Commercial Vehicle Overturn Resulting in Cargo Tank Rupture, Propane Release, and Fire
Stroud, Alabama
March 11, 2016

Accident Summary Report

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National Transportation Safety Board

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Highway Accident Summary Report

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National Transportation Safety Board

490 L'Enfant Plaza SW
Washington, DC 20594

National Transportation Safety Board. 2018. *Commercial Vehicle Overturn Resulting in Cargo Tank Rupture, Propane Release, and Fire, Stroud, Alabama, March 11, 2016.* Highway Accident Summary Report NTSB/HAR-18/01/SUM. Washington, DC.

Abstract: On Friday, March 11, 2016, about 6:20 a.m., a 2011 Peterbilt truck-tractor in combination with a 1962 North Texas Tank Company, specification MC330, 10,500-gallon cargo tank semitrailer loaded with noncorrosive liquefied petroleum gas, operated by River City Propane, was traveling northbound on US Highway 431, a two-lane undivided highway, near Stroud, Alabama. As it entered a right curve near the intersection of County Route 256, it began to encroach on the southbound lane, which was occupied by a 2004 Pontiac sport utility vehicle. The driver of the Pontiac reported that he observed the driver of the Peterbilt make a hard right turn. The cargo tank semitrailer then separated from its truck-tractor, traveled westward into a ditch, and struck a rock. The impact with the rock breached the front head of the cargo tank; as the cargo began to vent, the cargo tank's entire head became separated, releasing the tank's contents, which caught fire, and a deflagration occurred. The cargo tank semitrailer continued to travel westward through about 300 yards of forested area before coming to rest. The truck-tractor came to rest on the eastern ditch/embankment area and was destroyed. The Peterbilt driver was severely injured as a result of the crash and fire. Although the investigation determined that the condition of the tank was acceptable and its performance was consistent with its design, the National Transportation Safety Board (NTSB) investigation discovered the following safety issues: loading practices at Enterprise Propane Terminals and Storage, inspection and testing of MC330/MC331 cargo tanks, and certification and training of cargo tank inspectors. The NTSB makes two safety recommendations to the Federal Motor Carrier Safety Administration, three safety recommendations to the Pipeline and Hazardous Materials Safety Administration, and one safety recommendation to Enterprise Propane Terminals and Storage LLC.

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Abbreviations and Acronyms

ALPGB	Alabama Liquefied Petroleum Gas Board
ASME	American Society of Mechanical Engineers
CDL	commercial driver's license
CFR	*Code of Federal Regulations*
DOT	US Department of Transportation
Enterprise Propane	Enterprise Propane Terminals and Storage LLC
FMCSA	Federal Motor Carrier Safety Administration
H&W	H&W Tank Testing Company Inc.
LPG	liquefied petroleum gas
NBIC	*National Board Inspection Code*
NPGA	National Propane Gas Association
NTSB	National Transportation Safety Board
NTTC	National Tank Truck Carriers Inc.
PHMSA	Pipeline and Hazardous Materials Safety Administration
PRD	pressure relief device
psig	pounds per square inch gauge
RSPA	Research and Special Programs Administration
SUV	sport utility vehicle
UN	United Nations
US-431	US Highway 431

Executive Summary

Investigation Synopsis

On Friday, March 11, 2016, about 6:20 a.m., a 2011 Peterbilt truck-tractor in combination with a 1962 North Texas Tank Company, specification MC330, 10,500-gallon cargo tank semitrailer loaded with noncorrosive liquefied petroleum gas, operated by River City Propane, was traveling northbound on US Highway 431, a two-lane undivided highway, near Stroud, Alabama. As it entered a right curve near the intersection of County Route 256, it began to encroach on the southbound lane, which was occupied by a 2004 Pontiac sport utility vehicle. The driver of the Pontiac reported that he observed the driver of the Peterbilt make a hard right turn. The cargo tank semitrailer then separated from its truck-tractor, traveled westward into a ditch, and struck a rock. The impact with the rock breached the front head of the cargo tank; as the cargo began to vent, the cargo tank's entire head became separated, releasing the tank's contents, which caught fire, and a deflagration occurred.[†] The cargo tank semitrailer continued to travel westward through about 300 yards of forested area before coming to rest.

The truck-tractor came to rest on the eastern ditch/embankment area and was destroyed. The Peterbilt driver was severely injured as a result of the crash and fire.

Safety Issues

This investigation was undertaken to examine the performance and structural failure of the MC330 cargo tank. Although the investigation determined that the condition of the tank was acceptable and its performance was consistent with its design, the National Transportation Safety Board (NTSB) discovered three areas of concern that result in increased risk and decreased safety. Consequently, this summary report concentrates on the following safety issues:

- **Loading practices at Enterprise Propane Terminals and Storage.** Although the cargo tank was legally loaded at the time of the Stroud crash, the investigation determined that the driver had overloaded his cargo tank on about 80 percent of his loads before the crash. Overloading a cargo tank can have serious safety consequences.

- **Inspection and testing of MC330/MC331 cargo tanks.** Examination of the cargo tank following the crash indicated that the most recent tests and inspections conducted to qualify it had not been properly performed.[‡] Assessment of the company that performed the tests and inspections revealed significant issues with the quality of those inspections; data suggest that these issues are common across the industry.

[†] A deflagration is combustion that propagates through a gas or across the surface of an explosive at subsonic speeds, driven by the transfer of heat.

[‡] Cargo tanks used for the transportation of hazardous materials must qualify as authorized packaging, which means they must conform to specific federal regulations and, if required, to a US Department of Transportation specification. Cargo tanks manufactured to meet certain specifications must be periodically recertified to meet the specification.

- **Certification and training of cargo tank inspectors.** Information from the Federal Motor Carrier Safety Administration (FMCSA) suggests that improper certification and training of cargo tank inspectors may be a widespread problem and that current regulations and federal oversight are not adequately ensuring that inspectors have the knowledge, skills, and abilities to perform these critical safety inspections.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the Stroud, Alabama, crash was the combination vehicle driver's overcorrection while traveling on a curve, after he had encroached into the opposing lane of traffic. Contributing to the crash was the driver's excessive speed. Contributing to the severity of the crash outcome was the rupture of the tank and subsequent release and ignition of propane.

Safety Recommendations

As a result of the investigation, the NTSB makes two safety recommendations to the FMCSA, three safety recommendations to the Pipeline and Hazardous Materials Safety Administration, and one safety recommendation to Enterprise Propane Terminals and Storage LLC.

1 The Crash

The National Transportation Safety Board (NTSB) investigation into this crash focused on the condition and performance of the cargo tank. While looking at these factors, the NTSB discovered issues with the loading of cargo tanks at the Enterprise Propane Terminals and Storage LLC (Enterprise Propane) terminal in Opelika, Alabama; the inspection of MC330/MC331 cargo tanks; and the certification of cargo tank inspectors.[1] The investigation did not address any issues outside the probable cause of the crash, cargo tank loading at the Enterprise Propane facility, inspection of MC330/MC331 cargo tanks, and certification of inspectors. Consequently, this portion of this report includes the crash narrative; the injuries that resulted from the crash; and the highway, driver, and vehicle factors immediately related to the crash.

1.1 Crash Narrative

On Friday, March 11, 2016, at 5:27 a.m., the 33-year-old driver loaded a 1962 North Texas Tank Company, specification MC330, 10,500-gallon cargo tank semitrailer owned by River City Propane with 9,000 net gallons of noncorrosive United Nations (UN) 1075 liquefied petroleum gas (LPG) at the Enterprise Propane terminal in Opelika.[2] The load was to be delivered to a customer in Piedmont, Alabama.

About 6:20 a.m., as the combination vehicle was traveling northbound on US Highway 431 (US-431), a two-lane undivided highway, near Stroud, Alabama, it entered a right curve near the intersection of County Route 256 and began to encroach on the southbound lane, which was occupied by a 2004 Pontiac sport utility vehicle (SUV). The SUV driver reported that the truck-tractor was operating to the left of the centerline. He further stated that he saw the combination vehicle driver make a noticeable steering input to the right, which took the vehicle back into its proper lane. Following this maneuver, the cargo tank semitrailer separated from the truck-tractor and traveled westward into a ditch and struck a rock. The impact with the rock breached the front head of the cargo tank. As the cargo began to vent, the cargo tank's entire head became separated, releasing the tank's contents, which ignited, and a deflagration occurred.[3] The

[1] The Pipeline and Hazardous Materials Safety Administration (PHMSA) promulgates hazardous materials regulations in the United States, including those pertaining to the manufacture, fabrication, maintenance, reconditioning, and testing of containers used in the transportation of hazardous materials in commerce. The designation MC330/MC331 refers to the specific set of requirements that the tank (vessel) is required to meet. (See 49 *Code of Federal Regulations* [*CFR*] 178.337.) The MC330 specification is no longer authorized for cargo tank construction, but such tanks can still be used, provided that their initial construction began on or before May 15, 1967, and that they have been recertified in accordance with the regulations.

[2] (a) The cargo tank semitrailer was in combination with a 2011 Peterbilt truck-tractor. (b) The driver was loading by volume. According to Enterprise Propane loading tables, 9,000 gallons was the maximum load for this cargo tank and the temperature at the time. The 9,000 gallons equated to 38,160 pounds, or approximately 1,530 pounds less than the maximum of 39,690 pounds allowed by 49 *CFR* 173.315(b).

[3] A deflagration is combustion that propagates through a gas or across the surface of an explosive at subsonic speeds, driven by the transfer of heat.

cargo tank semitrailer continued to travel westward, through about 300 yards of forested area before coming to rest.

The truck-tractor came to rest on the eastern ditch/embankment area and was subsequently destroyed.[4] The truck-tractor driver was ejected and severely injured as a result of the crash. The crash location is shown in figure 1. Figure 2 shows the cargo tank at final rest.

Figure 1. Location of Stroud within Alabama and location of crash.

Figure 2. Cargo tank at final rest. (Courtesy Alabama Liquefied Petroleum Gas Board)

[4] It could not be determined whether the tractor was destroyed by the deflagration, the subsequent fire, or the fire that resulted from a release of the tractor's diesel fuel.

The crash occurred in daylight, the roadway surface was dry, and the sky was cloudy. Weather data from a nearby airport weather station indicated that the wind was from the south at 4.6 mph, and there was no precipitation.

In his report on the crash, the responding law enforcement officer indicated that the combination vehicle was most likely traveling above the speed limit and was going too fast to negotiate the curve.

1.2 Highway Information

The crash occurred on US-431 at milepost 172.3 near Stroud. In the vicinity of the crash, US-431 is a two-lane undivided highway consisting of a single northbound and a single southbound travel lane separated by double solid yellow lines, totaling 6 inches wide. Each of the travel lanes is about 12 feet wide. Beside each travel lane is a 1-foot-wide unpaved shoulder separated from the travel lane by a 6-inch-wide solid white line. The roadway surface is asphalt. The speed limit at the crash location for northbound traffic is 55 mph.

The horizontal alignment of US-431 in the vicinity of the crash consists of an 8º curve to the right for motorists traveling in the northbound direction. The horizontal curve is about 843.7 feet long. There is a curve warning sign with a suggested speed of 45 mph preceding this curve.

Investigators identified tire marks from the combination vehicle on the roadway encroaching about 1 foot over the centerline into the southbound lanes.[5] Additional tire marks running from the center line of the roadway to the point of impact with the rock indicated the point at which the trailer began to rotate clockwise.

1.3 Truck-Tractor Driver Information

1.3.1 Licensing and Experience

The driver was a 33-year-old male. At the time of the crash, he held a Georgia class "A" commercial driver's license (CDL) with tanker and hazardous materials endorsements; it would expire in July 2020. He had first obtained a CDL in September 2004. He had been employed by River City Propane since July 2015. According to the carrier's records and the Georgia Bureau of Motor Vehicles, the driver had no vehicle crashes. At the time of the crash, the driver held a US Department of Transportation (DOT) medical certificate, issued in July 2015 and expiring in July 2017. Investigators reviewed the documentation from that exam and found that the driver reported no medical conditions or medication use. No abnormalities were identified in the exam.

[5] Damage from the crash and deflagration prevented investigators from determining which tires on the combination vehicle left the marks.

1.3.2 Sleep and Rest

When interviewed by Federal Motor Carrier Safety Administration (FMCSA) investigators after the crash, the driver stated that he slept very well and tried to get 7–8 hours of rest per night.[6] He further stated that his typical schedule when working was to go to bed about 7:30 p.m., wake about 2:30–2:45 a.m., leave for work about 2:45– 3:00 a.m., and arrive at work about 3:30 a.m.

1.3.3 Toxicology

No postcrash toxicological testing was conducted on the driver. Responding law enforcement officers did not believe the driver was under the influence of alcohol or other drugs; therefore, they did not request postcrash testing. Under 49 *Code of Federal Regulations* (*CFR*) 382.303, postcrash drug and alcohol testing is required if (a) there was a fatality or (b) the commercial driver was issued a citation and there was either serious bodily injury or at least one vehicle was towed from the scene. In this crash, although there was serious bodily injury and the vehicle was towed from the scene, the driver was not cited; consequently, DOT testing was not required. The motor carrier did not have its own postcrash testing policy.

1.3.4 HOS Compliance

At the time of the crash, the driver was operating under the short-haul provisions.[7] His duty day began at 2:00 a.m. eastern standard time. The crash occurred about 6:20 a.m. central standard time. The NTSB reviewed the driver's timecards for the week of the crash and the previous week and determined that the driver had violated the short-haul provisions once during that period but was not in violation at the time of the crash.[8]

1.3.5 Driver's Account of the Crash

When interviewed after the crash, the driver said that he had no problems with the combination vehicle on the day of the crash. He said that he saw the Pontiac SUV in the oncoming lane about a mile or two before the crash. He recalled hearing a loud "pop" before the crash. Then he felt the vehicle starting to go over while he tried to hold the steering wheel straight. He said his next memory involved seeing the fire after the crash. He described his memory as "kind of a blur" but told police that he thought the crash had resulted from a front tire blowout. The driver stated that he was obeying the speed limit at the time of the crash, but he admitted to exceeding the speed limit on other sections of the road.

[6] NTSB investigators did not interview the driver while on scene because of his injured condition. When the FMCSA interviewed him after he had recovered from his injuries, the FMCSA asked some specific questions at the request of the NTSB.

[7] Title 49 *CFR* 395.1(e) exempts drivers of property-carrying commercial motor vehicles from the requirements of 49 *CFR* 395.8 (driver's record-of-duty status) and 395.11 (supporting documents) if the driver: operates within a 100 air-mile radius of the normal work reporting location; returns to the work reporting location and is released from duty within 12 consecutive hours; maintains time records as specified by the rule; and is not covered by the "non-CDL 150 air-mile radius" provision.

[8] (a) Two nights before the crash, the driver had 8.5 hours off duty; to meet the short-haul provisions, he was required to have 12 hours off duty. (b) River City Propane was the driver's only employer at the time of the crash.

1.4 Vehicle Information

1.4.1 Truck-Tractor

The power unit in this crash was a 2011 Peterbilt truck-tractor equipped with a Bendix antilock braking system, Cummins engine, and Eaton Fuller 10-speed transmission. Because the truck-tractor was largely consumed by the postcrash fire, investigators could not complete a full mechanical inspection. Instead, they performed a visual inspection of the remaining components. All remaining tires and brake components on the truck-tractor exceeded the minimum tread depth and pad thickness requirements. Given the driver's statement regarding a "pop" sound that occurred just before he felt the combination vehicle "go over," investigators specifically examined both steering axle tires for signs of failure (blowout); none were found. The passenger's side tire was still attached to the rim and inflated, indicating that it had not experienced a blowout. (See figure 3.)

Figure 3. Passenger's side tire.

The driver's side tire was separated from the rim and had been damaged by the postcrash fire; however, it showed no signs of deformation, imbedded asphalt, or gouges, indicating that it had not experienced a blowout. (See figure 4.)

Figure 4. Driver's side tire and rim.

The truck-tractor's kingpin was bent forward and exhibited deformation/material transfer marks. The load-bearing surface of the upper coupler plate appeared undamaged, although the upper coupler frame and the structure to which it was attached were torn and separated from the cargo tank. The fifth wheel was cracked, with the crack running about 3.75 inches from the forward end of the kingpin channel toward the front of the fifth wheel plate. The fifth wheel plate was deformed upwards near the crack. The right locking jaw was open and displaced against the kingpin channel. The spring-loaded yoke that secures and operates the locking jaws was bent and not aligned with the right jaw. The locking jaws, yoke, and a piece of the fifth wheel containing the crack were removed from the fifth wheel assembly for laboratory examination.

The laboratory examination revealed that the crack in the fifth wheel exhibited features consistent with an overstress fracture under tensile and bending loads. There was no indication of preexisting cracks or wear that would have contributed to the separation on either the fifth wheel or the kingpin before the crash.[9]

Based on the postcrash inspection of the truck-tractor, and particularly its tires and wheel assemblies, the NTSB concludes that the truck-tractor did not experience a tire blowout preceding the crash.

1.4.2 Cargo Tank Semitrailer

Background. The cargo tank semitrailer involved in the crash was purchased by River City Propane on September 1, 2011. When contacted by investigators, the previous owner stated that the cargo tank had been used by both that company and a previous owner for dedicated noncorrosive LPG transport service. (See figure 5.)

[9] The fifth wheel failure could have caused a "pop" noise such as the driver said that he heard, but the physical evidence indicates that the separation occurred after the loss of control, not before it, which is when the driver said that he recalled hearing the sound.

Figure 5. Crash cargo tank in precrash condition (photo taken February 5, 2013). (Courtesy Federal Motor Carrier Safety Administration)

Postcrash inspection. Investigators conducted a postcrash inspection of the MC330 cargo tank.[10] In this report, tank orientations are given as viewed facing forward from the rear of the trailer for both the front and rear tank heads. Thus, the left side of the cargo tank refers to the driver's side of the vehicle. Similarly, a reference to 3 o'clock on the head denotes the right side of the cargo tank, regardless of whether referring to the front or rear head.

Front tank head. The front tank head was damaged and compromised during the crash sequence. It was scraped and dented, and the dent was oriented horizontally. The dent ran from the top center of the head to the left side, becoming deeper as it progressed until transitioning to a puncture. The puncture features were consistent with an impact with a large rock. The interior of the front head also exhibited surface corrosion, with thinning in the regions of heaviest corrosion, but the head's thickness remained above the legal minimum. Investigators found no visual indications of any preexisting damage or defects. The front head material was tested and found to meet the mechanical and chemical requirements for American Society of Mechanical Engineers (ASME) SA-517 grade F steel (also known as "T-1" steel). The front tank head is shown in figure 6. Based on the condition of the tank head, the NTSB concludes that the release of the cargo tank's contents was due to the puncture of the front tank head by impact with a rock; the rupture of the tank and subsequent release and ignition of propane increased the severity of the crash outcome.

[10] The inspection team included a NTSB hazardous materials investigator, an NTSB materials engineer, two FMCSA investigators, two DOT Volpe National Transportation Systems Center investigators, and four Alabama Liquefied Petroleum Gas Board investigators.

Figure 6. Outside and inside view of front tank head.

Rear tank head. The rear tank head sustained dents in the center, at the 7 o'clock and 10 o'clock edges, and at the 5 o'clock location where it was welded to the tank shell. The rear head was also punctured in five locations. The rear tank head thickness was sufficient to meet legal minimums. Investigators removed the 15-inch manway from the rear of the tank to examine the condition of the gasket.[11] The gasket did not have any visible manufacturer markings other than the following statement: "contains fibers that could be harmful." The gasket material was hard and brittle.

Left and right sides. The left side of the tank body was scraped near the top along its entire length. Along the right side of the tank body, a spiral crack extended from the point of impact on the front head and progressed into the first barrel section of the shell. A large flap of steel protruded about 90º from the tank where the crack arrested. The left side of the tank is shown in figure 7.

[11] In this context, a manway is a small hatch or entry allowing a person to access the interior of a cargo tank for maintenance or cleaning.

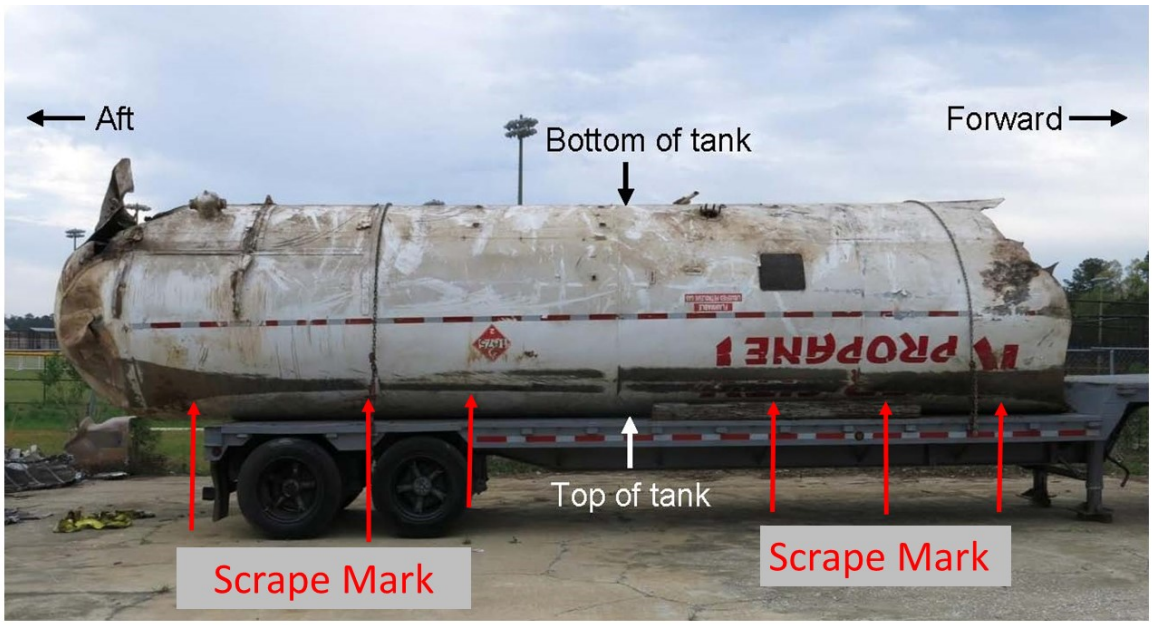

Figure 7. Left side of cargo tank.

Tank interior. Investigators measured the interior tank diameter at two locations and found it consistent with design specifications. The material thickness of the tank shell was measured in three locations and found sufficient to meet the legal minimum thickness at all three. The rear baffle was bowed forward about 6 inches from vertical and remained attached to the tank wall by two bolts on the bottom of the tank.[12] The forward baffle had become completely detached from all mounting points and had been ejected from the tank. Some of the baffle attachment points exhibited dull metal surfaces, while others were shiny and polished.

Pressure relief devices. The cargo tank was equipped with two pressure relief devices (PRD), which were removed from the cargo tank for inspection.[13] The forward-mounted PRD was a Fisher model H289-250, manufactured in November 1999. This PRD's valve body, disc, and nut had a surface coating of rust. The rear-mounted PRD was a Fisher model H282-250, manufactured in April 2003. The components of this PRD were clean and shiny. The valve stems of both PRDs were bent about 90º in opposite circumferential directions. Investigators determined that the damage to both PRDs was crash related.

[12] Baffles (baffle assemblies) are sheet metal structures placed across the interior diameter of the tank to minimize product surges in the tank during transportation by obstructing longitudinal liquid motion. This tank contained two cross-shaped (X) baffles.

[13] To prevent over-pressurization of a cargo tank when exposed to fire, 49 *CFR* 173.315(i) requires that cargo tanks transporting liquefied compressed gases be equipped with one or more spring-loaded reclosing PRDs that connect directly with the vapor space in the tank. The PRD must be able to prevent the pressure inside the tank from exceeding 120 percent of the design pressure. The total pressure-relieving capacity, flow rating, testing, and marking of PRDs are specified in pamphlet S-1.2 from the Compressed Gas Association.

1.5 Crash Summary

Because the NTSB found no evidence of a tire blowout that could have caused the loss of vehicle control (when the driver felt the truck “go over”), such as indicated by the combination vehicle driver when he described hearing a “pop” noise preceding the crash, the NTSB drew on other information to determine what led to this crash.

The sky was clear and the ground was dry when the crash occurred, in daylight hours. Investigators found no evidence that the combination vehicle driver was fatigued at the time of the crash. The driver did not indicate that he had experienced a medical event at the time of the crash, and no indication of medical issues was found on the driver’s most recent CDL medical exam.

The SUV driver who witnessed the combination vehicle in the moments before the crash stated that he saw the vehicle operating over the centerline. He further stated that he saw the combination vehicle driver make a significant steering correction that took the vehicle back into its lane. The combination vehicle driver also recalled that he made such a sudden steering maneuver immediately before the crash. In addition, the combination vehicle driver indicated that he had operated above the speed limit while on this road, although he did not concede that he was exceeding the speed limit at the time of the crash. However, the law enforcement officer who wrote the report on this crash indicated that the combination vehicle was traveling above the speed limit and too fast to negotiate the curve successfully. Therefore, the NTSB concludes that the combination vehicle driver overcorrected after encroaching into the opposing traffic lane, which, in part because of excessive speed, led to the loss of vehicle control that preceded the crash.

2 Safety Issues

Investigation by the NTSB determined that the cargo tank ruptured after striking a large rock. No evidence of a preexisting condition that would have weakened or otherwise compromised the tank was found. However, while examining the status of the cargo tank on the day of the crash and how it had been inspected and maintained, NTSB staff discovered issues associated with the loading of the cargo tank, the inspection and testing of the tank, and the qualification and training of cargo tank inspectors. Although none of these issues contributed to the crash or the subsequent rupture of the cargo tank, they nonetheless pose a substantial risk to the driving public and are addressed in separate sections below.

2.1 Loading Practices at Enterprise Propane

On the day of this crash, the driver entered a load of 9,000 gallons on the propane loading station metering system keypad. The loading chart indicated that the maximum load of UN 1075 propane at a product temperature of 67 °F for a tank with a maximum water capacity of 10,500 gallons was 9,000 gallons. These details matched the driver's input and the amount metered into the tank.

However, while examining the combination vehicle driver's typical loading practices, NTSB investigators reviewed Enterprise Propane's loading records for the driver. They found that the driver made 60 trips during the month before the crash between the Enterprise Propane terminal in Opelika and the River City Propane terminal in Tallapoosa, Georgia. By comparing invoices automatically generated by the loading system with the cargo tank capacities, investigators determined that on 48 of these 60 occasions (80 percent), the cargo tanks used on those trips had been overloaded by as much as 300 to 350 gallons relative to the Enterprise Propane loading chart for net allowable gallons per the conditions at the time of loading.

Enterprise Propane used a Toptech Systems Multiload II Preset system for loading propane cargo tanks and required truck drivers using its facility to be certified on using the system's loading procedures. Certification involved the driver's undergoing an orientation process and then being supervised by a certified driver while loading the first three loads. Enterprise Propane also provided an instruction booklet to carriers and drivers; the booklet described operating methods, rules, and safe practices.

According to the loading instructions, the driver was to check the load tables posted in the loading dock building and enter the desired load amount into the metering system. The system used pulses from a turbine meter, temperature and pressure information, and meter correction factors to calculate the net gallons being loaded. The system closed a valve and stopped the pump when the amount of dispensed product matched the driver's load input. Given the use of an automatic, computer-controlled filling system, the NTSB concludes that the recorded repeated overloading of cargo tanks by the crash driver resulted from his routinely entering loading amounts that exceeded the maximum specified loads for the cargo tanks on his vehicles' semitrailers.

Filling limits exist because an overfilled tank poses several safety risks. For instance, when a tank is overloaded, liquid product may be improperly released through devices intended to

release excess pressure as vapor, and tank pressure may become too high. Perhaps the greatest concern—although this situation did not occur in the case of the Stroud crash—is that in an impact scenario, an overfilled tank may be significantly more prone to puncture or other failure if the tank shell is dented or compressed.

The Pipeline and Hazardous Materials Safety Administration (PHMSA) recently published recommended best practices for the loading and unloading of cargo tanks (PHMSA 2015). These best practices recommend that persons responsible for overseeing the loading process implement procedures to monitor filling and ensure that the quantity of hazardous materials transferred is appropriate for the cargo tank. Although the driver training, operating rules, and driver certification program at Enterprise Propane were consistent with published PHMSA best practices, the fact that the crash driver overloaded his tank on 80 percent of his loads in the month before the crash demonstrates significant compliance issues involving tank loading. The NTSB concludes that the oversight of driver loading at Enterprise Propane is lacking and does not ensure compliance with cargo tank filling limits. Given the potentially severe safety consequences of an overloaded cargo tank and the fact that current procedures at its facilities are inadequate to detect and/or prevent a pattern of frequent tank overloading, the NTSB recommends that Enterprise Propane develop and implement an oversight procedure at its LPG loading facilities. The procedure should include periodic audits of driver compliance with loading limit requirements and corrective action, such as retraining and/or suspending drivers, when necessary.

According to 49 *CFR* 177.816, the carrier River City Propane is responsible for training its drivers, who are hazardous materials employees, in several areas, including loading and unloading procedures. After this crash, the FMCSA cited River City Propane for failing to maintain training records for its hazardous materials employees (specifically for the driver involved in the crash) and gave the company a conditional safety rating. Lacking these records, investigators were unable to document what training, if any, the driver received from River City Propane.

2.2 Inspection and Testing of MC330/MC331 Cargo Tanks

2.2.1 Requirements for Inspection

Safe operation of a cargo tank across its entire service life is contingent on periodic inspection and testing to identify and remedy potential issues before they result in catastrophic failures and the release of hazardous material. Title 49 *CFR* 180.407 covers the testing and inspection requirements of specification cargo tanks and stipulates that the testing and inspection of such tanks is required both under specific conditions and periodically.[14] The type and interval for each type of testing or inspection required for MC330 specification tanks are shown in table 1.

[14] Specified conditions include when dents, cuts, gouges, corrosion, or leakage is found; when the tank sustains damage; when the tank has been out of hazardous materials transportation service for a year or more; and when the DOT requires it to be tested based on probable cause that the tank is in an unsafe condition.

Table 1. Inspection/testing intervals for MC330/MC331 specification cargo tanks.

Test or Inspection	Symbol	Interval
External visual inspection	V	1 year
Internal visual inspection	I	5 years
Leakage test	K	1 year
Pressure test	P	5 years

2.2.2 Inspection of the Crash-Involved Cargo Tank

River City Propane, the owner of the cargo tank involved in this crash, used H&W Tank Testing Company Inc. (H&W) to perform the required testing. H&W was registered to perform inspections and testing on specification MC330 and MC331 cargo tanks. The company maintained a principal office in Ohatchee, Alabama, and operated an inspection/testing operation, using a mobile inspection truck, along the East Coast of the United States, from Florida to Connecticut. The company employed two registered cargo tank inspectors at the time of the crash.

H&W provided its test reports for the crash cargo tank to investigators. The cargo tank had undergone an external visual inspection, a leakage test, and an internal visual inspection in June 2011 and external visual inspection and leakage tests in August 2012, 2013, 2014, and 2015. This pattern of inspections is consistent with the required intervals (summarized in table 1 above). Each of the reports indicated that no defects were found and that the cargo tank met the requirements for a specification MC330 tank. The cargo tank involved in the crash was due for an external visual inspection, an internal visual inspection, a leakage test, and a pressure test within 6 months of the crash (by September 2016).

The H&W report for the June 2011 inspection of the crash cargo tank noted that LPG was the only commodity that had been transported in the cargo tank. It also noted that the following items were included in the inspection:

Tank shell
Tank heads
Head-to-shell seam
Valves
Gaskets
Manhole cover
Manhole gasket
Devices for tightening manhole
Self-closing stop valve
Excess flow valve
Remote closure devices
Reclosing pressure relief valves
Nuts and bolts
Frangible (rupture) disk
Major appurtenances
Upper coupler assembly
Suspension system and attachments
Connecting structures
Lining material
Corroded or abraded areas
Distortions
Dents
Welds

The report stated that two PRDs were removed, inspected, and tested. One of the valves was replaced and the other was reinstalled. The report further stated that a hydrostatic pressure test was conducted at 375 pounds per square inch gauge (psig) for 30 minutes.[15] The report stated that no defects or damage was discovered and that the tank met the requirements of DOT specification MC330.

The June 2011 inspection report contained several statements contradicted by the observations made during the postcrash inspection of the cargo tank. First, the report indicated that an internal inspection of the tank was performed; however, during the postcrash inspection, investigators found the manway gasket to be hard and brittle, indicating that it was very old. Its 2016 condition was such that the postcrash inspection team considered that it was most likely in an unsatisfactory condition when the 2011 inspection took place. Proper practice upon finding the manway gasket in such a condition would have been to replace it with a new gasket; the fact that it was not replaced strongly suggested to investigators that the manway had not been removed during the 2011 inspection. The only way an inspector can access the interior of the tank is through the manway; therefore, the condition of the gasket suggested that no internal inspection was performed in 2011.

Second, the postcrash inspection revealed that only two bolts were holding the baffles to the walls of the tank; some bolts were missing and had been missing for some time before the crash. The dullness of the metal contact surfaces indicated that they had been exposed to the tank's contents for some time. A properly performed internal inspection should have noted the missing bolts and resulted in their replacement.[16]

Third, during the postcrash inspection, investigators noticed corrosion on the lower half of the front tank head. Had a proper internal inspection taken place, the presence of this corrosion should have prompted the inspector to conduct the required material thickness testing and note the results in the report.[17] Although, despite the corrosion, the front tank head still exceeded the minimum required thickness at the time of the postcrash inspection, the report of the June 2011 inspection did not mention either corrosion or thickness testing.

Fourth, the postcrash examination of the PRDs from the cargo tank revealed that one was 18 years old and the other was 14 years old. At the time of the 2011 inspection, they would have been 13 and 9 years old, respectively. The manufacturer of the PRDs recommended that they not be used for longer than 12 years from the date of manufacture; consequently, the older PRD should have been replaced at that time.

[15] (a) Recording the testing in psig indicates that the pressure reading was taken relative to ambient pressure. (b) On another part of the report form, the check box for hydrostatic test was obliterated and a check was placed in the box signifying that a pneumatic test was performed. That makes it unclear which test, if any, was performed.

[16] Given that it is likely that no internal inspection of the tank was performed in 2011, investigators could not determine whether the bolts were missing in 2011 or had come loose between 2011 and 2016.

[17] Because of the demonstrably inaccurate documentation of the 2011 inspection, investigators could not determine when this corrosion began. However, given the amount of corrosion and the fact that the cargo tank had been continuously used to transport noncorrosive LPG, it is likely that some degree of corrosion existed at the time of the 2011 inspection.

An additional concern with respect to the PRDs was that, on July 3, 2014, the manufacturer had issued a notice to equipment distributors to stop selling type H282 PRDs for transport applications. The manufacturer then issued a voluntary safety recall for the devices on December 2, 2014, advising that vibration tests had indicated that when they were used in transport applications under certain conditions, type H282 PRDs might experience excessive bending stresses that could result in fatigue and valve stem failure over time. As a precautionary measure, the manufacturer offered to replace, free of charge, all type H282 PRDs manufactured between January 2003 and November 2014 that were used in transport applications. The recalled PRDs from the cargo tank were not replaced during the 2015 visual inspection and leakage tests and were still on the tank when the postcrash inspection took place.

Finally, as noted above, H&W uses a mobile inspection truck in conducting its cargo tank inspections. The use of such a truck suggests that the inspector most likely lacked the means to remove the upper coupler assembly from the semitrailer to inspect its underside for cracks and corrosion. The upper coupler assembly weighs about 300 pounds. Removing one requires the removal of numerous bolts, necessitating an alternative means to support several hundred pounds; therefore, such operations entail the involvement of more than one person and/or a jacking device. FMCSA investigators determined that at the time of the 2011 inspection of the cargo tank involved in the crash, the H&W inspector worked alone and did not have jacking equipment on the inspection truck sufficient to assist in the removal of an upper coupler assembly.

2.2.3 Precrash FMCSA Review of H&W

Before the crash, on August 21, 2015, FMCSA investigators conducted a review of the H&W cargo tank facility and identified four violations of the Hazardous Materials Regulations, as follows:

- Failure to retrain two hazardous materials employees (the registered cargo tank inspectors) every 3 years, as required by 49 *CFR* 172.704(c)(2);[18]

- Failure to perform an external visual inspection, as prescribed by 49 *CFR* 180.407(d). The inspector failed to identify an improperly labeled tank and a wetline that was less than 6 inches from the vehicle's crash protection;[19]

- Failure to perform a wet fluorescent magnetic particle test on an MC330/331 cargo tank before conducting a hydrostatic test, as required by 49 *CFR* 180.407(g)(3); and

- Failure to include all required information on test and inspection reports, as required by 49 *CFR* 180.417(b).

The FMCSA advised H&W to take corrective action and stated that if the required training of a hazardous materials employee (the inspector of the crash cargo tank) was not completed within

[18] One of the registered cargo tank inspectors had not been trained at any point since being hired in October 2003.

[19] A "vehicle's crash protection" refers to the structure that protects external piping and fittings from such damage as could be caused by collision with other vehicles or objects, jack-knifing, and overturning (see 49 *CFR* 178.337-10).

30 days, the company must cease certifying cargo tank inspections. After reviewing the case, the FMCSA did not levy a fine against H&W.

2.2.4 Postcrash FMCSA Review of H&W

On March 22, 2016, following the inspection of the cargo tank involved in the Stroud crash, FMCSA investigators opened another cargo tank facility review of H&W. The following violations were discovered:

- Failure to retrain a hazardous materials employee (the inspector of the crash cargo tank) every 3 years, as required by 49 *CFR* 72.704(c)(2);[20]
- Failure to perform an external visual inspection, as prescribed by 49 *CFR* 180.407(d);
- Failure to perform an internal visual inspection, as prescribed by 49 *CFR* 180.407(e);
- Failure to perform a thickness test during an internal visual inspection when corroded and abraded areas were discovered on the crash cargo tank, as prescribed by 49 *CFR* 180.407(e)(3);
- Failure to perform a pressure retest, as prescribed by 49 *CFR* 180.407(g);
- Failure to perform an internal inspection using the wet magnetic particle inspection method, as prescribed by 49 *CFR* 180.407(g)(3);
- Failure to perform a leakage test, as prescribed by 49 *CFR* 180.407(h); and
- Failure to include required information on test and inspection reports, as prescribed by 49 *CFR* 180.417(b).[21]

FMCSA investigators noted that, during the review, one inspector employed by H&W stated that he did not enter cargo tanks to perform visual inspections.[22] FMCSA investigators also determined that H&W inspectors did not use calibrated testing equipment (they did not even possess such equipment) and failed to properly test the PRDs on cargo tanks. The NTSB notes that the lack of calibrated pressure testing equipment suggests that pressure testing may not have been conducted on the crash cargo tank as had been reported on the 2011 inspection form. The NTSB concludes that, taken together, the brittle manway gasket, missing bolts, undocumented corrosion, failure to replace a recalled PRD, use of a PRD beyond its service life, and lack of proper inspection equipment indicate that the cargo tank inspections performed by H&W were not adequate and resulted in potentially unsafe cargo tank vehicles continuing to operate on public roadways.

[20] This inspector had not been trained at any point since being hired in October 2003; the violation was also noted in the 2015 audit and had not been corrected within 30 days, as directed.

[21] Investigators noted that the cargo tank serial number, specification number, and maximum allowable working pressure were missing from one report.

[22] Visually inspecting the inside of a cargo tank requires the inspector to enter the tank.

In recognition of a pattern of testing deficiencies at H&W, the FMCSA took the unusual step of issuing a safety advisory in April 2016 regarding the cargo tanks inspected and tested by H&W and its employees between April 2011 and March 2016 (FMCSA 2016). The action affected about 230 cargo tanks. The advisory required owners and operators of these cargo tanks to have them immediately reinspected and/or retested in accordance with 49 *CFR* 180.407 by another facility registered with the FMCSA and to submit documentation of such completed inspections to the FMCSA. The advisory warned that it was a violation of the Hazardous Materials Regulations to use these vehicles for the transportation of hazardous materials before they had been reinspected and/or retested.

About 144 of the 230 cargo tanks were reinspected.[23] Of those 144 cargo tanks, the following 3 failed reinspection:

- An MC331 cargo tank, inspected by H&W in April 2015, was found when reinspected by a different company in April 2016 to have a 20-year-old PRD, a delivery hose with extensive cracking, and corrosion that resulted in a tank wall thickness of less than half the minimum requirement;

- An MC331 cargo tank, inspected by H&W in June 2014 and May 2015, was found when reinspected by a different company in May 2016 to have a completely broken off baffle, several leaking valves, a worn delivery hose, an unreadable pressure gauge, leaking seals, and rollover protection welded directly to the tank wall; and

- A MC331 cargo tank, inspected by H&W in March 2016, was found when reinspected by a different company in May 2016 to have leaking valves and a substantial amount of rust and debris inside the tank.

In addition, the reinspections uncovered faded decals, leaks, hoses in poor condition, damaged or inoperable gauges, and improper documentation. Had H&W performed adequate inspections and identified these issues, the deficiencies should have been corrected or the cargo tanks should have been immediately removed from service. Instead, the H&W test and inspection reports for these cargo tanks indicated "no defect or damage discovered."

In June 2016, the FMCSA finalized its review of H&W and issued a Notice of Claim to the company for $35,750 for two violations of 49 *CFR* 172.704(c)(2)—failing to retrain hazardous materials employees every 3 years, and five violations of 49 *CFR* 180.407(e)—failing to perform an internal visual inspection as prescribed. As of December 12, 2017, both H&W's DOT number and its cargo tank facility number were inactive.[24]

[23] The FMCSA received 144 inspection reports. Five letters to cargo tank owners were returned as undeliverable. For the remaining cargo tanks, either the business was no longer operating, the tank had been sold or taken out of service, the reinspection was not performed, or the report was not sent to the FMCSA.

[24] The DOT number for H&W is voluntarily inactive; it is not inactive as a result of enforcement action.

2.2.5 State Action Taken Against H&W

Apart from the federal action, the state of Alabama also took enforcement action against H&W following this crash. The purpose of the Alabama Liquefied Petroleum Gas Board (ALPGB) is stated to be—

> The promotion of public safety, health, and general welfare of the people of Alabama through the enforcement of state and federal statutes related to the liquefied petroleum gas industry in the State of Alabama [ALPGB 2017].

The *Code of Alabama*, section 530, grants the ALPGB the power to make and enforce rules governing the design, construction, location, installation, and operation of containers, tanks, systems, and equipment for storing, utilizing, handling, and transporting LPG, as well as rules securing the substantial accuracy of all meters, safety devices, and regulators generally used in connection with such gases. On March 23, 2016, the ALPGB issued an order against H&W requiring the company to cease and desist all LPG-related inspection and testing activities in Alabama following its failure to demonstrate the capability to properly perform cargo test inspections.

2.2.6 Industrywide Inspection Issues

According to FMCSA investigators, the inspection deficiencies found at H&W are instances of a practice known to the cargo tank inspection industry as "licking and sticking," which is, in effect, falsifying cargo tank test reports and applying qualification stickers to insufficiently inspected cargo tanks. FMCSA inspectors told NTSB investigators that this practice is a widely known problem in the industry. Data from the FMCSA for 2015 and 2016, which are displayed in table 2, show how many inspection facilities, by both number and percentage of those examined, had the same violations of the Hazardous Materials Regulations as those committed by H&W (FMCSA 2017).

Table 2. Number and percentage of FMCSA-examined cargo tank inspection facilities with violations in common with those found at H&W (for 2015 and 2016).[a]

	2015		2016	
Violation	**Number**	**Percent**	**Number**	**Percent**
Missing required information on test/inspection report	45	51.7	42	58.3
Failure to retrain HM employee every 3 years	17	19.5	13	18.1
Failure to perform a pressure retest	16	18.4	20	27.8
Failure to perform an external visual inspection	15	17.2	11	15.3
Failure to perform a leakage test	10	11.5	7	9.7
Failure to perform a thickness test	4	4.6	2	2.8
Failure to perform a particle test	3	3.4	1	1.4
Failure to perform an internal visual inspection	1	1.1	2	2.8

[a] The FMCSA examined 87 facilities in 2015 and 72 facilities in 2016.

Additional FMCSA data show that the violations found at H&W have been issues across the industry for many years. Those data are summarized in table 3.

Table 3. Leading violations by cargo tank inspection industry for 2007–2016, with H&W violations highlighted.

Types of violations committed by cargo tank inspection industry by year, since 2007[a]

Issue	07	08	09	10	11	12	13	14	15	16
Missing information	X	X	X	X	X	X	X	X		X
Failure to retrain	X	X	X	X		X	X	X	X	X
No pressure retest	X	X	X	X	X	X			X	X
No external visual inspection	X		X	X	X	X	X	X	X	X
No leakage test		X	X	X	X		X	X	X	X
No thickness test	X	X							X	
No particle test	X						X	X		
No internal visual inspection		X			X					X

[a] An "X" indicates that the issue was a top violation that year; a shaded cell indicates that the issue was also found at H&W that year.

Based on these data, the NTSB concludes that the deficiencies found with H&W inspections demonstrate, and industry data from the FMCSA indicate, a consistent pattern of safety-critical violations across the cargo tank inspection industry.

The requirements for the qualification and maintenance of cargo tanks are contained in 49 *CFR* Part 180, subpart E. The term "requalification" refers to the periodic tests and inspections that must conducted on cargo tanks by a qualified inspector in accordance with the intervals prescribed in 49 *CFR* 180.407(c). On January 23, 2015, PHMSA published a notice of proposed rulemaking, which proposed amendments to update and clarify existing requirements of the Hazardous Materials Regulations.[25] The National Propane Gas Association (NPGA) filed a petition with PHMSA arguing that the 5-year requalification period for cargo tanks in propane service was a burden to the propane industry and cited a 2001 NPGA survey which found that none of the 203 respondents had experienced any 5-year hydrostatic test failures. In June 2016, PHMSA adopted a final rule that relaxed the standards for the continuing qualification and maintenance of cargo tank vessels by extending the interval from 5 years to 10 years for the visual inspection and pressure testing of MC330/331 cargo tanks in dedicated propane service with a water capacity of less than 3,500 gallons.[26]

The NTSB is concerned that this relaxation of requalification requirements for MC330/331 cargo tanks in dedicated propane service may not have been warranted. As documented by reinspections of cargo tanks affected by the FMCSA safety advisory, the H&W inspector's inadequate and/or false cargo tank test reports resulted in the release of unsafe cargo tanks into transportation. Further, FMCSA data suggest that inadequate inspections have been occurring

[25] See Docket No. PHMSA-2013-0225 (HM-218H); 80 *Federal Register* 3787.

[26] For the 2016 final rule, see "Hazardous Materials: Miscellaneous Amendments (RRR) Final Rule," 81 *Federal Register* 35484–35546.

frequently industrywide. For instance, the failure to perform a proper pressure retest has been a leading safety issue in the industry for 8 of the last 10 years. Increasing the inspection interval increases the risk that cargo tanks operating in transportation will have undetected faults, which could result in equipment failures and the release of hazardous materials. The NTSB concludes that, given the recent doubling of the length of the required inspection interval for some MC331 cargo tanks, conducting proper requalification inspections is more critical than ever for the safety of operators and the traveling public. To address this safety concern, the NTSB recommends that the FMCSA implement a compliance program for cargo tank facilities to enhance enforcement of the cargo tank requalification procedures specified by 49 *CFR* Part 180, subpart E.

2.3 Certification and Training of Cargo Tank Inspectors

Beyond the general problems with cargo tank inspection companies/facilities that were uncovered by the investigation, investigators also identified problems related to the H&W inspector, in particular, that he did not enter cargo tanks to perform visual inspections, despite being required to do so. Based on this investigation, this cargo tank inspector's lack of knowledge and skills allowed about 230 insufficiently inspected cargo tanks to be requalified and used for LPG transportation. When some of the cargo tanks were subsequently reinspected, they were found to have significant safety issues that should have placed them out of service. Use of these insufficiently inspected cargo tanks exposed their operators and the traveling public to a higher level of risk.

Of even greater concern is that data from the FMCSA suggest that this inspector may not be an anomaly in the inspection industry. In the 10 years from 2007 to 2016, failure to conduct recurrent training, as required; failure to perform visual inspections; incomplete documentation (missing information); and failure to perform required tests (pressure and leakage) were consistently among the top problems across the cargo tank inspection industry. The NTSB is concerned that this pattern suggests a systemic problem with the training and qualification of cargo tank inspectors.

2.3.1 Minimum Requirements for Inspectors

Federal regulations governing the minimum qualifications for cargo tank inspectors and testers can be found at 49 *CFR* 171.8 (under definitions: "registered inspector"), which defines a registered inspector as follows: [27]

> A person registered with the US Department of Transportation (DOT) in accordance with subpart F of Part 107 of this chapter who has the knowledge and ability to determine whether a cargo tank conforms to the applicable DOT specification. A *Registered Inspector* meets the knowledge and ability requirements of this section by meeting any one of the following requirements:

[27] The *CFR* requirements and language generally mirror the requirements in the *National Board Inspection Code*, which is published by the National Board of Boiler and Pressure Vessel Inspectors.

(1) Has an engineering degree and one year of work experience relating to the testing and inspection of cargo tanks;

(2) Has an associate degree in engineering and two years of work experience relating to the testing and inspection of cargo tanks;

(3) Has a high school diploma (or General Equivalency Diploma) and three years of work experience relating to the testing and inspection of cargo tanks; or

(4) Has at least three years' experience performing the duties of a registered inspector prior to September 1, 1991.

The fourth item, commonly known as the "grandfather provision," appeared in final rule HM 213,' which was issued in April 2003 by the Research and Special Programs Administration (RSPA).[28] HM 213 revised the definition of registered cargo tank inspector to permit an individual lacking the prescribed educational requirements to be recognized as a registered inspector; it also eliminated a requirement for individuals to have registered with the DOT before December 31, 1995. This provision was established in response to a petition from National Tank Truck Carriers Inc. (NTTC), which suggested that the inspector qualification and experience requirements were obstacles to attracting and retaining qualified tank maintenance personnel. The NTTC further suggested that the management of a cargo tank facility should be able to determine whether a person is sufficiently qualified to perform inspections under 49 *CFR* Part 180 (NTTC 2002).

2.3.2 Grandfather Provision

The H&W inspector who examined the cargo tank involved in this crash was qualified under the grandfather provision.[29] The NTSB is concerned about that provision and its associated rationale. First, leaving the decision as to whether a person is qualified to be an inspector to the management of a cargo tank facility may not sufficiently regulate small inspection entities in which the company's manager and the registered inspector are the same person—as was the case with H&W. Second, the oversight of this provision is poor. During this investigation, NTSB investigators asked the FMCSA for data on the number of inspectors qualified under the grandfather provision. Although it acknowledged that applicants continue to use the provision, the FMCSA was unable to provide the requested information; in fact, the FMCSA could not provide the total number of registered inspectors. Third, the FMCSA does not adequately check an inspector's background to confirm that he or she possesses the required experience. The application for a cargo tank registration number—which authorizes an individual to perform the duties of a registered inspector—does require the applicant to certify that he or she meets the minimum requirements, under the penalty of perjury, and warns that any representations made are

[28] (a) RSPA was established in 1992 as a DOT sub-agency focused on improving hazardous materials and pipeline safety, coordinating and advancing transportation research, promoting innovative transportation solutions, and managing the department's transportation-related emergency response and recovery responsibilities. RSPA was abolished on November 30, 2004, and some of its duties and responsibilities were transferred to PHMSA. (b) For the 2003 final rule, see Docket No. RSPA-98-3554 (HM 213); 68 *Federal Register* 19257–19291.

[29] The inspector stated that he started his business in 1988 after working for 2 years with a family member in Texas who was a registered inspector. FMCSA investigators determined that the inspector could not have met the requirements of any of the other three provisions addressing the requirements for a registered inspector.

subject to verification through inspection or records and documentation. However, no evidence of training or skills testing must be submitted before the issuance of a cargo tank registration number. Fourth, although when the rule was originally issued there may have been some justification for a grandfather provision, cargo tank inspectors currently operating under the provision have had ample opportunities over the 26 years since 1991 to become qualified by other means. Finally, as written, the provision allows individuals who performed cargo tank inspections for 3 years prior to 1991, but who may not have been performing them in the 26 years since then, to assert that they are qualified to perform them today.

Given the obvious issues with self-certification, the lack of tracking and oversight, and the poor wording of the provision, the NTSB concludes that the "grandfather provision" in 49 *CFR* 171.8 allows unqualified individuals to be certified to inspect cargo tanks, which poses an unacceptable safety risk.

Considering the safety risks associated with the certification of unqualified individuals and the reduced justification for the provision some 26 years after its adoption, the NTSB recommends that PHMSA revise the definition of "registered inspector" under 49 *CFR* 171.8 to eliminate the "grandfather provision," and develop and implement a process to ensure that all persons certified to inspect cargo tanks have the necessary knowledge, skills, and abilities to adequately perform inspections of cargo tanks to verify their safety.

2.3.3 Qualified Inspector Training

In addition to the problems identified with the qualification requirements for cargo tank inspectors and testers, the NTSB is concerned about the training of qualified cargo tank inspectors. As described above, federal regulations and industry guidelines both recognize that cargo tank inspectors must have a certain level of education and experience to effectively determine the safety of a cargo tank. Federal regulations go a step further; they require that, in addition to the initial education and experience, cargo tank inspectors undergo recurrent training at least once every 3 years. That training is to include job-specific training applicable to the functions performed under the Hazardous Materials Regulations. This investigation found that an H&W inspector had not been trained or retrained once during his 13 years with the company; he received no recurrent training even after the FMCSA specifically advised the company to train the employee within 30 days or cease inspections. Despite its auditing only a fraction of the country's cargo tank inspection facilities annually, the FMCSA has found that failure to properly train and qualify employees is a widespread industry problem; the issue has been among the top 20 violations cited every year since 2007.[30]

Additionally, the NTSB is concerned that some of the inspectors who appear to have had the required recurrent training may not be receiving training that meets the intent of the regulations. As with the grandfather provision, it is left to the company to determine whether the recurrent training taken is adequate. Nothing guarantees that the training—whether formal or informal, employer-developed or provided by another party—addresses the specific skills needed to perform effective cargo tank inspections. Therefore, the NTSB concludes that the existing system for

[30] In calendar years 2014 through 2016, the FMCSA annually audited between 59 and 87 (1.58 percent to 2.33 percent) of the country's approximately 3,730 cargo tank inspection facilities.

verifying the initial and recurrent training of cargo tank inspectors and testers does not ensure that they are adequately trained to perform cargo tank inspections.

To address the issues discovered, a training program for cargo tank inspectors should—

- Document both initial and recurrent training;
- Have successful completion of the training verified by an outside source;
- Be specifically oriented to the product being transported;
- Address the specific skills and knowledge inspectors should have;
- Contain an objective assessment of the inspector's knowledge and skills; and
- Include input from stakeholders, including suppliers, transporters, trade organizations, PHMSA, and the FMCSA.

The National Board of Boiler and Pressure Vessel Inspectors has developed the *National Board Inspection Code* (*NBIC*), which provides internationally recognized standards for the installation, inspection, and repair of pressure vessels and PRDs (National Board of Boiler and Pressure Vessel Inspectors 2017). Part 2 of the *NBIC* deals with the inspection of pressure-retaining equipment and provides information and guidance relating to personnel safety, nondestructive examination, tests, failure mechanisms, types of pressure equipment, fitness for service, risk-based assessments, and performance-based standards. Supplement 6 of Part 2 specifically addresses the continued service and inspection of DOT-specification transport tanks. The standard includes training qualifications for registered inspectors beyond those required by the Hazardous Materials Regulations, such as having successfully completed the national board's web-based training program for registered inspectors. Although the Hazardous Materials Regulations include *NBIC* references, they are limited to the 1992 edition requirements for repair, modification, stretching, rebarreling, and mounting of specification cargo tanks; the regulations do not reference the *NBIC* concerning minimum qualifications for inspectors and testers at 49 *CFR* 180.409, or under the definition of "registered inspector" at 49 *CFR* 171.8. Accordingly, the NTSB recommends that the FMCSA work with PHMSA to incorporate by reference the registered inspector training requirements of the existing industry cargo tank inspection code into the Hazardous Materials Regulations. The NTSB issues a corresponding recommendation to PHMSA.

2.3.4 Rescinding Inspector Registrations

After this crash, the state of Alabama ordered H&W to cease and desist all LPG-related inspection and testing activities in the state. Following the FMCSA review, the DOT number for H&W became inactive, indicating that the company is no longer in business.

However, neither action prevented the individual inspectors employed by H&W from continuing to work for other companies or on their own. While acting against a company with a questionable safety history is appropriate, the NTSB concludes that allowing cargo tank inspectors who have performed inadequate inspections that permitted potentially unsafe cargo tanks to remain

operating on the roadways to continue to perform inspections decreases safety and increases the risk to operators and the traveling public.

The FMCSA may currently suspend or revoke cargo tank inspector registrations either through an injunction or by declaring an imminent hazard. Injunctions are described as follows in 49 *CFR* 386.71:

> Whenever it is determined that a person has engaged, or is about to engage, in any act or practice constituting a violation of section 31502 of title 49, *United States Code*; of the Motor Carrier Safety Act of 1984; the Hazardous Materials Transportation Act; or any regulation or order issued under that section or those Acts for which the Federal Motor Carrier Safety Administrator exercises enforcement responsibility, the Chief Counsel may request the United States Attorney General to bring an action in the appropriate United States District Court for such relief as is necessary or appropriate, including mandatory or prohibitive injunctive relief, interim equitable relief, and punitive damages, as provided by section 213(c) of the Motor Carrier Safety Act of 1984 and section 111(a) of the Hazardous Materials Transportation Act (49 USC 507(c) 5122).

Thus, an injunction requires high-level action by the FMCSA and the involvement of the US Attorney General and a district court. Such a process is both cumbersome and lengthy, and, while the necessary procedures are being fulfilled, the subject of the injunction may continue to work or operate. The NTSB was unable to find any indication that the FMCSA has ever used this process against a cargo tank inspector.

The second available method of suspending or revoking registration, by declaring an imminent hazard, is described at 49 *CFR* 386.72. Title 49 *CFR* 386.72(b)(1)(i) states that for violations of section 31502 of Title 49, *United States Code*, of the Motor Carrier Safety Act of 1984; the Hazardous Materials Transportation Act; or any regulation or order issued under that section or those acts for which the FMCSA Administrator exercises enforcement responsibility, the FMCSA shall order—

> A commercial motor vehicle or employee operating such vehicle out-of-service, or order an employer to cease all or part of the employer's commercial motor vehicle operations, as provided by 49 USC 521(b)(5).

By its referring specifically to "an employee operating such vehicle," this language can be interpreted to exclude cargo tank inspectors, because they do not operate the commercial motor vehicle. The language is unclear as to whether a cargo tank inspector could be declared an imminent hazard. Again, the NTSB could find no indication that a cargo tank inspector has ever been declared an imminent hazard. After examining the options of using injunctions and the imminent hazard process, the NTSB concludes that the FMCSA does not have a clear and rapid way to suspend or revoke the registrations of highway cargo tank inspectors.

The DOT's need to have the regulatory authority to take action against a person's certification has been recognized in other modes of transportation. For example, when the Rail Safety Advisory Committee of the Federal Railroad Administration proposed a new section for

49 *CFR* Part 107, titled "Revocation for Cause," to allow for the revocation of rail tank car facility certifications, PHMSA stated that it recognizes the need for similar language and authority for highway cargo tank facilities and inspectors. The proposed authority change is currently in the rulemaking process.

Given the lack of a clear and rapid way to suspend cargo tank inspector registrations and the recognized need for such authority in other modes, the NTSB recommends that PHMSA revise 49 *CFR* Part 180, subpart E, to permit the suspension or revocation of the registrations of highway cargo tank inspectors for failing to meet the requirements of that subchapter.

3 Conclusions

3.1 Findings

1. The truck-tractor did not experience a tire blowout preceding the crash.

2. The release of the cargo tank's contents was due to the puncture of the front tank head by impact with a rock; the rupture of the tank and subsequent release and ignition of propane increased the severity of the crash outcome.

3. The combination vehicle driver overcorrected after encroaching into the opposing traffic lane, which, in part because of excessive speed, led to the loss of vehicle control that preceded the crash.

4. The recorded repeated overloading of cargo tanks by the crash driver resulted from his routinely entering loading amounts that exceeded the maximum specified loads for the cargo tanks on his vehicles' semitrailers.

5. The oversight of driver loading at Enterprise Propane Terminals and Storage is lacking and does not ensure compliance with cargo tank filling limits.

6. Taken together, the brittle manway gasket, missing bolts, undocumented corrosion, failure to replace a recalled pressure relief device (PRD), use of a PRD beyond its service life, and lack of proper inspection equipment indicate that the cargo tank inspections performed by H&W Tank Testing Company Inc. were not adequate and resulted in potentially unsafe cargo tank vehicles continuing to operate on public roadways.

7. The deficiencies found with H&W Tank Testing Company Inc. inspections demonstrate, and industry data from the Federal Motor Carrier Safety Administration indicate, a consistent pattern of safety-critical violations across the cargo tank inspection industry.

8. Given the recent doubling of the length of the required inspection interval for some MC331 cargo tanks, conducting proper requalification inspections is more critical than ever for the safety of operators and the traveling public.

9. The "grandfather provision" in Title 49 *Code of Federal Regulations* 171.8 allows unqualified individuals to be certified to inspect cargo tanks, which poses an unacceptable safety risk.

10. The existing system for verifying the initial and recurrent training of cargo tank inspectors and testers does not ensure that they are adequately trained to perform cargo tank inspections.

11. Allowing cargo tank inspectors who have performed inadequate inspections that permitted potentially unsafe cargo tanks to remain operating on the roadways to continue to perform inspections decreases safety and increases the risk to operators and the traveling public.

12. The Federal Motor Carrier Safety Administration does not have a clear and rapid way to suspend or revoke the registrations of highway cargo tank inspectors.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the Stroud, Alabama, crash was the combination vehicle driver's overcorrection while traveling on a curve, after he had encroached into the opposing lane of traffic. Contributing to the crash was the driver's excessive speed. Contributing to the severity of the crash outcome was the rupture of the tank and subsequent release and ignition of propane.

4 Recommendations

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

To the Federal Motor Carrier Safety Administration:

Implement a compliance program for cargo tank facilities to enhance enforcement of the cargo tank requalification procedures specified by Title 49 *Code of Federal Regulations* Part 180, subpart E. (H-18-1)

Work with the Pipeline and Hazardous Materials Safety Administration to incorporate by reference the registered inspector training requirements of the existing industry cargo tank inspection code into the Hazardous Materials Regulations. (H-18-2)

To the Pipeline and Hazardous Materials Safety Administration:

Revise the definition of "registered inspector" under Title 49 *Code of Federal Regulations* 171.8 to eliminate the "grandfather provision," and develop and implement a process to ensure that all persons certified to inspect cargo tanks have the necessary knowledge, skills, and abilities to adequately perform inspections of cargo tanks to verify their safety. (H-18-3)

Work with the Federal Motor Carrier Safety Administration to incorporate by reference the registered inspector training requirements of the existing industry cargo tank inspection code into the Hazardous Materials Regulations. (H-18-4)

Revise Title 49 *Code of Federal Regulations* Part 180, subpart E, to permit the suspension or revocation of the registrations of highway cargo tank inspectors for failing to meet the requirements of that subchapter. (H-18-5)

To Enterprise Propane Terminals and Storage LLC:

Develop and implement an oversight procedure at your liquefied petroleum gas loading facilities. The procedure should include periodic audits of driver compliance with loading limit requirements and corrective action, such as retraining and/or suspending drivers, when necessary. (H-18-6)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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Adopted: January 23, 2018

Appendix: Investigation

The National Transportation Safety Board (NTSB) received notification of this crash on March 18, 2016. In response, the NTSB Offices of Highway Safety and of Railroad, Pipeline, and Hazardous Materials conducted a limited launch, sending three investigators to carry out a focused investigation, with emphasis on the performance and structural failure of the MC330 cargo tank. Investigators addressed the subject areas of motor carrier factors, hazardous materials, and materials.

Parties to the investigation were the Federal Motor Carrier Safety Administration and the Alabama Liquefied Petroleum Gas Board.

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