Assignment

The following document lists a number (18, to be exact) of accidents involving toxic and/or hazardous materials. The first set includes some interesting recent and possibly local accidents for which I am not giving you very much information. The second set of accidents are reasonably well documented by the National Transportation Safety Board (variable information, so I tried to assign each of you examples with a variety of available data). Each of you will examine one example from the recent spill list, plus two from the better documented list, as follows:

<table>
<thead>
<tr>
<th>Recent Spill</th>
<th>NTSB Reported Spills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bobby Elliott</td>
<td>A</td>
</tr>
<tr>
<td>Rafi Khawaja</td>
<td>F</td>
</tr>
<tr>
<td>Matt Walker</td>
<td>C</td>
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<tr>
<td>Yukio Nara</td>
<td>D</td>
</tr>
<tr>
<td>Amy Stewart</td>
<td>B</td>
</tr>
<tr>
<td>Jason Kirby</td>
<td>E</td>
</tr>
</tbody>
</table>

I would like you to prepare preliminary evaluations for each of the three spills assigned to you (chemical, site, and evaluation information). These will include descriptions of the material involved in the accidents (summarize standard hazardous information and chemical characteristics for the chemicals involved), the amounts of material lost, the damage and effects caused, numbers of people involved, etc. In addition, I want you to outline how you would calculate the resulting concentrations and exposure durations for the accidents. Since we haven’t
started with chapter 4 yet, some of the information will probably have to wait until near the end of the working period for this assignment. Basically, I want you to determine the data needs for complete evaluations for these accidents, and obtain as much of the needed data as possible, and note the missing information and how that might be obtained. You can do some preliminary calculations using the material we have covered in chapters 1 through 3 (and some of 4). Your final exam will include a more detailed evaluation of one of the 3 accidents, including long-term social problems associated with the incident.

We have just completed the 5th week of the term, out of 15 weeks (not as far behind as I had feared). This mid term assignment will be due in 3 weeks, on October 16. Obviously, we will also have other module assignments during this period. Since I am giving you a rather long time to do this assignment, I expect a decent job. You should be able to do a pretty through search for accident, chemical, and site data during this time, and understand your problems pretty well. I will want a concise report (say, 15 pages, max) plus a presentation that you will give to the class.

**Recent Spills of Toxic or Hazardous Materials**

A. Howard Street railroad tunnel fire in Baltimore (a couple of years ago).

B. Knoxville train derailment (recent).

C. Fire at the BASF plant in Freeport, Texas. A railroad car containing ammonia leaked and exploded (this September?).

D. Birmingham, AL, Dursban pesticide spill associated with large warehouse fire, affecting Village Creek and Bay View Lake (a few years ago).

E. Tuscaloosa, AL, small industrial chemical spill on Warrior River (last summer).

F. Birmingham, AL, sewage trunk line failure discharging raw sewage into Village Creek for several weeks (a few years ago).
Executive Summary: About 3:45 a.m., eastern daylight time, on July 14, 2001, at the ATOFINA Chemicals, Inc., (ATOFINA) plant in Riverview, Michigan, a pipe attached to a fitting on the unloading line of a railroad tank car fractured and separated, causing the release of methyl mercaptan, a poisonous and flammable gas. About 4:09 a.m., shortly after the Riverview Fire Department chief arrived on scene, the methyl mercaptan ignited, engulfing the tank car in flames and sending a fireball about 200 feet into the air. Fire damage to cargo transfer hoses on an adjacent tank car resulted in the release of chlorine, a poisonous gas that is also an oxidizer. The fire was extinguished about 9:30 a.m. Three plant employees were killed in the accident. There were several other injuries; most of the injured were treated for respiratory symptoms and released. About 2,000 residents were evacuated from their homes for about 10 hours. Two tank cars, railroad track, and plant equipment (including hoses and fittings) were damaged in the fire.

The National Transportation Safety Board determines that the probable cause of the accident involving the release of methyl mercaptan from a tank car at the ATOFINA Chemicals, Inc., plant in Riverview, Michigan, was a fractured cargo transfer pipe that resulted from (1) the failure of ATOFINA to adequately inspect and maintain its cargo transfer equipment, and (2) inadequate Federal oversight of unloading operations involving hazardous materials. Contributing to the accident were ATOFINA’s reliance on a tank car excess flow valve to close in the event of a leak from cargo transfer equipment and the company’s failure to require appropriate safety equipment for employees involved in tank car loading and unloading operations.

As a result of its investigation of the accident, the National Transportation Safety Board identified the following safety issues:

- The adequacy of ATOFINA’s procedures for unloading tank cars containing hazardous materials.
- The adequacy of Federal regulations and oversight for cargo transfer operations involving bulk containers transporting hazardous materials.

As a result of its investigation of this accident, the Safety Board makes safety recommendations to the U.S. Department of Transportation, the Federal Railroad Administration, the Environmental Protection Agency, and the Occupational Safety and Health Administration.
Abstract: About 12:05 a.m. on February 18, 1999, railroad tank car UTLX643593, which was on the west unloading rack at the Essroc Cement Corporation (Essroc) Logansport cement plant near Clymers, Indiana, sustained a sudden and catastrophic rupture that propelled the tank of the tank car an estimated 750 feet and over multistory storage tanks. The 20,000-gallon tank car initially contained about 161,700 pounds (14,185 gallons) of a toxic and flammable hazardous waste that was used as a fuel for the plant's kilns. There were no injuries or fatalities. Total damages, including property damage and costs from lost production, were estimated at nearly $8.2 million.

The National Transportation Safety Board determines that the probable cause of the accident was the failure of Essroc Cement Corporation and CP Recycling of Indiana management to develop and implement safe procedures for offloading toluene diisocyanate matter wastes, resulting in the overpressurization of the tank car from chemical self-reaction and expansion of the toluene diisocyanate matter wastes.

This report discusses the following safety issues:

- Sufficiency of safety requirements addressing the procedures used for loading and offloading railroad tank cars and other bulk containers used to transport hazardous materials;
- Adequacy of inspection and testing requirements for pressure relief devices on railroad tank cars;
- Adequacy of provisions addressing changes in product service for railroad tank cars; and
- Adequacy of the U.S. Department of Transportation Hazardous Materials Regulations pertaining to the notification and reporting of hazardous materials incidents.

As a result of its investigation of this accident, the Safety Board makes recommendations to the Federal Railroad Administration, the Research and Special Programs Administration, the Association of American Railroads, the Railway Progress Institute, the Lyondell Chemical Company, the Olin Corporation, the Essroc Cement Corporation, and CP Recycling, Inc., and Affiliated Companies. The Safety Board also reiterates one recommendation to the Research and Special Programs Administration.
Overflow of Gasoline and Fire at a Service Station-Convenience Store, Biloxi, Mississippi
August 9, 1998

NTSB Number HZM-98/02
NTIS Number PB99-917007
PDF Document (878K)

Abstract: On August 9, 1998, about 12:53 a.m., a Premium Tank Lines, Inc., truck driver was transferring gasoline from a cargo tank to underground storage tanks at a Fast Lane gasoline station-convenience store in Biloxi, Mississippi, when an underground storage tank containing gasoline overflowed. An estimated 550 gallons of gasoline flowed from the storage tank, across the station lot into the adjacent highway, through an intersection, and into a storm drain. The gasoline ignited, and fire engulfed three vehicles near the intersection, which ultimately resulted in the deaths of five occupants and the serious injury of one. Damages were estimated at $55,000.

The National Transportation Safety Board determines that the probable cause of the accident was the failure of Premium Tank Line, Inc.’s officials to follow established company procedures in hiring and training new drivers, the company’s lack of adequate procedures for dispatching drivers and delivering cargo to customer facilities, and the failure of R.R. Morrison and Son, Inc., to have adequate safety procedures for accepting product offered for delivery at its Fast Lane stations. Contributing to the accident was the truckdriver’s various and numerous operating errors during the gasoline transfer process that led to the underground storage tank overfill.

The following safety issues are discussed in this report:

- Premium Tank Line, Inc.’s management oversight;
- R.R. Morrison and Son, Inc.’s procedures for accepting petroleum product deliveries to underground storage tanks; and
- Federal requirements and oversight.

As a result of its investigation of this accident, the Safety Board makes recommendations to the Federal Highway Administration, the Research and Special Programs Administration, the Environmental Protection Agency, Premium Tank Lines, Inc., R.R. Morrison and Son, Inc., the American Petroleum Institute, the National Tank Truck Carriers Association, the National Association of Convenience Stores, the National Association of Truck Stop Operators, the Petroleum Marketers Association of America, the Service Station Dealers of America, and the Society of Independent Gasoline Marketers of America.

Failure of Tank Car TEAX 3417 and Subsequent Release of Liquefied Petroleum Gas, Pasadena, Texas, November 22, 1997

NTSB Number HZM-98/01/SUM
NTIS Number PB98-917007
PDF Document (458K)

Abstract: On November 22, 1997, a frost ring that signified product leakage was discovered on the bottom center of a tank car that was being unloaded at the Georgia Gulf Corporation chemical plant in Pasadena, Texas. The tank car contained 29,054 gallons of a propylene/propane mixture, a liquefied flammable gas. The tank car had been purged with cryogenic nitrogen on October 17, about a month before the accident. No injuries or fatalities were reported as a result of the failure of the tank car. Georgia Gulf estimated that approximately 52 gallons of the cargo were released. Total damage, including the cost of the clean up, loss of product, and repair of the tank car, was estimated to be slightly less than $9,300.

The safety issues discussed in this report are the need to safeguard tank cars adequately when they are being purged with nitrogen and the use of engineering analyses of the properties of tank car steels in the development of industry-recommended procedures for the purging of tank cars with nitrogen.

As a result of its investigation, the National Transportation Safety Board issued recommendations to the Compressed Gas Association, Inc., the Federal Railroad Administration, and the Association of American Railroads.
5. Rail Car Cargo Loss of Carbon Disulfide, a Flammable and Toxic Gas, Tennessee, 1996

**Accident No.:** DCA-96-MZ-002  
**Transportation Mode:** Rail  
**Type of Accident:** Tank car failure and release of flammable and toxic liquid  
**Location:** Sweetwater, Tennessee  
**Date and Time:** February 7, 1996; 5:30 a.m.  
**Carrier:** Norfolk Southern Railway Company  
**Shipper:** Akzo Nobel Chemical Company, Inc.  
**Tank Car Specification:** DOT 111A100W1  
**Tank Car Manufacturer:** General American Transportation Corporation  
**Injured:** 4 people treated and released; 1 person admitted  
**Evacuated:** Approximately 500 people  
**Material Released:** Carbon disulfide, flammable liquid (toxic)  
**Type of Failure:** Circumferential fracture

**The Accident**

About 5:00 a.m. eastern standard time on February 7, 1996, in Sweetwater, Tennessee, Norfolk Southern eastbound train M34T5 stopped on the main track to allow a westbound train to pull onto a siding. About 5:30 a.m., as the engineer began to move his train forward, an uncommanded emergency brake application occurred. The train had moved about 33 feet and reached a speed of about two mph. When the train conductor walked back to determine the cause of the emergency brake application, he discovered that tank car GATX 92414 had separated almost completely into two halves near the middle of the tank and that about 8,000 gallons of carbon disulfide, a flammable and toxic material, had spilled. As a result of the spill, about 500 people were evacuated from the area, including residents of a nursing home. Five people were seen at a local hospital, but only one person was admitted.

About noon on February 9, 1996, emergency crews determined that the released carbon disulfide did not pose a problem outside the immediate area of the tank car, and the evacuation order was lifted. The Sweetwater Fire Department then relinquished control of the site to the Environmental Protection Agency on-scene coordinator (EPA OSC), and the focus of the activities at the site became environmental cleanup and product recovery.

About 4:45 p.m. on February 9, the EPA OSC decided to permit access to the tank car to examine the fracture surfaces before the tank was moved. Initially, polyethylene tarpaulins and plywood were placed over the spill area near the failed tank car. However, at 10:00 p.m., after discussions with the chemical shipper, Akzo Nobel Chemicals, Inc., the EPA OSC became concerned that the polyethylene tarpaulin and plywood could trap pockets of carbon disulfide vapors, which could possibly be ignited by people walking over the tarpaulin.

At 1:40 a.m. on February 10, as Norfolk Southern contractor personnel were attempting to remove the tarpaulin, a flash fire occurred. Four contractor personnel were caught in the flash fire, but because the fire was of short duration and the flames were low to the ground, no injuries resulted. Sweetwater emergency response agencies were not on scene at the time, but the Sweetwater fire chief resumed control of the site shortly after this fire and initiated a second area-wide evacuation. On February 12, following cleanup activities at the site, this evacuation was lifted.

**The Tank Car**

Tank car GATX 92414 was built in 1969 by the General American Transportation Corporation (GATC) as a Department of Transportation (DOT) specification 111A100W1 stub-sill tank car. The tank was constructed of ASTM A-515-70 steel with a minimum thickness of 7/16 inch. A 1986 Federal Railroad Administration (FRA) task force report noted that this steel has a ductile-to-brittle transition temperature of 30°F. The ambient temperature at the time of the accident was about 24°F, and the temperatures in the region the night before had been even lower.
On July 1, 1974, the Association of American Railroads (AAR) revised freight car design requirements because of increased train loads and evidence that the tanks of some stub-sill tank cars, primarily those built by GATC, were prone to buckling near the stub sills. In 1975, the AAR established voluntary provisions that would permit existing tank cars to be modified and approved as meeting the new standards. By July 1990, after determining that tank buckling was still occurring on unmodified cars, the AAR required that all such tank cars be modified in order to remain in normal rail service.

In response to the new standards, GATC initiated a long-term program to modify its stub-sill tank cars through the addition of reinforcement bars. In 1990, tank car GATX 92414 was sent to the GATC tank car shop at Hearne, Texas, to have reinforcement bars welded to the bottom of the tank. The modification design called for two continuous outer reinforcement bars extending along the entire length of the tank and one discontinuous center bar extending from either end of the car to almost the middle of the tank. (See figure 1A.) The two outer bars were designed to carry most of the live-load stresses on the car. According to the design, metal "pads" were to be welded to the bottom of the tank, and the reinforcement bars were to be filet welded, along their entire length, to these metal pads.

Postaccident examination of GATX 92414 revealed that neither of the two outer reinforcement bars extended the length of the tank. (See figure 1B.) Instead, all three bars were discontinuous, stopping in the middle of the tank within inches of the center sump plate, and each bar had welds near its termination point. Because records for the modification of GATX 92414 were discarded after 5 years, as allowed by Federal regulation, no records exist to explain why the reinforcement bars were not attached according to the modification design.

According to GATC, in response to changes in the AAR’s quality assurance requirements, the company in 1993 established a written quality assurance program, enhanced its training programs, and developed more detailed work cards that identify procedures used for tank car modifications. The company said that both shop and quality control personnel are now responsible for ensuring that tank car repairs are performed in accordance with the GATC requirements, specifications, and engineering designs.

Tank Car Failure -- Postaccident examination of the fracture surface revealed that the majority of the surface contained chevron markings typical of an overstress fracture that pointed to a fracture origin area at the lower center portion of the tank shell in the area of two small preexisting cracks. The largest crack measured approximately 0.41 inch long at the tank surface and was about 0.18 inch deep. The other crack measured approximately 0.27 inch long at the outer surface and was about 0.1 inch deep. These cracks were at or near the tips of two filet welds on the end of the pad for one of the reinforcement bars near the center of the tank. (See Figure 1B.) A small band area in the cracked region adjacent to the overstress fracture had features indicative of fatigue propagation; however, most of the surface of the two cracks was covered with black oxide deposits of the type typically formed when steel is subjected to extreme heat, such as the heat of welding. The fracture surface outside the crack regions was mostly cleavage indicative of a brittle fracture.

FRA Study of Bottom Reinforcement Bars

A 1987 FRA task force report entitled DOT-111A/100W Tank Cars Special Retrofit Stiffener Integrity Assessment concluded that a discontinuous stiffener, or a bottom reinforcement bar, in conjunction with a weld end, would decrease the safe crack growth life and safe inspection period by a factor of 8.... Another way to view this result is to note that, for [inspection] intervals of practical use, the stiffener discontinuity creates a stress concentration sufficient to allow undetectable cracks to grow to failure under normal service conditions.

The report also stated that a discontinuous stiffener that ends in the middle third of the tank increases the stress in the middle of the tank and poses an unacceptable risk to the shell integrity.

Postaccident Actions
Tank Car Inspections -- After the accident, GATC identified 97 tank cars still in rail service that were similar in design and construction to GATX 92414. The AAR issued several mechanical advisories, and by September 1996, all 97 tank cars had been stopped and inspected; 14 of the cars had discontinuous bars, and 9 cars were found with cracks at the reinforcement bar welds. By December 1997, all tank cars containing discontinuous reinforcement bars and weld cracks had been scrapped.

To determine the extent to which the problem affected other modified GATC tank cars, the FRA, the AAR, and GATC performed a 2-week focused inspection of tank cars built by GATC before 1974 and later modified. From a total of 6,000 such cars, 739 were randomly selected and inspected to determine whether other modifications had occurred which resulted in the installation of discontinuous reinforcement bars when the modification design called for continuous bars. No such modifications were found.

In June 1997, GATC developed fleet maintenance instructions directing that the 18,427 tank cars the company built between 1969 and 1982 be inspected at the time of their next shopping for any reason. Cars fitted with reinforcement bars are to be inspected for cracks at bar terminations, welds, and pads, and any cracks found are to be repaired. This program goes beyond 49 CFR 180.509(e), which requires that this inspection be performed during prescribed periodic inspections.

Emergency Response -- According to the EPA, all of its on-scene coordinators are now being trained to include local emergency response agencies, such as the Sweetwater Fire Department, in all decisions and actions taken at a spill site. The U. S. National Response Team, of which EPA is a primary member, issued, in June 1996, a technical assistance document titled "Incident Command System/Unified Command" to help accomplish such coordination.

Sweetwater emergency response agencies have taken several initiatives following this accident to enhance their overall response capability, including providing training in incident command and control organizational procedures, funding a new police/fire central communication facility, developing a list of available hazardous materials specialists, and developing a city mass casualty plan.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the failure of tank car GATX 92414 was the installation of discontinuous bottom reinforcement bars, which concentrated stresses on preexisting welding-induced cracks in the middle of the tank. Contributing to the severity of the failure was the brittleness of the tank steel, which promoted the rapid propagation of the overstress fracture and led to an almost complete separation of the tank.

Adopted: April 20, 1998

Accident No.: DCA-96-MZ-001
Transportation Mode: Rail
Type of Accident: Tank car failure and release of poisonous and corrosive vapors
Location: Gaylord Chemical Corporation, Bogalusa, Louisiana
Date and Time: October 23, 1995, about 4:45 p.m.
Shipper: Vicksburg Chemical Company
Tank Car Specification: DOT 105A500W
Tank Car Manufacturer: Union Tank Car Company
Injured: 4,710 people were treated at area hospitals, of whom 81 were admitted
Evacuated: Approximately 3,000 people
Material Released: Nitrogen tetroxide, a poisonous material (oxidizer)
Type of Failure: Corrosion

Accident Narrative

At 3:55 p.m. on October 23, 1995, at the Gaylord Chemical Corporation plant in Bogalusa, Louisiana, yellow-brown vapors began leaking from the dome of the DOT class 105A railroad tank car UTLX 82329 that contained a mixture of nitrogen tetroxide, which is a liquefied poisonous gas and oxidizer, and water. The vapors initially formed a plume between 10 and 15 feet in diameter. Plant personnel notified emergency response agencies and used two plant fire hoses to spray water into the plume to suppress the vapors. About 4:30 p.m. Bogalusa fire personnel arrived at the plant and set up fire hoses to help suppress the vapors.

The head on the B-end of the tank car failed about 4:45 p.m., resulting in one end of the tank car jacket being torn away and thrown about 350 feet. The tank car was then propelled 35 feet down the track and derailed at a track bumping block. A large reddish-brown vapor cloud was released from the tank car. Vapors continued to be released from the opening in the tank car for another 36 hours until the chemical reaction that had occurred within the tank was brought under control through neutralization and dilution.

Some 3,000 people were evacuated from the area as a result of the vapor cloud. Of 4,710 people who were treated at local hospitals, 81 people were admitted.

Events Preceding the Accident

On September 14, 1995, nitrogen tetroxide vapors had leaked at a valve on the tank car while it was at the Gaylord plant. A mechanic sprayed water to suppress the vapors and then directed the water stream onto the valve stem as the tank car was unloaded. When the water was turned off could not be determined. Another mechanic stated that the water was no longer being applied over the valve on September 22, when employees of the Union Tank Car Company (manufacturer and owner of the tank car) arrived at the plant to replace the valve; they replaced four valves. Postaccident examination of those valves removed from the tank car disclosed that one valve stem had significant wear.

The tank car was moved to the Vicksburg Chemical Company in Vicksburg, Mississippi, on September 26, for another load of nitrogen tetroxide. On October 5, the chemical company recorded that the tare weight of this tank car was 9,500 pounds over the marked weight for the tank car. A Vicksburg employee noticed the new valves on the tank car and assumed that the car had been rebuilt and that the tank car’s trucks had been replaced, thus changing the weight. He did not, however, verify these assumptions. The tank car was then filled with approximately 10,000 gallons (110,000 pounds) of nitrogen tetroxide. A quality check had been conducted on the nitrogen tetroxide before it was transferred to the tank car, and it was found to meet the specifications of the Gaylord Chemical Corporation.
No quality check was performed on the material after it was loaded into the tank car. The loaded tank car was returned to Gaylord.

On October 12, Gaylord mechanics began transferring nitrogen tetroxide from the tank car to a storage tank. While this transfer was taking place, the material in the storage tank was simultaneously being transferred into the plant. At 9 a.m., the process safety interlocks shut down the chemical reactor. Gaylord’s investigation into the cause of the chemical reactor shutdown revealed that the nitrogen tetroxide had been contaminated with water. To prevent corrosion damage from nitric acid, which results when water reacts with nitrogen tetroxide, Gaylord decided to transfer the contaminated material from the tank car and storage tank into stainless steel highway cargo tank trailers. A meter was used to measure the amount of product transferred from the tanks. A pressure gauge with a maximum calibrated pressure of 100 psig was used to monitor the internal pressure of the tank car.

Overnight, between October 12 and 13, the meter indicated that 10,100 gallons of product were transferred from the tank car into two cargo tanks. No other check was made on the tank car or the cargo tanks before the accident to determine how much material had been transferred. When the transfer operation was stopped, a material sample was taken from the transfer system; the sample contained a small amount of green liquid with foam. At 4 a.m. on October 13, Gaylord employees believed the tank car was empty, except for a small amount of residual material that could not be pushed up through one of the eduction pipes, and water was added to the tank car to dilute this residual material. Postaccident weighing of the material loaded into the two cargo tanks revealed that only 491 gallons (6,080 pounds) had been transferred. Postaccident examination of the tank car showed that the carbon steel eduction pipes had corroded and that only a small section of each, near the top of the tank, remained.

No work was performed on the tank car for several days while Gaylord employees were cleaning, testing, and inspecting the plant storage tank. On October 16, Gaylord determined that the vapors coming from the tank car were excessive, indicating that the material in the tank car was not dilute enough to permit discharge of the residual material into the plant sewer system. Plans were made to transfer the residual material into another cargo tank, but these plans were changed when vapors started leaking from the manway of another cargo tank that had been filled with material from the storage tank. Gaylord determined that several cargo tanks had gaskets and valves that were not appropriate for nitrogen tetroxide and fuming nitric acid and between October 17 and 20 replaced these gaskets and valves.

On October 19, material samples obtained from the tank car and the three cargo tanks were taken to the Vicksburg Chemical Company for chemical analysis. Gaylord employees began the transfer of the material remaining in the tank car on October 20, and by 6 p.m. that day, the meter indicated that 6,700 gallons of material had been transferred from the tank car to a cargo tank. At the conclusion of the transfer, a material sample taken from the transfer system was observed to contain foam and a very small amount of green liquid. Postaccident weighing of the material loaded into this cargo tank revealed that only about 850 gallons (10,520 pounds) of material had been transferred.

Water was added to the tank car using a fire hose to purge and clean it; the addition of water was discontinued when the internal pressure of the tank car rose to between 60 and 65 psig. Gaylord employees vented the vapors from the tank car through the plant scrubber to lower the pressure in the tank car. Later on the evening of October 20, Gaylord employees began emptying the material from the tank car into the plant sewer system; after 2 or 3 minutes, a large vapor cloud was released, and the unloading was stopped. On October 21, a Gaylord employee twice added water to dilute the material in the tank car and vented the vapors through the scrubber. The internal pressure of the tank car increased each time the water was added.

On October 23, the gauge on the tank car indicated that the internal pressure was 18 psig. Plans were made to complete the emptying and the cleaning of the tank car. At 12:54 p.m., Gaylord received the results of the chemical analysis of the material sample obtained from the tank car on October 19. The results indicated that the material was wet nitrogen tetroxide. These results were unexpected because Gaylord believed that on October 13 the nitrogen tetroxide had been unloaded from the tank car and that the residue had been diluted with water. After discussing the apparent discrepancy with the Vicksburg laboratory specialist who had tested the sample, Gaylord personnel decided the sample may not have been representative of the material in the tank car.
Between 1:30 and 1:45 p.m. on October 23, Gaylord employees put more water into the tank car, and the internal pressure rose from 18 to 80 psig in 4 to 5 minutes, at which point the water was turned off. About 2 p.m., the pressure reached 92 psig and then slowly began to decline. The plant scrubber was still being used to vent the vapors from the tank car, and an additional hose was run from one of the tank car valves to a water-filled drum for additional venting. The internal tank car pressure was 55 psig by 2:30 p.m. When Gaylord employees reopened the fire hose, the pressure rose to 100 psig, which is the maximum calibrated pressure on the gauge. The water was turned off, and the vapors were again vented. At 3 p.m., the pressure appeared to be falling, but at 3:30 p.m., it was still above the measurement limit of the gauge and appeared to be rising. At 3:55 p.m., a yellow-brown vapor was observed leaking from the dome of the tank car. The head on the B-end of the tank car failed about 4:45 p.m. releasing a huge reddish-brown vapor cloud.

Postaccident examination of the safety relief mechanism mounted in the dome revealed that it had recently activated. (Activation pressure is about 375 psig.) The examination also revealed an 8-inch-high by 66-inch-wide corroded opening in the B-end head of the tank car near the top. In addition, at least three distinctive horizontal bands of corrosion were found near the top of the interior tank wall; one band was at the same level as the opening in the tank head.

Postaccident Actions

Gaylord Chemical Corporation has discontinued the use of tank cars to transport nitrogen tetroxide and now uses smaller tanks that hold only 3 percent of the volume capacity of the tank car involved in the accident. Cargo purity assurance procedures, including the testing of cargo before and after loading, have been implemented to prevent the transport of contaminated cargo. The plant has additionally installed equipment to warn residents of any accidental release and, in coordination with the city of Bogalusa, has developed emergency procedures and conducted training.

The tank car destroyed in this accident was the last carbon steel tank car in use that had been approved by the US Department of Transportation for transporting nitrogen tetroxide.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the lack of adequate procedures on the part of the Gaylord Chemical Corporation and the Vicksburg Chemical Company to prevent or detect the contamination of nitrogen tetroxide with water, resulting in the formation of an extremely corrosive product and the subsequent failure of the tank car. Contributing to the severity of the accident were the Gaylord Chemical Corporation’s inadequate procedures for emergency transfer of contaminated cargo from the tank car.

Recommendations – None

Adopted: 1/27/98 NTSB Home | Publications

HAZARDOUS MATERIALS ACCIDENT REPORT
Adopted: March 19, 1985
RELEASE OF HAZARDOUS WASTE ACID
FROM CARGO TANK TRUCK
ORANGE COUNTY, FLORIDA
March 6, 1984
NTSB Number: HZM-85/01
NTIS Number: PB85-917003

SYNOPSIS
About 1:30 p.m., e.s.t. on March 6, 1984, orange colored vapors began escaping from an MC-307/312 cargo tank containing 3,200 gallons of mixed hazardous waste acids while it was parked at a truck dealership in Orange County, Florida. The volume of vapors increased as the acids rapidly corroded the cargo tank's stainless steel shell. At 5:39 p.m., the acids penetrated the cargo tank's shell and flowed onto the ground. About 250 persons were evacuated from a 3-square-mile area. Twelve persons who came in contact with the vapors were injured, four seriously. The cargo tank was destroyed.

The National Transportation Safety Board determines that the probable cause of this accident was the shipper's failure to specify a cargo tank constructed of materials compatible with the hazardous waste acids to be shipped, which resulted in a severe corrosive reaction and disintegration of the cargo tank shell. Contributing to the accident was the carrier's failure to make a positive identification of the material to be transported when it selected the cargo tank, the carrier's failure to provide information to the driver sufficient for him to assure that the load was the material which the carrier expected to be transported, and the lack of information available to the emergency response personnel from shipping papers, the shipper, and the carrier about the composition and hazards of the waste material.

RECOMMENDATIONS
As a result of its investigation, the Safety Board reiterated Safety Recommendation I-83-2 to the Research and Special Programs Administration:
Determine, by mode of transportation, the feasibility of requiring comprehensive product-specific emergency response information, such as Materials Safety Data Sheets, to be appended to shipping documents for hazardous materials transported in bulk quantities, giving particular attention to the early emergency response problems posed by nos. commodities in transit. For those modes of transportation for which a positive determination results, incorporate necessary requirements into Title 49 of the Code of Federal Regulations. (Class I, Priority Action)

Also, the Safety Board made the following recommendations:
--to Harris Corporation:
Establish procedures to determine safe and proper packaging for shipments of hazardous waste which assure that the materials shipped are compatible with the materials of construction of the packaging during transportation. (Class II, Priority Action) (I-85-2)
Revise operational procedures for shipping hazardous waste to assure compliance with Department of Transportation regulations. (Class II, Priority Action) (I-85-3)
Enter Information on shipping papers to better inform emergency response personnel about the composition and hazards of the waste material being shipped, as permitted by Title 49 CFR 172.202, and include action that can be taken to neutralize the material and mitigate its hazards. (Class II, Priority Action) (I-85-4)
--to Chemical Waste Management, Inc.: 
Evaluate company operational procedures and revise them, as necessary to require that vital information necessary for the safe transportation of hazardous waste is obtained from the shipper before equipment, such as a cargo tank, is dispatched and that drivers' are given necessary Information and instructions to confirm that the hazardous waste to be loaded conforms to the shipping order, and that proper loading procedures are followed. (Class II, Priority Action) (I-85-5)
Evaluate company training and instruction procedures, and revise them, as necessary, to instruct drivers in the recognition of problems that may be incurred during transportation of hazardous wastes and in the notification of emergency response personnel. (Class II, Priority Action) (I-85-6)

--to Department of Transportation:
In conjunction with the Environmental Protection Agency, develop and distribute to hazardous waste shippers (generators) information regarding shipper responsibilities under the Hazardous Materials Transportation Act when shipping hazardous wastes. (Class II, Priority Action) (I-85-7)

- Increase audits of hazardous waste shippers and roadside inspections of carriers to improve compliance with the Hazardous Materials Transportation Act. (Class II, Priority Action) (I-85-8)

--to Environmental Protection Agency:
In conjunction with the Department of Transportation, develop and distribute to hazardous waste shippers (generators) information regarding shipper responsibilities under the Hazardous Materials Transportation Act when shipping hazardous wastes. (Class II, Priority Action) (I-85-9),

--to Research and Special Programs Administration
Determine the adequacy of general shipping names on shipping papers for hazardous waste and the need for additional information, such as technical and chemical group names, to better inform emergency response personnel about the composition and hazards of the material being shipped. (Class II, Priority Action) (I-85-10)

Revise the hazardous materials regulations to clearly describe shipper responsibilities for performing a sufficient analysis to determine that materials shipped are compatible with the packaging materials to be used in transportation, and that particular emphasis is given to the unique hazards that waste material may present. (Class II, Priority Action) (I-85-II)

-- to the National Tank Truck Carriers Inc., and the National Solid Waste Management Association:
Inform its members of the circumstances of the March 6, 1984, hazardous material accident in Orange County, Florida, and urge them in light of the potential lack of compatibility of hazardous wastes with the materials used in the construction of cargo tanks to require that vital information necessary for the safe transportation of hazardous waste is obtained from the shipper before equipment, such as cargo tank, is dispatched and that drivers are given necessary information and instructions to confirm that the hazardous waste corresponds with the shipping order, and that proper loading procedures are followed. (Class II, Priority Action) (H-85-12)
8. Truck with Anhydrous Ammonia Cargo Loss, Texas, 1976

HIGHWAY ACCIDENT REPORT
Adopted: April 14, 1977
TRANSPORT COMPANY OF TEXAS
TRACTOR-SEMITRAILER (TANK) COLLISION
WITH BRIDGE COLUMN AND SUDDEN
DISPERsal OF ANHYDROUS AMMONIA CARGO
I-610 AT SOUTHWEST FREEWAY,
HOUSTON, TEXAS
MAY 11, 1976

NTSB Number: HAR-77/01
NTIS Number: PB-268251

SYNOPSIS
About 11:08 a.m., on May 11, 1976, a Transport Company of Texas tractor-semitrailer (tank) transporting 7,509 gallons of anhydrous ammonia struck and penetrated a bridge rail on a ramp connecting I-610 with the Southwest Freeway (U.S. 59) in Houston, Texas. The tractor and trailer left the ramp, struck a support column of an overpass, and fell onto the Southwest Freeway, approximately 15 feet below. The anhydrous ammonia was released from the damaged tank semitrailer.
Six persons died as a result of the accident, 78 persons were hospitalized, and approximately 100 other persons were treated for injuries.
The National Transportation Safety Board determines that the probable cause of this accident was the excessive speed of the vehicle combined with the lateral surge of liquid in the partially loaded tank truck, which caused it to overturn. The cause of 5 of the 6 fatalities and all of the 178 injuries was the inhalation of anhydrous ammonia.
Contributing to the severity of the accident was the failure of the bridge rail to contain or redirect the vehicle.
Innovations in transportation of pressurized liquefied products could result in a reduction of accident severity. As a result of its investigation of another tank-semitrailer accident near Eagle Pass, Texas, on April 29, 1975, the Safety Board recommended that the Secretary of Transportation "initiate a research program to identify new approaches to reduce the injuries and damages caused by the dangerous behavior of pressurized, liquefied flammable gases released from breached tanks on bulk transport vehicles." The Department of Transportation now intends to contract for such a study, depending upon the availability of funds, sometime during FY 1977. Ammonia will be included in the study.
RECOMMENDATIONS
As a result of its investigation of this accident the National Transportation Safety Board submitted the following recommendations to the Federal Highway Administration:
"Expedite past recommendations of the Safety Board regarding the adoption of standards for bridge barrier systems that require new installations to comply with performance standards." (Class II, Priority Followup) (H-77-4)
"In consultation with State and local governments, establish highway design criteria for the selection, location, and placement of traffic barrier systems that will redirect and prevent penetration when struck by heavy vehicles. The criteria for preventing vehicle penetration should consider the human exposure to injury and the effects of hazardous cargo that could result from barrier penetration." (Class II, Priority Followup) (H-77-5)
"Develop guidelines for local and State agencies to use in designating and periodically reviewing routes for the transportation of hazardous materials as a means of reducing injury and damage from accidents involving hazardous materials in their jurisdictions." (Class II, Priority Followup) (I-77-1)
As a result of its investigation of this accident the National Transportation Safety Board reiterates the following recommendations made after previous investigations:
to the Federal Highway Administration:
"The Bureau of Motor Carrier Safety (Federal Highway Administration) in cooperation with affected industries, as represented by the Tank Truck Technical Council, conduct an investigation designed to resolve the overturn stability problems created by liquid surging of partially loaded tank-truck combinations. The ultimate objective of such a research program should be the promulgation of Federal regulations to limit the effects of surge to a specific degree."
Such regulations might be based on acceptable liquid cargo outage and/or dampening requirements, consistent with safe tank-truck operations." (H-72-45)

to the U.S. Department of Transportation:
"Initiate a research program to identify new approaches to reduce the injuries and damages caused by the dangerous behavior of pressurized, liquefied flammable gases released from breached tanks on bulk transport vehicles.” (I-76-5)

HIGHWAY ACCIDENT REPORT
Adopted: October 17, 1973
MULTIPLE-VEHICLE COLLISION
FOLLOWED BY PROPYLENE CARGO-TANK EXPLOSION
NEW JERSEY TURNPIKE, EXIT 8
SEPTEMBER 21, 1972
NTSB Number: HAR-73/04
NTIS Number: PB-225032/AS

SYNOPSIS
At 8:25 p.m., on September 21, 1972, a tractor-semitrailer (tank) carrying propylene liquid petroleum gas sideswiped a Greyhound bus (carrying no passengers) in the southbound lanes of the New Jersey Turnpike about one mile north of Exit 8. After impact, the bus, while rotating clockwise and sliding across the highway, was struck by a southbound automobile. The tractor-semitrailer scraped, then straddled the turnpike's median guardrail, jackknifed, spun into the northbound lanes, and overturned. Before overturning, the tractor-semitrailer was struck by a northbound automobile.

Fire, which had erupted at the tractor as it scraped the median guardrail, spread to propylene which was leaking from the cargo tank's damaged plumbing. After the fire had burned for about 25 minutes, the cargo tank exploded in a ball of flame; segments of the tank rocketed more than 1,300 feet northeast and 500 feet southwest of the tractor-semitrailer.

As a result of the accident, the driver of the tractor-semitrailer suffered severe burns and multiple fractures; the busdriver received minor injuries. The two occupants of the northbound automobile which struck the semitrailer were killed. Twenty-eight persons, including seven police officers, were injured -- none seriously -- by the explosion of the cargo tank.

The National Transportation Safety Board determines that the probable cause of the initial collision was the evasive steering and skidding of the bus into the path of the overtaking tractor-semitrailer. Override of the median guardrail by and subsequent overturn of the tractor and the semitrailer were caused by the inability of the median guardrail to resist the forces generated by the tractor-semitrailer.

The initial fire was caused by friction sparks when the tractor-semitrailer scraped the median guardrail, which ignited fuel escaping from the tractor's damaged left-side fuel tank. Secondary fire was propagated by propylene which escaped from a rupture(s) in the cargo tank's external pipes. Contributing to the escape of propylene were (1) the exposed position of the cargo tank's external pipes, (2) the inadequacy of the "plumbing guard" to protect the pipes from impact damage, and (3) the failure of the flow-cutoff system to function as intended by applicable Federal regulations.

Explosion of the cargo tank was caused by extended exposure of a local segment of the tank shell to direct flame and by resultant overheating of that portion of the tank shell, which weakened it below design strength and permitted a break in the tank body. Contributing to the weakening of tank metal was the absence of tank-overheating countermeasures by emergency crews whose arrival was delayed by traffic congestion on a limited-access highway. The number of injuries was increased by lack of understanding of the range of the hazard.

RECOMMENDATIONS
The National Transportation Safety Board recommends that:
1. The Bureau of Motor Carrier Safety of the Federal Highway Administration OWA) study the existing regulations and requirements in 49 CFR 178.337, regarding LPG cargo tanks, for the purpose of instituting more explicit rulemaking toward reducing the likelihood of leakage and subsequent catastrophic failure of such cargo tanks in a variety of foreseeable types of accident crashes. (Recommendation No. H-73-37)
2. The National Highway Traffic Safety Administration, in cooperation with the Bureau of Motor Carrier Safety and the International Association of Chiefs of Police, Inc., as an addition to the official manual which supplements the Highway Safety Program Standard relating to police traffic services, develop criteria and procedures for the demarkation and evacuation of danger zones at hazardous-materials accidents occurring on highways. (Recommendation No. H-73-38)
3. The Bureau of Motor Carrier Safety and the National LP-Gas Association adopt a tentative distance of 1,400 feet as a danger-zone radius for M-331 cargo tanks carrying liquefied petroleum gas which are exposed directly to fire.
Such a radius should be used pending study and additional experience on which to base a more definitive danger-zone radius. (Recommendation No. H-73-39)

4. The Bureau of Motor Carrier Safety, the National LP-Gas Association, and the National Fire Protection Association jointly consider formally recognizing the fact that, while an LPG cargo tank continues to be directly exposed to fire, the opening and subsequent closing of a safety-relief valve (or valves) signals the dropping of liquid level below the fire-application point, and serves as an indicator of impending failure of the tank from heat softening. This information could then be included in approved safety manuals relating to LPG cargo-tank fires. (Recommendation No. H-73-40)
10. Truck Dynamite Cargo Explosion, Georgia, 1971

HIGHWAY ACCIDENT REPORT
Adopted: September 21, 1972
AUTOMOBILE-TRUCK COLLISION
FOLLOWED BY FIRE AND EXPLOSION OF DYNAMITE CARGO
ON U. S. HIGHWAY 78,
NEAR WACO, GEORGIA
JUNE 4, 1971

NTSB Number: HAR-72/05
NTIS Number: PB-213129

SYNOPSIS
At about 8:00 p.m., on June 4, 1971, a 1961 Volkswagen two-door sedan, traveling west on U. S. Highway 78 (Old Georgia Route 8), crossed over the centerline of the two-lane highway and collided head on with an eastbound tractor semi-trailer transporting a 25,414-pound cargo of explosives. Both vehicles were traveling at about 40 m.p.h. before impact. Fire broke out immediately along the left side of the tractor and in front of the trailer. Firemen arrived at the scene shortly thereafter and tried to put out the fire while the truckdriver tried to persuade bystanders to move from the burning wreckage. The cargo detonated about 10 or 15 minutes after the collision.
The automobile driver apparently was fatally injured in the collision. The truckdriver was not injured. Both drivers were alone in their vehicles. Two firemen, a wrecker driver, and two bystanders died as a result of the explosion.
Thirty-three people were injured and property damage was estimated in excess of one million dollars.
The National Transportation Safety Board determines that the probable cause of the collision was that the automobile crossed over into the opposing lane of traffic and collided with the oncoming tractor semi-trailer, which was carrying a cargo of explosives. Fire broke out due to fuel loss from the automobile fuel tank and leakage from the truck’s diesel fuel tanks.
The cause of the explosion was localized heat on the nitroglycerin-based dynamite. The explosion caused extensive property damage.
Contributing causes to the fatalities and injuries were: (1) a warning system that did not advise everyone within the danger range of the nature of the hazards; (2) the decision of the firemen to try to contain the hazardous fire; (3) the failure to notify emergency service personnel promptly and accurately of the hazards involved so that authoritative crowd-control measures could be taken; and (4) the inquisitive nature of bystanders and their partial disregard or lack of understanding of the truckdriver's warnings.

RECOMMENDATIONS
The National Transportation Safety Board recommends that:
1. The Bureau of Motor Carrier Safety in the Federal Highway Administration of the Department of Transportation, and the Office of Hazardous Materials in the Department of Transportation initiate appropriate action to develop standards for mandatory installation of fire barriers in trucks or trailers used to transport Class "A" explosives or other hazardous, heat-sensitive materials. Such standards should apply to future vehicles and, by retrofit, to present vehicles. (Recommendation H-72-31)
2. The Bureau of Motor Carrier Safetymodify Section 393.65 of the Motor Carrier Safety Regulations (as revised 2A-72) to eliminate the fuel crossover line and other lines and fittings which are subject to damage, as a result of their exposed location on the bottom of tanks close to the road. (Recommendation H-72-32)
3. The National Highway Traffic Safety Administration include in all future Federal Motor Vehicle Safety Standards that are applicable, requirements to eliminate fuel crossover lines and any other lines and fittings which may be subject to damage, as a result of their exposed location on the bottoms of fuel tanks close to the road. (Recommendation H-72-33)
4. The Bureau of Motor Carrier Safety and the National Highway Traffic Safety Administration develop regulations and standards to establish road clearance specifications for fuel systems to protect them from road damage as a result of tire failures or normal driving operations. (Recommendation H-72-34)
5. The National Fire Protection Association (NFPA) develop new guidelines dealing with explosives in emergencies and bring them to the attention of emergency service personnel at all levels. These guidelines should be based on the NFPA Document entitled *Fire Protection for Chemicals* and published separately with special emphasis placed on:
   1. Assessing the situation upon arrival at the scene of an emergency.
   2. Determining alternative courses of action.
   3. Evaluating the risks associated with each alternative.
   4. Selecting the alternative which presents the minimum amount of risk to people, facilities, and firefighting crews and their equipment.
   5. Guidelines should include not only explosives, but all heat-sensitive hazardous materials which are on fire or exposed to elevated temperatures as a result of a fire.

   This new publication should be as widely distributed as possible through channels which will make the guidelines available to all levels of fire-fighting operations. (Recommendation H-72-35)

6. The Office of Hazardous Materials (OHM) study warning-system deficiencies demonstrated in this accident. The proposal for a Hazard Information System issued by OHM on June 16, 1972 should be carefully reviewed to insure that warnings of impending danger and advice are given in an understandable manner to the general public as well as to emergency personnel. The capability of the system to warn those at a distance should be equal to the range of the hazard and should not rely on the physical condition of the driver. The system should function under all weather conditions and the range of warning should be specified by regulations. (Recommendation H-72-36)

7. The Office of Hazardous Materials in cooperation with the American Association of Motor Vehicle Administrators, the American Driver and Traffic Safety Education Association, the American Automobile Association, the North American Professional Drivers Association, and the National Safety Council provide information on precautions the public should take when confronted with hazardous materials in highway accidents. These agencies should have this information incorporated into driver-education curricula and driver licensing examinations and they should disseminate the information periodically as a public service. (Recommendation H-72-37)

11. Truck with Methyl Bromide Toxicant Release, Florida 1971

HIGHWAY ACCIDENT REPORT
Adopted: June 1, 1972
TRUCK-AUTOMOBILE COLLISION
INVOLVING SPILLED METHYL BROMIDE
ON U. S. 90
NEAR GRETNA, FLORIDA
AUGUST 8, 1971
NTSB Number: HAR-72/03
NTIS Number: PB-211596

SYNOPSIS
At approximately 6:50 p.m., on August 8, 1971, in the northbound lane of U. S. 90, near Gretna, Florida, a tractor van-type semi-trailer combination (hereafter called "truck"), traveling south at 50 m.p.h., collided with an automobile which turned into its path while making a left turn movement preparatory to going east on Florida S.R. 270A.

The impact was sufficient to rotate the automobile and entangle the vehicles together as they skidded forward to the southeast corner of the intersection. After leaving the pavement, the truck struck the embankment of a ditch and rapidly decelerated. During that deceleration, the truck's cargo of steel cylinders containing a methyl bromide 2 percent chloropicrin mixture, under pressure, shifted forward in the van. The automobile continued along the wall of the ditch embankment and impacted a telephone pole in its path, coming to rest soon thereafter.

As the truck came to rest, steel cylinders hurtled through the front wall of the van and impacted parts of the tractor, the automobile, and each other. Several of the cylinders were punctured and others experienced valve failures, a condition which precipitated the immediate release of high concentrations of the poison chemical mixture into the atmosphere. No fire ensued.

Four of the occupants of the automobile and the truckdriver escaped unaided from the contaminated atmosphere with relatively minor injuries. The four remaining occupants remained in or near the automobile and were exposed for a period of 30 minutes to high concentrations of toxic vapors. They did not survive. Several onsite rescue personnel and bystanders were affected by the contaminated atmosphere, both through inhalation and percutaneous absorption. In all, there were four fatalities and 14 injured. The cause of deaths in this accident has been directly attributed to exposure to the spilled cargo. No autopsies were requested by local authorities, nor were any conducted.

Rescue response was delayed because of tardiness in accident notification. No first aid was administered at the accident scene, nor were the victims removed from the contaminated atmosphere until after the arrival of the first ambulance, some 25 minutes after the collision.

The National Transportation Safety Board determines that the cause of this accident was the passing maneuver of the truckdriver who approached a recognizable intersection on the wrong side of a solid yellow centerline and the execution, without signaling, of a left turn by the automobile driver into the path of the overtaking truck. The probable cause of the fatalities in this accident was the prolonged exposure of the disabled occupants of the automobile to high concentrations of the poison chemical mixture which escaped from shifted and damaged containers.

Contributing to the severity of the losses was the failure of the carrier to comply with the Motor Carrier Safety Regulations which call for the securing of cargo against load shift in the event of an accident; the pressurization of the cargo containers; the stiff, hot, humid atmospheric conditions; the "fail-open" cylinder valve configuration; and delay in the removal of the disabled victims from the contaminated atmosphere.

RECOMMENDATIONS
The National Transportation Safety Board directed recommendations relating to this accident to the Secretary of Transportation on November 11, 1971, and April 27, 1972; copies are included as Appendix F.

The Safety Board further recommends that:
1. The Bureau of Motor Carrier Safety, Federal Highway Administration, develop and implement a program through which a statistical base can be accumulated for engineering design and crashworthiness criteria for container cargo
securement, cargo containment within the vehicle, and other hazard controls associated with vehicle acceleration and decelerations under accident conditions.

2. The Hazardous Materials Regulations Board (HMRB) of the Department of Transportation initiate rulemaking which would:
   (a) require manufacturers to submit to HMRB the hazard control measures utilized in the manufacture of hazardous materials.
   (b) compare the hazard control measures utilized in manufacture with those required for transportation of hazardous materials; and
   (c) take into consideration applicable hazard control measures resulting from these comparisons in the formulation of regulation's for the transportation of hazardous materials. The comparison should be placed in the public docket of rulemaking proceedings.

3. The Hazardous Materials Regulation Board of the Department of Transportation expeditiously act to bring about the development and implementation of “fail-closed” shut-off valves for containers used for transportation of liquefied hazardous materials under pressure to improve the crashworthiness of such containers in transportation accidents.
12. Transfer Operation and Mixing of Incompatible Chemicals Releasing H₂S, Maine 1971

HIGHWAY ACCIDENT REPORT
Adopted: August 26, 1971
ACCIDENTAL MIXING OF INCOMPATIBLE CHEMICALS FOLLOWED BY MULTIPLE FATALITIES DURING A BULK DELIVERY BERWICK, MAINE APRIL 2, 1971

NTSB Number: HAR-71/01
NTIS Number: PB-190202

SYNOPSIS
On April 2, 1971, at Berwick, Maine, a hose used for transferring a bulk liquid chemical cargo from a motor carrier's tank semitrailer to a tannery storage tank was incorrectly attached to a fill line leading to an indoor open-top tank. When the transfer began, the cargo mixed with the incompatible chemical stored in the indoor tank, resulting in a chemical reaction which generated toxic hydrogen sulfide gas. Six tannery workers died from inhalation of this toxic gas.

The National Transportation Safety Board determines that the cause of this accident was the failure of the carrier's drivers and the tannery foreman to establish an error-free exchange of information required to accomplish the safe transfer of the cargo from the vehicle into a plant storage tank. The likelihood of this failure was increased by the absence of instructions or training in information validation procedures to be followed during such exchanges, and by the absence of markings, devices, or other measures on the vehicle or tannery property which would have permitted such validation to be made unilaterally by either party.

RECOMMENDATIONS
The National Transportation Safety Board recommends that:
1. The Department of Transportation, with the participation of the Department of Labor and, if required, the Interstate Commerce Commission, conduct a comprehensive investigation into the risks associated with the delivery of bulk liquid cargoes in motor carrier vehicles, and initiate the implementation of risk-reduction measures.
2. The National Tank Truck Carriers, Inc., the Private Truck Council of America, Inc., and State trucking associations, pending implementation of the above recommendation, call their members' attention to the risks associated with communications failures during bulk liquid deliveries from motor carrier vehicles, and to the need, demonstrated in this accident, for development of, training in, and enforcement of procedures which incorporate information validation techniques to be used during such deliveries.
3. The Department of Labor and the agencies having jurisdiction in each State, pending implementation of recommendation No. 1, consider the establishment of rules, regulations, or standards which require the display of the name of the material to be delivered into each fill line connection at these connections in all facilities where bulk liquid materials are delivered from a motor carrier vehicle, similar to the rules adopted by the Maine Department of Labor and Industry after this accident.
4. The Department of Labor and the agencies having jurisdiction in each State consider developing and implementing requirements which would reduce the risks to employees and carrier personnel in the event of accidental mixing of incompatible bulk liquid materials at all locations where such materials are delivered by motor carrier vehicles.
5. The Department of Transportation initiate rulemaking action to amend 49 CFR 394 to require all carriers to report accidents occurring in connection with the delivery of bulk liquid materials from motor carrier vehicles, whether or not the carrier's employees, vehicle, or cargo suffered damages in the accident.