months."	Boise VA Medical Center
10/5/98	A form titled "Physical Examination Form" indicates "No" for the health history categories "Seizures, fits, convulsions, or fainting," "Extensive confinement by illness or injury," and "Permanent defect from illness, disease, or injury." The form indicates "Yes" for "Suffering from any other disease" and notes "Crohn's disease, remission since 1990, hypothyroidism." The form also notes "knee jerks not elicited even against reinforcement – likely related to hypothyroid state – just started replacement." It is signed by a physician (a different physician than signed the other examinations noted here) indicating that the driver is qualified with no restrictions.	Driver's employer
8/9/99	A form titled "Physical Examination of Drivers" indicates "No" for all health history categories, including "Seizures, fits, convulsions, or fainting," "Suffering from any other disease," and "Permanent defect from illness, disease, or injury." A note indicates "No known allergies, on no medications." The form notes no abnormalities, and is signed by a physician (the same physician who signed the 10/8/96 and 9/4/97 examinations) indicating that the driver is "qualified only when wearing corrective lenses."	Driver's employer

