Motorcoach Run-Off-the-Road and Collision With Vertical Highway Signpost Interstate 95 Southbound New York City, New York March 12, 2011

Accident Report

NTSB/HAR-12/01
PB2012-916201

National Transportation Safety Board

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Highway Accident Report

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National Transportation Safety Board

490 L'Enfant Plaza, SW
Washington, D.C. 20594

National Transportation Safety Board. 2012. ***Motorcoach Run-Off-the-Road and Collision With Vertical Highway Signpost, Interstate 95 Southbound, New York City, New York, March 12, 2011*****.** **Highway Accident Report NTSB/HAR-12/01. Washington, D.C.**

Abstract: On March 12, 2011, about 5:38 a.m., a 1999 Prevost 56-passenger motorcoach, operated by World Wide Travel of Greater New York, was traveling southbound on Interstate 95, en route from the Mohegan Sun Casino in Uncasville, Connecticut, to New York City, and carrying 32 passengers. Near mile marker 3.2, the motorcoach departed from the travel lanes, driving over the rumble strips on the right shoulder edge. It then crossed over the 10-foot-wide paved shoulder and struck a guardrail, traveling about 480 feet alongside and on the guardrail, before overturning and flattening it. The vehicle then collided with a vertical highway signpost consisting of two vertical 8-inch-diameter steel tubular poles linked by cross-beam diagonal metal supports. The support structure's two poles entered the passenger compartment along the base of the passenger windows as the vehicle slid forward, resulting in the roof panel being torn from the bus body for almost its entire length. Fifteen passengers were killed, 17 passengers received serious-to-minor injuries, and the bus driver received minor injuries.

Major safety issues identified in this investigation were motorcoach driver fatigue and onboard monitoring systems, commercial driver license history, heavy vehicle speed limiters, safety management systems and motor carrier safety ratings, roadside barriers for heavy commercial passenger vehicles, and occupant injuries and motorcoach crashworthiness. As a result of this accident investigation, the National Transportation Safety Board makes recommendations to the Federal Motor Carrier Safety Administration, the National Highway Traffic Safety Administration, the Federal Highway Administration, the American Association of State Highway and Transportation Officials, the American Bus Association, the National Motorcoach Network, and the United Motorcoach Association.

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Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
AOBRD	automatic on-board recording device
ATA	American Trucking Associations
ATRI	American Transportation Research Institute
BASIC	Behavioral Analysis Safety Improvement Category
BMI	body mass index
CAMI	Civil Aerospace Medical Institute
CAPRI	Compliance Analysis and Performance Review Information [system]
CDL	commercial driver's license
CDLIS	Commercial Driver's License Information System
CFR	*Code of Federal Regulations*
CG	center of gravity
CID	client identification number
CMV	commercial motor vehicle
CSA	Compliance, Safety, Accountability [program]
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
CVSA	Commercial Vehicle Safety Alliance
DDEC	Detroit Diesel Electronic Controls
DDWS	drowsy driver warning system
DOT	U.S. Department of Transportation
DMV	Department of Motor Vehicles
DVIR	driver vehicle inspection report
ECM	electronic control module
EMS	emergency medical service
EU	European Union
FARS	Fatality Analysis Reporting System
FDNY	Fire Department of New York
FHWA	Federal Highway Administration

FMCSA	Federal Motor Carrier Safety Administration
FMCSRs	*Federal Motor Carrier Safety Regulations*
FMP	fatigue management program
FMVSS	*Federal Motor Vehicle Safety Standards*
FR	*Federal Register*
GPS	global positioning system
Great Escapes	Great Escapes Tours & Travel Ltd.
GVWR	gross vehicle weight rating
I-65	Interstate 65
I-95	Interstate 95
LENS	License Event Notification System
LDWS	lane departure warning system
MASH	*Manual for Assessing Safety Hardware*
MC	motor carrier [number]
MCMIS	Motor Carrier Management Information System
MCSAC	Motor Carrier Safety Advisory Committee
MCSAP	Motor Carrier Safety Assistance Program
MCSIA	Motor Carrier Safety Improvement Act of 1999
MDMA	3,4-methylenedioxymethamphetamine
MRB	Medical Review Board
MVR	motor vehicle record
NAFMP	North American Fatigue Management Program
NCHRP	National Cooperative Highway Research Program
NDR	National Driver Register
NHTSA	National Highway Traffic Safety Administration
NPRM	notice of proposed rulemaking
NTSB	National Transportation Safety Board
NYDMV	New York Department of Motor Vehicles
NYPD	New York City Police Department
NYSDOT	New York State Department of Transportation
NYSP	New York State Police
NYSTA	New York State Thruway Authority

OBMS	onboard monitoring systems
OOS	out of service
OSA	obstructive sleep apnea
PCP	phencyclidine
PennDOT	Pennsylvania Department of Transportation
P.L.	Public Law
PSP	preemployment screening program
RSAP	Roadside Safety Analysis Program
SAFER	Safety and Fitness Electronic Records [system]
SafeStat	Safety Status Measurement System
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SEA	Safety Evaluation Area
SFD	Safety Fitness Determination
TL	Test Level [1–6]
TRB	Transportation Research Board
UMTRI	University of Michigan Transportation Research Institute
U.S.C.	*United States Code*
USDOT	U.S. Department of Transportation [number]
VER	video event recorder
World Wide Travel	World Wide Travel of Greater New York

Executive Summary

On March 12, 2011, about 5:38 a.m., a 1999 Prevost 56-passenger motorcoach, operated by World Wide Travel of Greater New York, headquartered in Brooklyn, was traveling southbound on Interstate 95, en route from the Mohegan Sun Casino in Uncasville, Connecticut, to New York City, and carrying 32 passengers. While in the vicinity of mile marker 3.2, the motorcoach departed from the travel lanes to the right, driving over the rumble strips on the right shoulder edge. The motorcoach then crossed over the 10-foot-wide paved shoulder and struck a strong-post W-beam guardrail, traveling about 480 feet alongside and on the guardrail, before finally overturning 90° onto its right side and flattening the guardrail. The front of the vehicle subsequently collided with a vertical highway signpost consisting of two vertical 8-inch-diameter steel tubular poles linked by cross-beam diagonal metal supports. The front roof also collided with a steel electrical box mounted to the sign support structure. After the motorcoach struck the support structure and electrical box, the two poles entered the passenger compartment along the base of the passenger windows as the vehicle slid forward. The impact resulted in the roof panel being torn from the bus body for almost the entire length of the bus. As a result of this accident, 15 passengers were killed, 17 passengers received serious-to-minor injuries, and the bus driver received minor injuries.

Investigative Synopsis

The accident occurred when the motorcoach departed from the travel lanes to the right at about a 7° departure angle from the roadway; no tire marks were made on the travel lanes to indicate braking or evasive steering. The driver then traversed a 10-foot-wide paved shoulder enhanced with rumble strips and struck a roadside barrier. Postaccident examination of electronic control module data revealed that the accident motorcoach was traveling at least 64 mph for at least 10 seconds before it struck the guardrail. The control module data also indicated that the driver did not apply the brakes in the 60 seconds before leaving the travel lanes, crossing the shoulder, and striking the guardrail.

Safety issues identified in this accident investigation include:

- **Motorcoach driver fatigue and onboard monitoring systems**: The motorcoach driver was experiencing both acute sleep loss and cumulative sleep debt at the time of the accident. Because of the driver's activities in the days leading to the accident, his sleep opportunities did not exceed 4 hours. Circadian factors related to the driver's inverted work schedule and the time of day at which the accident occurred, about 5:38 a.m., would have exacerbated the effects of fatigue. No Federal requirements currently exist for motor carriers to implement fatigue management programs. Research into fatigue management technologies is ongoing, though safety systems that monitor driver behavior, such as providing warnings to drowsy drivers or detecting unsafe driving behaviors, are already in the marketplace. However, motor carriers are in need of additional guidance on how to effectively use in-vehicle technology to monitor and improve driver safety.

- **Commercial driver license history**: A driver's history of crashes or moving violations is directly related to future crash risk. Currently, a motorcoach driver-applicant must submit a 10-year commercial driving employment history, and the states must provide carriers hiring commercial drivers with a 3-year driving history. However, for preemployment screening, motor carriers need access to a longer history of a commercial driver's license record to make informed hiring decisions. The National Transportation Safety Board (NTSB) is currently investigating two other accidents involving high-risk drivers.

- **Heavy vehicle[1] speed limiters**: The speed limit at the accident location was 50 mph, yet the motorcoach driver was traveling 64 mph after departing the travel lanes of I-95. Had he been driving at or below the speed limit (50 mph), he may have been able to steer the bus away from the guardrail, preventing the rollover and collision with the vertical highway signpost. The motorcoach was equipped with a speed limiter, but it was set to 78 mph. Although there is significant interest in the use of advanced speed limiting technology, no Federal performance standards address such technology or require its installation in heavy vehicles.

- **Safety management systems and motor carrier safety ratings**: The practices of both motor carriers that had employed the accident driver—such as not adhering to hours-of-service requirements and improperly addressing speeding violations—indicate inadequate oversight of drivers, which impacts passenger safety. This accident is one of many investigated by the NTSB in which the motor carrier's safety processes, as well as its corporate culture, may have set the stage for the driver's on-road operating performance. Motor carriers should receive a determination of their fitness to operate and a safety rating based upon on-road performance and adherence to safety regulations, performance that is currently tracked by the Federal Motor Carrier Safety Administration's Safety Measurement System. Federal rulemaking on a new safety fitness determination process is scheduled to begin by early 2013. The performance rating will be based on all safety-based regulations, rather than on critical and acute violations only. It will replace the current safety rating process, which relies exclusively on onsite investigation or compliance review. In addition, as part of a process called a Safety Management Cycle, motor carriers should be educated about, and required to actively assess, the root cause of safety violations that are correlated to crash risk.

- **Roadside barriers for heavy commercial passenger vehicles**: The NTSB evaluated roadside conditions at the accident site to determine the guardrail characteristics necessary to shield the vertical highway signpost. Examination of available research

[1] Defined by the National Highway Traffic Safety Administration as "…most vehicles over 10,000 pounds gross vehicle weight rating, including truck-tractors, single-unit trucks, buses, [and] motorcoaches…." For further information, see <http://www.nhtsa.gov/staticfiles/rulemaking/pdf/2011-2013_Vehicle_Safety-Fuel_Economy_Rulemaking-Research_Priority_Plan.pdf>, accessed May 3, 2012.

and testing methods for barriers reveals that guidance given to the states on upgrading barrier systems is inadequate. In addition, there is a clear need nationwide for higher performance traffic barriers to redirect heavy commercial vehicles and motorcoaches. New barrier performance standards are needed along with, possibly, new barrier designs with height and deflection characteristics capable of safely redirecting heavy commercial passenger vehicles from point hazards.

- **Occupant injuries and motorcoach crashworthiness**: The accident motorcoach hit the guardrail, rolled over, and slid on its passenger side into the vertical highway signpost. The point of impact on the motorcoach, just below the roofline, was not capable of attenuating a frontal crash and the resulting impact loading was beyond the vehicle's design scope. Further, survival space was compromised for passengers in the path of the vertical signpost structure. Because motorcoaches are not currently required to meet Federal performance standards for occupant protection, the 1999 Prevost motorcoach was not equipped with passenger seat restraint systems—systems which, if installed, could reduce ejection and secondary impact injuries. As a result of this accident investigation, the NTSB identified the design of seat spacing and armrests as a means of reducing occupant injury and advocates for their evaluation and, if safe configurations and spacing are identified, the development of guidelines.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the motorcoach driver's failure to control the motorcoach due to fatigue resulting from failure to obtain adequate sleep, poor sleep quality, and the time of day at which the accident occurred. Contributing to the accident was inadequate safety oversight of the accident driver by World Wide Travel's management. Contributing to the severity of the accident was the motorcoach's speed and a guardrail that was not designed to redirect the heavy vehicle and did not prevent it from colliding with the vertical highway signpost. Contributing to the severity of passenger injuries was the extensive intrusion of the vertical highway signpost into the passenger compartment.

Recommendations

As a result of this accident investigation, the National Transportation Safety Board makes recommendations to the Federal Motor Carrier Safety Administration, the National Highway Traffic Safety Administration, the Federal Highway Administration, the American Association of State Highway and Transportation Officials, the American Bus Association, the National Motorcoach Network, and the United Motorcoach Association. The National Transportation Safety Board reiterates four recommendations to the Federal Motor Carrier Safety Administration and two recommendations to the National Highway Traffic Safety Administration.

1. Factual Information

1.1 Accident Narrative

About 5:38 a.m.[1] on March 12, 2011, a 1999 Prevost 56-passenger motorcoach, operated by World Wide Travel of Greater New York (World Wide Travel), was traveling southbound on Interstate 95 (I-95) in the Bronx borough of New York City. (See figures 1–3.) The motorcoach, carrying the driver and 32 passengers, was en route from the Mohegan Sun Casino in Uncasville, Connecticut, to New York City.

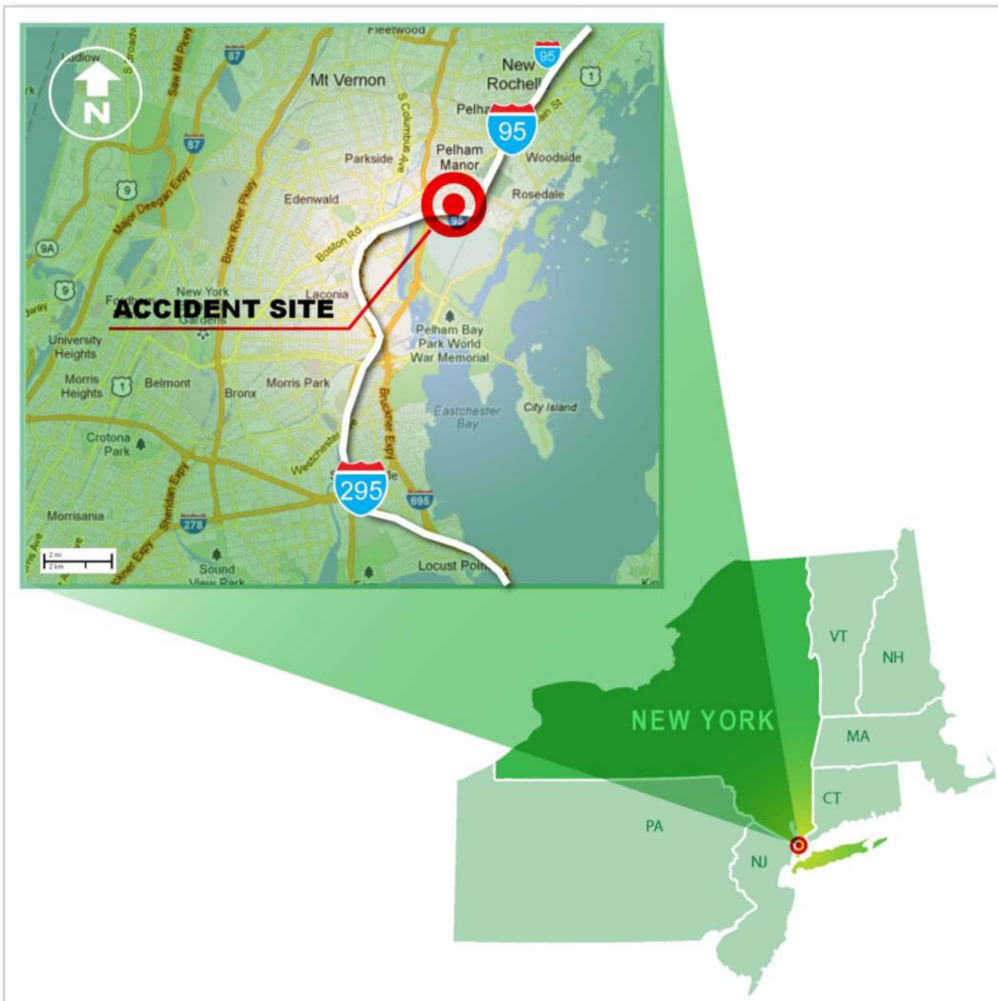

Figure 1. Regional map and view of accident site.

[1] Unless otherwise specified, all times in this report are eastern standard time.

Figure 2. Aerial view of I-95 and accident site. (Source: New York State Police [NYSP].)

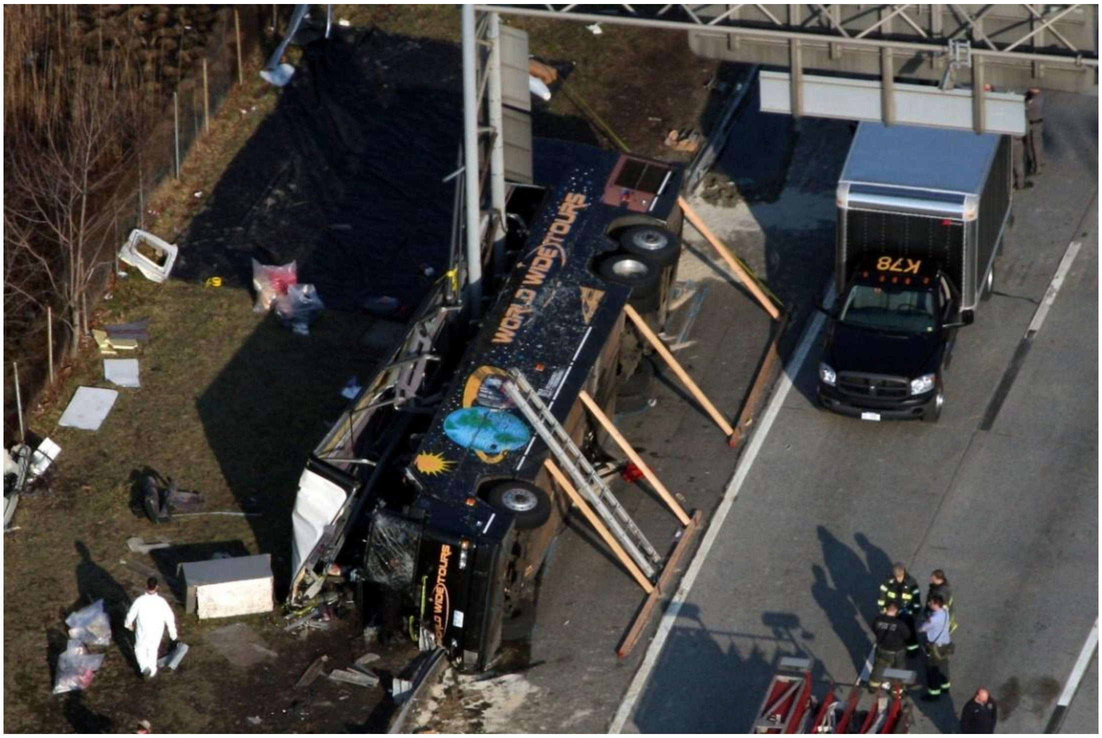

Figure 3. Aerial view of motorcoach. (Source: *The Journal News,* Frank Becerra)

As the motorcoach approached mile marker 3.2, the vehicle left the roadway and crossed the rumble strip on the 10-foot-wide right shoulder, striking a strong-post blocked-out W-beam guardrail[2] at 64 mph.[3] The motorcoach continued forward along the paved shoulder, sideswiping the guardrail, and then overturned to the right 90° on its longitudinal axis, flattening the guardrail as it continued to slide forward. (See figures 4 and 5.)

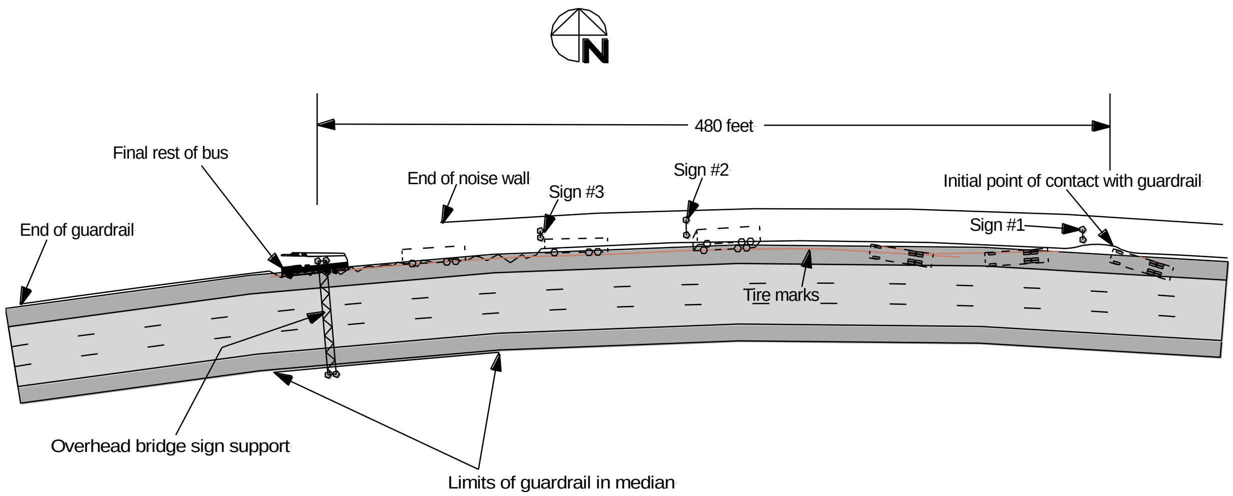

Figure 4. Accident scene diagram.

Figure 5. Damaged guardrail at the approach to the vertical highway signpost.

[2] A W-beam guardrail is a steel beam rail element shaped like a "W."

[3] The State of New York refers to these roadside barriers as *guiderails*. For the purposes of this report, the guiderail roadside barrier is referred to as a *guardrail*, the term used by the American Association of State Highway and Transportation Officials (AASHTO).

The front of the motorcoach subsequently collided with an overhead vertical highway signpost, consisting of two vertical 8-inch-diameter steel tubular poles linked by cross-beam diagonal metal supports and an attached steel electrical box.

After the motorcoach's windshield struck this support structure and steel electrical box, the two poles making up the vertical highway signpost entered the passenger compartment along the base of the passenger windows, as the motorcoach slid forward. The impact resulted in the vehicle's roof panel being torn from the bus body for almost the entire length of the bus. (See figure 6.) Fifteen passengers were killed, 17 passengers received serious-to-minor injuries, and the bus driver received minor injuries.

Figure 6. Roof separation due to intrusion of the vertical highway signpost poles.

At 5:51 a.m. on the morning of the accident, LaGuardia Airport[4] reported a temperature of 39° F, dry conditions, winds from 240° at 13–24 mph, and visibility unrestricted at 10 statute miles. The astronomical conditions from the U.S. Naval Observatory indicated the beginning of civil twilight[5] at 5:45 a.m. and sunrise at 6:13 a.m. At 5:45 a.m., the sun was 6.1° below the horizon at an azimuth of 89° or almost due east. The moon was more than 15° below the horizon and provided no illumination.

[4] LaGuardia Airport, the closest official weather-observing station, is approximately 8 miles southwest of the accident site.

[5] *Civil twilight* occurs during the intervals before sunrise and after sunset in which sufficient natural light exists for objects to be clearly distinguishable and for outdoor activities to commence (dawn) or end (dusk) without artificial illumination. For further information, see <http://aa.usno.navy.mil/faq/docs/RST_defs.php>, accessed February 22, 2012.

1.2 Injuries

Fifteen passengers died in this motorcoach accident. Autopsy reports from the New York City Office of Chief Medical Examiner state that the deaths were caused by blunt force trauma to the internal organs, extremities, and head. Seventeen other passengers were injured; serious injuries included internal blunt force trauma, rib fractures, extremity fractures, amputations, abrasions, lacerations, and contusions. The driver and injured passengers were transported to two local hospitals for treatment. (See table 1.)

Table 1. Injuries.

Injury[a]	Driver	Passengers	Total
Fatal	0	15	15
Serious	0	7	7
Minor	1	10	11
None	0	0	0
Total	1	32	33

[a] Title 49 *Code of Federal Regulations* (CFR) 830.2 defines fatal injury as any injury that results in death within 30 days of the accident. It defines serious injury as an injury that requires hospitalization for more than 48 hours, commencing within 7 days of the date of injury; results in a fracture of any bone (except simple fractures of fingers, toes, or nose); causes severe hemorrhages, or nerve, muscle, or tendon damage; involves any internal organ; or involves second- or third-degree burns, or any burn affecting more than 5 percent of the body surface.

Emergency responders reported seeing several passengers underneath the motorcoach between the ground and the vehicle roof and eight or nine fatally injured passengers near the front of the motorcoach, entangled together either in the aisle or on the right side of the bus. Other passengers were located toward the rear of bus, entrapped either around the vertical poles or between the poles and the motorcoach roof and roof-mounted luggage racks.

Passenger interviews provided information on seating positions for 8 of the 32 passengers.[6] (See figure 7.) The partial seating chart contains the known locations of bus occupants obtained through these interviews. All occupants are assigned a letter designation in the chart for reference; occupants whose seating position before the crash could not be determined are listed by letter designation and injury severity.

[6] Every occupant seating location could not be identified due to several factors, including the high number of fatalities.

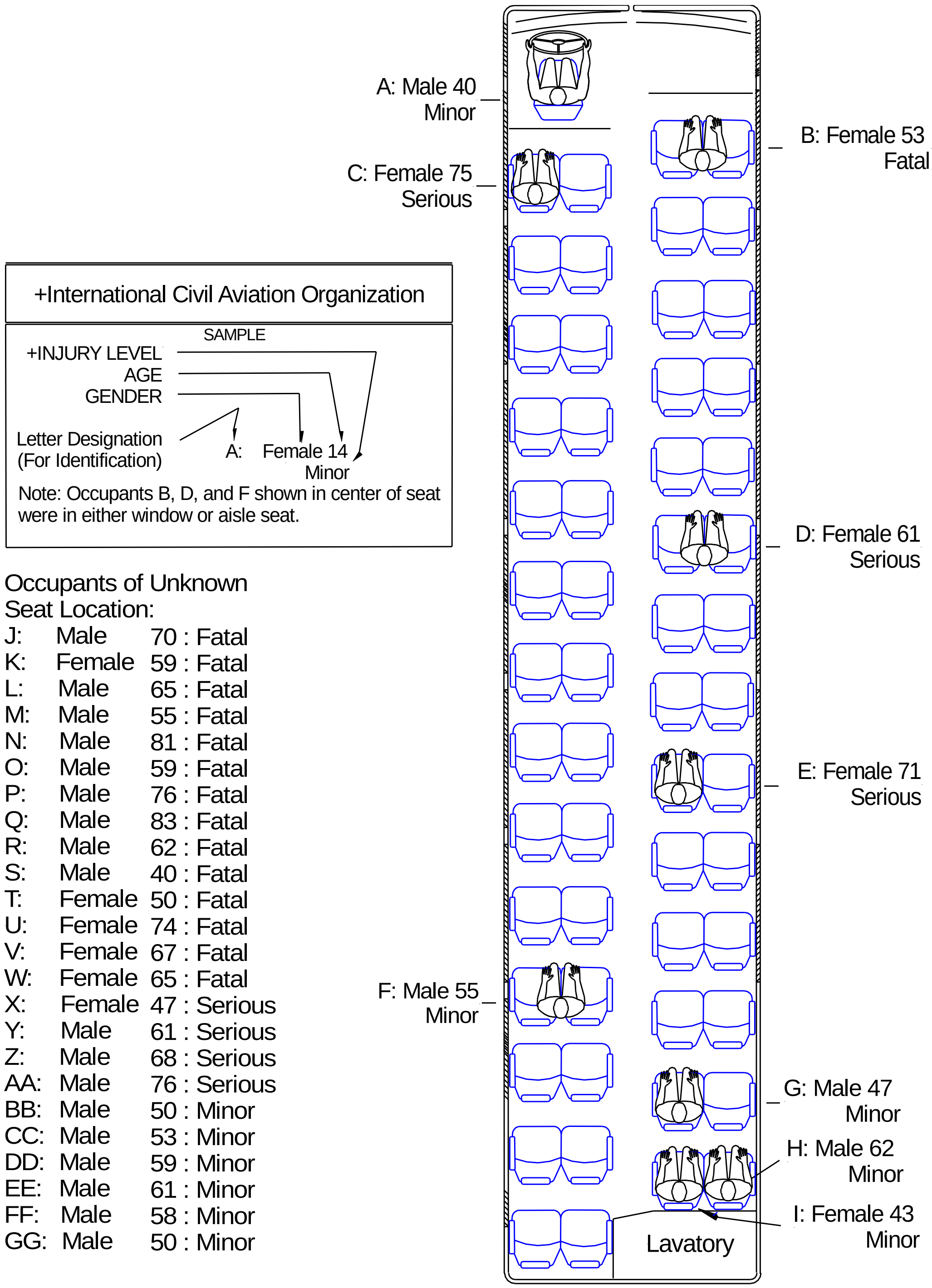

Figure 7. Passenger seating chart, injury, and demographic information.

1.3 Emergency Response

At 5:37 a.m.,[7] the New York City Police Department (NYPD) began receiving 911 calls from drivers on I-95 (New England Thruway) reporting a bus rollover accident. The Fire Department of New York (FDNY) dispatched emergency medical service (EMS) units between 5:38 a.m. and 6:10 a.m., with the first arriving on scene at 5:50 a.m. and the second at 6:00 a.m. The FDNY Battalion Chief arrived on scene, initiated the incident command system, and was the first incident commander. At 5:38 a.m., the NYPD received 911 calls from both northbound and southbound drivers who had witnessed the accident and aftermath. Troop T of the NYSP dispatched two units at 5:40 a.m. and 5:41 a.m., which arrived on scene at 5:49 a.m. and 5:52 a.m. The New Rochelle and Pelham Manor police departments received 911 calls at 5:43 a.m. The response to the accident consisted of the NYSP, local law enforcement, and the FDNY with approximately 10 fire and 16 EMS vehicles. In addition, three private ambulance services were called and arrived on scene starting at 6:43 a.m., with a total of six ambulances that responded and assisted with triage and transported patients to hospitals.

1.4 Driver Information

1.4.1 Certification, License, and Driving History

The 40-year-old motorcoach driver held a New York State class "B" commercial driver's license (CDL) with a "P" passenger endorsement and no restrictions. His current medical examiner's certificate (equivalent of a physical examination card) was issued on November 18, 2010, with an expiration date of November 2012. The accident driver's CDL was issued in February 2010, with an expiration date of December 2015. However, during its investigation of this accident, the National Transportation Safety Board (NTSB) discovered that the accident driver had incurred driving violations and suspensions prior to being licensed in New York. These violations were recorded under an alias. Two of the suspensions were still in effect at the time of the accident, meaning the driver was operating the motorcoach on a suspended license. (Table 2 summarizes the accident driver's driving history, and appendix B contains his full driving history.) The NTSB also obtained the driver's Commercial Driver's License Information System (CDLIS) record from the New York Department of Motor Vehicles (NYDMV), which contains the driver's total driving record. The following is a summary of that record: 5 suspensions (for failure to pay child support); 6 violations (1994–1996); and 21 separate suspensions[8] (for offenses other than failure to pay child support).

[7] Time differences between the electronic control module (ECM) recorded accident time and emergency response dispatch records can be attributed to desynchronized clocks.

[8] The record does not specify the underlying violations.

Table 2. Summary of accident motorcoach driver's driving history.

Source	Period	Violations
New York State License Event Notification System (LENS)[a] history obtained by motor carrier at time of accident motorcoach driver's employment[b]	1995–2011	• 0 moving violations • 5 restricted licenses • 7 class of license changes • 2 suspensions (failure to pay child support) • 0 accidents
New York State Driver's CDL abstract obtained by motor carrier March 30, 2011 (18 days after accident)	1996–2003	• 7 class of license changes • 6 suspensions (various offenses) • No violations • No accidents
Past commercial motor vehicle (CMV) employer A—Preemployment records obtained via 3rd party background service (May 1, 2006, and January 19, 2007) Past CMV employer B—Preemployment records obtained directly from New York State (November 9, 2006)	1996–2003	• 1 operating a vehicle–unlicensed • 1 operating a vehicle–uninsured • 1 suspension (failure to pay child support) • 1 revocation (1997, cleared in 2003) • 1 operating a vehicle–unlicensed • 1 suspension (failure to pay child support) • 1 revocation (1997, cleared in 2003)
NYDMV	1995–2010	• 7 violations (1995–2007) • 3 suspensions (failure to pay child support) • 1 suspension (no insurance) • 6 suspensions (failure to appear in court) • 1 revocation (1997) • 5 class of license changes

[a] State-run database that allows a carrier to view an employee's driving record (citations, accidents, and other NYDMV actions) in real time and to also be notified by the NYDMV when an action, such as a citation or accident, occurs.
[b] The day of the accident (March 12, 2011), the motor carrier ran a second driver history with similar results.

1.4.2 Employment Background

During its accident investigation, the NTSB reviewed the driver's qualification file. Prior to working for World Wide Travel, the accident driver had worked as a helper and driver of a hearse and limousine for a funeral home in Brooklyn, New York, from August 1989–March 2006.[9] From March 2006–December 2007, he was a motorcoach driver for Coach USA (doing business as Community Coach, Inc.) in Paramus, New Jersey, working as both a full- and part-time employee until being fired for too many absences. The driver was also employed part-time by the New York Metropolitan Transit Agency from February 5–20, 2007, until being terminated for failing to report two criminal convictions on his job application. The NTSB has no record of employment for the driver from December 2007–October 2010; the driver reported he was a caregiver for an ill family member during that period. The accident driver was hired by World Wide Travel on November 17, 2010, and, after undergoing the company's preemployment screening process, began working on November 23, 2010.

1.4.3 Preaccident Activities

Table 3 provides information on the driver's preaccident activities.[10]

[9] Not continuous employment; the driver was incarcerated twice during this period.

[10] This recent driver activity history (March 9–12, 2011) is based on two interviews with the accident driver, interviews with Mohegan Sun casino personnel, Mohegan Sun video camera footage, tollbooth records, World Wide Travel driver scheduling records, and the accident driver's cell phone records.

Table 3. Bus driver's preaccident activities (March 9–12, 2011).

Time	Activities	Location
Wednesday, March 9		
9:00 p.m.	Arrive for duty, World Wide Travel terminal	Brooklyn, NY
9:15 p.m.	Depart terminal	Brooklyn
10:00 p.m.	Pick up passengers; depart en route to Mohegan Sun	Flushing, NY
Thursday, March 10		
1:00 a.m.	Arrive Mohegan Sun casino, drop off passengers, and move motorcoach to parking lot	Uncasville, CT
1:20–3:15 a.m.	Sleep in bus (self-reported)	Parking lot
5:15 a.m.	Pick up passengers	Bus lobby entrance
5:30 a.m.	Depart Mohegan Sun en route to New York	I-95 south
8:58 a.m.	Return World Wide Travel terminal	Brooklyn
10:00 a.m.–4:00 p.m.	Sleep (self-reported)[a]	Residence
9:30 p.m.	Arrive for duty, World Wide Travel terminal	Brooklyn
9:45 p.m.	Depart terminal	Brooklyn
10:30 p.m.	Pick up passengers; depart en route to Mohegan Sun	Flushing
Friday, March 11		
1:56 a.m.	Arrive Mohegan Sun, drop off passengers	Uncasville
~2:00 a.m.–6:00 a.m.	Sleep in bus (self-reported)	Parking lot
~6:30 a.m.	Depart Mohegan Sun en route to New York	I-95 south
~9:50 a.m.	Arrive World Wide Travel terminal	Brooklyn
11:00 a.m.–4:00 p.m.	Sleep (self-reported)[b]	Residence
6:15 p.m.	Arrive for duty, World Wide Travel terminal	Brooklyn
7:40 p.m.	Pick up passengers; depart en route to Mohegan Sun	Bowery, New York City, NY
10:36 p.m.	Arrive Mohegan Sun, drop off passengers	Uncasville
10:54 p.m.	Drive to casino parking lot	Parking lot
11:46 p.m.	Drive from parking lot to casino for lost item	Bus lobby entrance
11:55 p.m.	Return to casino parking lot from bus lobby entrance	Parking lot
~11:55 p.m.–3:17 a.m.	Sleep on bus	Parking lot
Saturday, March 12		
3:17 a.m.	Receive incoming cell phone call (32 seconds)	Parking lot
3:19 a.m.	Pick up passengers	Bus lobby entrance
3:48 a.m.	Depart Mohegan Sun en route to New York	I-95 south
5:38 a.m.	Accident	I-95, near New York City

[a]The driver's cell phone was in use multiple times between 10:15 a.m.–12:03 p.m. Additionally, a 24-second incoming call occurred at 3:39 p.m.
[b]The driver's cell phone was in use numerous times during this period, with the longest period of nonuse between 11:38 a.m.–12:17 p.m. (39 minutes).

Figure 8 provides a graphical activity history for the 3 days leading up to the accident and includes information about the driver's driving/duty status, self-reported sleep times, cell phone use, and rental car use. Each block in the figure represents a 15-minute increment, with the letter "c" in a block representing a period in which the driver's cell phone was used for calls or outgoing text messages and the letter "r" representing a period when the rental car's ignition was on. The driver's work duty status did not show a violation of the commercial hours-of-service regulations. Evidence from the driver's cell phone records suggests that he was using his cell phone frequently during self-reported off-duty or daytime sleep periods over the 3 days before the accident.[11] Additionally, cell phone data obtained by the NYSP show that during the driver's self-reported sleep period, his cell phone was in use at several locations in New York City and Nassau County, New York. Factoring in the driver's cell phone use, his opportunity for sleep during off-duty periods would have been limited to short periods of approximately 4 hours or less.

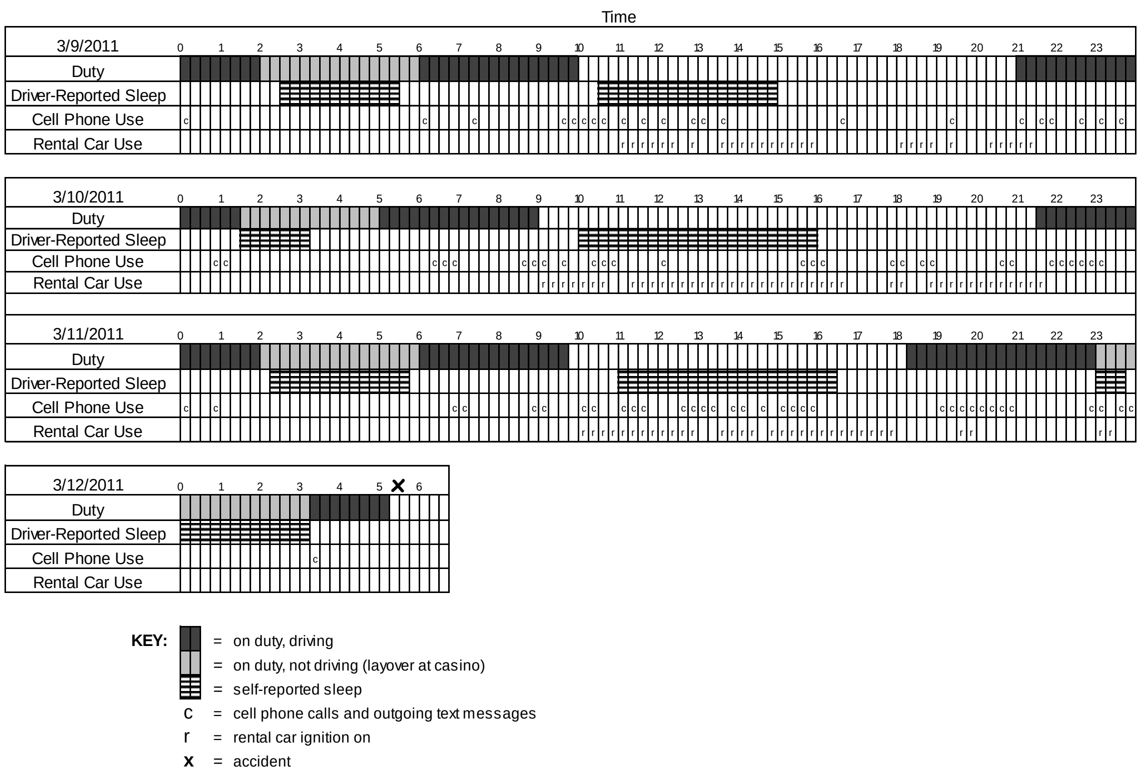

Figure 8. Recent driver activity history.

The accident driver had an account with a car sharing service, giving him access to vehicles in the rental car fleet and allowing their pick up and drop off at designated unmonitored parking spots throughout New York City. The most recent preaccident use of a rental car on the accident driver's account began on March 9, 2011, at 11:05 a.m., approximately an hour after the

[11] Investigators submitted questions to the driver through his attorney to determine whether others may have used the driver's cell phone, but no response was provided. A review of outgoing cell phone calls showed that several of the numbers dialed during the driver's driving periods were identical to numbers called during periods when he self-reported being asleep.

driver finished work and during a period in which he reported to NTSB investigators that he was asleep at his home. The car was returned postaccident on March 12, 2011, at 8:46 a.m. During this 3-day rental period, the car was driven 228 miles.[12]

1.4.4 Medical History and Toxicology

The accident driver checked "no" on his medical certificate form for all listed conditions, including "sleep disorders, pauses in breathing while asleep, daytime sleepiness, loud snoring." The driver reported his height as 68 inches and his weight as 240 pounds, equaling a body mass index (BMI) of 36.5; the U.S. Centers for Disease Control and Prevention[13] classifies a BMI of 30 or greater as "obese." During his postaccident interview with the NTSB, the driver stated that he was in good health overall. He self-reported asthma but said that he had not had problems with this condition for a long time. The driver also reported his collar size as being 17½–18½. He also said that he had never been told he had a sleep disorder, and his wife reported that he only snored when he was tired or had completed strenuous household chores. He stated that his sleep schedule on his days off included going to bed at 8:00–9:00 p.m. and awaking at 10:00 a.m.–noon.

The employer of a CMV driver who is involved in a fatal accident while operating on a public road in commerce must conduct alcohol and controlled substance testing on that driver (49 CFR 382.303). NTSB investigators spoke with an NYPD detective who stated he identified the bus driver at the accident scene and administered the portable breath test, noting that the accident driver "blew 000," indicating a negative test. Toxicological analysis by the Federal Aviation Administration's Civil Aerospace Medical Institute (CAMI) of a blood specimen collected from the driver during his postaccident hospitalization (a sample drawn at 1:40 p.m. on the day of the accident) determined that he was negative for all screened drug classes.[14]

[12] Zipcar, a car sharing service, provided the NTSB with data from the proprietary telematics unit installed on its vehicles. The telematics unit transmits data to a computer server at regular intervals and when certain trigger events occur (such as when the car ignition is turned on or off or when the doors are locked or unlocked). According to Zipcar, the vehicle was unlocked with its ignition off and usage ended at 8:46 a.m. on March 12.

[13] For further information, see <http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html>, accessed August 31, 2011.

[14] CAMI screened for several drug classes including amphetamines, opiates, marijuana, cocaine, phencyclidine (PCP), benzodiazepines, barbiturates, antidepressants, and antihistamines. For comprehensive information concerning all drugs detected by the laboratory, see the CAMI Drug Information website: <http://jag.cami.jccbi.gov/toxicology/>, accessed February 23, 2012. Blood specimens collected from the driver during his postaccident hospitalization at 10:15 a.m. on the day of the accident were also analyzed by the Westchester County Department of Laboratories and Research, which determined the sample was negative for alcohol and negative for amphetamines, barbiturates, benzodiazepines, cocaine metabolite, 3,4-methylenedioxymethamphetamine (MDMA, also known as "ecstasy"), oxycodone, PCP, methadone, propoxyphene, opiates, and 11-nor-9-carboxy-delta-9-tetrahydrocannabinol (marijuana metabolite).

1.5 Vehicle Information

1.5.1 Postaccident Inspections

The 1999 56-passenger Prevost model H3-45 motorcoach was 45 feet long and equipped with a Detroit Diesel Corporation Series 60, six-cylinder electronically controlled diesel engine; an Allison model B-500 automatic transmission; and a Detroit Diesel Electronic Controls (DDEC) Series IV ECM.[15] The motorcoach was also equipped with a Meritor WABCO antilock braking system and Knorr-Bremse (Bendix) type SN7 air disc brakes. The odometer reading at the time of the accident was an estimated 857,238 miles.[16]

All major mechanical systems were examined, including the steering, suspension, and braking systems. No damage was noted to any of the steering system components; all connections were solid and free of wear or excess play. The air brake system was examined and found to be functional and undamaged, passing all system checks; the brake disc rotors and pads were found to be within specified wear limits. The tires were all of the same size—the size specified by the manufacturer—and tread depths were found to exceed minimum requirements.[17]

Maintenance records pertaining to the accident bus, obtained from World Wide Travel, included approximately 1 month of daily vehicle inspection reports (DVIR), as well as 3 years (March 2008—March 2011) of maintenance and inspection records. No major mechanical system defects of the accident bus were noted in the DVIRs provided. The accident bus's maintenance records noted a variety of regularly scheduled maintenance and as-needed repairs.

1.5.2 Accident Motorcoach Damage

The primary mechanism of physical damage to the motorcoach occurred after the vehicle rolled 90° onto its passenger side and slid forward, striking the vertical highway signpost. The damage was due to the intrusion of the signpost's support poles and cross-beam diagonal metal support and attached steel electrical box, which nearly separated the roof from the motorcoach body at the passenger windows. (See figure 9.)

[15] The DDEC IV ECM can record vehicle speed, brake application, engine rpm, and other information for more than 1 minute before a vehicle's final stop.

[16] The odometer mileage consisted of the original ECM mileage of 763,160 when it was replaced on December 1, 2009, and the new DDEC mileage of 94,078, recorded at the time of the accident. The speed limiter on the motorcoach's DDEC was set at 78 mph.

[17] As measured in two adjacent tread grooves at any location on the tire, 4/32 inch for the steer axle and 2/32 inch for all other axles (*Federal Motor Carrier Safety Regulations* [FMCSRs], Title 49 *United States Code* [U.S.C.], Part 393.75 [Tires]).

Figure 9. Southbound view of accident motorcoach at rest.

Three of the four laminated windscreens that made up the windshield were destroyed; however, the driver side mirror, left headlights, left side bumper, and left windshield wipers were intact. The loading door, constructed of steel and fiberglass with large glass panels, was fractured into several pieces and displaced aft; the glass was destroyed. Due to impact with the vertical highway signpost, the left front corner of the roof section was folded down just above the lower windshield pane on the driver side and just above the loading door on the passenger side, which was facing the ground.

Further, the motorcoach “B” pillars (first roof struts)[18] were folded back due to the vertical highway signpost’s impact. The roof support pillars aft of the “B” pillars, which were constructed of 3-inch-square steel tubing, experienced distinctive deformation or separation at the base of each strut, indicating impact just above the passenger window frame and in line with the seat headrests at the front of the bus. As the intrusion moved farther aft, the driver side impact marks on the roof support pillars moved upward to the height of the interior parcel racks, and the passenger side support pillar impact marks to just below the interior parcel racks.

The motorcoach side windows were Prevost-patented thermopane frameless-sided double-glazed windows. The exterior tinted glazing was tempered safety glass, and the clear

[18] Constructed of 6-inch-square steel and located aft of both the driver seat and loading door frame.

interior pane was tempered safety glass.[19] All of the side windows, except for the ninth and tenth side windows on the driver side, were broken and missing from the frame postaccident.

The Prevost motorcoach interior was 95 inches wide by 72 inches high, and the vertical distance from the floor to the window base measured 32.7 inches. The passenger compartment had closed bin parcel racks supported by extruded aluminum above the passenger seats. The frame for the passenger side parcel racks remained in place but was heavily damaged, the parcel racks on the driver side and front portion of the bus were displaced, and the parcel racks in the rear half of the motorcoach remained in place. The driver side parcel rack doors were detached and damaged due to intrusion of the vertical highway signpost. (See figure 10.)

Figure 10. Roof and interior parcel rack damage (shown at left) caused by intrusion of the vertical highway signpost support poles.

There were 14 rows of passenger seats, with the seating rows on the driver side spaced rearward of those on the opposite side (by about a half row at the front of the bus to nearly a full row farther back). The driver seat was fitted with a two-point lap belt restraint; the buckle and inertia reel were found in functioning condition, with the webbing frayed along the edges from

[19] The two windows next to the driver and the loading door windows were not tinted. The first, second, sixth, ninth, and tenth windows were fixed, and the remaining side windows (six per side) were emergency egress windows; interlocking extrusions at the top of the frame provided hinge action for the window sash assembly, which opened from the bottom. The ninth side window on the passenger side had its outer tinted glass missing, but the clear interior glass was in place.

use or wear. No passenger seat restraints were present nor were such restraints required.[20] A lavatory was behind the last row of seats on the passenger side.[21]

Each seat set shared a common base frame, with individual cushions and backrests divided by armrests (except for one row near the rear). The seat sets were attached to the floor via a leg under the aisle seat and to the sidewall via a forward and aft anchor at roughly the level of the seatpan. Several passenger seat armrests were found broken; the armrest fracture pattern was consistent with an applied bending load (no evidence was found that armrests were cut by first responders during passenger extrication). Further, several seatbacks exhibited imprint marks (such as indentations) from occupant impact; the floor attachment of the driver side seat at row 3 was broken; and the seat attachment floor track at row 4 was pulled out of the floor, deformed, and protruding vertically. In addition, several seats were found cut by first responders to aid in the extrication of occupants.

1.5.3 New York State Commercial Passenger Vehicle Inspections

The New York State Department of Transportation (NYSDOT) Motor Carrier Safety Bureau performs biannual safety inspections on all buses in the State of New York, including motorcoaches and school buses. NYSDOT motor vehicle inspectors conduct these inspections at the operator's facility, which can normally take from 60–90 minutes, depending on the size and type of the vehicle. The biannual safety inspection also includes a review of required maintenance records, preventative maintenance program information, and DVIRs.[22] The World Wide Travel accident bus was last inspected on January 13, 2011, and passed inspection. The accident motorcoach also passed NYSDOT inspections in July 2010, March 2010, September 2009, April 2009, October 2008, and May 2008 without any mechanical defects noted or vehicle repairs needed.

1.6 Highway Information

1.6.1 General

The motorcoach accident occurred on I-95 south (New England Thruway) at mile marker 3.2, immediately south of the Westchester County line and just within Bronx County in New York City. The New York State Thruway Authority (NYSTA) has jurisdiction of the New England Thruway between the Pelham Parkway at mile marker 0.0 and the Connecticut

[20] According to Prevost, the passenger seats were tested as described in *Federal Motor Vehicle Safety Standard* (FMVSS) 210, as an internal design specification to satisfy a 3,000-pound forward longitudinal load for each double seat assembly.

[21] A row of club seating (one row could be rotated to face rearward) was available in the second-to-last row on the driver side and in the last row on the passenger side; these rows were found postaccident in the forward-facing configuration. The club row table on the driver side was found postaccident in the folded configuration; however, the table from the passenger side was found outside the bus during inspection.

[22] Inspections are conducted based on requirements contained in Title 17 *New York State Department of Transportation Bus and Passenger Vehicle Regulations* Parts 720–721. For regulations, see <http://www.nysdot.gov/divisions/operating/osss/bus-repository/busregs.pdf>, accessed May 9, 2012; for inspection criteria, see <http://www.nysdot.gov/divisions/operating/osss/bus-repository/oos.pdf>, accessed May 9, 2012.

State Line at mile marker 15.0. The NYSTA maintains and operates the 570-mile superhighway system known as the New York State Thruway.

I-95 in the vicinity of the accident, which is classified as an urban principal arterial road, was constructed in the 1950s and reconstructed in 1984. The southbound lanes consist of three travel lanes, each measuring approximately 12 feet wide and separated by evenly spaced white retroreflective pavement stripes 6 inches wide and 10 feet long. A 6-inch solid yellow pavement stripe delineates the inner edge of the roadway from the 10-foot-wide left shoulder, and a 6-inch solid white pavement stripe delineates the outer edge of the right travel lane from the 10-foot-wide right shoulder. (See figure 11).

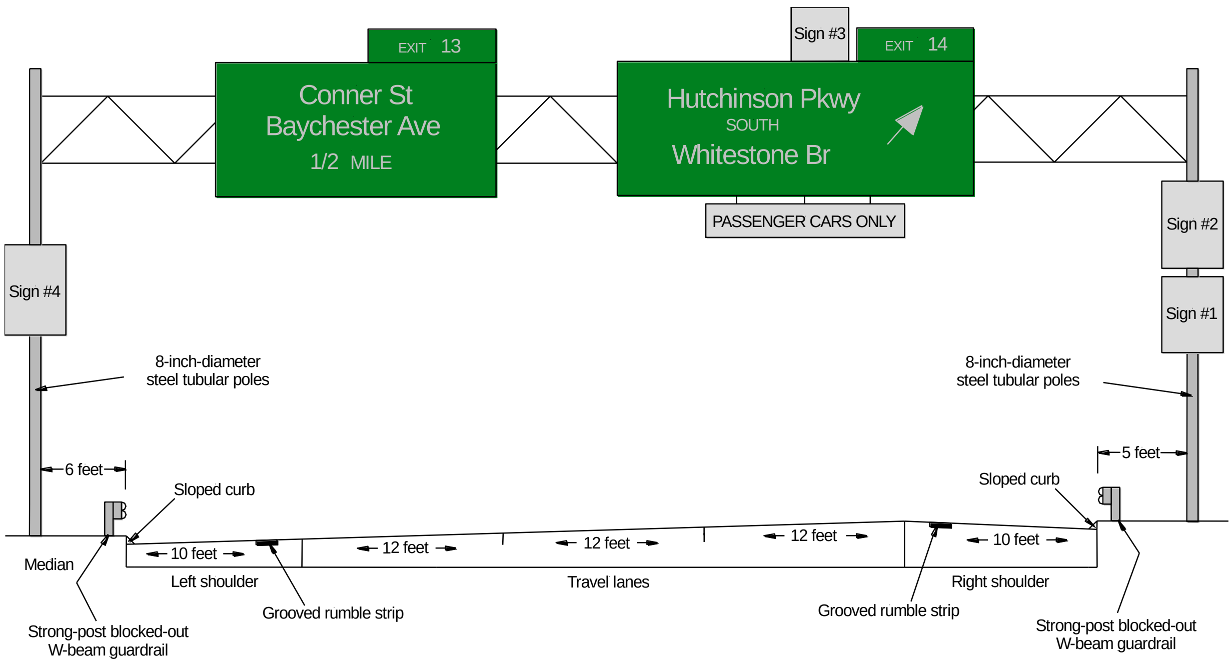

Figure 11. Typical section of I-95 southbound lanes in the vicinity of the accident.

A sloped (or mountable concrete) curb located at the edge of the 10-foot-wide paved right and left shoulders (see figure 11) had been installed in 1984 to convey stormwater runoff from the travel lanes of I-95 to a closed drainage system. The curb was approximately 5 inches high, as measured from the pavement surface.[23] The strong-post blocked-out W-beam guardrail was offset approximately 3 inches from the back face of the sloped curb. The installation of the curb complied with the NYSDOT *Highway Design Manual* guidance and standard sheet details in force at that time.[24]

The horizontal curvature of the I-95 southbound lanes near the accident scene consists of a 1,600-foot radius curve that turns to the right in the direction of travel and ends approximately

[23] The actual sloped portion of the curb on I-95 in the vicinity of the accident was 4 inches high, while the sloped portion of the curb began at a point raised 1 inch vertically from the right shoulder. The “mountable curb” was based on the design standards and criteria that existed when this section of I-95 was reconstructed in 1984.

[24] *Highway Design Manual*, “Chapter 10—Roadside Design, Guide Rail, and Appurtenances,” revision 57 (Albany, New York: New York State Department of Transportation, June 28, 2010), p. 10–37.

770 feet before the accident location and then transitions to a 4,500-foot radius curve that turns to the left in the direction of travel. The accident location was within the 4,500-foot radius curve. Grooved rumble strips (also called shoulder treatment for accident reduction, or STAR) were located on the right and left shoulders of the southbound lanes, along with a sloped curb at the edge of the right and left shoulders. (See figure 12 illustrating the two horizontal curves.)

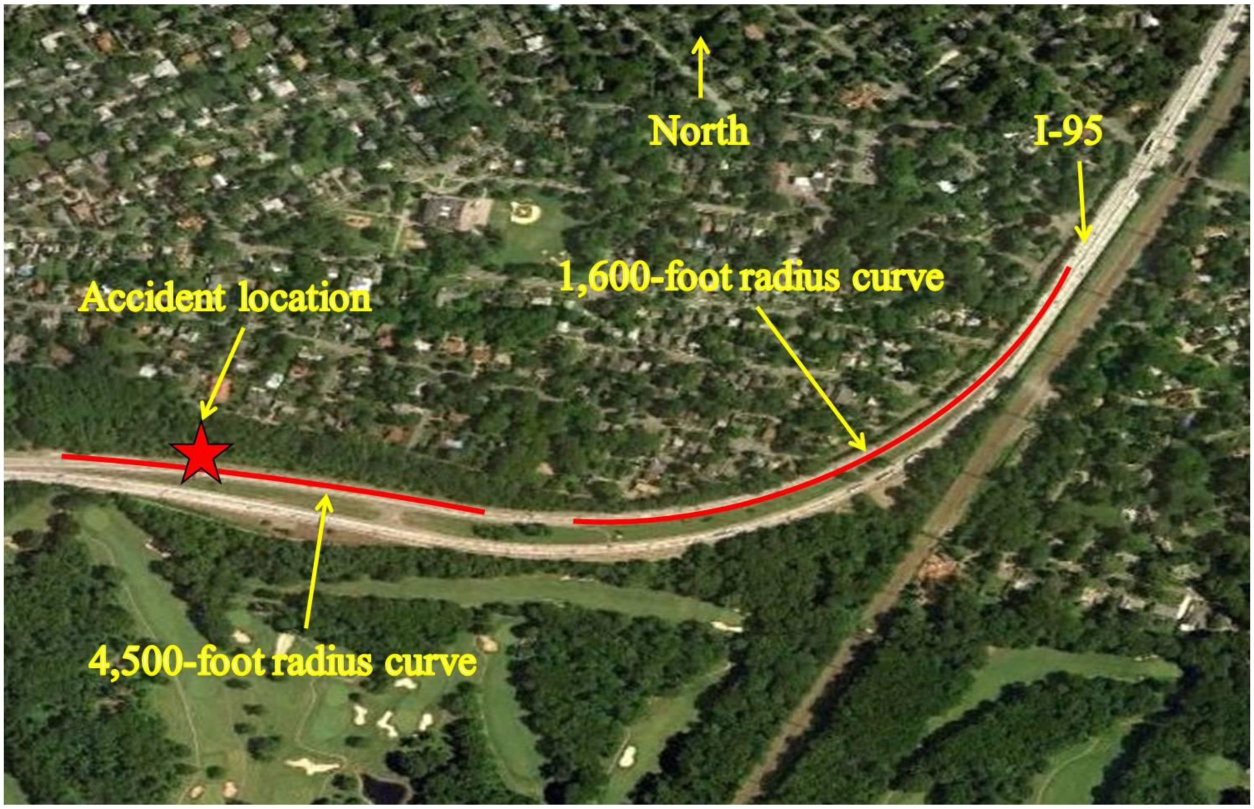

Figure 12. Horizontal curvature of I-95 southbound in the accident vicinity.

1.6.2 Speed Limit, Traffic, Vehicle Classification, and Accident Data

The posted speed limit at the accident location was 50 mph for both passenger cars and commercial vehicles.[25] On April 14, 2011, the NYSTA conducted a speed survey of I-95 southbound near the accident location, which recorded approximately 800 passenger cars, 200 trucks, and 29 buses. The speed study revealed that 85 percent of passenger cars were traveling at or below 67 mph; trucks, 60 mph; and buses, 59 mph.

According to NYSTA records, the most recent traffic count in the accident vicinity was 106,990 vehicles per day in 2009. At the New Rochelle toll plaza for the northbound lanes of I-95, near mile marker 6.9, passenger vehicles constituted 88 percent of the traffic volume in October 2010; buses, 0.1 percent; single-unit and single-trailer trucks (classes 5–9),

[25] The posted speed limit sign was located approximately 1,000 feet before the accident site. In Westchester County, immediately north of the accident site, the posted speed limit for the southbound lanes of I-95 is 50 mph for trucks and 55 mph for passenger cars.

11.1 percent; multitrailer trucks, 0.1 percent; and class 3 light trucks, 0.1 percent. From January 2006–March 2011,[26] 385 accidents occurred within a 2-mile radius of the accident location in the southbound lanes; 128 of these were injury accidents, with 179 vehicle occupants injured but no fatalities.

1.6.3 Vertical Highway Signpost

The four poles that supported the overhead vertical highway signpost were part of a fixed-base system and, as such, are not designed to yield or break away on impact. The four vertical support poles, two on I-95 northbound and two on I-95 southbound, were 8-inch-diameter steel tubular poles[27] with a wall thickness of 0.3125 inch. Each pair of poles was connected with cross bracing and separated by a lateral (parallel to the travel lanes) distance of 5 feet 2 inches. (See figure 13.) Two E-ZPass tag readers, wired to a metal cabinet installed on the cross bracing, were mounted on the overhead sign structure above the travel lanes. In addition, two wire conduits were attached to the vertical highway signpost to feed a variable message system sign above I-95 northbound. NTSB investigators documented accident damage to the two vertical poles, including a hole at the base and an indentation 9 feet above the base on the west pole and multiple scrape marks on the east pole from its base to a height of 9 feet.

Figure 13. Overhead vertical highway signpost (east and west poles).

[26] Detailed vehicle classification data for the northbound lanes were available because of the New Rochelle toll plaza being located in the northbound lanes near milepost 6.9. There was no toll plaza at New Rochelle for the southbound lanes; however, the NYSTA indicated vehicle classification data were comparable in both directions.

[27] ASTM A53, Type E, Grade B, Schedule 40 pipe (8 inch).

The vertical highway signpost support poles were located within the clear zone and offset from the edge of the travel lanes by 15 feet, which consisted of a 10-foot-wide paved shoulder and a 5-foot offset from the face of the W-beam guardrail. (See figure 11.) The clear zone concept, which recommends providing a traversable and unobstructed roadside area beyond the traveled way for use by errant vehicles, is usually set at 30 feet for freeways.[28]

In 1984, the existing concrete pavement along I-95 and the highway lighting system were replaced as part of a reconstruction project. In the accident area, two 400-watt high pressure sodium symmetrical distribution luminaires (lighting units) were mounted on top of a single pole extending approximately 45 feet high from the finished roadway grade; the poles were spaced about 250 feet apart in the median. In addition, new overhead sign structure supports, including the one struck by the accident motorcoach, were constructed.

The 1984 reconstruction project also included construction of a new strong-post blocked-out W-beam guardrail with steel block-out to protect the vertical highway signpost. A W-beam guardrail is considered a roadside barrier; the AASHTO[29] *Roadside Design Guide* states that the "primary purpose of roadside barriers is to prevent a vehicle from leaving the traveled way and striking a fixed object or terrain feature that is less forgiving than the barrier itself."[30] AASHTO defines a strong-post blocked-out W-beam as follows:

> 5.4.1.6 Blocked-Out W-Beam (Strong Post)
>
> Strong-post W-beam….consists of steel posts or wood posts that support a W-beam rail element that is blocked-out from the posts with routed timber, steel, or recycled plastic spacer blocks. These blocks minimize vehicle snagging on the posts and reduce the likelihood of a vehicle vaulting over the barrier by maintaining rail height during the initial stages of post deflection. Resistance in this and all strong post systems results from a combination of tensile and flexural stiffness of the rail and the bending or shearing resistance of the posts.

The strong-post blocked-out W-beam guardrail was an approved, crash-tested barrier system when it was initially constructed in 1984. At that time, the 1981 Transportation Research Board (TRB) National Cooperative Highway Research Program (NCHRP) Report 230[31] served as the primary reference for full-scale crash testing in the United States. The crash-test procedures were based on the barrier being evaluated for dynamic performance based on a minimum matrix of conditions; the report did not include site-specific guidance as to which

[28] The clear zone width is usually 30 feet for freeways, as measured from the edge of the paved traveled way or the intersection of the paved traveled way and shoulder. The nominal clear zone for a flat roadside on 60-mph highways is 30 feet. The clear zone width increases with higher speeds and steeper slopes. For more information, see section 1.6.4 of this report, "AASHTO Design Guidance for Location of Fixed Objects."

[29] AASHTO is an association representing highway and transportation departments in the 50 states, District of Columbia, and Puerto Rico. It sets standards for all phases of highway system development, to include the design and construction of highways and bridges.

[30] *Roadside Design Guide*, 4th ed. (Washington, D.C.: American Association of State Highway and Transportation Officials, 2011), p. 5-1.

[31] *Recommended Procedures for the Safety Performance Evaluation of Highway Appurtenances*, NCHRP Report 230 (Washington, D.C.: Transportation Research Board, 1981).

vehicle type was appropriate for a given location. In 1993, these procedures were updated in NCHRP Report 350,[32] which described full-scale crash testing using six levels to evaluate the structural integrity of a barrier system, as shown in table 4.

Table 4. Roadside barrier system levels and testing descriptions.

Test Level	Description
TL-1	Withstands 1,800-pound car impacting a barrier at 20° angle and 4,400-pound pickup truck impacting a barrier at 25° angle at 30 mph
TL-2	Withstands 1,800-pound car impacting a barrier at 20° angle and 4,400-pound pickup truck impacting a barrier at 25° angle at 45 mph
TL-3	Withstands 1,800-pound car impacting a barrier at 20° angle and 4,400-pound pickup truck impacting a barrier at 25° angle at 60 mph
TL-4	Withstands 17,600-pound single-unit truck impacting a barrier at 15° angle at 50 mph
TL-5	Withstands 80,000-pound tractor-trailer van impacting a barrier at 15° angle at 50 mph
TL-6	Withstands 80,000-pound tractor-trailer tanker impacting a barrier at 15° angle at 50 mph

In 1984, the strong-post blocked-out W-beam guardrail with steel block-out complied with the guidance in force at that time. More recently, in February 2000,[33] the Federal Highway Administration (FHWA) advised that strong-post blocked-out W-beam guardrails with steel block-outs had been crash tested and accepted in accordance with NCHRP Report 350 as a TL-2 barrier and that those with wood or approved plastic block-outs had been accepted as a TL-3 barrier.[34]

The roadside barrier was further modified in the accident vicinity in 1998, when a noise barrier was constructed behind it at the edge of the highway boundary. As part of this project, new strong-post blocked-out W-beam guardrail was installed to provide a continuous guardrail along the right side of the southbound lanes. [35] The W-beam rail element was blocked-out from the posts with W 6 x 9 steel I-beam[36] block-outs. The guardrail was offset approximately 3 inches from the back face of the sloped curb at the right shoulder and was installed

[32] *Recommended Procedures for the Safety Performance Evaluation of Highway Features*, NCHRP Report 350 (Washington, D.C.: Transportation Research Board, 1993).

[33] "NCHRP Report 350, Nonproprietary Guardrails and Median Barriers," FHWA memorandum to Division Administrators and Federal Lands Highway Division Engineers, February 14, 2000, pp. 1–2.

[34] According to AASHTO, one of the most commonly used designs, the steel post guardrail system with steel blocks, failed to meet NCHRP Report 350 crash testing evaluation criteria for a TL-3 barrier when a pickup truck snagged on a post and subsequently overturned. However, this system remains acceptable as a TL-2 barrier. According to AASHTO, "In order to provide a TL-3 barrier with steel posts….routed wood or plastic blocks of similar dimensions should be used as a substitute for the steel blocks…." For further information, see the *Roadside Design Guide*, 4th ed. (Washington, D.C.: American Association of State Highway and Transportation Officials, 2011), p. 5-17.

[35] The 12-inch-high W-beam rail element was raised approximately 12 inches from the ground surface; including the 5-inch-high sloped curb, the total height from the roadway surface to the top of the W-beam rail elements was approximately 29 inches.

[36] The W 6 x 9 steel I-beam shape measured 6 inches high and 4 inches wide, had a web thickness of 0.17 inch, and weighed 9 pounds per foot.

continuously along the shoulder approaching the accident scene, extending approximately 180 feet beyond the vertical highway signpost.

The NYSTA told the NTSB that it generally relies on the NYSDOT *Highway Design Manual* for roadside design issues, which states the following concerning barriers:

> TL-3 is used in New York State as the normal test level for all other highways except for bridge railings and pier protection. In practice, TL-3 devices are also used for most low-speed highways, rather than TL-2 or TL-1 systems.[37]

On March 15 and 16, 2011, the NYSTA repaired 256 feet of accident-damaged sections of the strong-post blocked-out W-beam guardrail with new strong-post W-beam guardrail with steel block-outs, remaining a TL-2 barrier. On April 29, 2011, in the immediate vicinity of the accident location and extending from the point at which the bus initially collided with the guardrail to south of the vertical highway signpost, the NYSTA replaced 627 feet, including the 256-foot section repaired in March 2011, of the steel block-outs with plastic block-outs, upgrading the performance of the guardrail from a TL-2 barrier to a TL-3 barrier.

1.6.4 AASHTO Design Guidance for Location of Fixed Objects

The current edition of AASHTO's *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* indicates the following regarding overhead sign supports and high-level lighting supports:

> 2.5.5 Overhead Sign Supports and High-Level Lighting Supports
>
> Overhead sign and high-level lighting structural supports should be placed outside the clear zone distance; otherwise, they should be protected with a proper guardrail or other barrier.[38]

One source of guidance available during the 1984 reconstruction project in the accident vicinity, the 1977 *AASHTO Guide for Selecting, Locating, and Designing Traffic Barriers*, stated

> Roadside obstacles are classified as nontraversable hazards and fixed objects. These highway hazards account for over thirty percent of all highway fatalities each year and their removal should be the first alternative considered. If it is not feasible or possible to remove or relocate a hazard, then a barrier may be necessary.
>
> Clear zone is defined as the roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles. Nontraversable hazards or

[37] Appendix C, p. 10C-3, was not added to the manual until its June 28, 2010, revision.

[38] *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals,* 5th ed. (Washington, D.C.: American Association of State Highway and Transportation Officials, 2009), p. 2-7.

> fixed objects should be removed, relocated, or shielded by a barrier if they are within the indicated minimum clear zone width.[39]

In addition, the 1975 AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, stated

> The locations of highway signing, lighting and traffic signal supports must be based upon safety considerations directed at minimizing the probability of their being struck by vehicles. Their locations should generally adhere to the following principles.
>
> When possible, roadside sign supports and luminaires should be placed behind existing or planned guardrail on retaining walls or bridges, or where viewing conditions are favorable, as far as possible from the roadway out of the likely path of an out-of-control vehicle. Otherwise, breakaway or yielding supports should be used.
>
> Overhead sign supports should be placed as far from the edge of traveled way as feasible (30 feet (9.14 meter) desirable) and proper guardrail provided for the protection of the motorist, when placed within 30 feet (9.14 meter) of the edge of traveled way.[40]
>
> Later versions of the AASHTO standard specifications indicated the following:
>
> Overhead sign and high-level lighting structural supports should be placed outside the clear zone distance; otherwise, they should be protected with a proper guardrail or other barrier.
>
> Overhead sign and high-level lighting supports are considered fixed-base support systems that do not yield or break away on impact. The large mass of these support systems and the potential safety consequences of the systems falling to the ground necessitate a fixed-base design. Fixed-base systems are rigid obstacles and should not be used in the clear zone area unless shielded by a barrier. In some cases, it may be cost effective to place overhead sign supports outside the clear zone with no barrier protection when the added cost of the greater span structure is compared with the long-term costs of guardrail and vegetation maintenance.[41]

The 1984 reconstruction project, in which the vertical highway signpost was initially constructed, specified removal or protection of all fixed objects within 30 feet of the roadway:

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[39] *Guide for Selecting, Locating, and Designing Traffic Barriers* (Washington, D.C.: American Association of State Highway and Transportation Officials, 1977), p. 15.

[40] *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, 1st ed. (Washington, D.C.: American Association of State Highway and Transportation Officials, 1975), p. 6.

[41] The language in the 1975 AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* (1st ed.) carried through to the 1985 and 1994 standard specifications (2nd and 3rd eds.). The language in the 2001 standard specifications (4th ed.) was updated and is the same as in the most current version (5th ed., 2009).

> From previous discussions on roadway deficiencies a list of resulting needs can be established. These needs have been incorporated in the preliminary plans for this project.
>
> All fixed objects within 30 feet of the roadway shall be removed or protected; protective devices shall include guide rail, concrete barrier or impact attenuators.[42]

More recent design manuals, including the 2010 NYSDOT *Highway Design Manual*, indicated the following regarding fixed objects:

> Fixed objects are defined as permanent installations, limited in length, which can be struck by vehicles running off of the road. Because of their limited extent, fixed objects should usually be removed from the clear zones, rather than being shielded with a barrier.[43]

1.7 FMCSA Oversight and Motor Carrier Operations

1.7.1 Federal Motor Carrier Safety Administration

As part of its mission of reducing crashes, injuries, and fatalities involving large trucks and buses, the Federal Motor Carrier Safety Administration (FMCSA) monitors motor carriers to ensure that they have adequate safety management controls in place to comply with the FMCSRs.

Compliance, Safety, Accountability Program. Until December 2010, the FMCSA used the Safety Status Measurement System (SafeStat) to evaluate the safety status of motor carriers. SafeStat, which analyzed current on-road safety performance and enforcement history information to measure a motor carrier's relative safety fitness, evaluated carriers in four Safety Evaluation Areas (SEA): Accident, Driver, Vehicle, and Safety Management. Using a weighted combination of individual SEA values, the system calculated a motor carrier's SafeStat score to prioritize it in relation to other carriers for subsequent compliance reviews and roadside inspections.

The FMCSA now monitors carrier safety through the Compliance, Safety, Accountability (CSA) program. A key component of the CSA is the safety measurement system, which analyzes all safety-based violations from inspections and crash data to determine a commercial motor carrier's on-road performance and potential crash risk. Thresholds for safety measurement system scores are determined through a mathematical formula that includes vehicle miles driven, number of vehicles and drivers in the fleet, and time since a violation. Violations are time-weighted, so older violations have less significance than more recent ones. The safety measurement system uses seven Behavioral Analysis Safety Improvement Categories (BASIC):

[42] *New England Thruway Route I-95, Design Report TANE 84-25* (Albany, New York: New York State Thruway Authority, 1984), p. 69.

[43] NYDOT *Highway Design Manual*, revision 57 (June 28, 2010), pp. 10–132.

Unsafe Driving, Fatigued Driving (Hours-of-Service),[44] Driver Fitness, Controlled Substances/Alcohol, Vehicle Maintenance, Improper Loading/Cargo Securement, and Crash Indicator. Each BASIC has a threshold that triggers an intervention by the FMCSA, including warning letters and more extensive scrutiny such as targeted roadside inspections and focused investigations. For passenger carriers, this threshold is set at the 50th percentile for Unsafe Driving, Fatigued Driving, and Crash Indicator and at the 65th percentile for Driver Fitness, Controlled Substances/Alcohol, and Vehicle Maintenance. For carriers with safety issues across multiple BASICs, the FMCSA will continue to conduct onsite comprehensive compliance reviews.[45]

In its independent evaluation of the CSA program's Operational Model Test (Op-Model Test), the University of Michigan Transportation Research Institute (UMTRI) found that crash rates for carriers exceeding BASIC thresholds were significantly higher than for carriers not exceeding any BASIC thresholds.[46] For example, the crash rate for carriers exceeding the Unsafe Driving[47] BASIC threshold was 7.44, which was greater than the crash rate for carriers exceeding the Crash Indicator BASIC threshold and 3.56 times greater than the rate for carriers exceeding no BASIC thresholds. Crash rates per 100 power units for carriers exceeding the Fatigued Driving, Controlled Substances/Alcohol, and Vehicle Maintenance BASIC thresholds are also high relative to the 2.09 crash rate for carriers exceeding no BASIC thresholds. The report also found relatively large numbers of carriers exceeding the Vehicle Maintenance, Fatigued Driving, and Unsafe Driving thresholds.[48] The evaluation concluded that although, in terms of safety, crash rates are generally considered one of the best measures for identifying high-risk carriers, five of seven BASIC measures have positive correlations with crash rates, and the Unsafe Driving BASIC has a strong and consistent linear association with high-risk carriers.

Compliance Reviews. A compliance review is an onsite examination by the FMCSA (or a qualified state or local jurisdiction agent) of a motor carrier's operations to determine its compliance with the FMCSRs and evaluate its safety culture. In addition to determining a carrier's on-road performance, the FMCSA uses the compliance review process to determine a carrier's overall fitness using the Safety Fitness Determination (SFD) process. The compliance review can include examination of the carrier's hours-of-service practices, vehicle maintenance and inspections, driver qualifications, CDL requirements, financial responsibility, accidents, hazardous materials compliance, controlled substances and alcohol testing requirements, and other safety and transportation-related records. In calendar year 2011, the FMCSA conducted

[44] Refers to the operation of CMVs by drivers who are ill, fatigued, or in noncompliance with the hours-of-service regulations. Examples of violations for this BASIC include exceeding hours of service, maintaining an incomplete or inaccurate logbook, and operating a CMV while ill or fatigued (FMCSR Parts 392 and 395). For more information, see <http://csa.fmcsa.dot.gov>, accessed May 31, 2012.

[45] For more information, see <http://www.fmcsa.dot.gov/about/news/news-releases/2010/CSA-Program-for-Commercial-Trucks-and-Buses.aspx>, accessed February 28, 2012.

[46] P. E. Green and D. Blower, *Evaluation of the CSA 2010 Operational Model Test*, UMTRI-2011-08 (Ann Arbor, Michigan: University of Michigan Transportation Research Institute, 2011).

[47] The Unsafe Driving BASIC metric, which is intended to capture driving a CMV in a dangerous or careless manner, is based on reported moving violations (such as speeding, reckless driving, unsafe lane changes, or unsafe turns).

[48] The total number of carriers exceeding any BASIC threshold was 44,881 (9.5 percent), close to the estimated 9.9 percent expected incidences by CSA based on data from the original four test states.

1,223 state and Federal compliance reviews. As of March 2012, 3,927 active motorcoach carriers were operating in interstate service in the United States.[49]

The FMCSA selects motor carriers for compliance reviews based on the following six factors or events: a complaint investigation, enforcement followup, carrier request, fatal accident, major hazardous materials incident, or high SafeStat score (historically) or high safety measurement system ranking (currently). To develop a safety rating for a compliance review, an FMCSA investigator or state or local agency agent[50] goes to a carrier's terminal to review the carrier's compliance with the safety fitness standard based on a selected number of FMCSRs (appendix B, 49 CFR 385.7 and 385.9). The regulations are considered either "critical" or "acute" based on their relative safety implication. A critical regulation is one that relates to management and operational controls; an acute regulation is one for which the consequences of noncompliance are so severe that immediate corrective action is required.

As a result of the compliance review, a safety rating is determined for the carrier, based on factors examined during the review. The compliance review covers six factors: general, driver, operational, vehicle, hazardous materials, and (recordable) accident rates. Each factor is assessed a point value based on the number and weight of the violation, and the rating is based on point accumulation, as follows: "satisfactory" = 0 points, "conditional" = 1 point, and "unsatisfactory" = 2 or more points. The factors are then summarized into a rating table to arrive at the overall rating determination of "satisfactory," "conditional," or "unsatisfactory."[51] After conducting the onsite compliance review, a proposed safety rating is generated based on the algorithm in the FMCSA's Compliance Analysis and Performance Review Information (CAPRI) system. FMCSA management then makes the final determination of a safety rating. A carrier may seek to upgrade its rating to "conditional" or "satisfactory" by submitting a plan and obtaining FMCSA approval to correct the deficiencies within 45 days. If corrections are not submitted or approved by the end of the 45-day period, the FMCSA will issue an "out-of-service" (OOS) order, meaning the carrier must cease operations. In addition to assigning safety ratings, the FMCSA can also assess civil fines for any violation of the FMCSRs.

Roadside Inspections. Under this FMCSA program, qualified[52] safety inspectors carry out roadside inspections[53] in accordance with the *North American Standard Inspection Program Guidelines*, which were developed by the Commercial Vehicle Safety Alliance (CVSA) and the FMCSA. During a roadside inspection, an inspector examines the CMV and its driver to

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[49] Data obtained from <http://www.ai.fmcsa.dot.gov/SafetyProgram/Review.aspx>, accessed April 17, 2012.

[50] A specially trained FMCSA employee or a state officer funded through the Motor Carrier Safety Assistance Program (MCSAP), which provides grants to the states for personnel and equipment to enforce the FMCSRs.

[51] Safety ratings are as follows: (1) *satisfactory*: the motor carrier has in place and functioning adequate safety management controls to meet the safety fitness standard prescribed in 49 CFR 385.5; (2) *conditional*: the motor carrier does not have adequate safety management controls in place to ensure compliance with the safety fitness standard, which could result in occurrences listed in 49 CFR 385.5 (a) through (k); (3) *unsatisfactory*: the motor carrier does not have adequate safety management controls in place to ensure compliance with the safety fitness standard, resulting in occurrences listed in 49 CFR 385.5 (a) through (k); and (4) *unrated:* the FMCSA has not assigned a safety rating.

[52] A state or local government employee who has been certified by the FMCSA or the state or local agency applying FMCSA standards (49 CFR Parts 385.201 and 385.203).

[53] Most roadside inspections are conducted by states using FMCSA-administered MCSAP grants.

determine FMCSR compliance. Serious violations[54] found during roadside inspections will result in driver or vehicle OOS orders; these violations must be corrected before the affected driver or vehicle can return to service. According to the FMCSA, 31,352 motorcoach roadside inspections were conducted in calendar year 2011.[55]

1.7.2 Company History

World Wide Travel was an authorized interstate for-hire passenger motor carrier headquartered in Brooklyn, New York. The company began operations in 1989 as a travel agency with a transportation component that included one bus. In 1998, World Wide Travel applied to the FMCSA for interstate operating authority[56] to operate a tour charter business in the greater New England area.

The owners of World Wide Travel opened another business, Great Escapes Tours & Travel Ltd. (Great Escapes) in 2001.[57] The FMCSA assigned separate USDOT and MC numbers specific to Great Escapes in May 2005, at which time the company entered the FMCSA's New Entrant Program. Before exiting the program in March 2006, Great Escapes underwent a compliance review, receiving a "conditional" safety rating. In November 2006, the FMCSA granted Great Escapes permanent interstate operating authority.[58] Both Great Escapes and World Wide Travel operated from the same terminal in Brooklyn. At the time of the accident, the FMCSA reported both carriers had 35 motorcoaches and 95 drivers (35 full-time and 60 part-time employees) combined between the two company USDOT numbers.[59] In addition to the casino line run[60] (the trip under which the accident motorcoach was being operated), World Wide Travel operated a commuter line run under the name "Long Island Transit" between a park-and-ride lot in Glen Cove, New York, and Manhattan; one line run between New York City and Boston, Massachusetts, and another between New York City and Washington, D.C.; and various charter trips.

During the 2 years before the accident,[61] World Wide Travel underwent 16 vehicle roadside inspections and 27 driver roadside inspections and Great Escapes, 17 vehicle roadside inspections and 34 driver roadside inspections. The companies' OOS rates, as compared with the national average for motorcoach roadside inspections, are shown in table 5.

[54] A condition so unsafe that a vehicle and/or its driver should not be allowed to proceed until it is completely remedied, as specified in the CVSA *North American Standard Out-of-Service Criteria Handbook and Pictorial*.

[55] For further information, see <http://www.ai.fmcsa.dot.gov/SafetyProgram/RoadsideInspections.aspx>, accessed May 1, 2012.

[56] U.S. Department of Transportation (USDOT) number 782392 and motor carrier (MC) number 34976.

[57] According to the New York Department of State, Division of Corporations.

[58] USDOT number 1369209 and MC number 523612.

[59] Motor Carrier Management Information System data in the Safety and Fitness Electronic Records system, also known as SAFER.

[60] Line runs are fixed routes with fixed schedules. Passengers may be picked up or dropped off at fixed terminals or roadside locations.

[61] March 17, 2009–March 17, 2011 (accident occurred March 12, 2011).

Table 5. World Wide Travel and Great Escapes roadside inspection OOS rates.

March 2009–March 2011	Vehicle OOS Rate	Driver OOS Rate
World Wide Travel	6.2%	0.0%
Great Escapes	11.8%	2.9%
Calendar Year 2011*	**Vehicle OOS Rate**	**Driver OOS Rate**
National motorcoach average	9.26%	4.32%
*For further information, see <http://www.ai.fmcsa.dot.gov/SafetyProgram/RoadsideInspections.aspx>, accessed May 1, 2012.		

Since the accident, Great Escapes has undergone additional roadside inspections, which determine a carrier's safety measurement system score. Thresholds for safety measurement system values are determined through a mathematical formula that includes vehicle miles driven, number of vehicles and drivers in the fleet, and time since a violation. Violations are time-weighted, so older violations have less significance than more recent ones. As of March 20, 2012, Great Escapes had safety measurement system scores above the threshold level (50 percent) in the following two BASIC areas: Unsafe Driving (operation of a CMV by a driver in a dangerous or careless manner) at 54.0 percent and Fatigued Driving at 52.5 percent.

Roadside inspections of Great Escapes resulted in: two driver OOS orders for false reporting of record–of-duty status, five OOS orders for failing to retain driver logs for the previous 7 days, and driver log violations and record-of-duty status violations that did not result in OOS orders.[62] The violations under Unsafe Driving included improper lane changes, improper passing, speeding 1–4 mph over the speed limit, speeding 15 or more mph over the speed limit, and not using a seat belt while operating a CMV.[63]

1.7.3 Company Compliance Review Histories

World Wide Travel underwent the first of four FMCSA compliance reviews in 1999; Great Escapes underwent a compliance review in 2007, following an FMCSA request earlier that year during a compliance review of World Wide Travel. The FMCSA noted in its remarks for both companies that "the two companies [World Wide Travel and Great Escapes] share the same office, same drivers and lease each other's vehicles." In 2008, World Wide Travel underwent another compliance review because the FMCSA had received a complaint from a passenger alleging that one of the carrier's drivers was driving in an unsafe manner, to include tailgating, taking his hands off the steering wheel, and making aggressive lane changes. The FMCSA also reported that the review was conducted because the carrier's name was mentioned in a U.S. Office of Inspector General hotline complaint regarding companies that were advertising their services on a website <www.gotobus.com> and operating without insurance and without

[62] Violations in 2011 occurred on March 22, March 24, May 4, June 10, July 4, July 9, July 16, July 23, October 11, October 27, and November 3. Additional violations occurred on January 26, 2012. OOS violations were for FMCSR 395.8(e) and 395.8(k)(2), and non-OOS were for FMCSR 395.8 and 395.8(f)(1).

[63] Violations of FMCSR 392.2 in 2011 occurred on May 4, July 4, August 4, and November 3, and on January 16, 2012.

authority. The 2007 and 2008 compliance review ratings for both World Wide Travel and Great Escapes were "satisfactory."

The FMCSA conducted a postaccident compliance review of World Wide Travel, which was finalized on April 7, 2011. The remarks section of the review noted that World Wide Travel and Great Escapes share carrier officials,[64] office staff, and drivers but operate different motorcoaches, commenting that documents for both companies "had to be reviewed throughout this review in order to decipher the trips and records required to be reviewed." Additionally, the FMCSA stated

> The trips that are actually performed by the carrier are assigned by the carrier dispatcher after determining which coach is available to conduct the trip. This dispatcher is an employee of both World Wide Travel of Greater New York and Great Escapes Tours & Travel LTD. If a trip is not able to be performed by one of the six coaches operated by World Wide Travel, then it is assigned to their "sister" carrier, Great Escapes Tours & Travel LTD.…
>
> The carrier's drivers were found to be operating for both carriers during any particular day of the month, and in some cases they were operating for both carriers on the same days.

The FMCSA's postaccident compliance review of World Wide Travel resulted in "unsatisfactory" ratings for the operational and accident rate factors, resulting in an overall "unsatisfactory" rating.[65] The majority of operational factor violations were related to hours of service, mostly due to the accident driver failing to record and submit his driver log records for the months that he was employed at World Wide Travel. Under the accident rate factor, the carrier had an accident rate of 5.7 per million miles; the FMCSRs require that a carrier with an accident rate greater than 1.5 per million miles be rated "unsatisfactory" for the accident rate factor. On June 4, 2011, the FMCSA placed World Wide Travel out of service. However, Great Escapes continues to operate out of the same shared terminal location, under most of the same management, and using the motorcoaches, dispatcher, mechanics, and some of the drivers that had been shared with World Wide Travel.

The FMCSA's postaccident compliance review of Great Escapes resulted in a proposed "conditional" rating, which became final on July 17, 2011. The rating was assigned because the carrier did not have adequate safety management controls in place and the operation was deficient in the following areas: driver qualification, vehicle inspection, repair and maintenance, controlled substance and alcohol use and testing, and driver hours of service. (See appendix C for violations found during postaccident compliance reviews of World Wide Travel and Great Escapes.)

[64] In addition, the 2007 and 2008 compliance reviews listed the same individuals as the company president and vice president for World Wide Travel and Great Escapes.

[65] FMCSA MCMIS information also noted two injury crashes and no fatal crashes for World Wide Travel during that 2-year period and one injury crash and no fatal crashes for Great Escapes.

According to the FMCSA, a pattern and/or repeated violation[66] of the same or related acute or critical regulation (violations of the same Part in Title 49 CFR) will result in the maximum penalties allowed by law.[67] The FMCSA closed an enforcement case in fiscal year 2006 against Great Escapes for Federal safety violations;[68] based on the safety violations in the postaccident compliance review, the FMCSA determined that Great Escapes management displayed a pattern of repeated violations. In the Notice of Claim, the FMCSA increased the company's penalties as a result of its pattern of repeated safety violations.

The FMCSA conducted a nonratable (focused onsite) review of Great Escapes on October 18, 2011, for the two safety measurement BASIC categories under CSA for Fatigued Driving and Driver Fitness. The FMCSA investigator noted in the review that background information was provided by World Wide Travel's president, who the investigator stated had been in business with the president of Great Escapes for several years. The other company contact for the review was Great Escapes' safety manager, who had also been the safety manager at World Wide Travel. The FMCSA investigator also reviewed the company's compliance regarding violations shown in the May 2011 compliance review (finalized in July 2011). The October 2011 nonrated review documented the continuing breakdowns in Great Escapes safety management processes pertaining to driver qualification, driver hours of service, and vehicle maintenance. (See appendix C for violations found during Great Escapes' nonrated review.)

As a result of the review, and in addition to the carrier's request to upgrade its postaccident "conditional" safety rating, the FMCSA determined that for Great Escapes to receive a "satisfactory" safety rating, it would be required to document that it has (1) installed automatic on-board recording devices (AOBRD) equipped with electronic mobile communication and tracking technology for driver hours-of-service dispatch and recordkeeping; (2) established a disciplinary program specific to hours-of-service compliance and records-of-duty falsification; (3) equipped all commercial vehicles with speed limiters set at speeds not exceeding 65 mph; (4) established monitoring systems to ensure that drivers are not driving at excessive speeds on all routes, including local and residential routes; (5) instituted a disciplinary program specific to speeding violations; and (6) enrolled in and will continue to participate in the FMCSA's preemployment screening program (PSP)[69] to assess individual driver histories prior to employment.

[66] A pattern of violations means two or more violations of acute and/or critical regulations in three or more Parts of Title 49 CFR discovered during any eligible investigation. Repeated violation means violation(s) of an acute regulation of the same Part of a CFR discovered in an investigation after one or more closed enforcement actions within a 6-year period and/or violation(s) of a critical regulation in the same Part of Title 49 CFR discovered in an investigation after two or more closed enforcement actions within a 6-year period.

[67] Section 222, Motor Carrier Safety Improvement Act of 1999 (MCSIA), Public Law (P.L.) 106-159.

[68] FMCSRs under 49 CFR 382.305(b)(2), 391.45(a), 391.11(a), and 391.11(b)(4).

[69] See section 1.8.1 for further discussion of this program.

1.7.4 Hiring Process and Initial Training

World Wide Travel required the following of potential drivers:

- Valid CDL with passenger endorsement and an original Social Security card or valid passport,
- At least 3 years of motorcoach driving experience,
- Successful completion of an oral interview,
- Preemployment physical and drug/alcohol screening,
- Company road test (including driving 8–10 miles on various roadways and conducting a pretrip inspection of the vehicle) with the safety manager or experienced driver, and
- Driving history check by the NYDMV.

Once hired, drivers receive initial information on company policies and are given pamphlets on drug and alcohol testing requirements,[70] hours-of-service requirements,[71] and the FMCSA's CSA program;[72] view videos on fatigue and on drug and alcohol use;[73] and, finally, accompany another driver on a trip. After fulfilling these requirements, drivers may begin driving on their own. The company did not have an ongoing in-service training program; drivers were counseled periodically by the safety manager in one-on-one discussions.

1.7.5 Applicant Driving History Check

World Wide Travel was enrolled in the NYDMV's LENS program, which, for a fee,[74] allows the carrier to view a driver's record (citations, accidents, and other NYDMV actions) in real time by logging on to the NYDMV website. The program also triggers an NYDMV notification to the carrier when an action affecting an employee's driving record—such as a suspension, citation, or accident—occurs.

[70] *Driver Alert! DOT Alcohol and Drug Testing Handbook* (Mill Valley, California: Buckley Productions, 2010).

[71] *Hours of Service, A Driver's Guide* (Neenah, Wisconsin: J.J. Keller, 2005).

[72] *CSA: The 7 Basics, A Driver's Handbook* (Neenah, Wisconsin: J.J. Keller, 2010).

[73] The 17-minute video on fatigue is from the FMCSA and the American Bus Association; the video on drug and alcohol use is from the National Safety Council.

[74] $15 to enroll and $15 per record accessed.

1.8 Commercial Driver Licensing and Oversight

1.8.1 Commercial Driver License Records

The 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy For Users (SAFETEA-LU)[75] mandated that the FMCSA develop a system to make driver safety performance information electronically available for preemployment screening. Congress also required that the process for providing access to MCMIS data be designed to assist the motor carrier industry in assessing an individual operator's crash and serious safety violation inspection history as a preemployment condition; however, the process would not be mandatory and could only be used for preemployment assessment of operator-applicants. In response, the FMCSA launched the electronic PSP[76] in April 2010, providing motor carriers access to certain commercial driver records to help them make more informed hiring decisions.

Carriers, after registering with the FMCSA to obtain access to the portal and obtaining the applicant's written consent, may use the PSP to review available driver-applicant records for the most recent 5 years of crash data and most recent 3 years of roadside inspection data (traffic violation records are not included). The PSP database, which contains only MCMIS roadside inspection[77] and crash information collected by FMCSA Federal staff and state partners, is updated at least every 30 days. The program does not provide a driver's record from a state DMV or state suspensions not related to safety.[78]

CDLIS is the FMCSA's driver records database. It is a central site that holds basic identification information about each commercial driver, such as date of birth, Social Security number, state driver license number, also-known-as alias information, and current state of record. However, CDLIS is a "pointer file" and not a complete database of historical records in that, when an inquiry is made, it "points" to the state of record and obtains the driver history, which is then relayed to the person making the inquiry. Access to this information is limited to authorized persons and agencies such as law enforcement. Carriers and individuals may not access this information, except when a state authorizes a release via its own tracking system.

[75] Title 49 U.S.C., section 31150, "Safety performance history screening," as added by section 4117(a) of SAFETEA-LU (P.L. 109-59, August 10, 2005).

[76] The PSP is a voluntary program. Carriers are charged $10 for each requested driver history, along with an annual subscription fee of $100; however, carriers with fewer than 100 power units qualify for a discounted fee of $25 per year. The fee remains $10 per applicant regardless of the number of states queried for the driver. Individual CDL drivers may also register with the FMCSA to request their personal driving history for $10 (no subscription fee applies). Drivers may also submit corrections to their records.

[77] Violations that result from a postcrash inspection are shown in the PSP; however, postcrash violations are neither displayed nor counted in the Violation Summary section. For more information, see <http://www.psp.fmcsa.dot.gov/Pages/FAQ.aspx>, accessed May 9, 2012.

[78] Such as lack of child support payment suspensions. For more information, see <http://www.psp.fmcsa.dot.gov/Pages/FAQ.aspx>, accessed May 9, 2012.

1.8.2 Motor Vehicle Records

A motor vehicle record (MVR) is the driving record held by the state in which the person is currently licensed or has held a license at one time. The manner in which a state Motor Vehicle Division or Department of Motor Vehicles (DMV) may release information from its driver license or motor vehicle records is regulated by Federal statute,[79] as well as by state laws.

The National Highway Traffic Safety Administration's (NHTSA) National Driver Register (NDR) is a nationwide database containing information provided by state DMVs on drivers who have had their licenses revoked or suspended or who have been convicted of serious traffic violations, such as driving while impaired by drugs or alcohol. When a person applies for a driver's license, the state checks to see whether that person has been reported to the NDR as a problem driver via the Problem Driver Pointer System.[80] If that is the case, the individual's license may be denied.

A request for an NDR by a motor carrier or other prospective employer must be initiated through the local DMV. The form must be submitted to the state in which the employee or driver-applicant is licensed. Any information reported by the states during the past 3 years will be disclosed by the NDR, subject to individual state release of information rules. World Wide Travel did not request an NDR check through the NYDMV.

1.8.3 Driver-Applicant Applications

A driver-applicant must include specific information when submitting an application to a prospective motor carrier, as required by 49 CFR 391.21:

- *All* motor vehicle accidents in which the applicant was involved during the 3 years *preceding* the date the application is submitted;
- *All violations* of motor vehicle laws or ordinances (other than parking violations) of which the driver was convicted or forfeited bond or collateral during the 3 years preceding the date the application is submitted;
- Statement describing in detail the facts and circumstances of any denial, revocation, or suspension of any license, permit, or privilege to operate a motor vehicle that has been issued to the applicant or a statement that no such denial, revocation, or suspension has occurred;
- All employers for the previous 3 years;
- Applicant's motor carrier employment for the past 10 years, per 49 CFR 383.35; and
- Signed waiver that allows the prospective employer access to the applicant's driving and employment history.

[79] Driver's Privacy Protection Act (18 U.S.C. 2721–2725).

[80] For more information, see <http://www.nationaldriverregister.com>, accessed October 7, 2011.

The motor carrier may require an applicant to provide additional information, and the driver-applicant must sign the application indicating the information is true and complete. Motor carriers are also required to make certain inquires of the driver-applicant's previous records, including driving history for the most recent 3 years per 49 CFR 391.23. Driver disqualification criteria found in 49 CFR 383.51, tables 1 and 2, include disqualification for traffic violations that occur in either the CDL holder's private vehicle or when operating a CMV. Also, per 49 CFR 383.31, CDL drivers are required to report to their employers all nonparking traffic violation convictions "in any type of vehicle." Employers are also required to make an annual inquiry of their driver employees' driving history from the state of licensure per 49 CFR 391.25.

1.8.4 Retention of Commercial Driver License-Holder Records

State DMVs are the primary repository for a driver's records—traffic violations, convictions, suspensions, revocations, and accidents are all reported to the state of license issuance. The amount of time that DMVs retain this information and to whom it may be reported are legally controlled on a state-by-state basis. Although state DMVs may have records for the past 15–20 years, released driver histories are usually limited to a much narrower time frame.

Federally mandated minimum retention and reporting standards for commercial drivers were most recently updated in 1999.[81] Under "Maintaining Record of All Violations," the MCSIA states that the *minimum* time a conviction or withdrawal must be retained from date of CDL or CDL-related convictions is as follows:

- 55 years for a major conviction;
- 4 years for a serious conviction;
- 4 years for a railroad grade crossing conviction;
- 15 years for an OOS conviction; and,
- 3 years minimum for all other convictions.[82]

How long states keep driver records past these minimum times varies; further, the MCSIA does not address retention times for records released by DMVs.

[81] M. L. Shankey, ed., *The MVR Access and Decoder Digest—The Complete National Reference of Motor Vehicle Records Access, Content, and Conviction Code Tables* (Tempe, Arizona: BRB Publications, 2011), p. 7.

[82] Section 384.225, MCSIA, P.L. 106-159. Also see 49 CFR 383.51 for retention of CDL holder records documenting disqualifying offenses.

1.9 Other Information

1.9.1 Mohegan Sun

The Mohegan Sun was established in 1996 by the Mohegan Tribe of Connecticut. Located in Uncasville, Connecticut, about 126 miles from New York City, it has multiple venues, including three separate casinos. According to the Mohegan Sun website, over 24 line bus companies arrive daily, and fare tickets are sold at bus depots and convenience stores throughout New England and Long Island. The website also links to the bus companies' websites, noting their phone numbers and pickup locations.

1.9.2 World Wide Travel Contract

World Wide Travel operated a line run from New York City to the Mohegan Sun under an October 2010 contract with the Mohegan Sun. The Mohegan Sun contracted with several ticket agents and transportation companies for two services: one for providing bus service transportation and one for selling tickets for bus transportation, along with other trip packages. The World Wide Travel contract was only for bus service transportation over a 3-year period; World Wide Travel was paid $665 per round trip. World Wide Travel drivers were paid per trip ($60 one-way or $115 round trip), and drivers could also receive tips from passengers. According to World Wide Travel, the contract required the carrier to complete 14 round trips per day. The scheduled trips departed at 1–4 hour intervals. The distance between the New York City departure locations and the Mohegan Sun was approximately 140 miles one way, a trip that normally took 2.5–3 hours.

1.9.3 Driver Histories in Other Accidents

Munfordville, Kentucky. On Friday, March 26, 2010, about 5:15 a.m. central daylight time, a truck-tractor semitrailer combination unit operated by a 45-year-old driver and traveling south on Interstate 65 (I-65),[83] departed the left lane, traveled across the median, and struck and overrode the cable barrier adjacent to the left shoulder of northbound I-65. It then entered the northbound travel lanes and was struck by a 2000 Dodge van operated by a 41-year-old driver and occupied by 11 passengers. As a result of the accident and subsequent truck fire, the truck driver, the van driver, and nine van passengers died. Two child passengers in the van, who were strapped in child restraint seats, sustained minor injuries.

The accident truck driver's history was obtained by the motor carrier at the time of employment using a third-party background search company, which obtained the record from the State of Alabama Driver License Division. The driver's record showed the traffic violation entries for an accident in August 2008 and one self-reported traffic violation, Failure to Stop for Stop Sign, in November 2009. The complete driving history that the NTSB obtained from the

[83] For further information, see *Truck-Tractor Semitrailer Median Crossover Collision With 15-Passenger Van Near Munfordville, Kentucky, March 26, 2010,* Highway Accident Report NTSB/HAR-11/02 (Washington, D.C.: National Transportation Safety Board, 2011). The NTSB's investigations of the two other accidents discussed in this section (Doswell, Virginia, and Miriam, Nevada) are still pending.

Alabama DMV showed additional adverse driving entries from 1984–2009 (11 of the 17 traffic violations were committed while driving a CMV), as summarized below:

- 1 moving violation;
- 8 equipment violations;
- 23 license suspensions/revocations;
- 1 CDL disqualification;
- 3 driving while suspended/revoked (not in a CMV);
- 1 license cancellation (reinstated); and,
- 1 traffic accident (in a CMV).

The NTSB also obtained the driver's CDLIS record that showed the following entries from 1984–2009 (7 of the 12 traffic violations were committed while driving a CMV), as summarized below:

- 7 moving violations;
- 5 equipment violations;
- 6 failure to appear in court—violation not recorded;
- 3 driving while license suspended/revoked;
- 23 suspensions/revocations;
- 2 driving while license suspended/revoked;
- 1 license cancellation; and
- 1 traffic accident.

Doswell, Virginia. On Tuesday, May 31, 2011, at approximately 4:55 a.m., a 2000 Setra motorcoach, operated by a 37-year-old driver with 58 passengers, was traveling northbound on I-95, en route from Raleigh, North Carolina, to New York City. Near milepost 103 in Caroline County, Virginia, the motorcoach departed the right-hand lane, ran off the paved roadway onto the grass embankment, and collided with a cable barrier. The motorcoach continued forward, eventually rolling 180° about its longitudinal axis, and came to rest upside down. As a result of the accident, four passengers were killed, and the bus sustained extensive damage.

NTSB investigators obtained the driver's history from the NYDMV, it showed no violations and no accidents. However, the driver had previously held non-CDL driver licenses in Virginia, Washington D.C., and Maryland. NDR information obtained by the NTSB showed the driver had seven traffic violations in Virginia, as follows:

- 1 violation for following too closely (2008);
- 1 seat belt violation (2008);

- 2 speeding violations (2008 and 2000);
- 2 speeding violations 15 mph or more over the limit (2005 and 1999); and,
- 1 failure to obey traffic light or signal (2004).

Miriam, Nevada. On Friday, June 24, 2011, about 11:20 a.m. Pacific daylight time, a 2008 Peterbilt truck-tractor in combination with two unloaded 2007 side dump trailers, operated by a 43-year-old driver, was traveling northbound on U.S. Highway 95 near Miriam, Nevada, when it crossed a protected[84] Union Pacific railroad grade crossing.

Amtrak train No. 5, the California Zephyr, was approaching from the northeast en route to Emeryville, California. The combination vehicle failed to stop before reaching the grade crossing and collided with the 977-foot-long train, impacting the train's left side and becoming embedded in a train car. A postcrash fire ensued that consumed the truck-tractor and the train's crew car and the passenger car directly behind it. As a result of the accident, 52 train passengers received serious-to-minor injuries and the truck driver, a train crewmember, and four train passengers were killed.

The motor carrier used a third-party background search company to obtain the accident driver's history at the time of employment. The history reported three speeding violations and two seat belt use violations. After the accident, the NTSB obtained the driver's driving history from 2002–2010 from the Nevada DMV, which showed 12 violations (9 in CMVs) and 9 suspensions (all cleared). The NTSB also obtained the driver's CDLIS record from 1992–2010, as summarized below:

- 10 speeding violations;
- 2 seat belt violations;
- 4 no insurance violations;
- 2 inattentive driving violations;
- 2 driving while license suspended;
- 1 driving over a fire hose violation;
- 1 traffic accident (2006); and,
- 8 driver license suspensions.

[84] Grade crossing protection consisted of gates and flashing red lights.

2. Analysis

2.1 Introduction

This section discusses those elements of the investigation that the NTSB determined were not factors in the accident.

The weather was clear and dry at the time of the accident. Although the bus driver reported that the accident motorcoach was contacted by another commercial vehicle just before departing the roadway, no evidence of any such interaction, contact, or damage was found. According to witness interviews with drivers in the vicinity, no vehicles were in the immediate vicinity of the accident motorcoach before its departure from the right travel lane to the paved shoulder at mile marker 3.2. Following the accident, the motorcoach driver was tested for alcohol and drugs of impairment, and all test results were negative.

The motorcoach departed from the travel lanes to the right, traversed a 10-foot-wide paved shoulder enhanced with rumble strips, and struck the guardrail. The horizontal curvature on the southbound lanes of I-95 approaching the accident site consisted of a 1,600-foot-radius right curve that transitioned to a 4,500-foot-radius left curve. Physical evidence indicated that the angle of departure from the roadway was about 7°; this angle, and the location at which the bus departed the roadway, are both consistent with the driver maintaining the steering input for the 1,600-foot-radius right curve as the curve ended and the left curve began.[85] This shallow angle of departure is not consistent with an abrupt, evasive steering maneuver. Additionally, no tire marks were made by the bus on the travel lanes prior to the departure point to indicate braking or evasive steering.

The accident ECM was configured to record data,[86] and postaccident examination of the data revealed that the road speed limiter was enabled and configured to limit the vehicle's maximum road speed to 78 mph. Data from the ECM indicated that a sudden deceleration[87] occurred at 5:38:04; however, the ECM also indicated that no braking occurred during the

[85] If the 1,600-foot-radius right curve were extended, its path would closely match both the departure angle from and the location where the bus left the roadway. If a driver were to maintain steering for the 1,600-foot-radius right curve after exiting the curve, the bus would follow the (approximate) path of the extended curve. The physical evidence was also verified by computer simulations conducted with TruckSim using three-dimensional survey data gathered at the accident scene. These simulations also supported the departure angle and hypothesis that the driver held his steering constant as he exited the 1,600-foot curve.

[86] The last stop record and two sudden deceleration events were captured during the accident. ECM recordings are for 2 minutes before and after the last time the engine was stopped and for 1 minute 15 seconds before and after a sudden deceleration. The ECM also stores additional data that could be relevant to understanding a crash, such as diagnostic conditions, engine data, ECM calibrations, and trip information. Several diagnostic fault codes, which contain engine parameter data, were identified but not determined to be relevant to the accident.

[87] Although the ECM classifies this deceleration as a "hard brake event," it is not necessarily indicative of a brake application. Sudden deceleration events are triggered or recognized when the calculated deceleration rate of the vehicle meets or exceeds a predetermined threshold or value (7 mph/second).

60 seconds prior to the deceleration, in which the motorcoach left the travel lanes, crossed the shoulder, and struck the guardrail. During that 60-second period, vehicle speeds ranged from 61–78 mph. The accident motorcoach was traveling at least 64 mph for at least 10 seconds before it struck the guardrail.

Postaccident inspection of the roadway found that the pavement markings were visible, with no defects in the roadway surface that would have caused or contributed to the motorcoach's departure from the travel lanes. Postaccident inspection of the accident motorcoach found no tire or wheel deficiencies; the bus was equipped with the appropriate size and load range tires, and tire inflation pressures and tread depths were within the suitable operating ranges. Further, the air brake system components were functional and undamaged; the brake disc rotors and pads were within specified wear limits; and the steering wheel, steering column, steering gear box, steering linkage, and suspension system were undamaged and functional.

The initial 911 calls provided an accurate location for the motorcoach accident, the emergency dispatch office did not encounter any problems while handling the emergency calls, and emergency responders were on scene within minutes. The first emergency call was received at 5:37 a.m.; the FDNY dispatched multiple firefighting and EMS units beginning at 5:38 a.m.; and by 5:47 a.m., the fire department had people on scene and setting up incident command. Law enforcement responders were dispatched immediately and began arriving on scene by 5:49 a.m. to provide roadway management. EMS units began arriving on scene within 12 minutes of the first 911 calls, and on-scene medical care and preparation for transport to hospitals were prompt and efficient. Therefore, the NTSB concludes that the emergency response was timely and adequate. The NTSB further concludes that none of the following were factors in the accident: (1) weather; (2) design and construction of the roadway surface; (3) any other vehicle; (4) alcohol or prescription, over-the-counter, or illicit drug use by the motorcoach driver; and (5) vehicle mechanical defects or deficiencies.

As a result of the investigation, the NTSB has identified several safety issues related to motorcoach driver fatigue, as discussed below. The remainder of the analysis discusses fatigue countermeasures, heavy vehicle[88] speed limiters, commercial driver license history, motor carrier safety management systems and ratings, the clear zone concept for highway design, roadside barriers,[89] and motorcoach crashworthiness and occupant kinematics (study of motion).

2.2 Driver Fatigue

The NTSB evaluated several factors to assess whether the driver was impaired by fatigue at the time of the accident, including his sleep/wake history, sleep quality, circadian factors, and health. The driver reported that, on his days off,[90] he typically goes to bed at 8:00–9:00 p.m. and

[88] NHTSA defines a "heavy vehicle" as "…most vehicles over 10,000 pounds gross vehicle weight rating (GVWR), including truck-tractors, single-unit trucks, buses, [and] motorcoaches…." For further information, see <http://www.nhtsa.gov/staticfiles/rulemaking/pdf/2011-2013_Vehicle_Safety-Fuel_Economy_Rulemaking-Research_Priority_Plan.pdf>, accessed May 3, 2012.

[89] A heavy commercial passenger vehicle, as used in this report, is a passenger CMV with a GVWR of 26,001 or more pounds.

[90] For the purpose of this analysis, the term "days off" refers to periods of approximately 24 hours when the driver was not scheduled to work.

awakens at 10:00 a.m.–noon, a sleep period of 13–16 hours. The driver also reported that, on work days, he typically gets home about 9:00 a.m., at which point he goes to bed. He stated that his wake time depends on when he is next scheduled to work, which in the case of a 6:15 p.m. start time would be 4:30–5:00 p.m. Therefore, the driver's self-reported typical sleep time during his daytime off-duty periods[91] was approximately 7.5 hours.

In an interview conducted 3 days after the accident, the driver reported that he slept approximately 3 hours 45 minutes on the bus before the accident trip[92] and that he had slept 5 hours 30 minutes during his daytime off-duty period the day before the accident. The driver reported similar sleep patterns during the 72 hours leading to the accident, with daytime sleep periods ranging from 4 hours 30 minutes–6 hours, and nighttime naps on the bus ranging from 1 hour 45 minutes–3 hours 30 minutes. However, evidence from the driver's cell phone and rental car records suggests that he was in the car and/or using his cell phone frequently during his self-reported daytime sleep periods over the 3 days before the accident.[93] The driver's cell phone records do not show an incoming or outgoing call or that the phone was in use at the time of the accident. Factoring in the driver's use of his cell phone and rental car activity, his opportunity for sleep in the days leading to the accident would have been limited to short periods of approximately 4 hours or less.[94]

The normative daily sleep need for humans is 7–9 hours. Epidemiological research has shown that drivers who reported getting 5 or fewer hours of sleep in the previous 24 hours had an almost threefold increase in risk for an injury crash.[95] Over multiple days of sleep deprivation, an individual incurs a "sleep debt" in which the impairing effects of sleep deprivation are compounded.[96] The driver's activity history suggested that his longest opportunity for continuous sleep during the 24-hour period preceding the accident was during the approximately 3 hours that he was on the bus (midnight–3:00 a.m.) and that his daily sleep opportunities in the days before the accident never exceeded 4 continuous hours. Therefore, the accident driver was experiencing both acute sleep loss and cumulative sleep debt at the time of the accident. The driver's statement that he slept 13–16 hours when he had a day off further suggests that he was routinely becoming sleep deprived during his work periods. Further, the sleep quality that the driver experienced on the bus was less than optimal. Like most motorcoaches, the accident bus did not have a sleeper berth, so the driver had to recline across the seats to sleep.

[91] For the purpose of this analysis, the term "off-duty periods" refers to shorter times between work shifts.

[92] The driver reported that this sleep period was interrupted when he was asked to return to the casino to search the bus for a missing money envelope.

[93] As discussed in section 1.4.3, several of the numbers dialed during driving periods were identical to numbers called during periods when the driver self-reported being asleep.

[94] Although evidence indicates that the driver was not the only user of the rental car, cell phone records and a witness statement suggest that he was in the car when it was used during off-duty periods.

[95] J. Connor and others, "Driver Sleepiness and Risk of Serious Injury to Car Occupants: Population Based on Case Control Study," *British Medical Journal*, vol. 324, no. 7346 (May 11, 2002), p. 1125.

[96] H.P.A. Van Dongen and others, "The Cumulative Cost of Additional Wakefulness: Dose-Response Effects on Neurobehavioral Functions and Sleep Physiology from Chronic Sleep Restriction and Total Sleep Deprivation," *Sleep*, vol. 26, no. 2 (2003), pp. 117–126.

Circadian factors also likely influenced the driver's sleep quantity and waking performance. Circadian factors are those factors associated with the human circadian rhythm or "biological clock," which affects numerous biological, physiological, and performance variables. With respect to circadian factors, there are three notable issues. First, the time of day when the accident occurred—approximately 5:38 a.m.—falls during the period in the circadian cycle when self-perceived sleepiness is most pronounced and when human performance is most degraded.[97] In addition, the driver's work schedule was inverted. That is, his work periods occurred during periods when humans typically sleep, and his off-duty periods occurred during periods when humans are typically awake. Research has shown that inverted work schedules are associated with shortened sleep lengths, higher subjective wake-time sleepiness, and degraded performance.[98] Furthermore, the driver's self-reported sleep times followed a more traditional diurnal pattern (that is, sleeping at night and awake during the day) during his days off. The result of such dramatic change to his sleep/wake schedule would have degraded the driver's sleep quality and quantity and led to performance impairment during waking periods.[99]

Additionally, the driver's work schedule was rotated backward by approximately 3 hours the day before the accident. His schedule indicates that he began his work shift at 9:00 p.m. on March 8, 9, and 10, and slept from approximately 2:00–6:00 a.m. during layover periods. On March 11, the day before the accident, the driver began his work shift at 6:15 p.m., and his layover period at the casino was from 11:00 p.m.–3:00 a.m. on March 12. Although this 3-hour backward rotation is minor in comparison to the large sleep/wake rotations the driver engaged in between his work and nonwork days, such rotations have been associated with sleep reductions, as well.[100]

In written statements, several passengers stated that the driver had driven over the rumble strips numerous times during the accident trip. Additionally, three truck drivers who saw the motorcoach approximately 10–20 minutes before the accident stated that the bus was speeding and swerving. One driver stated that the bus was "zig-zagging" over the white line and that he witnessed the bus moving "deep into the breakdown lane and coming extremely close to the guardrail." The accident driver's repeated excursions from the roadway onto the rumble strips suggest that his alertness was degraded the entire trip. The NTSB concludes that the driver was impaired by fatigue at the time of the accident due to sleep deprivation, poor sleep quality, and circadian factors; and his lack of evasive braking or corrective steering action as the bus drifted off the roadway was consistent with fatigue-induced performance impairment.

Research shows that even a healthy individual would suffer performance impairment if subjected to the sleep deprivation and circadian variation experienced by the driver in this

[97] H.P.A. Van Dongen, and D. Dinges, "Circadian Rhythms in Sleepiness, Alertness, and Performance," in M. H. Kryger, T. Roth, and W.C. Dement (eds.), *Principles and Practice of Sleep Medicine,* 4th ed. (Philadelphia, Pennsylvania: Elsevier, 2005).

[98] G. Richardson and H. Malin, "Circadian Rhythm Sleep Disorders: Pathophysiology and Treatment," *Journal of Clinical Neurophysiology,* vol. 13, no. 1 (January 1996), pp. 17–31.

[99] T. Akerstedt, "Altered Sleep/Wake Patterns and Mental Performance," *Physiology & Behavior*, vol. 90, issues 2–3 (February 28, 2007), pp. 209–218

[100] J.K. Walsh and others, "Transient Insomnia Associated with a 3-Hour Phase Advance of Sleep Time and Treatment with Zolpidem," *Journal of Clinical Psychopharmacology* (June 1990), vol. 10, no. 3, pp. 184–189.

accident.[101] However, it is worth noting that because of his BMI and other factors, [102] the accident driver would also have been considered at risk for obstructive sleep apnea (OSA), according to standards set by an FMCSA Medical Review Board (MRB)[103] and by a joint task force of the American College of Chest Physicians, American College of Occupational and Environmental Medicine, and National Sleep Foundation.[104] OSA is a sleep disorder that has been associated with a significantly increased motor vehicle crash risk compared to the general driving population.[105] In 2009, as the result of its investigation of accidents in all transportation modes, including a 2000 work zone accident,[106] the NTSB issued the following recommendations to the FMCSA aimed at improvements in the screening, treatment, and medical certification of drivers at risk for OSA:

> Implement a program to identify commercial drivers at high risk for obstructive sleep apnea and require that those drivers provide evidence through the medical certification process of having been appropriately evaluated and, if treatment is needed, effectively treated for that disorder before being granted unrestricted medical certification. (H-09-15)
>
> Develop and disseminate guidance for commercial drivers, employers, and physicians regarding the identification and treatment of individuals at high risk of obstructive sleep apnea (OSA), emphasizing that drivers who have OSA that is effectively treated are routinely approved for continued medical certification. (H-09-16)

These recommendations were classified "Open—Acceptable Response" pending further FMCSA action. In August 2011, the FMCSA tasked its Motor Carrier Safety Advisory Committee (MCSAC) and MRB to jointly provide information the agency should consider in developing regulatory guidance for motor carriers, CMV drivers, and medical examiners on OSA and whether drivers with this condition should be medically certified to operate CMVs in interstate commerce. MCSAC and the MRB submitted short-term recommendations to the FMCSA in December 2011 and long-term recommendations for regulatory action in

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[101] (a) D. F. Dinges, N. L. Rogers, and M. D. Baynard, "Chronic Sleep Deprivation," in M. H. Kryger, T. Roth, and W. C. Dement, eds., *Principles and Practice of Sleep Medicine*, 4th ed. (Philadelphia, Pennsylvania: Elsevier, 2005), pp. 67–76. (b) H. P. A. Van Dongen and D. F. Dinges, "Circadian Rhythms in Sleepiness, Alertness, and Performance," pp. 418–434.

[102] The driver's specific risk factors included a BMI of 36.5, a neck circumference greater than 17 inches, and self-reported snoring.

[103] Summary of FMCSA Medical Review Board Recommendations, updated June 17, 2010.

[104] N. Hartenbaum and others, "Sleep Apnea and Commercial Motor Vehicle Operators: Statement From the Joint Task Force of the American College of Chest Physicians, American College of Occupational and Environmental Medicine, and the National Sleep Foundation," *Journal of Occupational and Environmental Medicine*, vol. 48, no. 9 (Supplemental) (2006), pp. S4–37.

[105] S. Tregear and others, "Obstructive Sleep Apnea and Risk of Motor Vehicle Crash: Systemic Review and Meta-Analysis," *Journal of Sleep Medicine*, vol. 5, no. 6 (August 2009), pp. 573–581.

[106] *Work Zone Collision Between a Tractor-Semitrailer and a Tennessee Highway Patrol Vehicle, Jackson, Tennessee, July 26, 2000*, Highway Accident Report NTSB/HAR-02/01 (Washington, D.C.: National Transportation Safety Board, 2002).

February 2012. On April 20, 2012, the FMCSA published the MCSAC-MRB recommendations in the *Federal Register* (77 FR 23794) in a Request for Public Comments; however, on April 27, the request was withdrawn (77 FR 25226). The agency stated that the original publication was a "clerical error" and that the request for public comments would be republished later in the year. Because the FMCSA has yet to establish a program to identify commercial drivers at high risk for OSA or to provide guidance concerning the disorder, the NTSB reiterates Safety Recommendations H-09-15 and -16, which remain classified "Open—Acceptable Response."

2.3 Fatigue Countermeasures

The NTSB has a long history of issuing recommendations to prevent fatigue-related highway accidents, and human fatigue is an issue currently on the NTSB's Most Wanted List. From 1998–2010, the NTSB determined driver fatigue to be a factor in 7 of 19 motorcoach accidents, which resulted in 46 fatalities.[107]

Although World Wide Travel reported that new drivers were shown a video about driver fatigue during their initial training period, the company did not have a fatigue management program (FMP)—nor did the FMCSA require one. An FMP applies a comprehensive, tailored approach to the issue of fatigue within the operational environment in a particular industry or workplace. An FMP commonly addresses topics to help manage fatigue (for example, medical screening and treatment, scheduling policies and practices, employee education, fatigue monitoring technologies, task/workload issues, rest environments, commuting, and napping) and incorporates an overall organizational strategy for implementing, supervising, and evaluating the plan. Although it is unclear whether an FMP would have led the accident driver to sleep more during his off-duty periods, it may have addressed other fatigue-related issues such as the driver being at risk for OSA.

Since 1999, the FMCSA has collaborated with Transport Canada and others to develop and implement a comprehensive FMP for the commercial motor carrier industry, known as the North American Fatigue Management Program (NAFMP). In its report detailing the 2009 fatal truck-tractor rear-end accident in Miami, Oklahoma,[108] the NTSB acknowledged the success of an NAFMP-sponsored pilot study[109] when it recommended that the FMCSA

> Require all motor carriers to adopt a fatigue management program based on the North American Fatigue Management Program guidelines for the management of fatigue in a motor carrier operating environment. (H-10-9)

[107] A list of the 19 motorcoach accidents investigated by the NTSB from 1998–2010 appears in the public docket <http://www.ntsb.gov/investigations/dms.html> for the *Report on Curbside Motorcoach Safety*, Special Report NTSB/SR-11/01 (Washington, D.C.: National Transportation Safety Board, 2011).

[108] *Truck-Tractor Semitrailer Rear-End Collision into Passenger Vehicles on Interstate 44, Near Miami, Oklahoma, June 26, 2009*, Highway Accident Report NTSB/HAR-10/02 (Washington, D.C.: National Transportation Safety Board, 2010).

[109] A. Smiley and others, *Effects of a Fatigue Management Program on Fatigue in the Commercial Motor Carrier Industry: Summary Report*, TP 14921E (Ottawa, Ontario: Transport Canada, September 2009).

In a 2011 letter to the NTSB, the FMCSA reported that the NAFMP had entered its final phase, which involves the development of guidelines, manuals, and other training materials to help motor carriers implement an FMP. However, in the same letter, the FMCSA noted that it believes that the "voluntary adoption of standardized FMPs is an appropriate non-regulatory alternative to recommendation H-10-9." Consequently, on March 28, 2012, the NTSB reclassified Safety Recommendation H-10-9 "Open—Unacceptable Response." The NTSB continues to maintain that voluntary NAFMP guidelines will do little to reduce fatigue-related highway accidents. Consequently, the NTSB reiterates Safety Recommendation H-10-9 to the FMCSA to require that all motor carriers adopt an FMP based on NAFMP guidelines.

The NAFMP instructional program goes beyond the current approach to fatigue education by including modules on safety culture and management practices, sleep disorder screening and treatment, driver scheduling, and fatigue monitoring and management technologies. The inclusion of a module on fatigue monitoring technologies, in particular, recognizes that vehicle-based countermeasures offer an added layer of protection in preventing fatigue-related accidents.

In 2008, as part of its investigation of a fatal truck and motorcoach collision in Osseo, Wisconsin,[110] the NTSB recommended that the FMCSA

> Develop and implement a plan to deploy technologies in commercial vehicles to reduce the occurrence of fatigue-related accidents. (H-08-13)

In-vehicle technologies—such as drowsy driver warning systems (DDWS) that measure eye movements or steering behaviors and lane departure warning systems (LDWS) that warn a driver if the vehicle drifts from its lane—have the potential to alert drivers when their performance is impaired.[111] An advantage of driving performance-based systems is that they can potentially prevent crashes caused by a wide range of human performance impairment, including fatigue, distraction, drug/alcohol use, or medical impairment. However, to ensure such systems are employed effectively, factors such as the system's validity and reliability and its acceptability to drivers should be considered.[112] In 2009, the NTSB reclassified Safety Recommendation H-08-13 "Open—Unacceptable Response" due to the lack of progress made by the FMCSA in implementing in-vehicle technologies in commercial vehicles to address driver fatigue.

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[110] *Truck-Tractor Semitrailer Rollover and Motorcoach Collision with Overturned Truck, Interstate Highway 94, Near Osseo, Wisconsin, October 16, 2005*, Highway Accident Report NTSB/HAR-08/02 (Washington, D.C.: National Transportation Safety Board, 2008).

[111] T. J. Balkin and others, "The Challenges and Opportunities of Technological Approaches to Fatigue Management," *Accident Analysis and Prevention*, vol. 43, no. 2 (March 2011), pp. 565–572.

[112] D. F. Dinges and M. M. Mallis, "Managing Fatigue by Drowsiness Detection: Can Technological Promises Be Realised?" in L. R. Hartley (ed.), *Managing Fatigue in Transportation: Proceedings of the Third International Conference on Fatigue in Transportation* (Oxford, U.K.: Elsevier, 1998).

The NTSB concludes that had the motorcoach been equipped with in-vehicle technologies such as an LDWS or DDWS, the driver would have been alerted and had the opportunity to stop driving before the accident occurred. The NTSB therefore reiterates Safety Recommendation H-08-13 to the FMCSA to develop and implement a plan to deploy commercial vehicle technologies that reduce the occurrence of fatigue-related accidents.

Ideally, driver impairment or risky driver behaviors should be detected and mitigated well before safety critical events occur. Onboard monitoring systems (OBMS)[113] have the potential to provide early detection of a wide range of driving behaviors. OBMS are defined by FMCSA as hardware/software suites that allow for (1) online measurement of a set of unsafe driving behaviors, (2) real-time performance feedback to the driver, and (3) "roll-up" reports of driver behaviors for use by motor carriers for a "delayed discussion with the driver."[114] Driving behaviors that may be monitored include top speeds (also known as overspeeds), sharp vehicle decelerations (that is, hard braking), and lateral accelerations (indicative of speed on curves).

Video event recorders (VER) [115] are already recognized by the NTSB and many motor carrier operators as a viable safety tool. As a result of its investigation of a 2010 accident involving driver fatigue,[116] the NTSB recommended that the FMCSA

> Require all heavy commercial vehicles to be equipped with video event recorders that capture data in connection with the driver and the outside environment and roadway in the event of a crash or sudden deceleration event. The device should create recordings that are easily accessible for review when conducting efficiency testing and systemwide performance-monitoring programs. (H-10-10)
>
> Require motor carriers to review and use video event recorder information in conjunction with other performance data to verify that driver actions are in accordance with company and regulatory rules and procedures essential to safety. (H-10-11)

OBMS provide a proactive approach to identifying various vehicle and driving deficiencies, allowing for manual or automatic intervention rather than relying on enforcement personnel.

[113] Also referred to by industry and researchers as onboard safety monitoring systems or onboard safety systems.

[114] *Onboard Monitoring and Reporting for Commercial Motor Vehicle Safety*, FMCSA-RRR-07-011 (Washington, D.C.: Federal Motor Carrier Safety Administration, December 2007).

[115] VERs are devices that capture video and other parameters related to operator and vehicle performance. VER systems may be configured to save video and other data after a triggering event is detected, which the carrier can use as part of a carrier management program (OBMS) intervention when undesirable driving behaviors are detected.

[116] NTSB/HAR-10/02.

According to the American Trucking Associations (ATA), when compared with conventional driver safety measures, OBMS can

- Provide a 100-percent sample of driver behavior,
- Capture specific behaviors that cause crashes, incidents, and violations,
- Recognize and reward positive driving behaviors, and
- Recognize and correct negative driving behaviors before a crash, incident, or violation occurs.
- Establish driving behavior-based benchmarks so drivers know where they stand in relation to carrier expectations.
- Provide for frequent and timely valuations, feedback, and consequences (including both reward and punishment).[117]

Many motor carriers are already equipping vehicles with global positioning system (GPS) devices for navigation and as a safety feature to monitor driver speeds. Additionally, some motor carriers have reported that though they have not purchased OBMS, they have used features already available on their vehicles for monitoring driver behaviors—for example, bringing vehicles to a dealership for a readout of the engine ECM. These quarterly data downloads allow the carrier to review records for overspeeds and sudden decelerations.[118]

In recent years, the FMCSA has sponsored research to develop and design a prototype OBMS.[119] The FMCSA completed its pilot study of a prototype system in March 2010 and began large-scale field operational testing in 2011, including 3 carriers, 270 trucks, and over 500 drivers. After an initial 5-month setup period, data will be collected for 18 months, beginning in early 2012.[120] OBMS appear to have great potential to monitor and manage both fatigue- and nonfatigue-related driver behaviors and performance.

Behavior-based safety systems such as OBMS—involving both in-vehicle safety systems and fleet-based oversight—provide motor carriers the opportunity to detect unsafe driving behavior patterns, including speeding and lane departures. With that information, motor carriers can work with drivers to remediate their behavior or to remove them from their positions if they do not show improvement. The NTSB acknowledges that OBMS are most likely to be successful when paired with robust and consistent carrier oversight.

The NTSB concludes that had World Wide Travel employed and proactively used an OBMS to track the accident driver's performance, company management would have had the opportunity to detect his unsafe behavior and use such information to remediate the behavior or remove him from his position. The NTSB therefore recommends that the FMCSA develop and disseminate guidance for motor carriers on how to most effectively use currently available OBMS and develop a plan to periodically update the guidance. Additionally, the NTSB recommends that upon completion of the field operational tests for OBMS, the FMCSA

[117] R.R. Knipling, *Safety for the Long Haul: Large Truck Crash Risk, Causation, & Prevention* (Arlington, Virginia: American Trucking Associations, 2009).

determine whether test results indicate that such systems would reduce accidents or injuries, and, if so, require commercial motor carriers to use these systems to improve driver safety.

2.4 Speed Limiters on Heavy Commercial Motor Vehicles

In addition to being fatigued, the motorcoach driver was driving over the posted speed limit of 50 mph at the time of the accident. The bus ECM recorded a speed of up to 78 mph—the maximum governed speed setting for the bus—within 60 seconds before the accident and 64 mph when the motorcoach collided with the guardrail.

NTSB investigators examined the motorcoach's rollover propensity as a function of its speed when it initially collided with the roadside barrier (guardrail) using a TruckSim vehicle dynamics model based on motorcoach dimensions, center of gravity (CG) height,[121] and inertial and suspension properties. According to this examination, the motorcoach would roll over at speeds above 62 mph, as indicated by its maximum roll angle of 90° in table 6. At speeds less than 62 mph (as shown in table 6), the motorcoach would eventually return to its upright position. The NTSB's investigations and simulations indicated that had the driver been operating the accident motorcoach at or below the posted 50-mph speed limit, the rollover and subsequent collision with the vertical highway signpost might have been prevented by steering the bus away from the barrier after it returned to its upright position.[122]

Table 6. Motorcoach rollover propensity vs. speed at time of initial barrier impact.

Motorcoach Speed (mph)	Maximum Roll Angle (degrees)	Mph Over Speed Limit
50	20	0
55	27	5
60	41	10
61	44	11
62	90 (motorcoach rolls over)	12
63	90 (motorcoach rolls over)	13
64*	90 (motorcoach rolls over)	14
*Accident motorcoach speed as recorded by ECM at guardrail impact.		

[118] R.R. Knipling and others, *CTBSSP Synthesis Report 22: Safety Management in Small Motor Carriers, A Synthesis of Safety Practice* (Washington, D.C.: Transportation Research Board, 2011).

[119] J.A. Misener and others. *Onboard Monitoring and Reporting for Commercial Motor Vehicle Safety*, FMCSA-RRT-07-030 (Washington, D.C.: Federal Motor Carrier Safety Administration, December 2007).

[120] M. Mollenhauer, "Driver Monitoring Technologies: Drowsy Driver Detection SBIR and OBMS FOT Update," briefing presented at NTSB Headquarters, June 23, 2011.

[121] Prevost estimated the CG of the accident bus to be located 238.50 inches rear of the front axle and 53.08 inches above ground.

[122] Vehicle simulation parameters included motorcoach dimensions, CG height, inertial properties based on manufacturer's data, and the known number of passengers; highway parameters included a 5-inch-high angled right curb and roadside barrier modeled with elastic springs characterized by stiffness and the maximum lateral force applied on the vehicle. The steering wheel angle was fixed at 0 degrees in the simulation because no information on the driver's steering actions was available. Simulations should not be viewed as exact representations of the accident; for example, parameters such as the limited speed after the initial guardrail impact while still in motion and lateral forces between the guardrail and motorcoach as the guardrail was contacted and flattened by the motorcoach were not simulated.

The relationship between increased speed and crashes is well documented,[123] with the key correlation being speed and crash severity. Excessive speeding decreases the response time available to a driver and may increase risk as a result of speed-related increases in crash exposure. As noted by NHTSA, "Speeding reduces a driver's ability to steer safely around curves or objects in the roadway, extends the distance necessary to stop a vehicle, and increases the distance a vehicle travels while the driver reacts to a dangerous situation."[124] The impact force during a vehicle crash varies with the square of the vehicle speed; therefore, even small increases in speed have large and potentially lethal effects on the force at impact.[125]

One method of preventing speeding is to limit the vehicle's ability to exceed the posted speed limit. Heavy vehicle speed limiters, also referred to as speed governors and often part of a heavy vehicle's ECM, are devices that interact with a truck engine to limit a vehicle's maximum attainable preprogrammed speed.[126] Speed limiters in U.S. truck and bus fleets are commonly used for their safety contribution, as well as to reduce tire wear and increase fuel efficiency. And, since the early 1990s, technology that can limit speed has been standard equipment on all vehicles with ECMs, including motorcoaches, large trucks, and passenger vehicles.

Owners and operators of motorcoaches and other commercial vehicles equipped with speed limiters decide whether to voluntarily activate them and set the vehicle's maximum operating speed. Although speed limiters prevent vehicles from exceeding certain speeds, they do not (1) prevent speeding in locations where the speed limit is substantially lower than the governed speed (such as the accident location, where the speed limit was 50 mph and the motorcoach was speed-limited to 78 mph), or (2) stop vehicles from exceeding the governed speed when traveling downhill. No current U.S. regulations address heavy vehicle speed limiters.

Commercial vehicle speed limiters have been used in Europe and Australia for over a decade.[127] The European Union (EU) has limited the speed of large trucks (over 26,455 pounds) and buses to 56 mph since 1994.[128] In 1990, Australia limited the speed of heavy trucks over 26,455 pounds and buses over 11,023 pounds to 62 mph and the speed of road trains

[123] J. Stuster, Z. Coffman, and D. Warren, *Synthesis of Safety Research Related to Speed and Speed Management*, FHWA-RD-98-154 (McLean, Virginia: Federal Highway Administration, 1998).

[124] *Traffic Safety Facts 2003* (Washington, D.C.: National Highway Traffic Safety Administration, 2004).

[125] "Speeding Research Crash Risk" (Sydney, New South Wales: New South Wales Centre for Road Safety, 2005), <http://www.rta.nsw.gov.au/roadsafety/speedandspeedcameras/speedingresearch.html>, accessed May 7, 2012.

[126] R. Bishop and others, *CTBSSP Synthesis Report 16: Safety Impacts of Speed Limiter Device Installation on Commercial Trucks and Buses* (Washington, D.C., Transportation Research Board, 2008).

[127] In 2002, the European legislation was extended to apply to buses less than 22,046 pounds that carry more than eight passengers and trucks over 7,716 pounds by January 2008.

[128] The European Commission allows EU member states flexibility with specific regulatory provisions and implementation dates. However, core legislative objectives must be maintained. See A. Spoerri, *Summary Report: Assessment of a Heavy Truck Speed Limiter Requirement In Canada*, TP 14808 (Ottawa, Ontario: Transport Canada, Motor Carrier Division of Road Safety and Motor Vehicle Regulation Directorate, July 2008).

(a truck-tractor pulling multiple trailers) to 56 mph.[129] In 2003, Japan limited large trucks to speeds of 56 mph. More recently, speed limiters have been mandated for use in several Canadian provinces.[130] One study found that 60 percent of Canadian and U.S.-based commercial truck fleets already use speed limiters; and, because larger fleets are more likely to be speed limited, the percentage of speed-limited trucks is estimated at 77 percent, with the average speed limiter settings for large fleets in both countries set at 65 mph.[131]

In 2008, an FMCSA-sponsored study assessing the safety impacts of speed limiters on commercial trucks and buses found that speed limiter use was beneficial to fleet operations, with few negative effects on safety or productivity, and that speed limiter settings typically ranged from 65–69 mph.[132] In a March 2007 American Transportation Research Institute (ATRI) survey of nearly 150 commercial vehicle carriers, 69 percent of the respondents reported using speed limiters on at least some of their fleet vehicles.[133]

Speed limiters provide the opportunity to manage driver speed, especially on regular routes or in regions where speed limits are consistent. Information on the maximum speed limit for all states is accessible to motor carriers, and speed limiters can be set to match the locations of either charters or regular routes.[134] One wireless technology currently being tested is a variable speed limiter, which allows the carrier to alter the governed maximum speed remotely. This application can be linked to a database of posted speed limits so that as a heavy commercial vehicle passes from one zone to the next, the speed limiter adjusts automatically.[135] Intelligent speed adapters prevent drivers from exceeding speed limits by using GPS information about speed limits on particular roads; supporting research for such devices is currently being conducted in Europe.

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[129] The Australian Design Rule 65/00—Maximum Road Speed Limiting for Heavy Goods Vehicles and Heavy Omnibuses—specifies the devices or systems used to limit the maximum road speed of heavy goods vehicles. For further information, see <http://www.tmr.qld.gov.au/~/media/7ebc7a9d-b94b-4ee8-bf82-aab41c743252/speed--limiter--requirements.pdf>, accessed April 30, 2012.

[130] After Transport Canada published several reports on heavy vehicle speed limiters in January 2009, Ontario and Quebec began limiting the speed of commercial trucks, manufactured in or after 1995 and having a GVWR of 26,000 pounds or more, to 65 mph. See TP 14808 and six additional reports published by Transport Canada from 2007–2008 <http://www.tc.gc.ca/eng/roadsafety/safevehicles-motorcarriers-speedlimiter-index-251.htm>, accessed April 30, 2012.

[131] TP 14808.

[132] *Safety Impacts of Speed Limiter Device Installations on Commercial Trucks and Buses*, CTBSSP Synthesis No. 16 (Washington, D.C.: Transportation Research Board, Commercial Truck and Bus Safety Synthesis Program, 2008). For further information, see <http://onlinepubs.trb.org/onlinepubs/ctbssp/ctbssp_syn_16.pdf>, accessed May 8, 2012.

[133] *The Role of Speed Governors in Truck Safety*, *Industry Speed Governor Use Survey*, *Preliminary Analysis* (Alexandria, Virginia: American Transportation Research Institute, March 2007). For further information, see <http://www.atri-online.org/research/results/speedGovernorSurvey.pdf>, accessed May 8, 2012.

[134] See<http://www.iihs.org/laws/speedlimits.aspx>, accessed February 22, 2012.

[135] *The Motor Carrier Efficiency Study: 2008 Annual Report to Congress* (Washington, D.C.: Federal Motor Carrier Safety Administration, March 2010). For further information, see <http://www.fmcsa.dot.gov/documents/congress-reports/MC-Efficiency-2008-Annual-Report-Enclosure-FINAL-March-2010-508.pdf>, accessed April 30, 2012.

In 2006, two separate petitions for rulemaking were filed with NHTSA to establish a safety standard requiring devices to limit the speed of certain heavy trucks.[136] On January 26, 2007, NHTSA and the FMCSA published a joint Request for Comments Notice.[137] NHTSA has acknowledged to NTSB staff the benefits of heavy vehicle speed limiters, noting that a rule to require their use is expected to reduce the estimated 1,115 fatalities caused each year by crashes involving heavy trucks and buses on roads with posted speed limits of 55 mph or above. In October 2008, the ATA supported mandatory speed governing of no more than 65 mph for all large trucks manufactured since 1992.[138]

In January 2011, NHTSA announced that it plans to issue an NPRM on heavy vehicle speed limiters in 2012.[139] Along with research conducted by Transport Canada,[140] NHTSA has considered a 2005 U.S. Department of Transportation (DOT) Research and Special Programs Administration report[141] and a 2008 TRB synthesis of safety practice,[142] both of which indicate the potential of speed limiting devices to decrease crash severity. In March 2012, the FMCSA published the second phase of its study on heavy vehicle speed limiters, in which researchers assessed the impacts of implementing speed limiters in commercial vehicle fleet operations.[143] The results indicated a strong safety benefit for speed limiters. Significant safety benefits associated with speed reduction have been shown for years in research and real-world applications. The NTSB believes that NHTSA should utilize the safety benefits of speed limiters already available and focus on additional future benefits that could be realized through the use of variable speed limiters and intelligent speed adaptation. The NTSB concludes that the use of in-vehicle technologies to prevent commercial drivers from exceeding the speed limit would be

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[136] Two separate petitions for rulemaking, one submitted by the ATA and the other by Road Safe America and a group of nine motor carriers (Schneider National, Inc.; C.R. England, Inc.; H.O. Wolding, Inc.; ATS Intermodal, LLC; DART Transit Company; J.B. Hunt Transport, Inc.; U.S. Xpress, Inc.; Covenant Transport, Inc.; and Jet Express, Inc.). Schneider National, Inc., a major trucking fleet, in a comment submitted for the 2007 notice of proposed rulemaking (NPRM), reported that its trucks had been speed-limited to 65 mph since 1996. According to Schneider's self-reported crash data, vehicles without speed limiters accounted for 40 percent of the company's serious collisions while driving 17 percent of the company's total miles.

[137] *Federal Register*, vol. 72, no. 3904 (January 26, 2007).

[138] See <http://www.trucking.org/AdvIssues/Safety/Pages/SpeedGovernorsLimiters.aspx>, accessed April 3, 2012.

[139] *Federal Register*, vol. 76, no. 1 (January 3, 2011).

[140] For further information, see <http://www.tc.gc.ca/eng/roadsafety/safevehicles-motorcarriers-speedlimiter-index-251.htm>, accessed May 10, 2012.

[141] *Cost-Benefit Evaluation of Large Truck-Automobile Speed Limits Differentials on Rural Interstate Highways*, MBTC Report No. 2048 (Fayetteville, Arkansas: Mack-Blackwell Rural Transportation Center, University of Arkansas, 2005).

[142] CTBSSP Synthesis No. 16.

[143] R.J. Hanowski and others, *Research on the Safety Impacts of Speed Limiter Device Installations on Commercial Motor Vehicles: Phase II*, FMCSA-RRR-12-006 (Washington, D.C.: Federal Motor Carrier Safety Administration, 2012). This is the second of two reports and covers detailed research design and analysis; best practices applications; and identification of carrier, insurer, and enforcement official perspectives related to speed limiter implementation. The 2009 phase I report centered on a detailed literature review that updated and expanded on the recent TRB *Synthesis Report on the Safety Impacts of Speed Limiter Device Limitations on Commercial Trucks and Buses.*

beneficial in reducing both the instances and the severity of accidents involving heavy vehicles. The NTSB recommends that NHTSA develop performance standards for advanced speed-limiting technology, such as variable speed limiters and intelligent speed adaptation devices, for heavy vehicles, including trucks, buses, and motorcoaches. The NTSB further recommends that NHTSA, after establishing performance standards for advanced speed-limiting technology for heavy commercial vehicles, require that all newly manufactured heavy vehicles be equipped with such devices.

2.5 Commercial Driver Licensing Background Checks

Drivers with histories suggesting a high risk for accident involvement should optimally be screened out during a motor carrier's selection and hiring processes. Naturalistic research has suggested that, although the vast majority of commercial drivers are safe, a small percentage of drivers account for a large proportion of safety-critical events.[144] Research has also indicated that a driver's history of crashes and/or moving violations is highly related to future crash risk.[145]

Currently, driver-applicants must submit an application to a prospective motor carrier employer containing specific employment history information for the 10 years preceding the application date. Motor carriers are also required to make certain inquiries regarding the driver-applicant's previous records, including obtaining the applicant's driving history for the most recent 3 years from any state in which the driver held a CDL license.[146] The 3-year requirement was first incorporated in the FMCSRs in 1970, as part of a general rewrite of Part 391.[147] No documented rationale for the 3-year period was provided, and the 3-year requirement is still in place today, even though the FHWA[148] stated in its 1970 rule:

> The overwhelming weight of the available evidence establishes, beyond rational doubt that a driver's predilection for involvement in serious accidents can frequently be foretold by his past driving record and his general character. Since this is the case, drivers whose records demonstrate that they are likely to cause highway accidents should not continue operating heavy commercial vehicles.

In 1980, the NTSB completed a safety effectiveness evaluation concerning the detection and control of problem CMV drivers—drivers whose records of license suspensions, accidents, and traffic convictions indicated a flagrant and repeated disregard for the safety of other highway

[144] S. Soccolich, J. Hickman, and R. Hanowski, *Identifying High Risk Commercial Truck Drivers Using a Naturalistic Approach*, Report No. 11-UF-012 (Blacksburg, Virginia: Virginia Tech Transportation Institute, 2011).

[145] R. Knipling and others, "*Individual Differences and the High-Risk Commercial Driver*," Synthesis Report No. 4 (Washington, D.C.: Transportation Research Board, 2004).

[146] Per section 383.35, to include (1) names and addresses of the applicant's previous CMV employers; (2) dates of employment; (3) reason for leaving such employment; and (d) applicant certification that all information furnished is true and complete. However, prospective motor carriers must investigate, at a minimum, employment information from all previous CMV employers within the previous *3* years

[147] See *Federal Register*, vol. 35, no. 640 (April 22, 1970) and *Federal Register*, vol. 35, no. 17420 (November 13, 1970).

[148] At the time of the rule publication, the FMCSA was the Office of Motor Carriers, a division of the FHWA.

users.[149] As a result of the evaluation, the NTSB found that many problem drivers, despite unsafe driving records, continued to be licensed by the states and employed by motor carriers to operate the largest and heaviest vehicles on the highway. During its evaluation, the NTSB investigated 44 accidents that resulted in 51 fatalities and 95 injuries. All of the drivers had records of at least 2, and as many as 41, traffic convictions; the total number of convictions for the 44 drivers was 456. Of these convictions, 280 were for speeding; 12 were for driving with a suspended or revoked license; and 9 were for driving without a license or while in violation of license classification. (These are some of the same convictions the NTSB continues to see for drivers in current accident investigations, including this one.) As a result of the safety evaluation, the NTSB issued the following safety recommendation to the FHWA:

> Define fully, in the *Federal Motor Carrier Safety Regulations*, the information that a motor carrier must request from an applicant driver's former employer(s) when making the investigations and inquires required by the regulations. (H-80-20)

The FHWA's final response to the recommendation cited findings from a study that it had funded, entitled "Correlation between a Driver's Driving Records While Operating a Non-Commercial Vehicle in an On-Duty Status," and noted:

> At this time we have no convincing evidence that the information currently being transferred from one motor carrier to another is not sufficient for the employing motor carrier to determine if the driver applicant should be employed on safety grounds. We believe the present employment techniques, when coupled with Section 391.23 of the *Federal Motor Carrier Safety Regulations*, which defines the required driver information, are adequate.

The FHWA's response also addressed the requirement for a prospective employing carrier to contact the driver-applicant's previous employers; however, previous employers are not required to respond.[150] Based on the FHWA's response, the NTSB classified this recommendation "Closed—Unacceptable Action."

More recent research, such as the FMCSA's *Large Truck Crash Causation Study*, has shown that unsafe driver behavior is a major contributor to CMV-related crashes.[151] In August 2011, UMTRI, under contract to the FMCSA to evaluate the effectiveness of the CSA 2010 Operational Model, published a report, which states that the CSA Unsafe Driving BASIC has a strong and consistent linear association with crash rates and "further supports the notion that past driving behavior is a good predictor of future driving behavior."[152] In another

[149] *Safety Effectiveness Evaluation of Detection and Control of Unsafe Interstate Commercial Drivers Through the National Driver Register, State Driver Licensing Policies, and the Federal Motor Carrier Safety Regulations*, Safety Evaluation Report NTSB/SEE-80/1 (Washington, D.C.: National Transportation Safety Board, 1980).

[150] Except for records of drug and alcohol testing (49 CFR 391.23—Interpretation–Question #1 and 49 CFR 382.405).

[151] For further information, see http://csa.fmcsa.dot.gov/, accessed May 31, 2012.

[152] *Evaluation of the CSA 2010 Operational Model Test*, UMTRI-2011-08/FMCSA–RRA-11-019 (Ann Arbor, Michigan: University of Michigan Transportation Research Institute, 2011), pp. i and 40.

study, ATRI used 2008 CDLIS and MCMIS driving record data and 2009 crash MCMIS involvement data to assess the relationships between driver offenses and the increased likelihood of crashes.[153] The 2011 ATRI study found that a driver with a past crash or an improper passing conviction has an associated increase in crash likelihood of 88 percent; a conviction for failure to obey a traffic sign, 68 percent; and a conviction for driving more than 15 mph over the speed limit, 67 percent.

When hired by World Wide Travel, the accident driver's full length driving history included the following, many of which are cited by the ATRI study: four citations for driving without a license and one citation each for nonuse of seat belts, improper passing, failure to stop at stop sign, disobeying a traffic sign, unregistered motor vehicle, expired vehicle inspection, and driving without insurance. Further, his license had been suspended on several occasions for not paying child support. However, with the exception of two license suspensions, none of the history cited above was reflected in the information the NYDMV provided to World Wide Travel in November 2010.[154]

Therefore, the NTSB examined whether a 3-year driver license history is sufficient to evaluate a driver's background. The NTSB reviewed driver histories provided to motor carriers for the drivers in three recent accidents involving commercial vehicles.[155] In each of these cases, the more extensive violation histories discovered postaccident by the NTSB were markedly different from the information provided to the motor carriers during preemployment screening. The results of these investigations provide little confidence that the driving record a prospective employer is required to obtain will be sufficient to make an informed decision about the driver-applicant. Detection of high-risk drivers is thus heavily dependent on information furnished by the driver, who may be reluctant to provide information that may jeopardize an employment opportunity or lead to termination of employment.

Research into the safety management practices of the safest motor carriers includes a strong focus on preventing crashes before they happen through preemptive measures targeting a prospective employee's driver history and its correlation to future crashes.[156] For example, research by the John A. Volpe National Transportation Systems Center and North Dakota State University identified driver-related factors as the leading causes of accidents;[157] driver and

[153] M.D. Lueck and D.C. Murray, *Predicting Truck Crash Involvement: A 2011 Update* (Arlington, Virginia: American Transportation Research Institute, 2011).

[154] Another reason the information was unavailable was because of the three open suspensions incorrectly classified under a different driver name in the NYDMV system.

[155] (a) NTSB/HAR-11/02. (b) Amtrak Passenger Train and Truck Tractor Combination Unit Collision near Miriam, Nevada, on June 24, 2011 (NTSB accident investigation case number HWY-12-MH-012). (c) Motorcoach Roadway Departure and Overturn on Interstate 95 near Doswell, Virginia, on May 31, 2011 (NTSB accident investigation case number HWY-12-MH-010).

[156] T. M. Corsi and E. Barnard, *Best Highway Safety Practices: A Survey about Safety Management Practices among the Safest Motor Carriers* (Washington, D.C.: Federal Motor Carrier Safety Administration, March 2003).

[157] B. Lantz, *Development and Implementation of a Driver Safety History Indicator into the Roadside Inspection Selection System* (Cambridge, Massachusetts: Volpe National Transportation Systems Center/Fargo, North Dakota: Upper Great Plains Transportation Institute, North Dakota State University, 2006). For further information, see <http://www.ugpti.org/tssc/projects/downloads/ISS-DFinalReport.pdf>, accessed May 8, 2012.

carrier conviction scores are highly indicative of OOS and accident rates;[158] and the worse the conviction score, the higher the OOS rate.[159] A 2005 ATRI study found that a violation for reckless driving increased the likelihood of a future crash by 325 percent.[160] Given the extensive body of research suggesting that a driver's history is a strong predictor of future accident involvement, the NTSB believes that motor carriers should have access to this information to make informed hiring decisions.

Access to at least 10 years of offense history would parallel the required 10 years of commercial driving employment history and provide employers information that could permit safer hiring decisions. States should increase the amount of driver history information they provide motor carriers. Some states are already doing so; for example, in July 2010, the Pennsylvania Department of Transportation (PennDOT) issued guidelines to provide CMV employers a complete driving history through a PennDOT electronic service channel. Further, PennDOT staff told NTSB investigators they plan to expand the driver record to include information on crash severity, specifying whether the crash involved fatalities, injuries, or property damage, regardless of the type of driver's license held.

In 2010, the FMCSA established the PSP, designed to assist the motor carrier industry in assessing individual drivers' crash and serious safety violation history. However, the PSP is not part of the CSA initiative, and participation by carriers is voluntary. Further, prospective motor carrier employers using the PSP can review driver profiles including only 3 years of inspection history and 5 years of crash data; the PSP does not contain conviction data. Although numerous studies show the correlation between a driver's history and crash risk, the NTSB could find no studies or documentation supporting the 3-year-only time period. The NTSB believes 3 years is insufficient to judge trends in driver behavior (both good and bad) and that making a minimum of 10 years of driver information available would provide motor carrier employers with more comprehensive information to make an informed hiring decision.[161] The NTSB concludes that by providing a 10-year driving history on prospective employees, the states could better assist motor carriers in identifying problem commercial drivers and reduce the number of commercial motor vehicle accidents and fatalities. The NTSB further concludes that the current provisions of 49 CFR 391.23 requiring a motor carrier to inquire into an applicant's driving history for the most recent 3 years are insufficient to make an informed hiring decision and result in the motor carrier not having access to sufficient safety-related information prior to hiring drivers.

The NTSB continues to see in this and other investigations drivers with poor driving records outside of the 3-year window operating commercial vehicles. A driver who cannot safely operate a motor vehicle should not be allowed behind the wheel of a commercial vehicle or a bus, whether it is an 80,000-pound commercial truck or a motorcoach transporting passengers. Providing motor carriers with a 10-year driving history on prospective drivers provides effective

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[158] B. Lantz and M. Blevins, *An Analysis of Commercial Vehicle Driver Traffic Conviction Data to Identify Highway Safety Risk Motor Carriers* (Fargo, North Dakota: Upper Great Plains Transportation Institute, North Dakota State University/Washington, D.C.: Federal Motor Carrier Safety Administration, 2001). For further information, see <http://www.ugpti.org/research/downloads/CDC09_10_01.pdf>, accessed May 8, 2012.

[159] B. Lantz, 2006.

[160] *Predicting Truck Crash Involvement: Developing a Commercial Driver Behavior Model and Requisite Enforcement Countermeasures* (Arlington, Virginia: American Transportation Research Institute, 2005). For further information, see <http://www.atrionline>, accessed May 8, 2012.

detection and screening of high-risk drivers and may decrease the number of commercial vehicle accidents and resulting injuries and fatalities. Therefore, the NTSB recommends that the FMCSA revise 49 CFR 391.23 to require that motor carriers obtain a 10-year driving history for all prospective commercial vehicle drivers. The NTSB further recommends that the FMCSA revise 49 CFR 384.225 to require that the states retain on the CDLIS driver record all convictions, disqualifications, and other licensing actions for violations during the prior 10 years.

2.6 Motor Carrier Oversight

2.6.1 Safety Fitness Determination of Motor Carriers

The FMCSA requires that a motor carrier meet the safety fitness standards by demonstrating it has adequate safety management controls in place to reduce operational risks, such as those associated with the use of fatigued drivers. In this case, the driver failed to obtain adequate sleep before reporting for duty, and although common sense should have prompted him to acquire adequate sleep before driving, the Federal regulations do not specifically address lack of sleep—only that a driver has adequate time off duty. Nonetheless, the Federal safety regulations' intent is to provide the opportunity for adequate sleep, and the driver's fatigue was causal to the accident. Title 49 CFR Part 392.3 states that a driver will not be permitted to operate a CMV "while the driver's ability or alertness is so impaired, or so likely to become impaired, through fatigue, illness, or any other cause, as to make it unsafe for him or her to begin or continue to operate the commercial motor vehicle." The FMCSA determined the New York City accident was a "preventable accident," as defined by 49 CFR 385.3; consequently, the FMCSA counted it in the carrier's postaccident compliance review, which—combined with operational factors—resulted in an "unsatisfactory" safety rating. Great Escapes, which also employed the accident driver, received a separate postaccident compliance review, resulting in a "conditional" rating.

Since these postaccident compliance reviews, World Wide Travel has ceased operations and sold its motorcoaches to Great Escapes; the shared drivers now work solely for Great Escapes. Also since the accident, Great Escapes has been issued citations for violations discovered during an October 2011 nonrated review and received two safety alerts in the FMCSA's safety measurement system for exceeding the BASIC thresholds for Fatigued Driving and Unsafe Driving. The safety measurement system evaluates the safety performance of motor carriers by using a carrier's roadside inspections, including all safety-based violations, state-reported crashes, and Federal motor carrier census data to quantify performance in the seven BASICs.[162] The system uses this on-road safety performance to identify carriers for interventions, determine

[161] Part 391.25 requirements regarding the annual inquiry and review of driving records call for all motor carriers to consider a driver's accident record and any evidence that the driver has violated motor vehicle laws, giving great weight to violations such as speeding, reckless driving, and operating while under the influence of alcohol or drugs, which indicate a disregard for public safety.

[162] A carrier's BASIC measurement depends on the number and severity of adverse safety events (violations related to that BASIC or crashes) and when they occurred (more recent events receive more weight). After its measurement is determined, the carrier is placed in a peer group with other carriers having similar numbers of inspections. Percentiles from 0–100 are then calculated by comparing the carrier's BASIC measurements to the measurements of other peer group carriers, with a percentile of 100 indicating the worst performance.

specific safety problems, and provide monitoring to show whether a carrier's safety problems are improving or worsening.

In addition to determining a carrier's on-road performance, the FMCSA uses the compliance review process to determine a carrier's overall fitness using the Safety Fitness Determination (SFD) process. Currently, the FMCSA determines a carrier's fitness to operate based only on the outcome of an onsite comprehensive investigation or a compliance review. However, the FMCSA has announced it intends to issue rulemaking in early 2013 to replace the current safety rating process with a new one in which safety measurement system scores (such as Fatigued Driver, Unsafe Driving, or Vehicle Maintenance BASICs) will be used to determine whether a carrier should continue to operate or be rated unfit[163] and suspended from operating (that is, ordered "out-of-service").[164] Under the new system, the FMCSA could propose adverse safety ratings using safety measurement system scores without the need to conduct a compliance review. In other words, if the relative safety performance of a motor carrier was poor enough to exceed a specified BASIC threshold, the FMCSA could issue the carrier a proposed adverse safety rating.[165] The FMCSA states that the most significant differences between the current system and the proposed SFD process[166] are as follows:

- An SFD rating will not be tied exclusively to an onsite investigation, where currently a rating is only issued or downgraded via an onsite investigation or compliance review.
- The new SFD will be regularly updated, unlike the current system, which provides a snapshot of compliance only on the date of the most recent compliance review (which the NTSB has found can be years or even a decade old).
- The new SFD will be based on violations of all safety-based regulations; the current SFD is based on critical and acute violations only.[167]

Until a final rule is implemented, the FMCSA will continue to use the current compliance review process for determining a carrier's fitness to operate. The NTSB recognizes that the FMCSA can use safety measurement system scores to monitor these carriers and conduct interventions under the CSA process, unlike previously, when the FMCSA usually would not revisit a conditionally rated carrier unless the carrier requested a safety rating upgrade, a consumer lodged a complaint, or a fatal accident occurred. However, even with the CSA

[163] If a passenger motor carrier receives an "unfit" determination, it would have 45 days to improve its SFD by (1) undergoing another investigation or compliance review; (2) lodging a 385.15 appeal to the Chief Safety Officer (if there are material errors in information related to roadside data or interventions); or (3) lodging a 385.17 appeal in which the motor carrier files evidence of corrective action.

[164] As mentioned previously, the FMCSA can currently issue a carrier SFD, but it must have conducted an onsite comprehensive investigation before doing so. However, the FMCSA can propose an adverse safety rating based on the onsite investigation.

[165] For further information, see <http://www.fmcsa.dot.gov/about/news/speeches/Statement-of-Anne-S-Ferro062310.aspx>, accessed May 8, 2012.

[166] For further information, see <http://csa.fmcsa.dot.gov/faqs.aspx?faqid=1446>, accessed March 12, 2012.

[167] *Motor Carrier Safety: More Assessment and Transparency Could Enhance Benefits of New Oversight Program*, GAO-11-858 (Washington, D.C.: Government Accountability Office, 2011).

intervention options available to FMCSA, under the current compliance review process and SFD, carriers such as Great Escapes can continue to operate in “conditional” status and not improve on their driver oversight deficiencies.

The New York City motorcoach accident, with its high loss of life, underscores the urgency for the FMCSA to move forward more expeditiously to provide timely public safety ratings (using the safety measurement system) and to more quickly remove unsafe motor carriers and their drivers from the nation’s highways. The safety measurement system is a methodology intended to measure the safety of motor carriers, and the NTSB agrees with the FMCSA that one benefit of including these scores in determining a carrier’s fitness to continue operating is that it allows the FMCSA to expedite the process of shutting down unsafe carriers. The NTSB has found that driver violations are a clear indicator of accident risk; therefore, the NTSB concludes that the FMCSA’s new SFD process could address deficiencies in the current compliance review process by basing a motor carrier’s safety rating on violations of important safety-based regulations (as found in roadside inspections), helping to prevent unsafe carriers from continuing to operate. Therefore, the NTSB recommends that the FMCSA include safety measurement system rating scores in the methodology used to determine a carrier’s fitness to operate in the safety fitness rating rulemaking for the new CSA initiative.

2.6.2 Safety Management Systems

Safety culture refers to the shared values and beliefs within an organization that establish safety as a priority and drive organizational policies and practices. Safety culture, which is embodied in company priorities, rules, management practices, worker behaviors, and employee attitudes, is fundamental to an organization’s ability to manage safety-related operations.[168] Whenever an accident occurs in which inadequate company oversight of safety practices may have been a contributing factor, regardless of the mode, the NTSB investigates how corporate culture potentially set the stage for the accident.[169] If an employee’s operating performance conforms to carrier procedures or reflects the accepted values and attitudes found in the carrier’s

[168] For further information on safety culture, see A.I. Glendon and N.A. Stanton, “Perspectives on Safety Culture,” *Safety Science*, vol. 24, no. 1–3 (2000), pp. 193–214.

[169] (a) *Downeast Airlines, Inc., DeHailland DHC-6-200, N68DE, Rockland, Maine, May 30, 1979*, Aviation Accident Report NTSB/AAR-80/05 (Washington, D.C.: National Transportation Safety Board, 1980). (b) *Air Illinois Hawker Siddley, HS748-2A, N748LL, Pinckneyville, Illinois, October 11, 1983*, Aviation Accident Report NTSB/AAR-85/03 (Washington, D.C.: National Transportation Safety Board, 1985). (c) *Collision of Northeast (METRA) Train and Transportation Joint Agreement School District 47/155 School Bus at Railroad/Highway Grade Crossing, Fox River Grove, Illinois, October 25, 1995,* Highway Accident Report NTSB/HAR-96/02 (Washington, D.C.: National Transportation Safety Board, 1996). (d) *Collision of Washington Metropolitan Area Transit Authority Train T-111 With Standing Train at Shady Grove Passenger Station, Gaithersburg, Maryland, January 6, 1996*, Railroad Accident Report NTSB/RAR-96/04 (Washington, D.C.: National Transportation Safety Board, 1996). (e) *Head-On Collision Between Burlington Northern Railroad Freight Trains 602 and 603, Ledger, Montana, August 30, 1991*, Railroad Accident Report NTSB/RAR-93/01 (Washington, D.C.: National Transportation Safety Board, 1993). (f) *Highly Volatile Release From Underground Storage Cavern and Explosion, Mapco Natural Gas Liquids, Inc., Brenham, Texas, April 7, 1992*, Pipeline Accident Report NTSB/PAR-93/01 (Washington, D.C.: National Transportation Safety Board, 1993). (g) *Explosion and Fire on Board the U.S. Tankship OMI Charger at Galveston, Texas, October 9, 1993*, Marine Accident Report NTSB/MAR-94/04 (Washington, D.C.: National Transportation Safety Board, 1994).

workplace and an unsafe situation occurs, the corporate culture (company safety management) may be at fault.

Through its actions, a transportation company can communicate an attitude to its employees that influences their degree of compliance with operating rules and safe operating practices. World Wide Travel's and Great Escapes' lack of adherence to Federal safety regulations, as documented through numerous compliance reviews and roadside inspections of both companies, serves as evidence of a corporate culture that fostered indifference to passenger safety. It is also evident in the lack of safety management controls to address not only the accident driver's hours-of-service violations and lack of fitness for duty, but also the continued actions by Great Escapes' drivers indicating that adherence to hours-of-service rules was not a company priority, as evidenced by the carrier's safety measurement system score for the Fatigued Driving BASIC. In September 2011, Great Escapes indicated to the FMCSA that the company was implementing AOBRDs and was in the process of cross-training its employees. Great Escapes also participates in the PSP. However, the company has not submitted a request for a rating upgrade since the August 2011 denial letter and remains in conditional status with the FMCSA.

Safety management systems are designed to continually monitor operations and collect appropriate data to identify emerging and developing safety problems before they result in death, injury, or significant property damage. Having identified these risks, safety management systems require that managers devise interventions and evaluate their success in mitigating risk. In addition to reactive management procedures (that is, crash and incident investigations), a safety management system includes proactive measures to anticipate and prevent or mitigate safety risks. It is apparent that company officials at both World Wide Travel and Great Escapes did not employ a safety management system, missing an opportunity to identify crash and safety risks and methods to address them.

The FMCSA has always required that carriers have safety management controls to operate safely and in compliance with the FMCSRs; implementing a safety management system is essential to the concept of safety management controls. In addition, the FMCSA is now using the Safety Management Cycle model as a structured investigative tool to determine why a motor carrier may be having safety or compliance problems. The Safety Management Cycle promotes the practice of reviewing safety programs and self-diagnosing breakdowns that lead to safety violations as an ongoing process. During the investigation of a motor carrier, FMCSA enforcement personnel use six safety management processes to discover which areas are deficient: policies and procedures, roles and responsibilities, qualifications and hiring, training and communication, monitoring and tracking, and meaningful action (proactive measures). Although the compliance review process identifies a carrier's violations of Federal safety regulations, the Safety Management Cycle educates carrier management on how to determine why violations occur and how to prevent them.

For over three decades, the NTSB has expressed concern about the lack of safety management in the transportation industry. NTSB accident investigations[170] have revealed that, in numerous cases, safety management systems or system safety programs could have prevented

[170] For a list of related investigations, see <http://www.ntsb.gov/safety/mwl-3.html>, accessed May 7, 2012.

loss of life and injuries. Although an impaired operator or mechanic, a broken vehicle part, or severe weather may be the initiating factor in an accident, there frequently is evidence of a continuous safety problem long before the accident occurred. The NTSB recognizes that most of the officials, supervisory personnel, and dispatchers from World Wide Travel are now employed at Great Escapes. For this reason, the NTSB concludes that, as evidenced by Great Escapes' safety measurement system scores and the FMCSA's refusal to upgrade its safety rating, it is apparent that the carrier's management does not have a safety system to resolve the proximal causes and associated risks with driver behaviors, leading to repeated driver safety violations proven to increase the risk of accidents. NTSB accident investigations have revealed that, in numerous cases, a safety management system could have prevented loss of life and injuries. Therefore, the NTSB recommends that the FMCSA include in the safety fitness rating rulemaking for the new CSA initiative a structured process, such as the Safety Management Cycle, to be used by FMCSA investigators and their state MCSAP agents, as an audit tool for investigators to (1) identify the root cause of safety risks found during compliance reviews, and (2) deliver constructive guidance to motor carriers to ensure the promotion of safety management. Associations that represent motorcoach operators are a far-reaching and important venue to provide information to passenger carriers; therefore, the NTSB recommends that, as a source of education and promotion of safety in the motorcoach industry, the American Bus Association, the National Motorcoach Network, and the United Motorcoach Association alert their members to (1) the circumstances of this accident, (2) the existence of the FMCSA's Safety Management Cycle, and (3) how the safety management process can positively influence carrier safety.

Under SAFETEA-LU, the FMCSA is pursuing increased outreach and education initiatives to promote the safe operation and best highway practices for CMVs. An example of one of these outreach programs—the *Safety is Good Business* website—contains materials for motor carriers to promote, educate, and support safety, including information on industry best practices, driver wellness programs, fatigue management, accident countermeasures, and drug and alcohol programs. The NTSB supports this effort and maintains that although the FMCSA has worked with many companies to institute a safety management system concept, until a safety management plan is required to be in place as part of an SFD, all motor carriers should be provided the important keys to successfully implementing a safety management system. Therefore, as part of its outreach and education initiatives, the NTSB recommends that the FMCSA include information regarding the Safety Management Cycle in its *Safety is Good Business* motor carrier website.

2.6.3 Affiliated Motor Carriers

In its compliance reviews, both preaccident and postaccident, the FMCSA referred to World Wide Travel and Great Escapes as "sister" companies. According to the FMCSA, it is not illegal for a carrier to apply for multiple USDOT numbers because it may have legitimate reasons for needing more than one number. For example, carriers that operate in different locations may want to separate their business practices across multiple routes or businesses; other reasons include a transfer of ownership, reincorporation, or both, in the case of a divorce, death, relocation, or new business opportunities. However, as the GAO has stated, the use of multiple USDOT numbers, whether through reincarnation or affiliation, to evade safety enforcement allows the continued operation of unsafe at-risk carriers.[171]

The FMCSA has addressed affiliated carriers and, on April 26, 2012, it published a final rule (effective May 29, 2012) revising its Rules of Practice to address operational affiliation and reincarnation of carriers. The rule will establish that FMCSA can determine that a motor carrier is reincarnated if substantial continuity exists between the entities or that a motor carrier is affiliated if the business operations are under common ownership and/or common control.[172] The final rule also adds a new section (386.73) to the FMCSRs that establishes procedures to address entities that attempt to reincarnate or operate affiliated entities for the purpose of evading FMCSA orders, avoiding statutory and regulatory compliance, or concealing a history of noncompliance; these new procedures would more fully implement the agency's current authority to prohibit unsafe entities from operating.

According to the FMCSA, the goal of the rule is to standardize and codify the process of linking corporate entities. The FMCSA final rule establishes regulatory criteria for determining successor corporate liability in situations where a company seeks to avoid negative enforcement history, penalty assessments, and/or orders to cease operating by simply changing names or identities. Further, the final rule establishes that records and the compliance history of companies that attempt to evade enforcement actions through reincarnated or affiliated companies will be combined. The NTSB concludes that the safety benefits of consistently and effectively addressing high-risk (either reincarnated or affiliated) interstate motor carriers resulting from the FMCSA's new rule addressing operational affiliation and reincarnation of carriers should assist in curtailing their continued unsafe operations.

The NTSB is concerned that the affiliation between World Wide Travel and Great Escapes allowed Great Escapes to continue to operate using the same owner/managers, dispatchers, administrative staff, space, drivers, and vehicles used by World Wide Travel. However, the NTSB notes that Great Escapes was allowed to continue operations under a "conditional" rating and with close scrutiny by the FMCSA. A followup focused onsite compliance review of Great Escapes was conducted on October 18, 2011, and the FMCSA identified continuing breakdowns in Great Escapes safety management processes pertaining to driver qualification, driver hours of service, and vehicle maintenance. As a result of the review,

[171] *Report to Congressional Committees: Motor Carrier Safety: New Applicant Reviews Should Expand to Identify Freight Carriers Evading Detection,* GAO-12-364 (Washington, D.C.: Government Accountability Office, 2012).

[172] In making this determination, the FMCSA may consider, among other things, the following factors: (1) whether the new or affiliated entity was created for the purpose of evading statutory or regulatory requirements (such as an FMCSA order, enforcement action, or negative compliance history)—in weighing this factor, the Field Administrator or Director may consider the stated business purpose for the creation of the new or affiliated entity; (2) consideration exchanged for assets purchased or transferred; (3) dates of company creation and dissolution or cessation of operations; (4) commonality of ownership between the current and former company or between current companies; (5) commonality of officers and management personnel; (6) identity of physical or mailing addresses, telephone, fax numbers, or email addresses; (7) identity of motor vehicle equipment; (8) continuity of liability insurance policies or commonality of coverage under such policies; (9) commonality of drivers and other employees; (10) continuation of carrier facilities and other physical assets; (11) continuity or commonality of nature and scope of operations, including customers for whom transportation is provided; (12) advertising, corporate name, or other acts through which the company holds itself out to the public; and (13) history of safety violations and pending orders or enforcement actions of the Secretary.

the FMCSA determined that for Great Escapes to receive a "satisfactory" safety rating, it would be required to document that it has (1) installed AOBRDs equipped with electronic mobile communication and tracking technology for driver hours-of-service dispatch and recordkeeping; (2) established a disciplinary program specific to hours-of-service compliance and records-of-duty falsification; (3) equipped all commercial vehicles with speed limiters (engine governors) limited to speeds not exceeding 65 mph; (4) established monitoring systems to ensure that drivers are not driving at excessive speeds on all routes, including local and residential routes; (5) instituted a disciplinary program specific to speeding violations; and (6) enrolled in and will continue to participate in the FMCSA's PSP to assess individual driver histories prior to employment.

2.7 Highway Issues

Roadway departure crashes are frequently severe and account for the majority of highway fatalities. In 2009, 14,968 fatal roadway departure crashes resulted in 16,265 fatalities, accounting for 49 percent of all fatal crashes in the United States that year.[173] As mentioned earlier in this report, the accident location contained rumble strips; however, the driver could not safely steer his vehicle back onto the roadway and instead struck the guardrail and eventually the vertical highway signpost. The vertical highway signpost was considered a fixed-base support system, which is designed not to yield or break away on impact. The signpost was offset from the edge of the roadway by 15 feet, within the area defined as the "clear zone."

NTSB investigators examined the event sequence of fatal accidents on high-speed roadways involving collisions with guardrails from 2004–2010, using NHTSA Fatality Analysis Reporting System (FARS) data. Figure 14 shows the locations of the accidents involving heavy vehicles. In those accidents, "collision with guardrail" was typically not the first event, indicating that one or more precipitating events led to the interaction with the guardrail. Because most guardrails are set back a distance from the traveling lanes, "ran-off-road" was the event most often cited as the preceding event, similar to the accident described in this report. Also, "collision with guardrail" was rarely recorded as the most harmful event specifically involving large buses and other heavy vehicles. The most likely subsequent event after a vehicle collided with the guardrail was "rollover" for truck-tractors and "ran-off-road" for large buses. On average, very few fatal accidents involved vehicles colliding with guardrails and then subsequently colliding with supports (such as a highway sign, overhead sign, light, or traffic sign).

[173] *Fatality Analysis Reporting System Encyclopedia*, National Highway Traffic Safety Administration database. For further information, see <http://www-fars.nhtsa.dot.gov/Main/index.aspx>, accessed May 8, 2012.

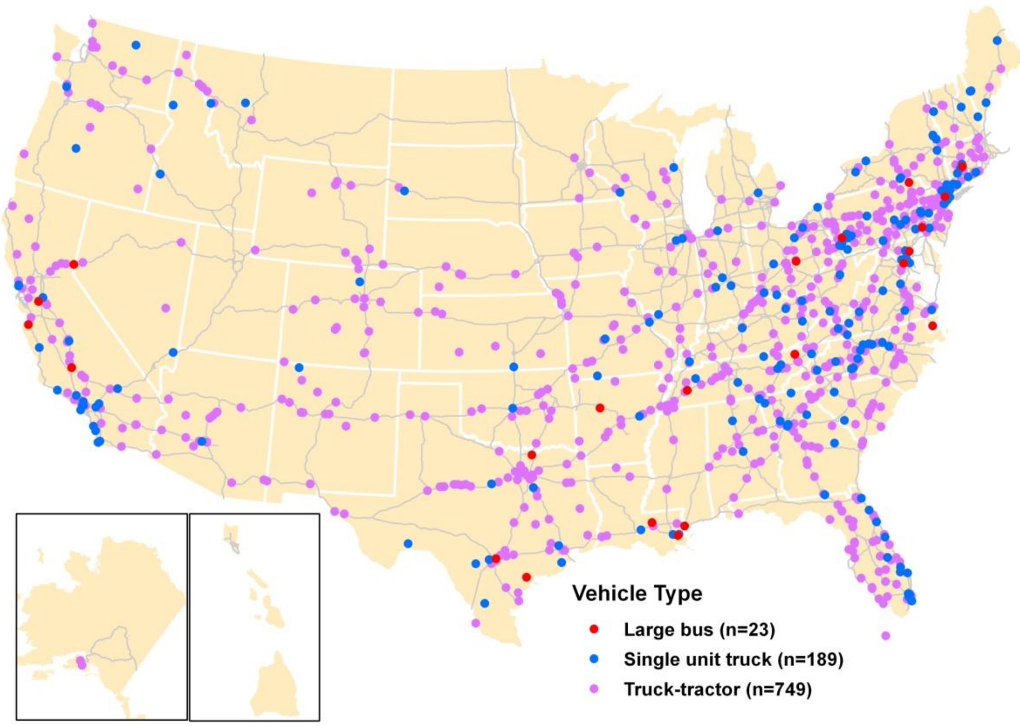

Figure 14. Fatal accident locations involving heavy vehicles colliding with a guardrail on high-speed roadways (2005–2010).

2.7.1 Clear Zone Concept

The clear zone concept involves providing a traversable and unobstructed roadside area beyond the traveled way for use by errant vehicles.[174] Obstacles located outside of the clear zone generally do not need shielding by a traffic barrier. According to AASHTO, providing 30 feet or more from the edge of the travel lane on high-speed highways would allow sufficient space for about 80 percent of the vehicles leaving the roadway in an uncontrolled event to recover. As previously noted, AASHTO generally recommends that obstacles located within the clear zone be removed, relocated, redesigned, or shielded by traffic barriers or crash cushions.[175]

After the accident, the NTSB asked the NYSTA why the vertical highway signpost was constructed within the clear zone. The NYSTA responded[176] (in part) that, when the highway

[174] The clear zone's width is usually 30 feet for freeways, as measured from the edge of the paved traveled way or the intersection of the paved traveled way and shoulder. The nominal clear zone for a flat roadside on 60-mph highways is 30 feet. The clear zone width increases with higher speeds and steeper slopes. For more information, see section 1.6.4 of this report, "AASHTO Design Guidance for Location of Fixed Objects."

[175] *Roadside Design Guide*, 4th ed. (Washington, D.C.: American Association of State Highway and Transportation Officials, 2011), pp. 3-1 and 3-2.

[176] NYSTA correspondence concerning NTSB followup questions about the March 12, 2011, accident.

pavement system was reconstructed in the 1980s, (1) the concept of "clear zone," as defined in the current NYSDOT *Highway Design Manual*, did not exist; (2) general roadside design practice for reconstruction projects was to provide satisfactory clear areas, whenever practical, and appropriately designed barriers, when not; and, (3) post columns were commonly located in the clear area and protected with a barrier system to provide an economical sign structure. The NYSTA noted that the design was similar to many bridges constructed during this period, with piers or abutments within the clear area and an appropriate horizontal clearance and barrier system provided. However, as noted in section 1.6.4, the NTSB found the design guidance that would have applied to the reconstruction project does not correspond with the NYSTA's rationale. Design manuals that were in effect in the 1980s classified roadside obstacles as nontraversable hazards and fixed objects, accounting for over 30 percent of all highway fatalities each year, and stated that *their removal should be the first alternative considered*.[177]

The 1984 reconstruction project design report (construction contract TANE 84-25), under which the vertical highway signpost was initially constructed, cited removal or protection of all fixed objects within 30 feet of the roadway. In addition, the NYSTA indicated it generally relies on the NYSDOT *Highway Design Manual*, as modified by NYSTA policies and practices for roadside design. The 2010 NYSDOT *Highway Design Manual*[178] indicates that fixed objects located within the clear zone can be struck by vehicles running off of the road and should usually be removed, rather than being shielded with a barrier. Adequate space was available (32 feet) to locate the vertical highway signpost at the accident site outside of the clear zone.

The NTSB believes that the decision to construct the vertical highway signpost within the clear zone in 1984 was based partially on the desire to design an economical sign structure and partially on common practice. Design guidance in the 1980s recommended that fixed objects in the clear zone be removed as the first alternative, yet the NYSTA chose to locate the vertical highway signpost approximately 15 feet from the edge of the traveled way and shield it with a strong-post blocked-out W-beam guardrail. The NTSB concludes that the fact that the overturned motorcoach struck the vertical highway signpost located within the clear zone, despite a barrier system being in place, directly contributed to the severity of this accident. The NYSTA has informed the NTSB that it plans to redesign and construct a new vertical highway signpost,[179] to include relocating the vertical poles outside of the clear zone.

2.7.2 Roadside Barriers

Where fixed objects cannot be relocated outside of the clear zone due to limited right-of-way space, severe slopes, or other physical limitations, roadside barrier systems are necessary. Because crash test performance levels have evolved over the years for barrier systems, NTSB investigators examined the site conditions on I-95 near the accident against updated criteria to determine the most cost-beneficial method of shielding the vertical highway signposts.

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[177] *Guide for Selecting, Locating, and Designing Traffic Barriers* (Washington, D.C.: American Association of State Highway and Transportation Officials, 1977), p. 15.

[178] NYSDOT *Highway Design Manual*, "Chapter 10—Roadside Design, Guide Rail, and Appurtenances," revision 57 (June 28, 2010), pp. 10–132.

[179] The NYSTA anticipates starting construction of the new structure in late 2012, with completion in mid 2013.

Crash tests have shown that in locations where high-speed, high-angle impacts are likely, the use of most curb and guardrail combinations, such as the one in the accident vicinity, should be discouraged.[180] However, because the built-up, urban nature of the I-95 corridor limited the space available to drain stormwater runoff, a closed drainage system with a sloped (or mountable) concrete curb (as opposed to an open drainage system of roadside ditches) was necessary. Further, this curb and guardrail combination conformed to the standards and protocols of numerous published research projects and reports. The NTSB's accident simulations determined that the sloped curb was not a factor in the motorcoach's rollover.

The NTSB also examined 1982 crash tests and evaluations of W-beam and Thrie-beam[181] guardrails against bus impacts.[182] Applying the 1982 evaluations to the conditions in this accident, the NTSB believes that a Thrie-beam guardrail could have redirected the motorcoach and prevented the rollover. However, no testing has been done since 1982 to account for the increased weight, height, and roll stability of newer motorcoaches, which could affect these guardrail evaluations. Current testing uses a commercial straight truck, which has a shorter wheel base than a typical 45-foot motorcoach and a potentially higher CG, and a tractor-trailer combination unit, which differs substantially from a typical motorcoach in both CG and vehicle dynamics after initial impact with a barrier system.

The strong-post blocked-out W-beam guardrail with steel block-out at the accident location, although an approved, crash-tested barrier system when it was initially constructed in 1984, was primarily designed to redirect passenger cars and pickup trucks. Further, the primary reference for full-scale crash testing in the United States at that time used crash-test procedures based on the barrier being evaluated for dynamic performance against a minimum matrix of conditions. The report did not include site-specific guidance[183] as to which barrier type would be appropriate for a given location.

In 2006, AASHTO issued its *Roadside Design Guide*, which recognized that most roadside barriers were developed, tested, and installed with the intention of containing and redirecting passenger vehicles weighing up to 4,400 pounds (not heavy commercial vehicles). Although the *Roadside Design Guide* mentions three subjective factors most often considered for the use of higher performance traffic barriers—the severe consequences associated with penetration of a barrier by a large vehicle, adverse geometrics (such as sharp curvature), and high percentage of heavy vehicles in a traffic stream—it does not contain objective warrants for the use of such barriers to redirect larger vehicles, such as motorcoaches and heavy commercial vehicles.

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[180] Where no feasible alternatives exist, such as on I-95, a sloped curb no higher than 4 inches should be considered. For further information, see *Roadside Design Guide*, 4th ed. (Washington, D.C.: American Association of State Highway and Transportation Officials, 2011), p. 5-43.

[181] A Thrie-beam guardrail is a steel beam rail element shaped like a "W," except for an additional undulation.

[182] Conducted by the Texas A&M Research Foundation, Texas Transportation Institute, Texas A&M University System for the FHWA. The W-beam rail element used in the Texas Transportation Institute tests was approximately 12 inches high. The Thrie-beam rail element used in the Texas Transportation Institute tests was approximately 20 inches high.

[183] Includes specific information on the percentage of heavy vehicles in the traffic stream, traffic volume, distance of fixed items from the traveled way, and the roadway's design speed.

In 2009, AASHTO published the *Manual for Assessing Safety Hardware* (MASH), which contained revised testing and evaluation criteria based on updated test vehicles, impact conditions, and changes in vehicle fleets since the 1993 report. While not a design standard, MASH is used to evaluate the structural adequacy of barrier systems. As with the previous research projects and reports, MASH utilizes full-scale crash testing but does not provide site-specific guidance on barrier performance.

NCHRP Report 638 was published in 2009 to provide better guidance for selecting guardrail performance levels. This report's study objectives included (1) developing objective guardrail selection guidelines for identifying the most cost-beneficial guardrail performance level to be used on any given route; (2) identifying circumstances when a more detailed analysis is warranted; and, (3) presenting procedures for conducting a more thorough evaluation of guardrail need.[184] When necessary, the NTSB followed the NCHRP report criteria to examine conditions at the accident site.

Applying NCHRP Report 638 criteria to the accident location indicates that installing a TL-3 barrier would provide the most cost-beneficial guardrail performance level for shielding the vertical highway signpost at benefit/cost ratios[185] equal to 1, 2, 3, and 4.[186] However, a TL-3 barrier would not have prevented the accident motorcoach from rolling over and striking the vertical highway signpost because it was not designed to redirect a motorcoach. Yet, the findings of NCHRP Report 638 indicate that higher test level barriers (TL-4 and TL-5) are shown to be much more cost beneficial when placed adjacent to long hazards (steep slopes that are typically 4,000 feet long) rather than severe point hazards (3-foot-diameter fixed objects).

After the accident, AASHTO published the 2011 *Roadside Design Guide*,[187] which added one additional subjective factor most often considered when recommending higher performance traffic barriers; but, as was the case with the previous edition, it does not contain objective warrants for the use of higher performance traffic barriers. The 2011 *Roadside Design Guide* recommended an analysis procedure called Roadside Safety Analysis Program (RSAP) to compare several alternative safety treatments and provide guidance to the designer in selecting an appropriate guardrail. The site conditions on I-95 in the vicinity of the accident were input to the RSAP, which revealed that a TL-3 barrier would be recommended to shield the vertical highway signpost, similar to the findings in NCHRP Report 638.

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[184] D. L. Sicking, K. A. Lechtenberg, and S. Peterson, *Guidelines for Guardrail Implementation*, National Cooperative Highway Research Program Report No. 638 (Lincoln, Nebraska: Midwest Roadside Safety Facility, University of Nebraska-Lincoln, 2009), pp. 1–28.

[185] A benefit/cost analysis provides an economic assessment of the extent to which a project or program may achieve its ultimate goal of reducing the number and/or severity of crashes. The analysis ultimately provides a means of selecting the most cost-effective countermeasure for any given project. The benefit/cost ratio is computed by dividing the annual benefit by the annual cost. The countermeasure with the highest ratio is normally the recommended alternative.

[186] The following site conditions were used as input variables for NCHRP Report 638: a severe point hazard offset 18 feet from the edge of the traveled way; road curvature 2° to the left on a grade varying from 0 to −2 percent; and freeway traffic volumes of 100,000 vehicles per day.

[187] The 2011 *Roadside Design Guide* was a regularly scheduled update, which generally occurs every 4–5 years.

Based on the NTSB's examination of available testing research, guidance given to states regarding upgrading of barrier systems, and site-specific information, it is apparent that the dynamics of the current fleet of commercial buses, including motorcoaches, are not properly captured in the AASHTO *Roadside Design Guide*. Further, the most recent barrier testing was completed in 1982. The accident motorcoach was initially redirected prior to rolling over (partially due to speed), which suggests that, with improvements, barriers could potentially safely redirect commercial passenger vehicles, such as a motorcoach, even in high-speed collisions. Motorcoaches transport over 750 million passengers annually throughout the United States, and unlike other heavy commercial vehicles, a single bus or motorcoach accident can expose large numbers of people to the risk of death or injury. When a commercial passenger vehicle such as a bus departs from the travel lanes and impacts a guardrail, guardrail performance standards can significantly affect the outcome of the vehicle-to-barrier system performance interaction. Therefore, the NTSB concludes that the forces in this accident exceeded the capability of a strong-post, blocked-out W-beam guardrail barrier system that was not designed to safely contain or redirect the accident motorcoach.

Also as a result of its examination, the NTSB concludes that the AASHTO *Roadside Design Guide* does not contain objective warrants for the use of higher performance traffic barriers (TL-4 and -5) to redirect larger commercial vehicles, such as buses and motorcoaches. The NTSB recommends that AASHTO and the FHWA work together to establish performance and selection guidelines for state transportation agencies to use in developing objective warrants for high-performance barriers applicable to new construction and rehabilitation projects where barrier replacement has been determined to be appropriate. The NTSB also recommends that AASHTO evaluate the adequacy of barrier systems currently approved through NCHRP Report 350 or the MASH for safely redirecting commercial passenger vehicles and, if warranted, develop new barrier designs incorporating appropriate height and deflection characteristics capable of safely redirecting commercial passenger vehicles. Further, the NTSB recommends that, once barrier testing has been completed and selection guidelines have been developed, AASHTO revise chapter 5 of the *Roadside Design Guide* to incorporate guidance for the selection of high-performance barriers used in new construction and rehabilitation projects; this guidance should specifically address the unique considerations of shielding commercial passenger vehicles from point hazards. In the interest of safety in the short term, the NTSB recommends that, until barrier testing has been completed, selection guidelines have been developed, and barrier guidance has been updated in the AASHTO *Roadside Design Guide*, the FHWA provide information to state transportation agencies about (1) the unique considerations associated with commercial passenger vehicle "run-off-the-road" accidents involving point hazards, and (2) the associated potential for catastrophic loss of life.

2.8 Vehicle Crashworthiness and Occupant Protection

2.8.1 Motorcoach Crashworthiness

The accident motorcoach experienced three main impacts during the collision sequence: (1) the bus left the roadway and struck the curb and guardrail; (2) the bus rolled nearly 90° onto its passenger side during interaction with the guardrail and subsequently hit the ground; and (3) the bus slid on its passenger side to final rest, striking the vertical highway signpost at the horizontal window line of the bus, resulting in the most substantial damage to the vehicle and intrusion into the passenger cabin. The bus's point of impact with the vertical highway signpost was at a location that is not designed, intended, or sufficiently rigid for frontal crash attenuation. As a result, the vertical highway signpost intruded into the passenger cabin for almost the entire length of the vehicle, separating the roof from the motorcoach. Roof strength and parcel rack retention strength were not issues in this accident because the vertical highway signpost caused crash impact loading outside of the motorcoach's design scope.

Occupants were not ejected from the motorcoach during the accident sequence when the bus made contact with and slid along the guardrail; however, the roof separation provided ample space for occupant ejection. Once the roof separated and the windows and frames were destroyed, occupants were partially ejected and found postaccident on the ground in the area of the broken windows, trapped under the roof section of the bus at its final rest position. The severe destruction of the motorcoach's interior, coupled with the roof being sheared from the vehicle and opening up a path for passenger ejection, compromised survival space and prevented some occupants from remaining within the vehicle to ride down the crash. Some fatally and seriously injured passengers were found by emergency responders entrapped around the vertical highway signpost in the wreckage. The location of partially ejected occupants suggested that they were dragged under due to contact with the vertical poles or fell into the open space created by the roof separation. Evidence indicated that no one was ejected via the windows before the vertical highway signpost intruded into the occupant compartment. Passengers who sustained minor to no reported injuries were seated in the rear, where the seating area was not compromised by intrusion of the vertical poles. Therefore, the NTSB concludes that the survival space was compromised for passengers in the path of the vertical highway signpost as the signpost traversed the motorcoach interior for almost the entire length of the vehicle.

2.8.2 Occupant Kinematics

NHTSA issued an NPRM on August 18, 2010, that proposes to amend FMVSS No. 208 (occupant crash protection) to require lap/shoulder seat belts for each passenger seating position in new motorcoaches.[188] NHTSA stated that it believes the seat belt assemblies installed on motorcoach passenger seats pursuant to this rulemaking could reduce the risk of fatal injuries in rollover crashes by 77 percent, primarily by preventing occupant ejection in a crash.

[188] See <http://www.nhtsa.gov/staticfiles/rulemaking/pdf/NPRM_Belts_on_motorcoaches.pdf>, accessed May 8, 2012.

Because restraint installation would redefine occupant kinematics in a motorcoach crash and could reduce ejection, secondary impacts, and intrusion factors, the NTSB undertook a simulation study to characterize occupant kinematics with and without passenger lap/shoulder belts.[189] The study focused on two full rows of passenger seats near the bus's CG and included variable occupant density, restraints, and armrest configurations. Offset rows were identified as a factor greatly affecting occupant kinematics and injury predictions for unrestrained passengers in rollover events. As discussed in section 1.5.2, offset rows refer to the seating rows on the driver side of the bus being offset slightly rearward from the same rows on the opposite side of the bus. (See figure 15.)

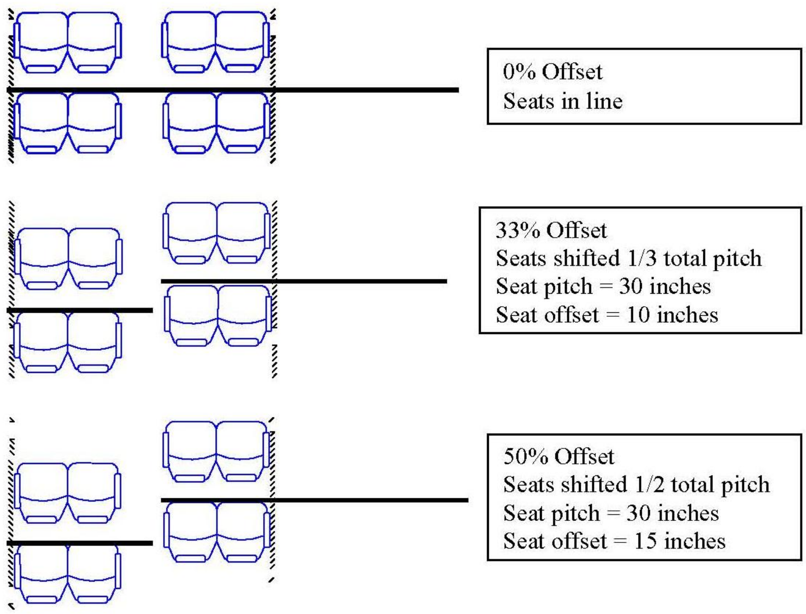

Figure 15. Simulation study seat row alignments and offset row configurations.

The simulation showed that unrestrained occupants were vulnerable to injury during the bus overturn due to impacts with other occupants and interior surfaces. Unrestrained occupants were in close contact with the window and sidewall structure adjacent to the ground toward the end of the simulated accident sequence and were also vulnerable to ejection where window integrity was lost. Simple variations in seating configuration, such as the amount of row offset and armrest position, greatly affected kinematics and injury predictions. After the accident bus overturned, unrestrained occupants were piled on top of one another next to the windows between the seats and the luggage racks. This positioning made them vulnerable to injury, given the intrusion that followed from the secondary impact with the vertical highway signpost.

[189] The vehicle dynamics study, discussed in section 2.4, provided the input parameters for the occupant simulations. It should be noted again that the vehicle dynamics study provides a representation of the bus motion rather than a validated simulation of the event. Further, the occupant simulation study characterizes general occupant kinematics and is not intended to represent the actual motion of specific individuals in the crash.

In the simulation, lap/shoulder-belted occupants were contained within their seating compartments. Occupants seated on the far side of the roll (opposite the side near the ground) were able to partially escape the shoulder harness during the roll sequence, which then placed them in a position closer to the floor of the bus than to the luggage racks, reducing their vulnerability during intrusion of the vertical highway signpost at the window level later in the impact sequence. Near side occupants remained in a more upright position during the simulation, making them potentially more vulnerable to impact and intrusion of the signpost's poles. For all lap/shoulder-belted occupants, the simulation resulted in low predicted injury levels for the motorcoach rollover without intrusion. A comparison of unrestrained occupant kinematics and lap/shoulder-belted occupant kinematics is shown in figure 16.

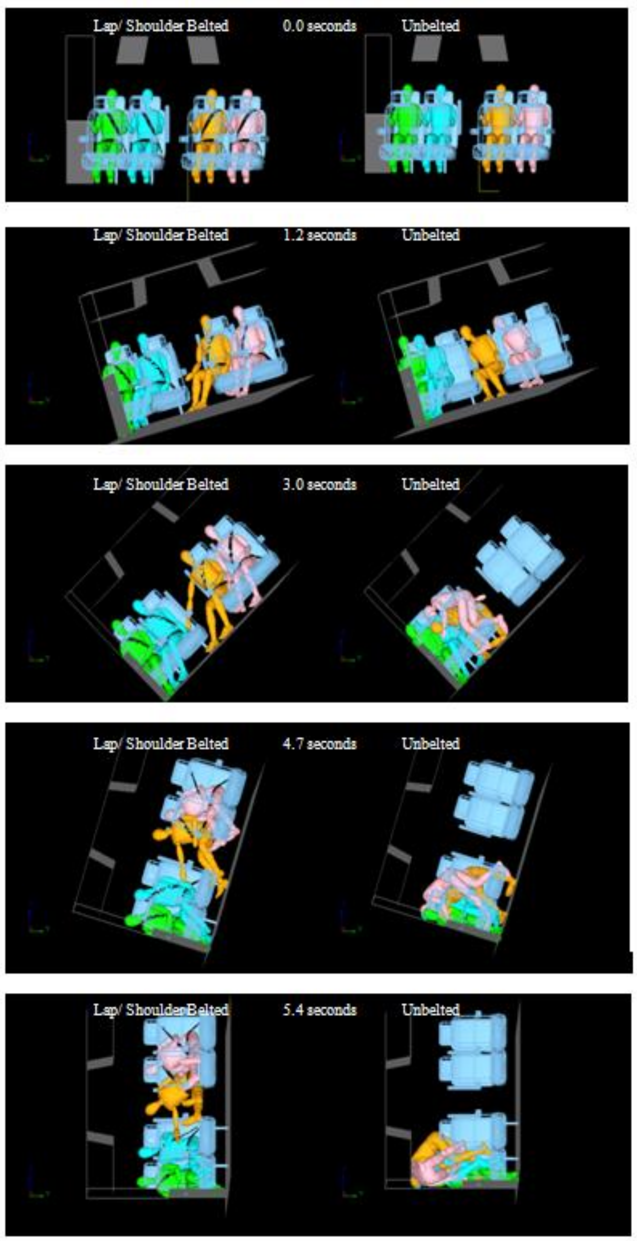

Figure 16. Time history of unrestrained and lap/shoulder-belted occupant kinematics.

The study found that the benefits of motorcoach passenger lap/shoulder belts included mitigating ejection, mitigating interior compartment impacts, reducing occupant-to-occupant impacts, and maintaining occupants in the seating area. The passenger seating area is a strong portion of the bus, providing enhanced protection during secondary events such as impacts or rollovers. This study indicates that well-fitted and worn restraints provide significant benefit.

The findings from the NTSB's simulation study are consistent with findings in other studies. For example, light vehicle research supports these observations by showing that the vast majority of fatalities in rollovers are from single-vehicle cases with multiple events (a rollover plus a secondary impact event). Only 12 percent of first event fatal rollovers in passenger cars and light trucks did not involve a collision.[190] Rollover distributions from the National Automotive Sampling System Crashworthiness Data System show that 65.6 percent of fatal rollover cases and 73.6 percent of fatalities are from single-vehicle rollovers with multiple events.[191]

The occupant simulation study did not model the vertical highway signpost's penetration due to the extensive intrusion. The postaccident seatback angle was used as an indicator of intrusion into the passenger compartment.[192] Inspection of the accident bus indicated that the intrusion, progressing from front to rear, moved upward (from the base of windows toward the motorcoach roof) and was angled with the vertical poles lower along the window line on the passenger side. This intrusion zone was corroborated by the seatback angle measurements. The vertical poles appeared to directly contact the seats in rows 1–10 on the passenger side and rows 1–4 on the driver side. The middle region of the bus saw intrusion above the seat, and the rear of the bus had no intrusion.

Assessment of the intrusion effect on passenger survivability was combined with the previously described occupant simulation study results to better understand the potential benefits of passenger lap/shoulder restraint systems. Figure 17 shows the injury risk trend for both unrestrained and restrained occupants along the length of the bus, based on the amount of intrusion in that area of the bus and occupant kinematics from the simulation study. Green represents low potential for injury, progressing to yellow, orange, and finally red, which represents high potential for serious injury or death. These injury zones represent the general regions of benefit but are not intended to match specific injuries or fatalities in the accident.

[190] "Vehicle Multiple Event Rollover Crashes: NASS and CIREN Analysis, NHTSA CIREN Public Meeting September 2011." For further information, see <www.nhtsa.gov/DOT/NHTSA/NVS/CIREN/Presentations/2011/UVA-CIREN-Sep2011.pdf>, accessed April 28,2012.

[191] The study consisted of about 4.3 million rollovers with about 80,500 fatalities. The remaining events are Single Vehicle/Single events (16.4 percent) with 12.4 percent fatalities and Multiple Vehicle/Multiple events (18 percent) with 14 percent fatalities. For further information, see "Vehicle Multiple Event Rollover Crashes: NASS and CIREN Analysis, NHTSA CIREN Public Meeting September 2011." For further information, see <www.nhtsa.gov/DOT/NHTSA/NVS/CIREN/Presentations/2011/UVA-CIREN-Sep2011.pdf>, accessed April 28, 2012.

[192] A potential confounding factor was the postcrash recovery of the bus, in which the collapsed roof and parcel racks remained on the bus with some areas contacting the seats on the passenger side (but not seats on the driver side). This factor was accounted for by considering the other physical evidence, including scene photos, the location of impact marks on the window frames, and damage to individual seats.

The characteristic motion of the unrestrained occupants compared to the intrusion zone evaluation indicates that the vertical highway signpost's intrusion appears to have caused most of the injuries and all of the fatalities in this accident. The motorcoach's occupant compartment was not compromised before the vertical highway signpost's impact, and the regions of intrusion are clearly identified.

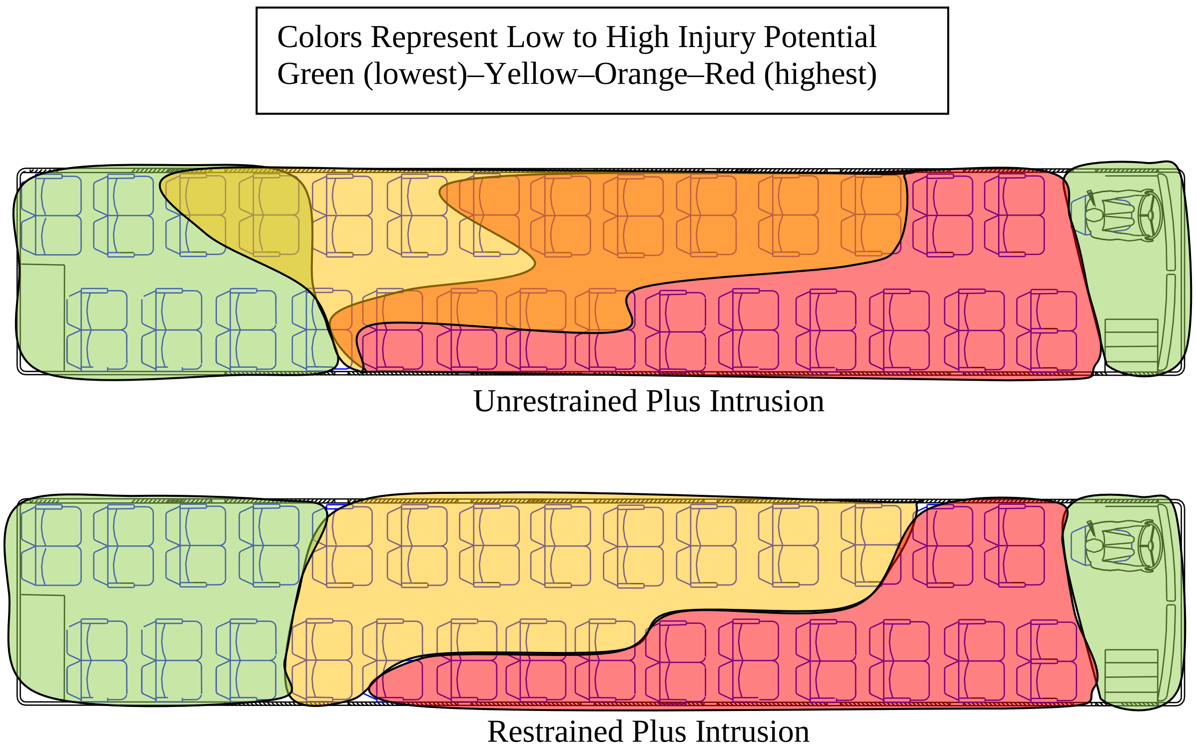

Figure 17. Risk zone approximation using intrusion and occupant study data.

Although the accident dynamics before the vertical highway signpost's intrusion were severe enough to have caused serious injuries for some unrestrained occupants, the fatal injuries did not likely occur prior to the vertical poles' impact. However, passenger lap/shoulder belts on newer motorcoaches may mitigate fatalities and serious injuries for some occupants by reducing injuries during rollover events and reducing exposure to intrusion for some occupants in accidents such as this one. The NTSB concludes that equipping new motorcoaches with passenger lap/shoulder belts, even in the case of accidents such as this one, would likely mitigate serious and fatal injuries for some passengers during a rollover and subsequent impact events.

For more than 30 years, the NTSB has addressed the issue of motorcoach crashworthiness and occupant protection.[193] The NTSB has long held that the capability of

[193] (a) *Interstate Bus–Automobile Collision, Interstate Route 15, Baker, California, March 7, 1968*, Highway Accident Report NTSB/SS-H-3 (Washington, D.C.: National Transportation Safety Board, 1968). (b) *Greyhound Bus Collision With Concrete Overpass Support Column on Interstate 80, San Juan Pass, Sacramento, California, November 3, 1973*, Highway Accident Report NTSB/HAR-74/05 (Washington, D.C.: National Transportation Safety Board, 1974). (c) National Transportation Safety Board, Docket No. SRH-96-FH-015.

passengers to remain within the vehicle, especially within their seating compartments, and to be afforded survival space is essential. In its 1999 bus crashworthiness report, the NTSB concluded that a primary cause of preventable injury in motorcoach accidents involving a rollover, ejection, or both, is occupant motion out of the seat during a collision when no intrusion occurs into the seating area.[194] The NTSB further concluded that the overall injury risk to occupants in motorcoach accidents involving rollover and ejection may be significantly reduced by retaining the occupant in the seating compartment throughout the collision. Numerous recommendations designed to mitigate occupant injury during a crash followed from the 1999 bus crashworthiness report, including two that have been reiterated to NHTSA as a result of several NTSB motorcoach accident investigations over the last decade, including the 2008 motorcoach rollover accidents near Sherman, Texas, and Mexican Hat, Utah:[195]

> In 2 years, develop performance standards for motorcoach occupant protection systems that account for frontal impact collisions, side impact collisions, rear impact collisions, and rollovers. (H-99-47)
>
> Once pertinent standards have been developed for motorcoach occupant protection systems, require newly manufactured motorcoaches to have an occupant crash protection system that meets the newly developed performance standards and retains passengers, including those in child safety restraint systems, within the seating compartment throughout the accident sequence for all accident scenarios. (H-99-48)

Previous NTSB motorcoach investigations have concluded that passengers would be safer with an occupant protection system, and NHTSA crash testing shows that injury risk is much lower for lap/shoulder-belted dummies than for unrestrained dummies.

In November 2009, the DOT published its motorcoach safety action plan, an integrated strategy to reduce crashes involving motorcoaches.[196] According to the action plan, an average of 19 motorcoach occupants die annually. Although motorcoach accidents are rare events, even one accident can result in a significant number of fatalities or serious injuries. The DOT determined that driver fatigue, vehicle rollover, occupant ejection, and operator maintenance issues contributed to the majority of motorcoach accidents. Consequently, seven priority action items were identified as having the greatest impact on reducing motorcoach accidents, fatalities, and injuries. These action items include three related to evaluating and developing roof crush performance requirements to enhance structural integrity; initiating rulemaking to require the

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[194] *Bus Crashworthiness Issues*, Highway Special Investigation Report NTSB/SIR-99/04 (Washington, D.C.: National Transportation Safety Board, 1999).

[195] (a) *Motorcoach Run-off-the-Bridge and Rollover Near Sherman, Texas, August 8, 2008,* Highway Accident Report NTSB/HAR-09/02 (Washington, D.C.: National Transportation Safety Board, 2009). (b) *Motorcoach Rollover Near Mexican Hat, Utah, January 6, 2008,* Highway Accident Report NTSB/HAR-09/01 (Washington, D.C.: National Transportation Safety Board, 2009). (c) NTSB/HAR-08/01. (d) *Motorcoach Run-off-the-Road and Rollover off Interstate 90, Victor, New York, June 23, 2002*, Highway Accident Report NTSB/HAR-04/03 (Washington, D.C.: National Transportation Safety Board, 2004).

[196] *Motorcoach Safety Action Plan*, DOT HS 811 177 (Washington, D.C.: U.S. Department of Transportation, November 2009).

installation of seat belts on motorcoaches to improve occupant protection; and, developing performance requirements and assessing the safety benefits for stability control systems to reduce rollover events.

Despite the lack of Federal requirements, manufacturers have already introduced passenger lap/shoulder belts into the U.S. market, and some manufacturers equip their motorcoaches with these restraints as a standard feature.[197] The NTSB recognizes that this accident motorcoach, a 1999 Prevost, was manufactured before the NTSB initially issued its occupant protection recommendations to NHTSA. However, until the DOT publishes the final rule on motorcoach occupant protection systems, and because these safety recommendations remain classified “Open—Unacceptable Response” and are currently on the NTSB’s Most Wanted List, the NTSB reiterates Safety Recommendations H-99-47 and -48 to NHTSA.

NHTSA stated in its August 2010 NPRM that the goal of its 2010 rulemaking to require lap/shoulder seat belts for each passenger seating position in new motorcoaches is to reduce occupant ejections. The NTSB believes it is also worthy to consider measures to prevent occupant movement from their seats and exposure to injury within the vehicle, including impacts or intrusion that may occur with a secondary impact during the accident sequence. Therefore, the NTSB recommends that NHTSA evaluate the effects of seat spacing and armrests as factors for potential occupant injury, and if safer spacing or armrest configurations are identified, develop and implement appropriate guidelines.

[197] For example, in January 2009, American Seating and SafeGuard introduced lap/shoulder belt-equipped seats on Prevost motorcoaches.

3. Conclusions

3.1 Findings

1. The emergency response was timely and adequate.

2. None of the following were factors in the accident: (1) weather; (2) design and construction of the roadway surface; (3) any other vehicle; (4) alcohol or prescription, over-the-counter, or illicit drug use by the motorcoach driver; and (5) vehicle mechanical defects or deficiencies.

3. The driver was impaired by fatigue at the time of the accident due to sleep deprivation, poor sleep quality, and circadian factors; and his lack of evasive braking or corrective steering action as the bus drifted off the roadway was consistent with fatigue-induced performance impairment.

4. Had the motorcoach been equipped with in-vehicle technologies such as a lane departure warning system or drowsy driver warning system, the driver would have been alerted and had the opportunity to stop driving before the accident occurred.

5. Had World Wide Travel employed and proactively used an onboard monitoring system to track the accident driver's performance, company management would have had the opportunity to detect his unsafe behavior and use such information to remediate the behavior or remove him from his position.

6. The use of in-vehicle technologies to prevent commercial drivers from exceeding the speed limit would be beneficial in reducing both the instances and severity of accidents involving heavy vehicles.

7. By providing a 10-year driving history on prospective employees, the states could better assist motor carriers in identifying problem commercial drivers and reduce the number of commercial motor vehicle accidents and fatalities.

8. The current provisions of 49 *Code of Federal Regulations* 391.23 requiring a motor carrier to inquire into an applicant's driving history for the most recent 3 years are insufficient to make an informed hiring decision and result in the motor carrier not having access to sufficient safety-related information prior to hiring drivers.

9. The Federal Motor Carrier Safety Administration's new safety fitness determination process could address deficiencies in the current compliance review process by basing a motor carrier's safety rating on violations of important safety-based regulations (as found in roadside inspections), helping to prevent unsafe carriers from continuing to operate.

10. As evidenced by Great Escapes' safety measurement system scores and the Federal Motor Carrier Safety Administration's refusal to upgrade its safety rating, it is apparent that the carrier's management does not have a safety system to resolve the proximal causes and

associated risks with driver behaviors, leading to repeated driver safety violations proven to increase the risk of accidents.

11. The safety benefits of consistently and effectively addressing high-risk (either reincarnated or affiliated) interstate motor carriers resulting from the Federal Motor Carrier Safety Administration's new rule addressing operational affiliation and reincarnation of carriers should assist in curtailing their continued unsafe operations.

12. The fact that the overturned motorcoach struck the vertical highway signpost located within the clear zone, despite a barrier system being in place, directly contributed to the severity of this accident.

13. The forces in this accident exceeded the capability of a strong-post, blocked-out W-beam guardrail barrier system that was not designed to safely contain or redirect the accident motorcoach.

14. The American Association of State Highway and Transportation Officials *Roadside Design Guide* does not contain objective warrants for the use of higher performance traffic barriers (Test Levels 4 and 5) to redirect larger commercial vehicles, such as buses and motorcoaches.

15. Survival space was compromised for passengers in the path of the vertical highway signpost as the signpost traversed the motorcoach interior for almost the entire length of the vehicle.

16. Equipping new motorcoaches with passenger lap/shoulder belts, even in the case of accidents such as this one, would likely mitigate serious and fatal injuries for some passengers during a rollover event and subsequent impact events.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the motorcoach driver's failure to control the motorcoach due to fatigue resulting from failure to obtain adequate sleep, poor sleep quality, and the time of day at which the accident occurred. Contributing to the accident was inadequate safety oversight of the accident driver by World Wide Travel's management. Contributing to the severity of the accident was the motorcoach's speed and a guardrail that was not designed to redirect the heavy vehicle and did not prevent it from colliding with the vertical highway signpost. Contributing to the severity of passenger injuries was the extensive intrusion of the vertical highway signpost into the passenger compartment.

4. Recommendations

As a result of its investigation, the National Transportation Safety Board makes the following safety recommendations:

4.1 New Recommendations

To the Federal Motor Carrier Safety Administration:

Develop and disseminate guidance for motor carriers on how to most effectively use currently available onboard monitoring systems and develop a plan to periodically update the guidance. (H-12-13)

Upon completion of the field operational tests for onboard monitoring systems, determine whether test results indicate that such systems would reduce accidents or injuries, and, if so, require commercial motor carriers to use these systems to improve driver safety. (H-12-14)

Revise 49 *Code of Federal Regulations* 391.23 to require that motor carriers obtain a 10-year driving history for all prospective commercial vehicle drivers. (H-12-15)

Revise 49 *Code of Federal Regulations* 384.225 to require that states retain on the Commercial Driver's License Information System driver record all convictions, disqualifications, and other licensing actions for violations during the prior 10 years. (H-12-16)

Include safety measurement system rating scores in the methodology used to determine a carrier's fitness to operate in the safety fitness rating rulemaking for the new Compliance, Safety, Accountability initiative. (H-12-17)

Include in the safety fitness rating rulemaking for the new Compliance, Safety, Accountability initiative a structured process, such as the Safety Management Cycle, to be used by Federal Motor Carrier Safety Administration investigators and their state Motor Carrier Safety Assistance Program agents, as an audit tool for investigators to (1) identify the root cause of safety risks found during compliance reviews, and (2) deliver constructive guidance to motor carriers to ensure the promotion of safety management. (H-12-18)

Include information regarding the Safety Management Cycle in your *Safety is Good Business* motor carrier website. (H-12-19)

To the National Highway Traffic Safety Administration:

Develop performance standards for advanced speed-limiting technology, such as variable speed limiters and intelligent speed adaptation devices, for heavy vehicles, including trucks, buses, and motorcoaches. (H-12-20)

After establishing performance standards for advanced speed-limiting technology for heavy commercial vehicles, require that all newly manufactured heavy vehicles be equipped with such devices. (H-12-21)

Evaluate the effects of seat spacing and armrests as factors for potential occupant injury, and if safer spacing or armrest configurations are identified, develop and implement appropriate guidelines. (H-12-22)

To the Federal Highway Administration:

Work with the American Association of State Highway and Transportation Officials to establish performance and selection guidelines for state transportation agencies to use in developing objective warrants for high-performance barriers applicable to new construction and rehabilitation projects where barrier replacement has been determined to be appropriate. (H-12-23)

Until barrier testing has been completed, selection guidelines have been developed, and barrier guidance has been updated in the American Association of State Highway and Transportation Officials *Roadside Design Guide*, provide information to state transportation agencies about (1) the unique considerations associated with commercial passenger vehicle "run-off-the-road" accidents involving point hazards, and (2) the associated potential for catastrophic loss of life. (H-12-24)

To the American Association of State Highway and Transportation Officials:

Work with the Federal Highway Administration to establish performance and selection guidelines for state transportation agencies to use in developing objective warrants for high-performance barriers applicable to new construction and rehabilitation projects where barrier replacement has been determined to be appropriate. (H-12-25)

Evaluate the adequacy of barrier systems currently approved through National Cooperative Highway Research Program Report 350 or the *Manual for Assessing Safety Hardware* for safely redirecting commercial passenger vehicles and, if warranted, develop new barrier designs incorporating appropriate height and deflection characteristics capable of safely redirecting commercial passenger vehicles. (H-12-26)

Once barrier testing has been completed and selection guidelines have been developed, revise chapter 5 of the *Roadside Design Guide* to incorporate guidance for the selection of high-performance barriers used in new construction and rehabilitation projects; this guidance should specifically address the unique considerations of shielding commercial passenger vehicles from point hazards. (H-12-27)

To the American Bus Association, the National Motorcoach Network, and the United Motorcoach Association:

> Alert your members to (1) the circumstances of this accident, (2) the existence of the Federal Motor Carrier Safety Administration's Safety Management Cycle, and (3) how the safety management process can positively influence carrier safety. (H-12-28)

4.2 Previously Issued Recommendations Reiterated in this Report

The National Transportation Safety Board also reiterates the following safety recommendation:

To the Federal Motor Carrier Safety Administration:

> Implement a program to identify commercial drivers at high risk for obstructive sleep apnea and require that those drivers provide evidence through the medical certification process of having been appropriately evaluated and, if treatment is needed, effectively treated for that disorder before being granted unrestricted medical certification. (H-09-15)

> Develop and disseminate guidance for commercial drivers, employers, and physicians regarding the identification and treatment of individuals at high risk of obstructive sleep apnea (OSA), emphasizing that drivers who have OSA that is effectively treated are routinely approved for continued medical certification. (H-09-16)

> Require all motor carriers to adopt a fatigue management program based on the North American Fatigue Management Program guidelines for the management of fatigue in a motor carrier operating environment. (H-10-9)

> Develop and implement a plan to deploy technologies in commercial vehicles to reduce the occurrence of fatigue-related accidents. (H-08-13)

To the National Highway Traffic Safety Administration:

> In 2 years, develop performance standards for motorcoach occupant protection systems that account for frontal impact collisions, side impact collisions, rear impact collisions, and rollovers. (H-99-47)

> Once pertinent standards have been developed for motorcoach occupant protection systems, require newly manufactured motorcoaches to have an occupant crash protection system that meets the newly developed performance standards and retains passengers, including those in child safety restraint systems, within the seating compartment throughout the accident sequence for all accident scenarios. (H-99-48)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

DEBORAH A.P. HERSMAN
Chairman

ROBERT L. SUMWALT
Member

CHRISTOPHER A. HART
Vice Chairman

MARK R. ROSEKIND
Member

EARL F. WEENER
Member

Adopted: June 5, 2012

Member Weener filed the following concurring and dissenting statement on June 8, 2012.

Board Member Statement

Notation 8308A
Member Earl F. Weener, Concurring and Dissenting

I support the probable cause identified in the New York City, New York, Highway Accident Report (Report), as well as most of the findings and recommendations. However, I am troubled by passages in the Report concerning safety management systems (SMSs), and the Board's adopted recommendation to the Federal Motor Carrier Safety Administration (FMCSA) recommending the agency include in its safety fitness rating (SFD) rulemaking the adoption of an inspection policy.

As is well established, I am a strong supporter of SMS. Adoption of SMS within the aviation and marine industries has clearly yielded significant safety benefits; and the rail and pipeline industries are actively pursuing an understanding of how SMS principles can be adapted to their industry. Simultaneously, I believe the motor carrier industry can also benefit from understanding and adapting SMS principles and concepts.

However, I do not believe FMCSA's "Safety Management Cycle," as described in the Report or discussed at the Board meeting, equates to or provides a basis for establishing SMS within the motor carrier industry. Further, I continue to find that we, as an agency, often have an insufficient understanding of SMS principles, let alone how such principles can be applied within the motor carrier industry. It is worth noting the development and implementation of SMS originated within industry and has been promoted by industry, historically. "Regulators" have only later, and at times reluctantly, accepted SMS principles – primarily due to a lack of understanding. Yet, government actions, typically, only establish safety thresholds. To go beyond these thresholds and achieve greater safety gains industry initiatives requiring a commitment from the entire organization, such as SMS, are necessary. In short, FMCSA's Safety Management Cycle, albeit a valuable tool, is not a safety management system nor is it an initial step toward introducing SMS principles to the motor carrier industry.

Additionally, as explained in the Report and discussed at the Board meeting, the Safety Management Cycle is an investigative process the *agency* uses to assist carriers to comply with the regulations. It is not a requirement to be imposed upon motor carriers. Alternatively, rulemakings are generally actions to establish requirements for regulated entities, not to establish agency policy. The Safety Management Cycle has valid application; however, it does not require a rulemaking to establish. As a policy, FMCSA can establish (and as the Report notes, has established) the use of the Safety Management Cycle for their inspectors. By contrast, the SFD rulemaking is for the purpose of revising the methodology used to determine fitness by incorporating a broader array of data sources, such as roadside inspections and violation history – it does not involve how an inspection is conducted, why the carrier is non-compliant or how to assist the carrier to be compliant. This rulemaking process should not be used to establish an agency policy concerning investigation practices.

I do not support the recommendation to include establishment of an agency policy as part of a rulemaking, particularly a rulemaking unrelated to the policy. Further, I believe the Board needs to become better educated on SMS, and how SMS principles and concepts can be applied within the motor carrier industry.

Appendix A: Investigation and Public Hearing

Investigation

The National Transportation Safety Board was notified of this accident on March 12, 2011. An investigative team was dispatched with members from the Washington, D.C.; Denver, Colorado; Gardena, California; and Arlington, Texas, offices. Groups were established to investigate human performance; motor carrier operations; onboard recorders; and highway, vehicle, and survival factors. The NTSB team also included staff from the Office of Communication Public Affairs and Transportation Disaster Assistance Divisions. Vice Chairman Christopher Hart was present on scene.

Parties to the investigation were representatives of the Federal Highway Administration, Federal Motor Carrier Safety Administration, the New York State Department of Transportation, the New York State Thruway Authority, the New York State Police, Prevost, and World Wide Travel of Greater New York.

Public Hearing

No depositions were taken, and no public hearing was held.

Appendix B: Driving Record and Licensing

Accident Motorcoach Driver's Full Driving Record

Between 1987–1991, *before* the accident driver had obtained a driver's license, he was driving and committing traffic offenses. The New York Police Department had issued the driver numerous traffic tickets, which he failed to pay, resulting in 10 suspensions against his "privilege to drive." The New York Department of Motor Vehicles (NYDMV) considers a suspension against an individual's *privilege to drive* as applicable as a suspension against a driver's license; thus, an unlicensed driver would be required to clear each suspension of his privilege to drive before qualifying to apply for a driver's license.

When a New York State-licensed driver is issued a traffic ticket, that event is entered in the driver's NYDMV record by matching the name and client identification number (CID) that appears on the driver's license with information in the NYDMV database. Every driver is issued a unique CID that allows the NYDMV to distinguish between drivers with the same name. Later actions to a traffic ticket, such as a license suspension, also become part of the driver's NYDMV record. In instances when the information on a traffic ticket does not match a name or CID on file, such as when data are entered incorrectly by the NYDMV or law enforcement personnel or when drivers supply false information, the NYDMV creates a "header" record for the ticket. Because the accident driver had no driver's license for identification before 1995, he gave his middle name and last name as an identity when stopped by law enforcement officers for driving offenses; the middle/last name identity was then used on the traffic tickets. Therefore, because the name on the accident driver's tickets could not be matched to a licensed driver in NYDMV records, the NYDMV created a header record under the accident driver's middle and last name, where each ticket he received was assigned. If the NYDMV subsequently matches a header record with an existing name and CID, the multiple records are merged to create a full record of the driver's history.

When the accident driver failed to pay any of the tickets he received from 1987–1990, the NYDMV issued 10 suspensions to the header record. Knowingly driving with open suspensions constitutes *Aggravated Unlicensed Operation of a Motor Vehicle* (New York Vehicle and Traffic Law, Section 511); having three open suspensions for failure to answer a summons issued on three or more dates enhances the violation. Under NYDMV standard procedures, notices of the 10 suspensions would have been mailed to the address indicated on the tickets, which was the accident driver's home address during that period. For details of the driver's violation and licensing history prior to the accident, see table B-1.

Table B-1. Accident driver violation and licensing history.

Period	Event
March 1992	Under middle/last name identity, the accident driver pled guilty to manslaughter and was sentenced to state prison.
May 1994	The accident driver was released on parole, with parole records linked to the middle/last name identity.
December 1994	For first time, law enforcement records noted the accident driver's alias (middle/last name identity) and full, legal name (first name, last name, and suffix, omitting his middle name).
August 1994	Two of 10 privilege suspensions on the driver's header record were still being processed in the New York City Traffic Violations Bureau. The other eight open and unresolved suspensions were postponed to a court date in December 1994; when the accident driver failed to appear, the suspensions were reissued in early 1995.
January 1995	The State Division of Criminal Justice Services notified the State Division of Parole that both of the "identities" used by the accident driver were the same person.
February 1995	The accident driver obtained his first driver's license under his full legal name (first, last name) without his past header record using the middle/last name identity (with the eight suspensions) being merged with his new, full legal name driver license record.[a] To legally obtain his driver's license, the accident driver would have been required to clear any open suspensions on his driving record.
June 1996	The accident driver applied for and obtained a commercial driver's license (CDL) under his full, legal name. Again, he would have been required to clear any open suspensions on his driving record to obtain his license; however, these suspensions remained under the header record and therefore the NYDMV was unaware of them when it issued the CDL.[b]
December 1995–February 1997	The accident driver received six traffic-related tickets under his full name in the 20 months after he obtained his driving license, and his license was suspended six times between December 1995–February 1997 for failing to pay the tickets.
February 1997	Five of the accident driver's suspensions were cleared; he pled guilty to Operating Without Insurance, and his license was revoked. Separately, his license was suspended for failure to pay child support; that suspension was never resolved.
December 1998	While in prison for unrelated convictions, the accident driver's revoked license also expired.[c]
June 2003	After his release from prison, the accident driver was arrested on charges of Aggravated Unlicensed Operation of a Vehicle; he pled guilty to Operating a Vehicle Without a License in July 2003.
November 2003	The accident driver's February 1997 license revocation for Operating Without Insurance was cleared (along with the December 1996 license suspension for failing to pay child support). The accident driver applied to have his license reinstated in November 2003, which was granted.
March–November 2006[d]	The accident driver obtained his CDL-B license to drive a commercial vehicle with a "P" passenger endorsement. He did not disclose the eight open suspensions on his application when asked about past suspensions and revocations.[e] According to the New York State Inspector General, the three necessary applications that the accident driver submitted to obtain his CDL-B license with "P" endorsement contained false, incomplete, or inconsistent information regarding prior suspensions and use of an alias. On his March 9, 2006, application, the accident driver answered "no" to the question, "Have you ever had a driver license, learner permit, or privilege to operate a motor vehicle suspended, revoked or cancelled?" On his July 31, 2006, and November 8, 2006, applications, the driver answered "yes" to the above question and "yes" to the followup question, "Has your license, permit, or privilege to drive been restored?" The accident driver answered "no" on all three applications" to the question, "Has your name changed?"

Period	Event
April 2007	The accident driver's license was suspended twice for failure to pay child support. He cleared one suspension on May 8, 2007, but the other one remained in effect.
May 2007	The accident driver applied for a restricted license that granted him limited driving privileges (commute to and from work and school, travel to medical appointments, and other strictly defined uses). His CDL was also changed from CDL-B to CDL-D, meaning that he was disqualified from being a bus driver and could not transport passengers. He continued employment with Coach USA from his initial employment in July 2006–December 2007, driving without the required CDL-B passenger license.
September 2009	The accident driver applied for a license renewal, falsely answering "no" to the question whether his license had ever been suspended or revoked.
February 2010	When applying to upgrade his license, the accident driver left blank the question regarding prior license suspensions or revocations. Although the NYDMV prohibited the processing of incomplete applications, the accident driver's application was processed and upgraded license issued. New York law at the time of the accident did not consider previous repeated suspensions or multiple open suspensions as a basis for disqualification as a bus driver. However, to become a bus driver or obtain a license, the accident driver would have been required to clear the open suspensions.

[a] The New York State Inspector General's report stated concerning the two separate records that the accident driver presumably did not disclose the open suspensions or prior use of another name on his license application.The NYDMV could not produce a copy of the 1995 license application, preventing the New York State Inspector General from examining it during its investigation.

[b] Under 49 *Code of Federal Regulations* 383.73(g), "Penalties for False Information," if a driver supplies false information on any part of the CDL application process, either at the time of application or discovered after issuance of the CDL, the issuing state must (at a minimum) suspend that license for 6 months, pending a review. A final determination of CDL status would depend on evaluation of the correct information and whether the applicant then qualifies for retention of the CDL. Open suspension and revocation orders remain on the record as long as they remain open.

[c] Had the accident driver been convicted of *Aggravated Unlicensed Operation of Motor Vehicle (1st)*, he would have been disqualified from operating a commercial vehicle with passengers in New York for 5 years from the conviction date and could only have requalified with an acceptable Certificate of Relief from Civil Disabilities or Certificate of Good Conduct and an appropriate restricted, conditional, or full license endorsed for bus operation. (See "Other Disqualifying Convictions for Both School Bus and Non-School Drivers," Vehicle and Traffic Law, Section 511(3), Article 19-A.)

[d] During this period, the NYDMV reviewed its records and cleared open suspensions relating to tickets issued by police officers who were no longer in service. As a result, five of the eight header record suspensions were cleared without the accident driver having to take any action. Three suspensions remained open on this header record.

[e] The regulations in force at the time of the accident called for an individual found to have made a false statement to have his or her license or privilege to obtain a license suspended or revoked.

Despite 10 open suspensions in the header record, the NYDMV issued the accident driver a driver's license in 1995 and a CDL-B in 1996, reinstated his license in 2003, and issued another CDL-B and a passenger endorsement in 2006. At the time of the accident, the NYDMV, prior to issuing a license, would have conducted an electronic search of header records to match them with the license applicant. This search would have focused on first name, last name, and date of birth, but not on name variants or other names, as was the case with the accident driver's two identities, using his middle name as his first name and his full, legal name (first name and last name). Had the header record containing the driver's middle and last name and the full record containing the driver's legal name been combined, according to the NYDMV, the open suspensions would have caused the driver's applications to be denied, at least until he had paid the fines to clear the suspensions. However, once the driver had paid the fines, he could have obtained his bus driver license without additional consequence. Neither his criminal record nor driving history would have disqualified him from obtaining a license or driving a commercial bus in New York at the time he was issued his licenses or at the time of the accident.

Postaccident Actions

After the accident, on March 15, 2011, the NYDMV merged the header record with the full, legal name record for the accident driver, and, due to the open suspensions under the header record, suspended the accident driver's license. On March 17, 2011, the NYDMV issued an additional suspension due to the alleged false statements the driver made on his license or learner permit applications on November 14, 2003, and July 31 and November 8, 2006. On each application, the accident driver reportedly claimed that his prior license suspensions had been cleared, when in fact, the suspensions he was issued under his header record remained open and unresolved. Following an April 14, 2011, hearing, an administrative law judge affirmed the charges against the accident driver and revoked his license on April 23, 2011.

Appendix C: Postaccident Compliance Reviews of World Wide Travel and Great Escapes

Table C-1. Violations identified in postaccident FMCSA compliance review of World Wide Travel of Greater New York.

Critical Violations:[a]

- Failing to require driver to make a record-of-duty status (395.8[a])
- Failing to require driver to forward within 13 days of completion, the original of the record-of-duty status (395.8[i])

Acute Violations:[b] None listed.

Additional Violations:

- Failing to request information from previous U.S. Department of Transportation (DOT)-regulated employers of driver applicant for the 2 years prior to the date of application or transfer (40.25[b] and 382.105)
- Failing to ask employee if any preemployment test conducted in the preceding 2 years resulted in a positive test result or refusal to test (40.25[j] and 382.105)
- Failing to ensure that each driver selected for random alcohol and controlled substances testing has an equal chance of being selected each time selections are made (382.305[i][2])
- Failing to perform the required referral, evaluation, and treatment in accordance with 49 CFR Part 40, Subpart O (382.605 and 40.287)
- Using a driver who has not completed and furnished an employment application (391.21[a] and 391.21[b][5,10lv, 12])
- Failing to investigate a driver's background (391.23[a] and 391.23[a][2], [c][1])
- Requiring or permitting a passenger-carrying commercial motor vehicle (CMV) driver to drive for more than 10 hours (395.5[a][1])
- Requiring or permitting a passenger-carrying CMV driver to drive after having been on duty 15 hours (395.5[a][2])
- False reports of records-of-duty status (395.8[e])
- Failing to require driver to prepare record-of-duty status in form and manner prescribed (395.8[f] and 395.8[d][4,7])
- Failing to record the name of the city, town, or village, with state abbreviation where each change of duty status occurs (395.8[h][5])
- Failing to keep a maintenance record that identifies the vehicle, including make, serial number, year, and tire size (396.3[b][1])
- Failing to ensure driver vehicle inspection report is complete and accurate (396.11[b])

[a]During a safety audit, the Federal Motor Carrier Safety Administration (FMCSA) gathers information by reviewing a motor carrier's compliance with "critical" and "acute" regulations. Critical regulations are those in which noncompliance relates to management and/or operational controls; such violations are indicative of breakdowns in a carrier's management controls (49 *Code of Federal Regulations* [CFR] Part 385, Appendix A, "Explanation of Safety Audit Evaluation Criteria," paragraphs III [b] and [c]).
[b]Acute regulations are those for which noncompliance is so severe as to require immediate corrective actions by the motor carrier regardless of its overall basic safety management controls.

Table C-2. Violations identified in the postaccident FMCSA compliance review of Great Escapes Tours & Travel Ltd.

Critical Violations:[a] • Failing to require driver to make a record-of-duty status (395.8[a]) • Failing to require driver to forward within 13 days of completion, the original of the record-of-duty status (395.8[i])
Acute Violations:[b] None listed.
Additional Violations: • Failing to request information from previous DOT-regulated employers of driver applicant for the 2 years prior to the date of application or transfer (40.25[b] and 382.105) • Failing to ask employee if any preemployment test conducted in the preceding 2 years resulted in a positive test result or refusal to test (40.25[j] and 382.105) • Failing to ensure that each driver selected for random alcohol and controlled substances testing has an equal chance of being selected each time selections are made (382.305[i][2]) • Failing to perform the required referral, evaluation, and treatment in accordance with 49 CFR Part 40, Subpart O (382.605 and 40.287). This is the same violation and same driver as the one in the violation listed for World Wide Travel of Greater New York. • Using a driver who has not completed and furnished an employment application (391.21[a] and 391.21[b][5,10lv, 12]) • Failing to investigate a driver's background (391.23[a] and 391.23[a][2], [c][1]) • False reports of records-of-duty status (395.8[e]) • Failing to require driver to prepare record-of-duty status in form and manner prescribed (395.8[f] and 395.8[d][4,7]) • Failing to record the name of the city, town, or village, with state abbreviation where each change of duty status occurs (395.8[h][5]) • Failing to keep a record of inspection, repairs, and maintenance indicating their date and nature (396.3[b][3]) • Failing to maintain completed inspection form for 12 months from the date of inspection at the carrier's principal place of business (396.9[d][3]) • Failing to ensure driver vehicle inspection report is complete and accurate (396.11[b]) • Failing to certify that repairs were made or were not necessary (396.11[c][1]) [a]During a safety audit, the FMCSA gathers information by reviewing a motor carrier's compliance with "critical" and "acute" regulations. Critical regulations are those in which noncompliance relates to management and/or operational controls; such violations are indicative of breakdowns in a carrier's management controls (49 CFR Part 385, Appendix A, "Explanation of Safety Audit Evaluation Criteria," paragraphs III [b] and [c]). [b]Acute regulations are those for which noncompliance is so severe as to require immediate corrective actions by the motor carrier regardless of its overall basic safety management controls.

Table C-3. Violations identified in the FMCSA's October 2011 nonrated review of Great Escapes Tours & Travel Ltd.

Critical and Acute Violations[a]

None listed

Additional Violations

- Failing to provide the required employment history information to prospective employer for the 10 years preceding the date the application was submitted (383.5[a])
- Failing to maintain a medical exmainer's certificate in driver's qualification file (391.51[b][7])
- Requiring or permitting a passenger-carrying CMV driver to drive for more than 10 hours (395.5[a][1])
- False reports of records-of-duty status (395.8[e])
- Failing to require driver to prepare record-of-duty status in form and manner prescribed (395.8[f])
- Failing to complete graph grid on the driver's record-of-duty status to include the name of the city, town, or village, with state abbreviation where each change of duty status occurs (395.8[h][5])
- Failing to maintain complete inspection form for 12 months from the date of inspection at the carrier's principal place of business (396.9[d][3])
- Failing to retain vehicle inspection report for at least 3 months (396.11[c][2])

[a]During a nonrated review, violations are not designated as "critical" or "acute."