UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

PLAINTIFF'S EXHIBIT
AN-103

CERTIFICATE OF TRUE COPY

I HEREBY CERTIFY that the attached is a true copy of the original on file in the Information Products Division, National Transportation Safety Board, which original comprises the material available from the NTSB public reference file concerning the railroad accident at New Orleans, Louisiana on September 8, 1987, NTSB/HZM-88/01, and that I have legal custody of the record involved.

Signed and dated at Washington, DC

this 23rd day of December 1999

by Susan Stevenson
(Signature)

Archives Technician
(Title)

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I HEREBY CERTIFY that Susan Stevenson who signed the foregoing certificate is now, and was, at the time of signing the Archives Technician, Public Inquiries Branch, Information Products Division, National Transportation Safety Board, that she has legal custody of the record involved, and that full faith and credit should be given her certificate as such.

IN WITNESS WHEREOF, I have hereunto subscribed my name and caused the seal of the National Transportation Safety Board to be affixed this

23rd day of December 1999

Melba D. Moye
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National Transportation Safety Board

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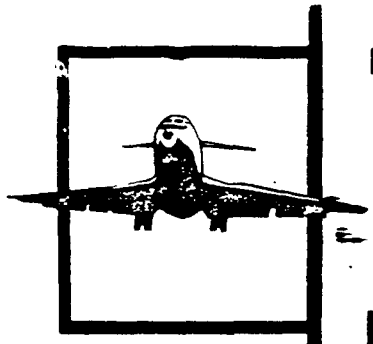

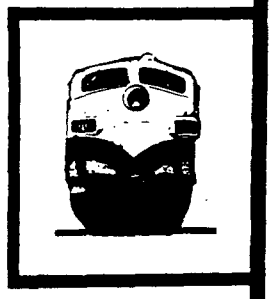

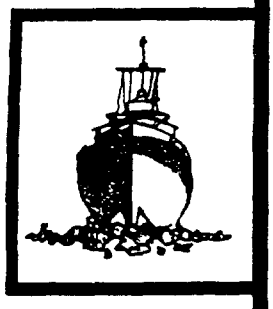

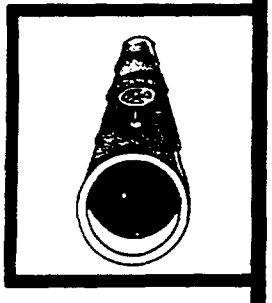

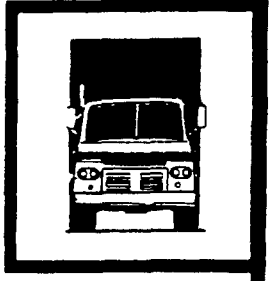

PB88-917005

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

HAZARDOUS MATERIALS/ RAILROAD ACCIDENT REPORT

BUTADIENE RELEASE AND FIRE
FROM GATX 55996 AT THE
CSX TERMINAL JUNCTION INTERCHANGE
NEW ORLEANS, LOUISIANA,
SEPTEMBER 8, 1987

NTSB/HZM-88/01

UNITED STATES GOVERNMENT

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15. Supplementary Notes

16. Abstract:

On September 8, 1987, a New Orleans Terminal (NOT) crew moved six tank cars of butadiene from the NOT's Oliver Yard in New Orleans and at 7:35 p.m. placed them on track 3 of the CSX Transportation's (CSXT) Terminal Junction Interchange Yard for delivery to the CSXT. On September 9, 1987, butadiene leaking from one of the tank cars was ignited and the resulting flames rising about 100 feet into the air engulfed both bridge spans of Interstate 10. The fire receded to the leaking tank car where it burned beneath the tank car until September 10, 1987. During the emergency, more than 200 city blocks were evacuated affecting 800 to 1,000 residents.

The Safety Board determined that the butadiene leaked from the bottom manway of tank car GATX 55996 which was being used for the first time since it was inspected and tested in a tank car repair facility in November 1986 before being sold. The gasket used in the manway and the closure attachments for the manway were not of the types specified on the design drawings for GATX 55996.

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Abstract (continued)

The safety issues discussed in this report are effectiveness of hazardous materials emergency response activities for handling releases from railyards; effectiveness of Federal Railroad Administration's delegation of authority to tank car manufacturer's, to tank car repair shops, and to the Association of American railroads; performance of tank cars equipped with bottom manways; and effectiveness of means for providing technical assistance to emergency responders.

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EXECUTIVE SUMMARY

On September 8, 1987, a New Orleans Terminal (NOT) crew moved six tank cars of butadiene from the NOT's Oliver Yard in New Orleans and at 7:35 p.m. placed them on track 3 of the CSX Transportation's (CSXT) Terminal Junction Interchange Yard (interchange yard) for delivery to the CSXT. About 1:50 a.m. on September 9, 1987, butadiene leaking from one of the tank cars was ignited and the resulting flames rising about 100 feet into the air engulfed both bridge spans of Interstate 10. The fire receded to the leaking tank car where it burned beneath the tank car until 1:55 p.m. on September 10, 1987. During the emergency, more than 200 city blocks were evacuated affecting 800 to 1,000 residents.

Observation of the emergency response activities and the conditions that led to the hazardous materials release from the bottom manway of the tank car prompted the Safety Board to conduct this hazardous materials accident investigation. The investigation revealed that the City of New Orleans previously had recognized that because of the large amount of hazardous materials handled within and transported through its boundaries, the potential was great that its citizens would be endangered by releases of hazardous materials. The city had developed plans for responding to hazardous materials emergencies; however, these plans had not been fully coordinated with all city agencies and they had not been evaluated through exercises. The local railyards also had developed emergency response plans, but these had not been coordinated with one another nor with the plans of the city. Additionally, response personnel had not been adequately equipped and sufficiently trained for responding to a large hazardous materials emergency.

The investigation also revealed that the release of butadiene from the bottom of the tank car occurred because the gasket in the bottom manway had been severely damaged at the time it was reinstalled and that large amounts of sealant had been used when installing the gasket. The Safety Board determined that the butadiene leaked from the bottom manway of tank car GATX 55996 which was being used for the first time since it was inspected and tested in a tank car repair facility in November 1986 before being sold. The gasket used in the manway and the closure attachments for the manway were not of the types specified on the design drawings for GATX 55996. As a part of this investigation, the Safety Board reviewed the adequacy of procedures used by the Association of American Railroads, by tank car manufacturers, and by tank car repair facilities for ensuring that tank cars comply with Federal requirements and that they are safely maintained. The safety issues discussed in this report are:

- effectiveness of hazardous materials emergency response activities for handling releases from railyards;
- effectiveness of Federal Railroad Administration's delegation of authority to tank car manufacturer's, to tank car repair shops, and to the Association of American railroads;
- performance of tank cars equipped with bottom manways; and
- effectiveness of means for providing technical assistance to emergency responders.

As a result of its investigation, the Safety Board issued recommendations to improve emergency preparedness for handling releases of hazardous materials from railyards, for evaluation of the adequacy of bottom manways for safely containing hazardous materials in tank cars, for establishing performance criteria for heat-resistant properties of gaskets, for establishing performance criteria for the use of sealants on gaskets used in tank cars, for establishing quality control requirements for tank car manufacturers and tank car repair shops, and for requiring notice to tank car owners and

repair shops of special requirements and materials required for maintaining the integrity of tank cars.

The National Transportation Safety Board determines that the probable cause of the uncontrolled release of butadiene from the bottom manway of tank car GATX 55996 was the misalignment and subsequent tearing of the the gasket when the manway cover was improperly closed. Contributing to the improper closing of the manyway cover were the lack of established procedures by both the North American Tank Car Corporation and Phillips 66 for correctly using the uniquely designed cover hinge and the insufficient training of the carman who performed the work. Contributing to the length of the emergency and the increased risk to life and property were the lack of any means to stop the flow of butadiene from the bottom manway of the tank car and the failure of personnel responding to comprehend the extent of the danger posed by the burning tank car and to promptly evacuate the threatened area.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D. C. 20594

HAZARDOUS MATERIALS/RAILROAD ACCIDENT REPORT

BUTADIENE RELEASE AND FIRE FROM GATX 55996 AT THE CSX TRANSPORTATION TERMINAL JUNCTION INTERCHANGE NEW ORLEANS, LOUISIANA SEPTEMBER 8, 1987

INVESTIGATION

The Accident

On September 8, 1987, a New Orleans Terminal (NOT)[1] crew moved six tank cars of butadiene from the NOT's Oliver Yard in New Orleans and at 7:35 p.m.[2] placed them on track 3[3] of the CSX Transportation's (CSXT) Terminal Junction Interchange Yard (interchange yard) for delivery to the CSXT. The switch foreman then placed the waybills for these tank cars in a waybill box at the west end of the interchange yard and radioed the Oliver Tower operator to notify the North East Tower operator of the rail car placement. (See figure 1.)

Butadiene leaked from the bottom of tank car GATX 55996, and the released liquid vaporized and spread along the railroad tracks into adjacent residential areas. While the specific time the butadiene began being released is not known, neither the NOT engineer in the yard locomotive, who pushed the tank cars into the interchange track, nor the NOT switch foreman, who walked beside GATX 55996 when performing his brake inspection, detected any indication of a leak, odor, or unusual sound when GATX 55996 was placed on track 3. During brake inspections, crewmembers do not inspect individual fittings, valves, etc., on tank cars, but they are instructed to look for obvious defects such as a leak of the product from tank cars. Other railroad operating personnel working in the general area of track No. 3 at the time the tank cars were placed also stated that they detected nothing unusual.

When the NOT switch crew returned to the interchange yard at 10:35 p.m. to deliver an additional 21 rail cars, they placed these cars on track 2, south of track 3. The switch foreman, who inspected the cars on track 2, stated that he detected nothing unusual in the interchange yard. However, the NOT engineer and brakeman stated that while at a position northeast of GATX 55996, they thought they smelled "a dead animal" in the general area. They did not report this observation until the next day because they did not associate the odor with any particular petroleum or chemical product.

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[1]The NOT is a subsidiary of the Southern Railway Company which is a subsidiary of the Norfolk Southern Corporation. The Norfolk Southern Corporation is a holding company that was formed when the Southern Railway Company and the Nolfork and Western Railway Company merged on June 1, 1982.

[2]All times are central daylight saving time.

[3]Track No.3 is a CSXT track siding at the CSXT's Terminal Junction Interchange Yard designated for the interchange of rail cars between the NOT and the CSXT.

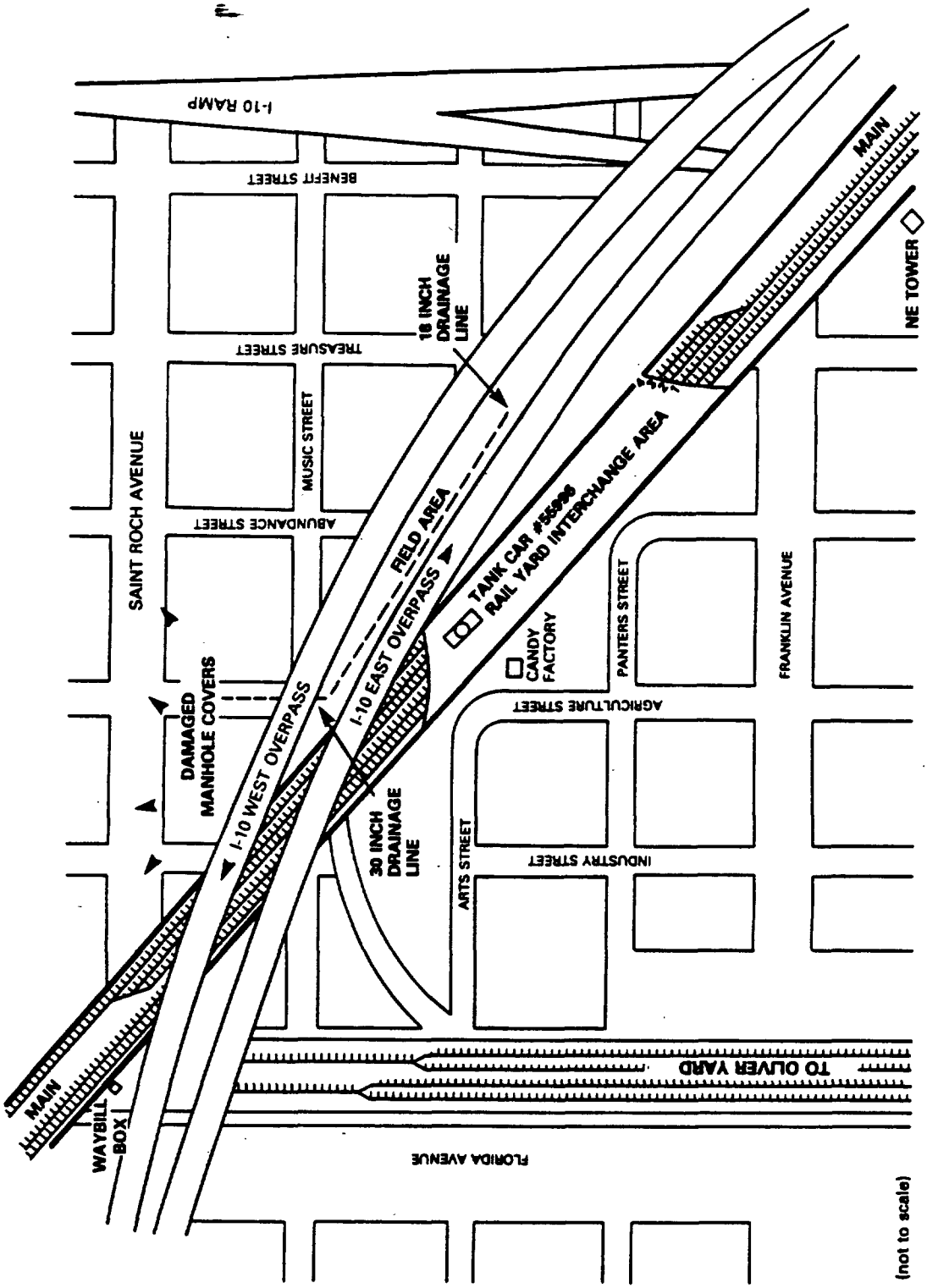

Figure 1.--Accident scene diagram showing the CSXT Terminal Junction Interchange Yard.

At 9:30 p.m., an employee of Sathers Candy Manufacturing (Sathers) smelled "an unusual odor emanating from an area located in the rear of the [Sathers] building nearest the tracks and the tank car." This location was about 100 yards east of track 3 and the tank cars of butadiene. (See figure 1.) At this time, the odor appeared to be concentrated outside around the boiler room area near the interchange yard. During the next 2 hours, two other employees of Sathers sensed a "strong nauseating odor" at the rear of the Sathers building and reported to their supervisor that the odor was becoming progressively stronger.

About midnight, a Sathers employee confirmed the presence of an unusual odor at the rear of the building which he believed was "natural gas related." This was reported to the local natural gas company, New Orleans Public Service (NOPSI) about 1:14 a.m. on September 9, 1987. The Sathers employee stated that the NOPSI employee advised that "at the time he had one truck available and he was out on a call, but as soon as he got through with that call he would send him on over here." Even though NOPSI had a direct telephone line to the New Orleans Fire Department (NOFD), NOPSI did not notify the NOFD of the Sathers employee's complaint.

About the same time, a resident on Music Street, located 400 feet northwest of the tank cars of butadiene on track 3, detected a "slight nauseating odor" around the storm drain covers near his residence. He also detected the same odors in a bedroom at the rear of his house, but he did not associate the odor as being uncommon for this area. As a result, he took no further action.

A motorist on Interstate 10 (I-10) detected a "gas leak," and at 1:25 a.m., he reported to the NOFD a "possible gas leak" in the area of Clematis and Bay Streets, located about 1,500 feet north of the tank cars of butadiene on track 3. At 1:32 a.m., the NOFD dispatched engine company 12 (E-12) to investigate a possible gas leak. The NOFD dispatcher did not notify NOPSI of this report.

While E-12 was en route, the NOFD dispatcher received a second complaint of a gas-like odor. This time the odor was reported to be in the area of Peoples Avenue and Bay Street, 1,500 feet northeast of Clematis and Bay Streets. This report was radioed to E-12. When E-12 arrived at Clematis and Bay Streets, a spotlight was used to search the area. After detecting nothing that would indicate a safety problem, the captain of E-12 communicated by radio with the NOFD dispatcher to determine if any additional information had been received. The NOFD dispatcher advised that no additional information was available, and the captain of E-12 then advised that he would check the Peoples Avenue location. Detecting nothing at Peoples Avenue and Bay Street that would indicate a safety problem, the captain of E-12 determined that the complaints were "false alarms," and the engine company returned at 1:42 a.m., arriving at its fire station about 10 minutes after its departure.

Part of the activities of E-12 were observed by the North East Tower operator,[4] 3,700 feet northeast of the tank cars of butadiene on track 3. (See figure 1.) Through binoculars, the tower operator observed the NOFD fire engine company search the vicinity on Peoples Avenue with a spotlight. The tower operator scanned the area using his binoculars; however, he did not detect any smoke or fire.

Around 1:50 a.m., on September 9, 1987, residents in the immediate area of track 3 were awakened by "three successive explosion-like" sounds that occurred about 4 seconds apart. The residents observed a wall of flame spanning 300 or more feet beneath the I-10 overpass and noted that there were small grass fires extending several blocks along Music Street. On their own initiative, many residents evacuated the area and headed west towards St. Roch Avenue.

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[4]The tower operator was an employee of the NOT and was responsible for controlling NOT and CSXT train interchange movements.

Emergency Response

After the explosions, five residents near the interchange yard immediately notified "911"[5] and the NOFD of the emergency. A resident on St. Roch Avenue reported that a train had exploded and that pieces of "burning coal" were in her back yard. Within 2 minutes, 911 operators received four additional reports of fires and/or explosions from residents within a two-block area west of track 3. These calls were transferred to the NOFD communications center.

Also at 1:50 a.m., the Sathers employees heard a loud noise followed by two more loud noises. An employee then informed his supervisor of a fire in back of the building in the railyard. The supervisor advised all employees to go home, and at 1:55 a.m., he called 911 and reported "a rail car fire." The 911 operator advised him that they already knew of it.

The tower operator also reported that at 1:50 a.m., he heard an "explosion," and based on his observation with binoculars, he observed "a large fire ball" with flames rising about 100 feet and engulfing both I-10 bridge spans southwest of the North East Tower. He reported that "flames appeared initially to extend along the ground northward approximately 200 feet" and he observed that "it kind of exploded at one time, [and] it covered an area approximately 75 to 100 feet from the tracks toward Interstate 10." He stated that "it was a rapid combustion."

The tower operator notified the CSXT Gentilly terminal yardmaster and then he notified the NOT Oliver Yard trainmaster. Next, the tower operator called a nonemergency New Orleans Police Department (NOPD) telephone number posted in the tower. The person answering the telephone advised the tower operator to call the NOFD using 911. When he contacted 911, he told the operator that there was an emergency at Franklin Avenue and I-10. The 911 operator advised the tower operator to call the NOFD dispatcher. About 1:55 a.m., the tower operator contacted the NOFD dispatcher and advised him of the emergency and how best to approach the area. The NOFD dispatcher told him that they were already responding to a call in the vicinity of Agriculture and Abundance Streets. The tower operator reported that he then advised the dispatcher that the NOPD should go to Franklin Avenue and I-10 because there definitely was a big fire there. The tower operator advised that a list of pertinent emergency telephone numbers was mounted under glass on his desk; however, he used the nonemergency NOPD telephone number because he happened to see it first.

At 1:50 a.m., four fire units were dispatched, including E-12 that had investigated the gas leak report earlier. These units were staffed by 12 firefighters under the command of a district chief. En route, the NOFD dispatcher advised the district chief of the reported train explosion. The district chief radioed the NOFD dispatcher at 1:54 a.m. while traveling to the emergency site and reported that there appeared to be "a long grass fire at this time. Correction, it is a train." The district chief reported that he was unable to determine at that time if any rail cars were involved because the large area of fire and smoke limited his view. He was able to observe that fire was beneath the overpasses of both the east and west bound lanes of I-10. After his observations, the district chief requested additional fire units, that the deputy chief (a higher ranking fire officer) be dispatched to Music and Abundance Streets, and that I-10 be closed.

About 1:55 a.m., the district chief approached the area of the fire on Abundance Street from the west. While driving through the residential area adjacent to I-10, he noted that people were moving throughout the area in a state of confusion, that covers were missing from manholes in the street, and that smoke was coming from debris on St. Roch Avenue. About 1:56 a.m., he met E-12 at

[5]The "911" number is a general emergency telephone number for reporting all types of emergencies. Operators receiving emergency reports may either record the information and provide it to the appropriate agency, fire, police, etc., or may transfer the caller to the dispatcher of the appropriate agency.

Abundance Street and St. Roch Avenue, and he instructed the captain of this engine company to begin fighting the fire where he deemed most appropriate. The district chief then drove to the east side of the fire.

Believing that they were to be fighting brush fires, the firefighters proceeded east along Abundance Street to north of I-10. Because the wall of fire created by flames was extending up to the I-10 overpass, the firefighters were only able to observe "trash fires under the Interstate and the brush along the railroad track burning." While fighting the brush fires, the captain of E-12 observed a burning tank car. Surprised by the presence of the burning tank car, the captain of E-12 ordered the firefighters to return to the fire engine. At this time, the rescue squad[6] arrived and the captain of E-12 advised the captain of the rescue squad that there was a possibility of an LPG[7] tank car fire. At 1:59 a.m., the district chief was alerted about the burning tank car while he was en route to the east side of the fire. The district chief advised the captain of E-12 "to be sure that the tanker was burning and not trash around the bottom of the tanker." The district chief also cautioned him "to be extremely careful and beware of a possible BLEVE."[8] The district chief then radioed the deputy chief to go directly to the west side to command operations on that side of the emergency and advised that he would command the east side activities.

At 2 a.m., soon after arriving on the east side of the fire, the district chief again radioed the NOFD dispatcher and requested additional fire units. About that time, the deputy chief arrived on the east side of the fire rather than the west side as recommended by the district chief. During his meeting with the district chief, the deputy chief observed that many residents were in the area, and he recommended that the district chief initiate an evacuation.

About 2:02 a.m., additional fire units with 26 fire personnel, including the hazardous materials officer, arrived on the east side. It was decided that these fire units would be used to establish unmanned monitor hose streams to cool the burning tank car. Soon thereafter, the deputy chief drove to the west side where he was initially directed.

On the west side of the fire, the captain of the rescue squad, while beneath the I-10 overpass, observed "the tank car spilling liquid from the bottom and a 5-foot red circle on the side of the car." Based on his observations, he directed that unmanned monitors be placed beneath the I-10 overpass so that water could be sprayed on the burning tank car to cool it. He also directed firemen to evacuate nearby houses on Music Street.

When the deputy chief arrived at the west side, the firemen had completed the installation of one unmanned monitor hose, had evacuated several of the houses along Music Street, and were in the process of charging the hose with water. The deputy chief met with the captain of the rescue squad who advised him that by using binoculars, they had identified the burning tank car as GATX 55996 and that it possibly contained LPG.

At 2:14 a.m. by radio, the deputy chief ordered all personnel back 1,000 feet because the product in the tank car was not known. Firefighters on the east side did not withdraw in response to the deputy chief's order; rather, they continued establishing unmanned monitors. The deputy chief then directed all personnel on the west side of the burning tank car to withdraw to Music and Abundance Streets, about 600 feet from the burning tank car. He also requested 10 to 12 NOPD units to support the evacuation of nearby residences.

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[6]The NOFD rescue squard is a unit equipped with special tools and reference materials that may be required during an emergency. The rescue squard carried in its vehicle response guides for handling hazardous materials emergencies.

[7]LPG is liquefied pertroleum gas which is highly flammable and its hazard classification by the U.S. Department of Transportation is "Flammable Gas."

[8]BLEVE is an acronym for boiling liquid expanding vapor explosion.

The deputy chief established his command post at Music and Abundance Streets and announced its location by radio. (See figure 2.) He then viewed the tank car from beneath the I-10 overpasses, and from its silhouette, he recognized that it was a pressure-type tank car, but he could not determine if it was equipped with insulation and/or a steel jacket. At this time, firefighters reported that the fire appeared to be concentrated at the center of the tank car with a "bright cherry red spot approximately 5 feet in diameter at the center of the car's side" and "burning liquid appeared to be spilling from the bottom with flames extending 5 to 10 feet above the car."

The CSXT assistant trainmaster, who was notified at 2 a.m. by the Gentilly terminal yardmaster, arrived on the east side of the burning tank car. Because the railroad cars on track 2 limited his view, he drove to the west side. At this location, he observed that fire was concentrated toward the center of a tank car on track 3. He radioed the Gentilly Terminal yardmaster and told him to call the CSXT terminal manager, the general car foreman, and the CSXT chief dispatcher and request that the CSXT initial-response plan be implemented. (See appendix F.) The assistant trainmaster then requested one of the firefighters to direct him to the person in charge. The assistant trainmaster went to the command post and the firefighter staffing the command post, who was an assistant to the captain of the rescue squad and who had received training in handling hazardous materials incidents, advised him that the burning tank car was GATX 55996 and that the NOFD needed to identity the product in the tank car. As the assistant trainmaster was requesting the identification of the material in GATX 55996, a NOT special agent at the scene, who had retrieved the waybills from the St. Roch Avenue waybill box, heard the assistant trainmaster's radio request and advised by radio that he had the waybills. The assistant trainmaster then retrieved the waybills from the NOT special agent. After reviewing the waybills, at 2:18 a.m., the assistant trainmaster advised that the product was "Butadiene, Inhibited" and that there were five additional tank cars containing butadiene coupled to the burning tank car. He gave the waybills to the firefighter at the command post.

The waybills also identified Mitsui and Company (Mitsui) as the shipper and Polysar Latex (Polysar) as the receiver (consignee) of GATX 55996, and it advised, "for chemical emergency notify CHEMTREC[9] at 800-424-9300 and the shipper." (See appendix B.) The firefighter at the command post provided the NOFD dispatcher with the identity of the product, and the NOFD dispatcher provided applicable emergency product guidance from the U.S. Department of Transportation (DOT) *Emergency Response Guidebook, Guide 17.* The guidebook indicated that butadiene was "extremely flammable, if inhaled may be harmful, contact may cause burns to skin and eyes, keep unnecessary people away, let a tank car burn unless leak can be stopped."

At 2:16 a.m., a NOPD officer called CHEMTREC, advised that a problem existed at the CSXT Gentilly railyard and then had to hang up to answer incoming telephone calls. At 2:18 a.m., based on information transmitted by radio, the NOPD officer again called CHEMTREC and advised that a tank car had blown up, and the product was "EUTAEIENE." The CHEMTREC operator questioned this spelling, and the NOPD officer stated that he would check it and call back.

At 2:18 a.m., the firefighter at the command post radioed the deputy chief, who was beneath the I-10 overpass, and advised him that the tank car contained butadiene. He also provided information on the hazards, physical properties, and recommended response actions from the *Chemical Hazard Response Information System* (CHRIS) manual which was kept on the rescue squad vehicle. Using the information, the deputy chief stated, "We had to make an attack on the tank car, in order not to put the fire out, but to cool the tank car. So I permitted my people to go back in and set up the two master-streams [unmanned monitors] that they had set up before." The deputy chief then requested NOPD units to evacuate the area west of the railroad tracks bounded by Industry

[9]CHEMTREC is a voluntary service established by the Chemical Manufacturer's Association to provide information to persons responding to chemical emergencies.

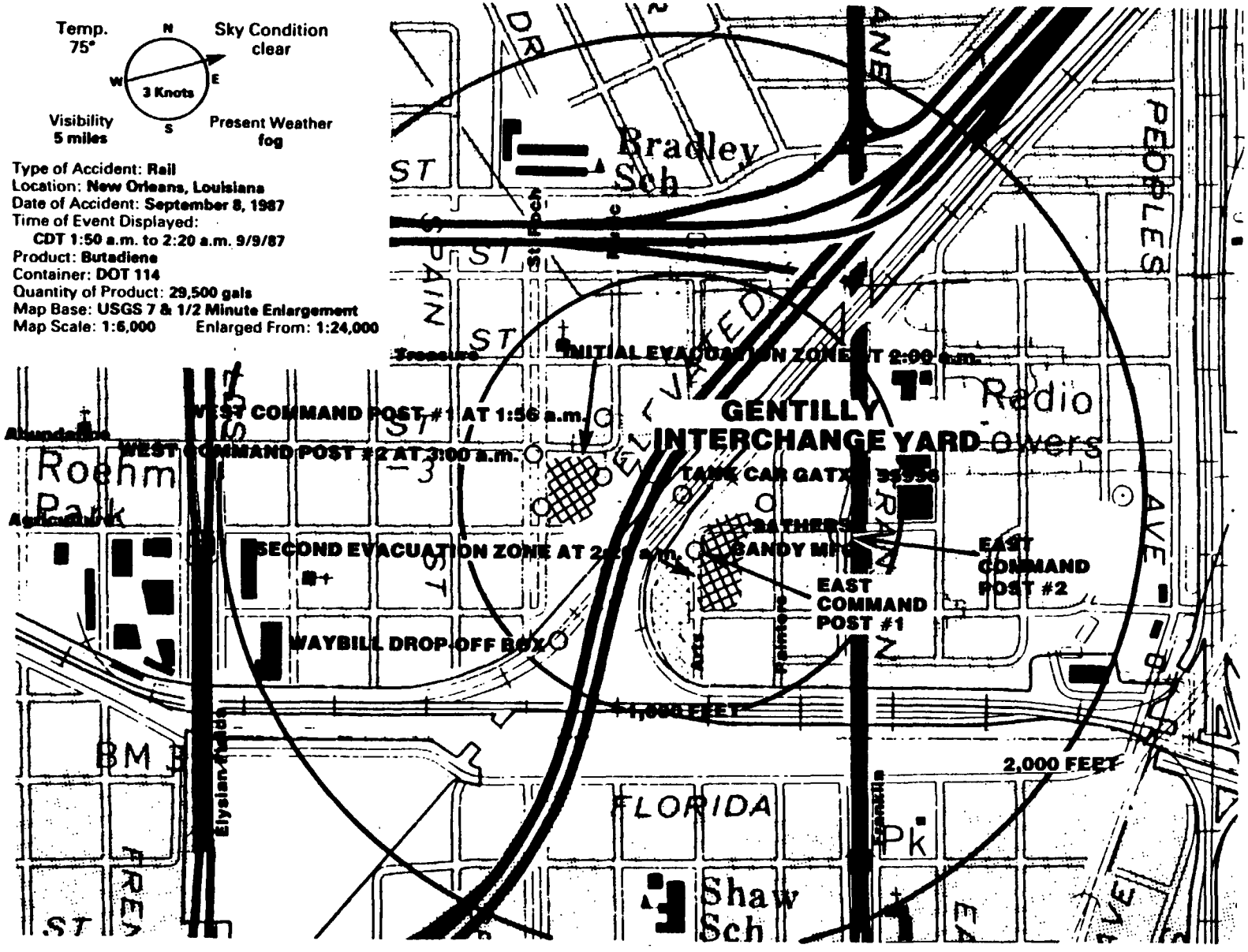


Figure 2. -- Command post locations and areas evacuated during the first hours of the emergency.

Street on the south, by St Roch Avenue on the west, and by Benefit Street on the north. (See figure 1.)

The NOFD superintendent arrived at St. Roch Avenue and Abundance Street at 2:20 a.m., and using his vehicle as the command post, he assumed command of all response activities. Soon thereafter at 2:23 a.m., two streams of water from unmanned monitors on the east side of the burning tank car were placed in service. Water was then directed over the cars on track 2 in an attempt to cool the burning tank car on track 3. The district chief then evacuated fire personnel on the east side to Franklin Avenue and Agriculture Street; however, it was necessary for firefighters to reenter the area several times to adjust the unmanned monitor water streams. (See figure 2.)

At 2:33 a.m., a second CHEMTREC operator answered a call from the NOFD. The NOPD dispatcher provided the tank car number as GATX 55996 and provided the product as "BETHUNE, INHIBITED."

At 2:51 a.m. while the first CHEMTREC operator was trying to obtain information about the tank car, its product, the shipper, and the carrier, the NOPD officer called and advised that the tank car was "GAKY 55996," that the "L and N Railroad" was the carrier, and that the NOPD would contact the L and N for contents and shipper information.

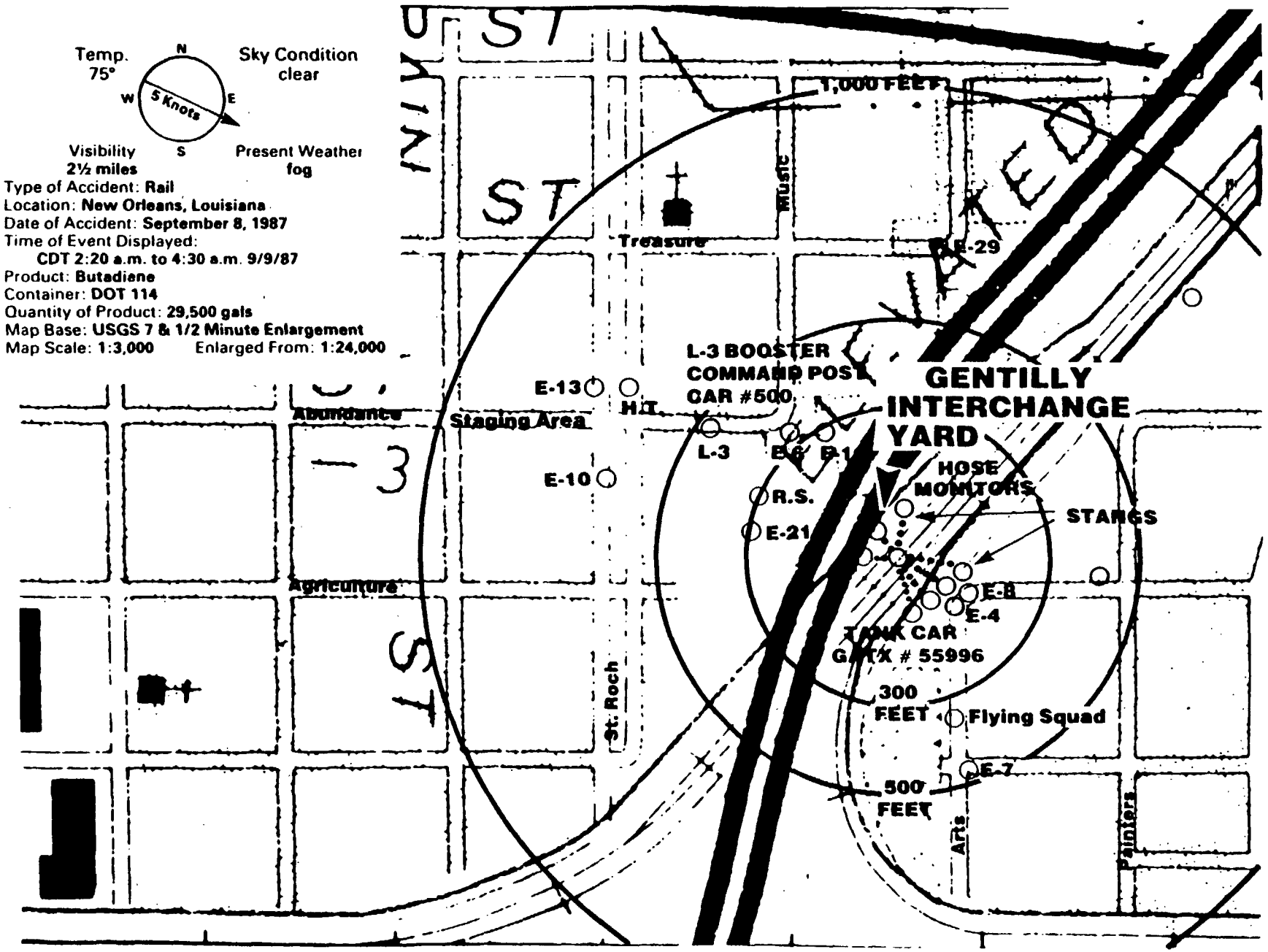
On the west side, firefighters returned to the location beneath the I-10 overpass where they had previously set up an unmanned monitor, and they again began erecting unmanned monitors. They had difficulty in obtaining an adequate water supply for the monitors, and additional fire engines and hoses were used to boost the water pressure to the monitors. These arrangements were completed, and by 3 a.m., there were three monitors on the west side and four monitors on the east side attempting to apply water on the burning tank car. Water for these monitors was supplied from hydrants up to 600 yards away which required using fire engines to relay the water between the hydrants and the monitors. Fire engines that supplied water directly to the monitors were within 150 feet of the burning tank car. (See figure 3.)

About 3 a.m., the NOFD requested the NOPD to evacuate a six-block area on the east side. It was also decided that the command post should be moved to the perimeter of the evacuated area to reduce the exposure of fire department personnel. The superintendent's car was then moved to St. Roch Avenue and Abundance Street, about 900 feet west of the burning tank car. (See figure 2.) Soon after these actions, additional NOFD units and personnel arrived. There were 296 NOFD personnel, and 20 fire department vehicles used during the emergency response.

At 3:06 a.m., the NOPD officer again called CHEMTREC and requested information about the product, but again the officer had to discontinue the call to answer incoming calls. At 3:13 a.m., the CHEMTREC operator contacted the NOPD officer and read to him from CHEMTREC files the product information for butadiene, inhibited.

Command Post Operations

About 3 a.m., the NOFD superintendent met in front of the Sathers building with the CSXT Gentilly terminal manager and other personnel to discuss possible actions for handling the emergency. At this time, a "cherry red" area was still visible on the side of the burning tank car. CSXT personnel recommended to the NOFD superintendent that the railroad cars adjacent to the burning tank car should be moved because they were obstructing the application of water to the fire. Additionally, there were concerns that the adjacent tank cars containing butadiene may be heated by the fire sufficient to cause polymerization--a chemical reaction that could increase the pressure and temperature of the material in the tank car and could cause a violent rupture. This recommendation was accepted and preparations to move the railroad cars were begun.


Temp.
75°
N
W
E
S
5 Knots
Sky Condition
clear
Visibility
2½ miles
Present Weather
fog
Type of Accident: Rail
Location: New Orleans, Louisiana
Date of Accident: September 8, 1987
Time of Event Displayed:
CDT 2:20 a.m. to 4:30 a.m. 9/9/87
Product: Butadiene
Container: DOT 114
Quantity of Product: 29,500 gals
Map Base: USGS 7 & 1/2 Minute Enlargement
Map Scale: 1:3,000 Enlarged From: 1:24,000
1,000 FEET
Treasure
Music
E-29
L-3 BOOSTER
COMMAND POST
CAR #500
GENTILLY
INTERCHANGE
YARD
E-13
H.T.
Abundance
Staging Area
L-3
E-10
R.S.
E-21
HOSE
MONITORS
STANDS
E-8
E-4
TANK CAR
GATX # 55996
300
FEET
Flying Squad
E-7
500
FEET
Agriculture
St. Roch
Arts
Painters

To minimize risks to railroad personnel during the removal of the railroad cars, CSXT requested NOT to remove those tank on the west nearest its rail facilities, while the CSXT removed the tank cars on the east nearest its Gentilly terminal. In response to this request, the NOT superintendent responded that he did not want to put his crew in that situation. (In later testimony, the NOT stated that it did not have an available crew and locomotive to remove the cars.) CSXT used volunteer railroad personnel to operate the locomotive to remove the cars, and a CSXT general car foreman uncoupled each end of the burning tank car and released the brakes. All rail cars on tracks 2 and 3, excluding the burning tank car, were initially moved 400 to 500 yards from the burning tank car. The east end cars were moved at 3:51 a.m., and at 4:04 a.m., the west end cars were moved.

About 5 a.m., the NOFD superintendent reassessed the status of activities. Based on recommended evacuation standards for fires involving LPG tank cars and on the recommendation of a hazardous materials chief from the neighboring Jefferson Parrish fire department[10] who was on scene, the NOFD increased the evacuation area from a radius of 300 yards to 1/2 mile. The command post was moved to Elysian Fields and Abundance Street (about 2,100 feet west of the burning tank car), and the NOFD requested the NOPD to evacuate the residents in the new area. This final evacuation area included more than 200 city blocks and affected 800 to 1,000 residents. (See figure 4.)

Between 6 a.m. and 7:30 a.m., NOFD personnel entered the evacuation area several times and approached close to the burning tank car to monitor the condition of the tank car, to determine if the position of the monitors had changed, and to reposition the monitors. Also, about 6:15 a.m., a representative of the Federal Railroad Administration (FRA) entered the evacuation area to assess the tank car. The FRA representative told a U.S. Environmental Protection Agency (EPA) representative, who minutes earlier had arrived at the command post, "Liquid was leaking from the tank car, and the car could go at any time."

Personnel of the EPA's Region VI Technical Assistance Team (TAT) were directed to assess the environmental impact and to document and evaluate the completeness of mitigation actions. During the incident, the TAT monitored the response activities and coordinated with Louisiana Department of Environmental Quality (LDEQ) to provide air monitoring downwind of the fire. LDEQ's air testing, using portable infrared analyzer and organic vapor analyzers, detected no concentrations of butadiene that would pose a danger to the surrounding population. The results of these tests were communicated to the command post.

In response to the CSXT assistant trainmaster's 2 a.m. request of CSXT headquarters to implement the CSXT initial response plan, CSXT dispatched its own hazardous materials specialist and a representative of Hulcher, a private emergency response company used by the CSXT on previous occasions.

At 7 a.m., the mayor of New Orleans arrived at the NOFD command post. Soon thereafter, a mobile command post was brought in and all command post operations were moved into the mobile unit. Jefferson Parrish fire department personnel video taped the burning tank car to assess the status of the fire and the tank car. The mayor directed his representative of the Emergency Reponse Office to prepare shelters for the evacuees. He telephoned the superintendent of schools and requested the use of school buildings for emergency shelters, and he also telephoned the local chapter of the American Red Cross and the Sheriff's Department and requested that they provide other necessities for the evacuees.

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[10]The Jefferson Parrish fire department is equipped with a hazardous materials response vehicle, a mobile communications command post, and specialized equipment and reference materials for handling hazardous materials emergencies. Its firefighters receive more than 100 hours of hazardous materials training each year. Additionally, its hazaredous materials division is headed by an officer highly trained in handling hazardous materials emergencies.

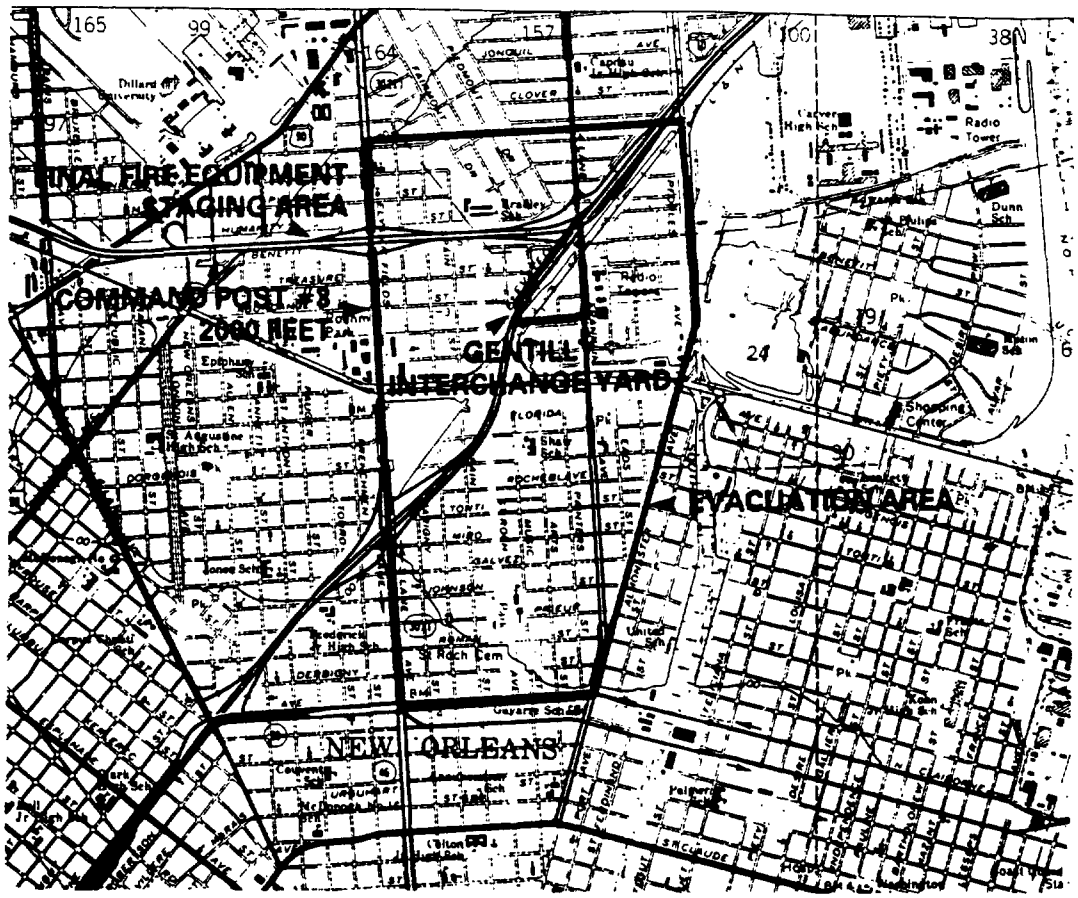

Figure 4.--Final evacuation area.

About 7 a.m., a representative of Western Emergency Services Incorporated (WES) arrived on scene. WES is a wholly-owned subsidiary of International Technology. The WES representative had been dispatched earlier by his supervisor in response to news media accounts of the emergency. When the WES representative reached the command post, he met with the NOFD superintendent, a fire chief from Jefferson Parrish, other NOFD fire chiefs, a representative of CSXT, and the mayor. Based on the WES representative's discussions about his company's capabilities, the mayor expressed interest in using WES to resolve the emergency.

About 7:30 to 7:45 a.m., NOFD firefighters and CSXT's initial response team in protective gear entered the area of the burning tank car. By observing the flame intensity and direct flame impingement on the tank car, the team estimated that there was a 90 percent chance of an explosion. They reported the findings and advised that the command post was located within the outer limits of the danger area.

About 8:30 a.m., a newsman in a fixed-winged aircraft flying near the area at 4,400 feet photographed the accident scene using a telephoto lens camera. This photograph shows the flames burning up through the center of the tank car, a small flame at one end of the tank car, a fire beneath the tank car, and four streams of water directed toward the tank car. (See figure 5.)

When the CSXT initial-response team returned at 8:30 a.m., the NOFD firefighters and the WES representative entered the evacuation area to view the burning tank car. However, they abandoned this attempted entry when the fire intensified. Using binoculars, the WES representative observed the fire and concluded that butadiene escaping as a liquid rather than as a vapor was fueling the fire. He stated that he did not observe any evidence of material pooling beneath the tank car.

About 9 a.m., the NOFD superintendent, representatives of the city, Louisiana State Police (LSP), FRA, Association of American Railroads (AAR), CSXT, NOT, WES, and General American Transportation Corporation (GATC) met at the command post to discuss actions to take for preventing a BLEVE and to resolve the emergency. The WES representative suggested several options for preventing a BLEVE and potential options for reducing the duration of the emergency. The NOFD expressed concern about the logistics involved in maintaining water on the tank car using the unmanned monitors and the impact on the evacuees of an extended evacuation.

In response to these concerns, the mayor met with representatives of NOT and CSXT requesting that one of the railroads accept responsibility for the burning rail tank car and to contract with WES to assist with the emergency response. However, neither railroad had any previous experience with WES, had any knowledge of WES's capabilities, or had sufficient information about WES to assess its qualifications for handling the emergency. Initially, neither the CSXT nor the NOT would accept responsibility either for the burning tank car or for contracting with WES. The railroads could not agree who had responsibility. The NOT believed that its placement of the railroad cars on the CSXT's receiving yard tracks constituted a change in responsibility for the rail cars from the NOT to the CSXT. The NOT considered that the problem was the CSXT's because the tank cars were on CSXT property. However, the CSXT did not believe that the tank cars were its responsibility because it had not yet inspected and accepted them. Since neither railroad would accept responsibility for the tank car, the mayor advised WES that the city would contract on its own with WES for assistance; however, WES would enter into a contract only with one of the railroads. After further consultation with CSXT headquarters, the CSXT representative advised the mayor that, without accepting responsibility for the tank cars, it would contract with WES. The WES representative then arranged to fly his emergency response team from Keller, Texas.

The mayor and the NOFD superintendent comanaged the remainder of the emergency response activities with the mayor retaining approval for any action taken relative to the disposition of the burning tank car. WES formulated action plans based on information and recommendations obtained from other technical experts at the command post. Representatives of Polysar, LSP, CSXT, EPA, NOT, FRA, LDEQ, and AAR were present at the command post.

When the five-man WES team arrived on scene at 1:30 p.m., they entered the evacuation area to examine the burning tank car and to assess the options for handling the emergency. However, the fire had intensified, and the radiant heat was too intense to approach the burning tank car. The WES team leader believed that a BLEVE was imminent, and he reported to the command post that in his estimation a BLEVE would occur within the next 2 to 3 hours.

Figure 5 --Aerial photograph of scene taken at 8:30 a.m.
(Photo courtesy of Bryan S. Berteaux of the Times Picayune.)

About 3 p.m., WES provided two options: cutting a hole through the tank car's steel jacket at the bottom of the tank and then cutting through the steel shell (tapping) to drain and burn the liquid butadiene; or tapping above the liquid level to vent and flare the butadiene vapor. The NOFD officials, CSXT, and LSP opposed these options because of the many potentially unsafe conditions.

Later, WES proposed that water be introduced into the tank through one of the loading valves atop of the tank to displace the liquid butadiene to the top of the tank where it could be forced out through the vapor valve and be burned as it left the tank. When the water displaced the butadiene, the fire then would be extinguished due to the lack of fuel. However, there were concerns about the structural integrity of the tank and the effect of the weight of the added water on the tank. This proposal was also rejected because the added weight of the water could collapse the tank and result in an uncontrolled release of butadiene, the outer jacket of the tank had been breached by the fire, some of the insulation between the jacket and the tank shell had been destroyed, and the fire had intensified.

At a 9 p.m. command post meeting, the NOFD superintendent advised that fire engines, some of which were as close as 50 yards to the burning tank car and were being used to pump water on the tank car, were low on fuel. If the fire engines did run out of fuel, the amount of water being applied to the burning tank car would systematically be lessened. The NOFD superintendent expressed concern about the safety of firefighters who may be required to enter the evacuation area to refuel the fire engines. Because it was believed that the application of water to cool the burning tank car had played a major role in controling the extent of the emergency, it was decided that it was best to accept the risks posed by refueling. By 3 a.m. on September 10, 1987, the refueling was completed without incident.

Throughout the night of September 9 and during the early morning hours of Spetember 10 the fire on the tank car continued to burn with the same intensity. Shortly after 6 a.m., the mayor met with the technical experts on scene and the NOFD superintendent to discuss options to resolve the emergency. At that time, it was decided that no change should be made, but that another meeting would be held at 10 a.m. to reevaluate the situation.

About 6:30 a.m., the intensity of the fire on the tank car visibly decreased. As a result, it was decided that another entry into the evacuation area should be made to evaluate the fire and the condition of the tank car more closely. About 9 a.m., 10 firefighters providing a shield of water spray allowed the WES team to approach the west end of the burning tank car. During this approach, the WES team observed that the steel jacket of the tank car was wrinkled in the area of the fire and that the intensity of the fire had decreased. Using a ladder at the end of the tank car, three members of the WES team in full protective suits climbed atop the burning tank car to install a gauge to determine the pressure in the tank car. After it was installed, the gauge indicated 0 pressure. This reading confused the WES team as the fire continued to burn high on the sides of the tank car. A NOFD chief at the command post questioned if there was a chance that the tank car was empty. The WES representative responded that because of the amount of fire, he did not believe the tank was empty.

Discussion at the command post again focused on possible actions to take for ending the emergency. Around 10 a.m., WES, the LSP, and the NOFD considered several options: 1) using a "flare and burn" procedure along with introducing water into the tank; 2) using a tap into the tank to remove the liquid to a safe area for burning; 3) using a thermite grenade to penetrate the tank to accelerate the rate of burning; 4) taking no action since the gauge indicated no pressure and the tank could now be empty; and 5) discontinuing the application of water to cool the tank, thereby accelerating the rate of burn.

Ultimately, it was decided to introduce water into the tank to remove the butadiene. As the butadiene was removed, it would be burned at a flare pipe installed on top of the tank car. The WES

team, again being protected by firefighters, approached the end of the tank car and climbed on top of the car to install equipment needed for the "flare and burn" operation. Soon thereafter, at 1:55 p.m., the fire went out. Believing that the water being applied to the tank had extinguished the fire, attempts were made to relight the fire. Any butadiene still being released from the tank was insufficient to support combustion, and the emergency condition was determined to have ended.

When the fire was extinguished, LDEQ personnel conducted tests at the site and EPA personnel monitored the tests. Organic vapor levels were determined to be well below the threshold limit valve of 1,000 parts per million for 1,3-butadiene as reported in the CHRIS manual. Based on this preliminary inspection of the immediate area for environmental impact, it was determined that all of the 1,3-butadiene had been consumed by the fire. The EPA determined that "little if any material entered the environment, no evidence of detrimental impact to the environment was found following the incident, and the planned cleanup by the CSXT was deemed to be sufficient and would be monitored by State and local agencies." CSXT advised the Safety Board that in checking the site regularly, there has been no indication of butadiene odors at the site.

Injuries to Persons

	Crewmembers	Response Personnel	Others	Total
Fatal	0	0	0	0
Nonfatal	0	3	0	3
Total	0	3	0	3

Three firefighters were treated for heat exhaustion and inhalation complaints.

Damages

Estimates of the dollar value of losses incurred were:

Rail track	$ 1,000
Rail equipment	25,000
Cargo	50,000
CSXT response	70,000
Civilian response	317,700
Total	$463,700

Amtrak, which uses the main lines adjacent to the interchange yard to provide passenger service, had to reroute its trains during the emergency. No attempt was made to estimate the costs of business interruption to the railroads or to other business, the costs to evacuees, the costs to motorists as a result of the closing of I-10, or other costs not specifically listed.

Meteorological Information

From September 4 through 8, 1987, the average daily temperature was 81°F, with an average maximum of 91°F and minimum of 71°F. From 10 p.m. on September 8 until 6 a.m. on September 9, there were scattered clouds, visibility was 5 to 6 miles with fog and haze during the evening, the temperature dropped from 80°F to 72°F, and the winds were from the west and varied from calm to 4 knots. At the time of the accident and for at least 24 hours afterwards, a shallow 350-foot ceiling

temperature inversion in southeastern Louisiana was observed by radio soundings. The weather conditions were observed at the New Orleans International Airport.

CHEMTREC Assistance

Mitsui was shown on the waybill as the shipper; however, no emergency telephone number was shown nor is there a requirement to do so. During the several communciations CHEMTREC had with the NOFD and the NOPD, CHEMTREC was unable to obtain the name of the shipper. During a 2:54 a.m. communication with the CSXT Operations Center, CHEMTREC learned that the tank cars had been transferred from the Illinois Central Gulf Railroad Company (ICG) to the CSXT and that because the CSXT had not inspected and accepted the tank cars, the CSXT did not have information from the waybills in its computer. The CHEMTREC operator contacted the ICG, and through a conference call, the operator arranged for the ICG to provide the waybill information to the CSXT. CHEMTREC then learned that Mitsui at Good Hope, Louisiana, was the shipper and that Polysar at Chattanooga, Tennessee, was the consignee. However, the ICG had no emergency telephone number for Mitsui.

The CHEMTREC operator searched available chemical company listings, but found none for Mitsui. The operator then called several chemical companies, including Polysar, to inquire about an emergency telephone for Mitsui, but this was unsuccessful. One of the companies called was Exxon and because it had an employee knowledgeable of the properties of butadiene, it agreed to provide whatever assistance it could. During the early hours of the emergency, Exxon provided information on the properties and hazards of butadiene to several agencies including the CSXT and the city. When Polysar was called by CHEMTREC at 4:48 a.m., it also offered to provide technical assistance and other support. Later, Polysar dispatched an emergency response team to New Orleans.

The CHEMTREC operator continued efforts to obtain a telephone number for Mitsui, but still had no success. Finally, the CHEMTREC operator began calling telephone company area code operators and requesting a listing for Mitsui. First, the operator called area code 504, southeastern Louisiana, and then area code 212, an area in New York. A telephone listing for Mitsui was provided by the telephone operator in area code 212, and at 7:47 a.m., CHEMTREC contacted Mitsui. The Mitsui representative, when told of the emergency, advised that for hours he had been attempting to contact the NOFD and NOPD, but that he had not been successful. The CHEMTREC operator provided telephone numbers for the NOFD and NOPD, and the Mitsui representative advised that he would contact the city.

Command, Communications, and Management

Initial Command and Communications.--The district chief reported that he did not establish a command post when he arrived on scene or thereafter. He stated that the response area was divided by the railroad tracks into two areas of operation and that he controlled operations on the east side and that he reported to the deputy chief who, on his arrival, became the incident commander. During the early minutes of the NOFD's response, the NOFD dispatcher's log records indicate that two command posts existed: one at Music and Abundance Streets, the area of operations in which the deputy chief was located; and the other at Agriculture and Arts Streets, the area of operations where the district chief was located. Later, at a time not recorded on the NOFD dispatcher's log, east and west command post locations were recorded to have been relocated to Elysian Fields and Abundance Street and to Franklin Avenue and Arts Streets, respectively. The first command post locations were identified only by radio notification to the NOFD dispatcher; these notifications could be heard only by personnel whose radios incorporated the same frequency. Several city agencies responding to the emergency, such as the NOPD, were equipped to monitor the radio frequencies used by the NOFD, but no means was provided for making other emergency personnel aware of the the command post(s) locations. Additionally, the NOFD dispatcher's log contains no notation reflecting that the command post at Music and Abundance Streets was first moved to St. Roch Avenue and Abundance Street before finally being moved to Elysian Fields and Abundance Street.

At 2:20 a.m., when the New Orleans Health Department and Emergency Medical Services (HD/EMS) administrator arrived on the east side of the burning tank car, she had difficulty in locating the command post. She observed that numerous spectators were in the streets and that NOPD officers about one block from the area of the burning tank car were limiting access. The HD/EMS administrator advised bystanders to return to their homes, close the windows and doors, and await further advice from the NOFD or NOPD as to actions they should take.

The HD/EMS reported that about 2:35 a.m., it learned that the NOFD had one command post at Arts Street and Agriculture Avenue and another at Music and Abundance Streets. The concern expressed by HD/EMS personnel at this time was that they were not aware of the nature of the emergency or of the hazards of the materials involved. A railroad employee advised the HD/EMS administrator that the chemical involved could be explosive. When the HD/EMS administrator located the NOFD superintendent, the superintendent advised the administrator that this was an extremely dangerous fire. Based on this information, the HD/EMS administrator directed her employees to remain at least five blocks from the fire, and she established her command communications center at Elysian Fields and North Miro Streets about 3,700 feet from the burning tank car.

Evacuations.--At 3:10 a.m., CSXT Operations Center called the NOFD dispatcher to obtain information and to offer technical assistance. At that time, the NOFD dispatcher advised that an 8-block evacuation was in effect.

At 3:13 a.m, CHEMTREC called the NOPD to provide product information for butadiene. At this time, the NOPD advised that it had evacuated a two-square-block area, that it was not known if the tank car was burning, and that building fires had been confirmed.

At 3:25 a.m., CSXT Operations Center contacted the NOPD and was advised that there was a two-block evacuation in effect and that some product had entered the sewer system where it was still burning. CSXT recommended that the evacuation be extended in the downwind direction if smoke and strong odors were detected. CSXT advised that it concurred with letting the fire burn itself out while keeping the adjacent tank cars cool using unmanned monitors.

About 3:30 a.m., firefighters arriving at St. Roch Avenue and Abundance Street (on the west side of the burning tank car) observed that the area had not been evacuated. Personnel of this engine company, on their own initiative, began going door-to-door evacuating residents. They then heard on their emergency radio that the situation was becoming critical, and at that time, they began using the public address system on the fire engine to evacuate residents in a six-block area.

About 4:30 a.m., HD/EMS personnel on the west side of the burning tank car observed that all persons in the immediate one- to two-block area had not been evacuated. HD/EMS personnel assisted in evacuating two persons still in the area; one was an invalid.

A 6 a.m. report to the CSXT Operations Center from the Gentilly yard manager, who was being kept current on activities by on-scene CSXT personnel, advised that the evacuation had been extended to a 1-mile radius.

At 9:15 a.m, an on-scene CSXT employee reported to the CSXT Operations Center that a 1/2-mile evacuation was in effect. He also advised that a WES representative estimated that the flow of butadiene from the bottom of the tank car was about 10 gallons per minute.

Emergency Management.--In response to questions concerning NOFD operations during this emergency, the deputy chief testified at the public hearing that some of the coordination on scene "was excellent and some left a lot to be desired." He stated that the geographical layout of the fire

scene created two areas of operation, but he believed that there was only one command post. The deputy chief stated that tactically all actions taken were correct for the incident. However, he believed that the NOFD's liaison and logistics for this emergency would have been improved by using the incident command system that is taught by the National Fire Academy.

A Hazardous Materials Officer (JP officer) from the Jeffferson Parrish fire department, who arrived on scene about 3 a.m. on Spetember 9, 1987, stated that when he first arrived, firefighters were working to establish unmanned monitors to put water on the burning tank car; he believed that this was a proper first action to be taking. He then met with the NOFD superintendent at the command post when it was at St. Roch Avenue and Abundance Street which he estimated to be about 300 feet from the burning tank car. After being briefed on the emergency, the JP officer recommended that the command post be relocated. He stated that based on the emergency response guidance for butadiene, his initial action would have been to have evacuated everything within 1 mile of the burning tank car. His concern was that, had it exploded, pieces of the tank car could have traveled up to 1 mile and that people within 1,500 feet of the tank car could have been burned. In response to this recommendation, the NOFD superintendent directed the command post to be relocated to Elysian Fields and Abundance Street.

The JP officer observed that the NOFD firefighters, in positioning their equipment to put water onto the burning tank car, had made a forward lay[11] which resulted in exposing many pieces of fire equipment to the fire. He also observed, "There was an obvious lack of coordination in the early stages of this incident. . ." and "There seemed to be communication problems between other agencies involved. . .police, public service, EMS." He stated that during the early stages, these agencies did not share a common command post, there was a lack of communication among the agencies, and "It . . . appeared that nobody was really taking charge of the incident." The JP officer further stated, "There was chaos when the evacuation was called. I don't think that anybody was clear on just [what] area was to be evacuated."

Moreover, the JP officer observed that many firefighters working within the evacuation areas were not using self-contained breathing apparatus that was required given the health hazards of butadiene. Further, they were not wearing protective clothing appropriate for the emergency because NOFD did not have any available. Also, because an incident command management system[12] was not used during the early phases, all personnel and outsiders had access to the NOFD superintendent and could have distracted him from managing the emergency.

It was the JP officer's opinion that implementing an incident command management system would have benefited the NOFD superintendent by providing a tighter span of control over emergency personnel, and a clearer line of communication, and more accurate records.

The JP officer was also concerned by approaches the WES and NOFD firefighters made to the tank car. He stated that if an approach is to be made, it is safer to approach from the sides of the burning tank car because the greater exposure distance is parallel to a tank car. However, the JP officer advised, "If that tank has been burning over several hours, then I would not approach that tank."

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[11]A forward lay means that the fire hoses are laid from the hydrant to the pump on the fire engine, rather than positioning the fire engine near the hydrant and then laying hose to the location where water is needed for fire fighting.

[12]An incident command management system is one in which the incident commander divides duties into distinct, manageable activities (liaison with other agencies, marshalling of equipment, liaison with on-scene technical experts, etc.) and designates for the management of those activities a qualified officer or other person. The incident commander then obtains needed information and directs actions to be implemented through his appointed personnel.

The NOFD superintendent stated that the goals he established in his handling of this emergency were to "not lose any lives, not to lose any property." He observed, that after he arrived on scene and was apprised of the situation, he took full command. He acknowledged that he did not spend all of his time at the command post; rather, he moved from the activities on one side of the burning tank car to the other to "visit with the men," and on approximately 20 occasions during his 38 hours at the scene, he went into the evacuation area to observe and appraise the condition of the tank car. However, during his many observations of the burning tank car, he was not able to observe any steam where the water was hitting the tank jacket; thus it was his evaluation that there was not much heating occurring in the tank car. The NOFD superintendent also stated that during one visit to the tank car, he was able to place his hand on the jacket of the tank car.

The NOFD superintendent acknowledged that he had no part in some decisions made during the emergency response, including the decision to move the other rail cars from the area of the burning tank car. Other decisions, such as areas to be evacuated, were jointly made by himself, the NOPD, the city's chief administrative officer, and the mayor. Although he took no action to confirm that all agencies that responded to the emergency were present at meetings conducted by the NOFD superintendent, it was his impression that all were present and that through his meetings, all agencies were kept informed on the status of the emergency and on all hazards to health and safety posed by the emergency. The NOFD superintendent stated that they presently use incident command management procedures and that during this emergency, he had designated his chiefs to be responsible for various activities, including overall operations of the NOFD and liaison with other agencies.

Although the WES team was being consulted by the mayor, the NOFD superintendent stated that he "considered all of the options [presented by anyone at the command post]" and that he "maintained the right to veto [any recommended option when] . . . we felt it wasn't safe, and [we] let everybody know that. . .any time that this fire chief did not agree,. . .we would scrub it."

In carrying out his activities at the command post, the mayor stated that he was not guided by any specific plan such as the NOFD's Hazardous Materials Incident-Response Plan or the city's emergency disaster preparedness plan because he was not familiar with them. The mayor also was not aware that in 1983, the chief administrative officer for the city had designated the NOFD as the lead agency for coordinating the field activities of all city agencies during a hazardous materials incident. Further, the mayor stated that when he was on scene, the NOFD superintendent was in charge of the fire scene, but that he wanted to give his approval before anything was done to the tank car.

The mayor stated that the city coordinated with all other agencies throughout the emergency, that they all worked together, and that he "made the final decision on what was to happen." However, the mayor pointed out that, as a result of the Norfolk Southern's early refusal to take any responsibility for the emergency, the city did not work with personnel from the Norfolk Southern in determining what actions to take with respect to the emergency.

Shipping Operations

Mitsui and Company.--Mitsui leases a number of tank cars from various companies to transport butadiene. In February 1987, GATC, a subsidiary of GATX, Inc., leased 30 DOT specification tank cars, including GATX 55996, to Mitsui.[13] After Mitsui accepted the tank cars, they were delivered from El Reno, Oklahoma, by way of several railroads to the GATX Destrahan Yard near Good Hope, Louisiana.

Under terms of the GATC contract, Mitsui was to inspect the tank cars within 5 days of their arrival at the Destrahan Yard and before each loading. When Mitsui received those cars, it assumed that the tank cars met specification requirements for butadiene service based on the fact that a DOT specification number was stenciled on each car. Mitsui did not physically inspect the tank cars to determine compliance with AAR or DOT requirements for butadiene service. Without further inspection, in April 1987, GATC applied its tank car numbers and the commodity stencils to these tank cars (including GATX 55996). In August 1987, GATX Terminals (GATXT), another subsidiary of GATX, Inc., directed the ICG to move these tank cars to its terminal loading rack at Good Hope, Louisiana.

Polysar was receiving butadiene by ship at the GATXT and needed immediate shipment of butadiene for its plants in Pennsylvania and Tennessee. Through telex communication, Polysar arranged for Mitsui to unload, store, and ship the butadiene to its plants. GATXT selected tank car GATX 55996 and GATX 65014[14] as two of seven tank cars to be loaded for Polysar's shipment. Also on behalf of Polysar, Mitsui directed GATXT to inspect, load, and certify the tank cars and in accordance with Polysar's instructions, to route the rail shipment through the ICG and CSXT.

GATXT.--On September 4, 1987, 4 days before the accident at New Orleans, GATXT loaded several tank cars with butadiene directly from the S/S HERMAN SCHULTE, the ship that transported Polysar's butadiene to Good Hope. Before unloading the S/S HERMAN SCHULTE, Laboratory Services, Inc., performed quality control testing of the butadiene and determined that the concentration of tertiary butyl catechol, an inhibitor, was acceptable. Laboratory Services, Inc., next tested each tank car to determine if the oxygen content was at an acceptable level for loading.[15] Additionally, Laboratory Services, Inc., determined the amount of butadiene to be loaded into each tank car and computed the proper settings for the gauging devices on the cars.

After it was determined through tests that the oxygen content in all the cars was acceptable, GATXT personnel set the hand brakes on each car, inspected each car to determine if outlets, caps, and plugs were secured, and recorded the stencil information (safety valve and tank test dates, car number, and commodity) on an internal inspection report. After completing the inspections, GATXT personnel determined that all of the tank cars were in satisfactory condition for loading.

The S/S HERMAN SCHULTE began discharging butadiene at 5:25 p.m. on September 4, 1987. Seven tank cars were connected to the terminal piping, and the tank cars were simultaneously loaded. After the seven tank cars were loaded, around 9:05 p.m. on September 4, 1987, four of the tank cars, including GATX 55996, were flared to reduce the oxygen content.

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[13]During the 20-year transfer history of this tank car and others, none of the successive owners/purchasers physically inspected the tank cars for compliance with DOT and AAR requirements.

[14]Bottom manway tank cars that have an opening in the bottom to permit access to the interior of the tank for cleaning, inspecting, and making repairs.

[15]Since butadiene is considered extremely flammable, GATXT procedures for handling butadiene require tank cars and tanks to be purged with nitrogen/butadiene and tested to be sure the oxygen content is below 0.3 percent or 3,000 parts per million.

After the flaring operations, each of the four tank cars was again tested for its oxygen level, and Laboratory Services, Inc., certified that all seven tank cars had acceptable oxygen levels. Laboratory Services, Inc., personnel recorded the temperature of the butadiene in tank car GATX 55996 as 38°F, and the internal pressure after loading as 4.9 psi. The internal pressure in the other six tank cars was recorded to be between 3.4 and 7.2 psi.

GATXT personnel then installed plugs into the loading valves on the tank cars and checked these connections to determine if there was any leakage. With no indication of leakage, the dome covers were closed and the tank cars were sealed. GATXT personnel then proceeded to the bottom of the tank cars, removed the chocks around the tank car wheels, inspected the placards, and checked for leaks as they walked around the cars. GATXT personnel reported that the jacket manway access, which enclosed the bottom manways on tank cars GATX 55996 and GATX 56014, were not opened during this inspection. Even so, GATXT personnel stated that no leaks were visually apparent on any of these tank cars following the loading.

The GATXT internal facility checklist requires that all fittings on the dome or top manway of the tank car be properly checked for leaks after loading butadiene. The checklist does not include any requirement to inspect bottom manway tank cars, and it does not include a requirement to inspect the condition of gaskets at locations other those specified on the checklist. Consequently, the jacket manway access on GATX 55996 and GATX 56014 were not opened and the bottom manway closure assemblies were not inspected by GATXT personnel.

A bill of lading for each of the seven tank cars was prepared and certified by GATXT facility personnel as agent for Mitsui. The bill of lading showed Mitsui as the shipper of record offering the butadiene to the ICG for transportation. (See appendix C.) (Since the accident, Mitsui stated that the bills of lading for these seven tank cars were wrong. Mitsui contends that the tank car moved under a single-trip lease agreement, and that Polysar, as the owner of the butadiene and the user of the tank car, should have been shown on the bill of lading as the shipper. Polysar contends that its agreement with Mitsui included shipping the butadiene; consequently, Mitsui was properly shown on the waybill as the shipper.) GATXT personnel, acting as an agent of the ICG, accepted the bills of lading for the ICG. About 5 p.m. on September 4, 1987, the GATXT notified the ICG by phone that after 11 p.m., seven tank cars would be available for transportation.

Tank car GATX 55996 and the other six tank cars loaded for Polysar were pulled from the GATXT loading rack at 12:01 a.m., September 5, 1987, and placed on the GATXT railyard lead track. Five of the tank cars were destined to the Polysar facility in Chatanooga; two of the tank cars were destined to a Polysar facility in Pennsylvania.

Following completion of an airbrake test[16] on September 5, 1987, the ICG transported the Polysar shipment along with 35 additional cars from the GATXT to the ICG Mays Yard, Harahan, Louisiana. (See figure 6.) From September 6 through 7, 1987, following airbrake inspections on terminal departure and during yard interchanges, the butadiene shipment was moved through the NOT, Shrewsbury Yard, at Metairie, Louisiana, to the NOT Oliver Yard, New Orleans, Louisiana.

Federal Shipper Regulations.--Title 49 CFR 173.31 provides loading and shipping requirements for tank cars. Section 173.31(b)(1), *Examination before shipping*, states:

> When tanks are loaded and prior to shipping, the shipper must determine to the extent practicable, that the tank, safety appurtenances and fittings are in proper condition for the safe transportation of the lading.

[16]Under freight train airbrake test requirements, Title 49 Code of Federal Regulation 232, an inspection of brake application of added cars including the rearmost car is required.

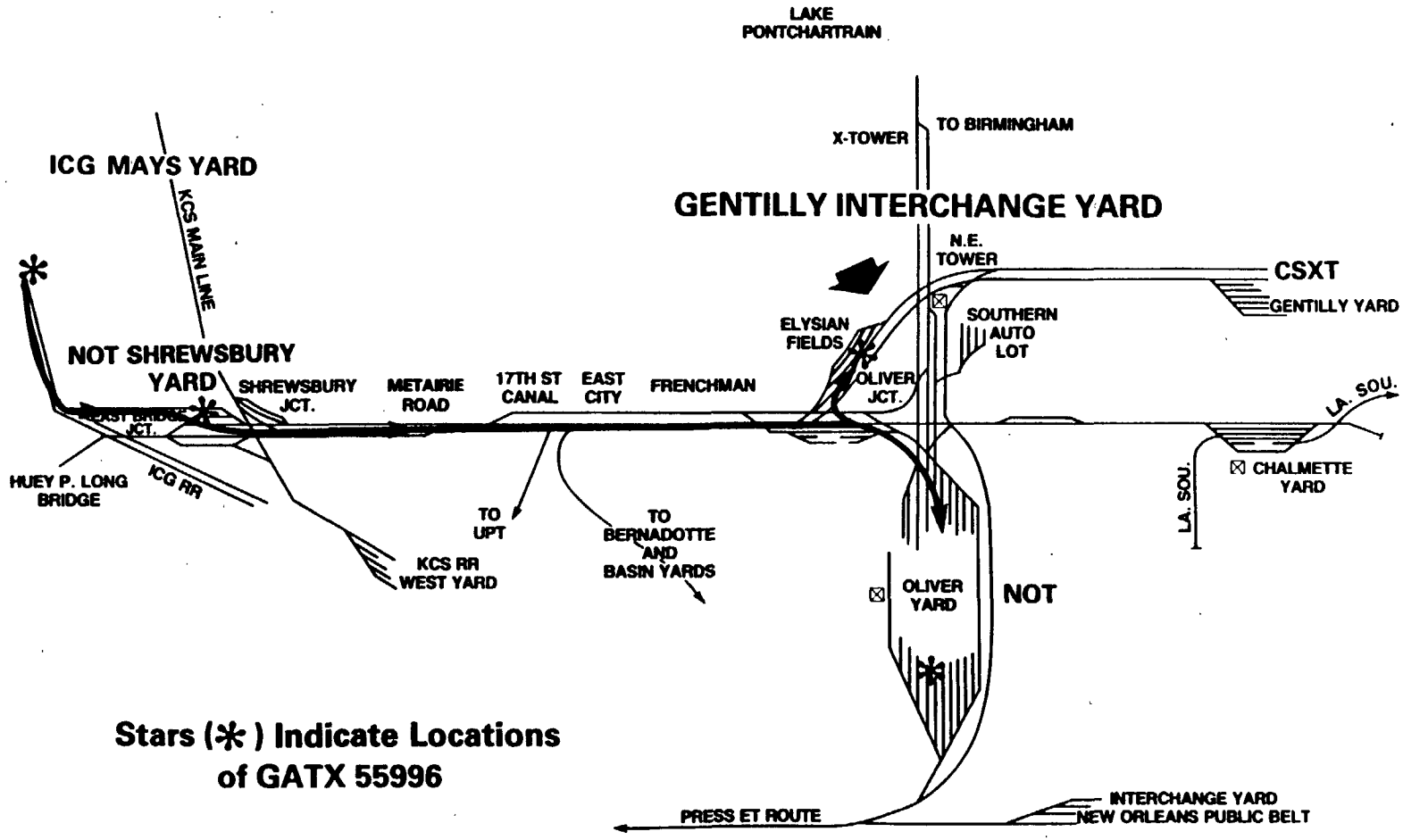


Figure 6.--The route used for transporting GATX 55996 through major railyards in the greater New Orleans area.

Section 173.31 (b)(3), *Securing closures*, states:

> All closures of openings in tank cars and of their protective housings must be properly secured in place by a bar, wrench, or other suitable tool. . . .Manway covers and outlet valve caps must be made tight against leakage of vapor and liquid, by use of suitable materials, before cars are tendered to carrier for transportation. Luting (packing) materials must not be used in outlet cap or on threads of bottom outlet. All closures of openings in tank cars must be inspected to the extent practical for corrosion of or damage to the gasket seating surface and for serviceability of packing, gaskets, and hold-down bolts. All defective packing, gaskets, bolting or threaded elements must be replaced.

Hazardous Materials Emergency Preparedness

The Safety Board reviewed 10 emergency response contingency plans that were applicable to the New Orleans accident. Of these plans, the Hazardous Materials Incident Response Plan (HMIRP) for New Orleans, the NOFD Hazardous Materials Response Plan, the NOPD and the Department of Health Emergency Plans, the Norfolk Southern's Emergency Response Plan, the CSX's Hazardous Materials Yard Contingency Plan, the Louisiana Statewide Emergency Response Plan, and the EPA National Contingency Plan were implemented. This report addresses only those that had a major impact on the handling of this emergency.

City Planning.--Because there are over 100 petroleum chemical plants within 80 miles of New Orleans, the city is a major center through which hazardous materials are transported. Conservative estimates by the city indicate that more than 375 hazardous materials tank cars move daily through any of 15 railyards in the city. In 1972, concerns over the increasing risks and hazardous materials exposure prompted the NOFD superintendent to submit a budget request for increasing its hazardous materials training and for obtaining specialized equipment. Similar requests were made almost every year since 1972. However, these request did not result in obtaining funds for the proposed hazardous materials emergency response capabilities.

On July 11, 1983, New Orleans submitted comments to the Safety Board and requested that they be included in the record of the July 26, 1983, Safety Board public hearing on Railroad Safety--Hazardous Materials and Emergency Preparedness.[17] In part, these comments were:

> The metropolitian region has a population of nearly 1.2 million people. Louisiana's natural resources, including the Mississippi River and extensive oil and gas reserves, help make New Orleans a major transportation center and thus a major center of activity for the transportation and storage of hazardous materials.
>
> In May of 1982, I [the then mayor] appointed a twenty-nine member Hazardous Materials Advisory Council. Both the Bureau of Explosives of the Association of American Railroads and the Federal Railroad Administration are represented on the Advisory Council. The Advisory Council, in conjunction with the Environmental Affairs Unit in my Office of Analysis and Planning, developed a written hazardous materials incident response plan. . . . This plan will go into effect whenever a hazardous materials incident occurs in New Orleans; it lists the primary areas of

[17]Special Investigation Report: Railroad Yard Safety--*Hazardous Materials and Emergency Preparedness, April 30, 1985* (NTSB/SIR-85/03).

> responsibility for City agencies and guides them in identifying and cooperating with other public and private response and support groups.
>
> The "Hazardous Materials Incident Response Plan" is the first comprehensive plan of its kind for the City of New Orleans. It was written to complement the City's existing plans for natural disaster emergencies, and designates the New Orleans Fire Department as the lead agency in responding to any hazardous materials incident. The response plan also includes a directory which provides information on the capabilities of many agencies in the New Orleans area.
>
> Additionally, we believe that facilities manufacturing, storing, handling, or transporting substantial quantities of hazardous materials should initiate approved safety programs and plans, coordinating such programs and plans with the New Orleans Fire Department.

The New Orleans' HMIRP enclosed with the city's comments established formal guidelines for fire department coordination during hazardous materials emergencies of designated city agencies--fire, police, public health department. The plan instructs the on-scene commander to determine:

> . . .the most appropriate manner of responding to the threat and to encourage the individual or company responsible for the incident to undertake all necessary countermeasures including the responsibility for clean-up and disposal. The command post representatives assist by monitoring the operation and providing advice and support.

The plan further directs all city agencies to develop departmental procedures based on the general policies stated in this plan. The plan, however, did not include procedures for updates or interdepartmental exchanges of these procedures for review and coordination. The plan directs that on-scene support personnel will accept direction from the NOFD officer-in-charge at the scene and that off-scene city departments will cooperate as fully as possible with any request for support from the officer-in-charge. The plan also requires all city departments to submit written plans and procedures related to the HMIRP to the chief administrative officer to document their response activities and costs during an incident. The NOFD would be responsible for:

- establishing a field command post;
- determining the priorities for rescue, protection, and containment;
- monitoring the city's role in the containment, clean-up, and removal of hazardous materials;
- coordinating communications and public information at the scene;
- terminating the city's response operations; and
- collating the postincident reports of all departments.

None of the separate plans prepared by the fire, police, health or other city departments have been reviewed by the NOFD or the city's Office of Emergency Management--the city agency responsible for the overall coordination of the hazardous materials contingency plan. Furthermore, comprehensive critiques involving all agencies responding to hazardous materials incidents apparently have not been conducted to assess the adequacy of the various plans and to define modifications necessary in the overall city policy or the individual plans. After the

September 9, 1987, accident, most of the agencies that responded did conduct critiques of their individual actions; however, no overall, comprehensive critique was conducted.

On September 17, 1987, the New Orleans City Council passed a resolution requesting the mayor, as president of the Public Belt Railroad Commission, an executive branch of city government responsible for coordinating rail operations in the New Orleans area, to allocate funds and undertake:

- an analysis of and the development of recommendations addressing the rail transport, transfer, and related temporary storage of hazardous materials cargo, including prevention, response, training, the routing and flow of hazardous commodities, safe handling methods, accident statistics, regulations and enforcement, vulnerable populations, and public awareness; and

- the support of a special hazardous materials unit to be created in the New Orleans Fire Department.

NOFD Planning.--At the time of the accident, the fire department had three instructors to provide recruit level and in-service training for the 729-person department. Training included courses on basic fire science, equipment operation, vehicle maintenance, hazardous materials recognition and identification, and fire suppression. In 1980, 1982, and 1984, CSXT held training sessions for the fire department personnel that covered CSXT procedures for obtaining hazardous materials assistance and information the traincrew would provide in the event of a derailment. Additionally, several supervisory fire personnel have taken basic hazardous materials training at a local college and at the National Fire Academy.

At the time of this incident, the NOFD had only one hazardous materials officer. Following this incident, several midlevel fire department officers attended courses in hazardous material incident management that included identification of hazardous materials, chemical properties, specialized equipment, containment procedures, tactical considerations, and evacuation and decontamination procedures.

CSXT Planning.--Recently implemented in March 1987, the CSXT Hazardous Materials Yard Contingency Plan involves the coordination of CSXT's emergency procedures with those of the community.[18] (For specific details, see appendix F.) The CSXT plan provides for immediate technical assistance to the local responders and concentrates on providing notification, initial decisions, and environmental controls during a hazardous materials incident. CSXT hazardous materials safety specialists provide an 8-hour training program for all CSXT employees that includes notification, tank car damage assessment, personnel protection, and spill mitigation. In addition to the designated hazardous materials assessment team at the New Orleans CSXT yard, CSXT hazardous materials handling and recovery specialists were dispatched from Alabama, Florida, and Texas.

Norfolk Southern Planning.--Norfolk Southern was one of the first rail carriers to develop and begin implementing systemwide yard-specific hazardous materials emergency planning. During the public hearing on Hazardous Materials Yard Safety on July 23, 1983, the Norfolk Southern representative stated, "The respective division superintendents and their staffs are responsible for the implementation of the plan for each yard, because each yard's circumstances differ and merit differing responses." Key elements of this plan include familiarization tour with local emergency

[18]Other than provide training sessions to members of the fire department and several meetings with NOFD regarding the condition of and access to rail yard hydrants, CSXT personnel had not met with or been requested by city officials to meet for providing specific information or for preplanning railyard hazardous materials incidents.

response personnel, emergency notification lists, scale map of the yard, and readily available product handling and response guides. Despite the Norfolk Southern's policy regarding hazardous materials yard planning, the NOT yards in New Orleans had not implemented this policy fully. NOT reported that before the September 9, 1987, accident, there had been several planning meetings between the city fire officials and Norfolk Southern concerning the company's emergency plans. The latest such meeting occurred on September 18, 1986, and an official of the NOFD and the city's emergency management coordinator attended. Also, NOT reported that during this meeting, both the Norfolk Southern Emergency Response Procedures and the NOT Company Emergency Response Plan were reviewed. However, during the Safety Board's hearing, city officials stated that they were not knowledgeable of the Norfolk Southern's specific emergency plans for its Oliver or Shrewsberry railyards.

The Norfolk Southern includes in its response procedures an emergency notification list. At the time of this accident, this list was not current in the emergency procedures reviewed by the Safety Board. In response to this finding, Norfolk Southern advised that between September 1-9, 1987, numerous changes in personnel were made at the NOT Company. While the list in the emergency procedures was not current, Norfolk Southern advised that a correct, current phone number list of key employees, who during this time resided in motels, was kept by the yardmaster on duty in the Oliver Tower.

Other Information

At atmospheric temperatures and pressures, butadiene is a flammable, colorless gas with a mild aromatic odor; it is a liquid when under pressure or refrigerated to a temperature below its boiling point. It is transported as a compressed gas (liquid, inhibited) and described on shipping papers as butadiene, inhibited, flammable gas, UN1010. It has a flash point of -105°F, flammable limits of 2 to 12 percent in air, and boils at 24°F. The vapor pressure is 17.65 psig at 32°F and about 36 psig at 70°F. Liquid butadiene vaporizes rapidly at atmospheric temperatures and pressures, and the vapors, which are heavier than air, can travel long distances along the ground.

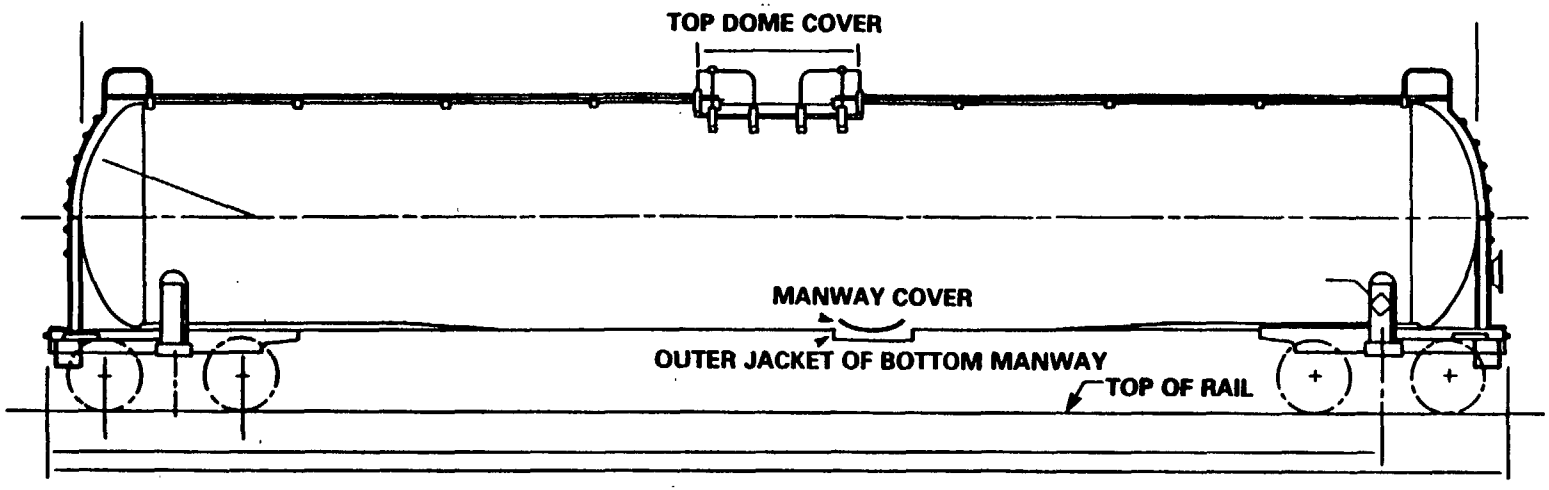
The primary use of butadiene is in the manufacture of synthetic rubber. It also is used in developing rocket fuels, plastics, and resins.

Tank Car Information

GATX 55996.--Tank car GATX 55996, a 33,872-gallon DOT specification 114J340W tank car, was built by North American Tank Car Corporation (NATX) in May 1966.[19] The tank car was specifically designed to transport LPG and anhydrous ammonia. It was equipped with 100-ton trucks and type E top- and bottom-shelf couplers, and it was insulated by a 1-inch-thick mineral wool blanket that was enclosed by a 1/8-inch-thick steel jacket with 1/2-inch-thick jacket heads. The tank had an inside diameter of 115 inches, an inside length of 64 feet 11 inches, and was fabricated from AAR M-128, Grade B tank car steel. The tank heads and the tank shell were 11/16-inch thick. The tank was equipped with an 18-inch internal, self-energizing bottom manway entrance, two 3-inch liquid eduction angle valves, one 3-inch vapor angle valve, a 280.5 psig safety relief valve, a gauging device, a sampling line, and a thermometer well. The car was equipped with body-mounted brakes, and its lightweight was 108,400 pounds.

Unlike most tank cars whose manways are colocated on the top center of the tank with the valve housing, the manway was located near the center of the tank bottom. (See figure 7.) The manway

[19]NATX performed the final assembly and trucking of the completed tank car. AMF Riley Beaird, Inc., fabricated the tank shell and attachments based on drawings which were subject to final approval by NATX.



ENLARGED VIEW OF MANWAY

18" INTERNAL SELF ENERGIZING MANWAY
(21-1C-420-B)

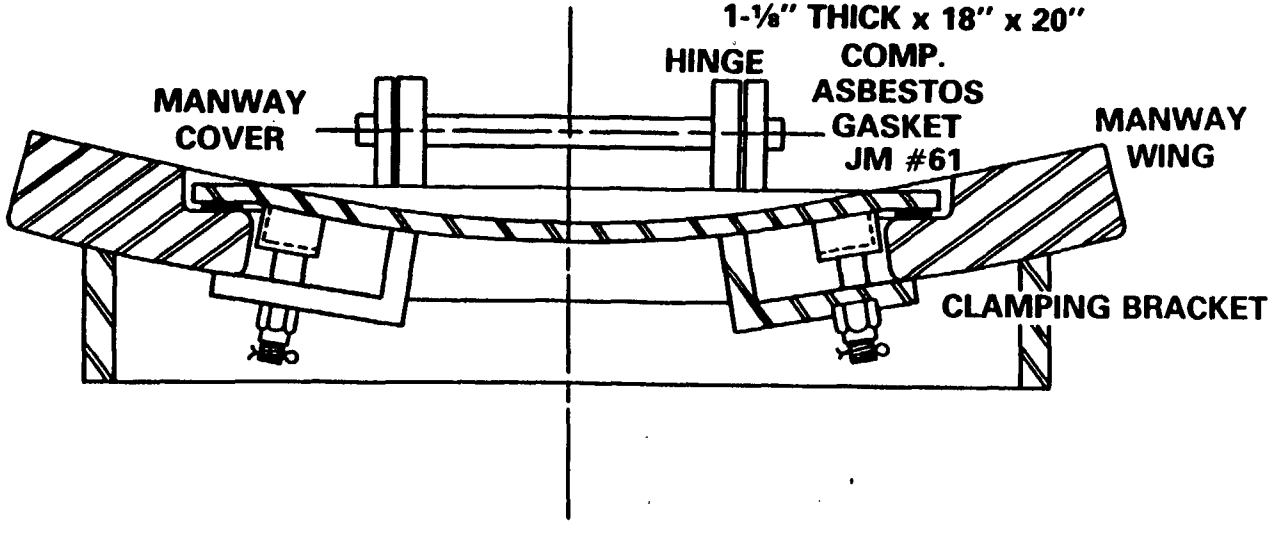


Figure 7.--Tank car with an 18-inch bottom manway.

opening was 18 inches in diameter and had an internally-hinged cover which opened to the inside of the tank. The manway cover was secured in the closed position by six L-shaped brackets that were bolted to the manway cover and designed to maintain pressure to seal the manway seat until liquid was added to the tank. When liquid was loaded into the tank, the weight of the liquid above the manway cover and the vapor pressure of that liquid resulted in additional pressure being applied to the manway and the manway seat. Thus, this manway design became known as an internal, self-energizing manway. The AAR-approved tank car design drawing specified the use of an asbestos type gasket (1/8-inch-thick by 18-inch inside diameter by 20-inch outside diameter asbestos gasket - JM #61) between the manway cover and the manway flange.

The manway cover of GATX 55996 was attached to the inside of the tank through a slotted hinge, rather than the usual pin-type hinge. The slotted hinge allowed the cover to move up or down so that the heel of the cover (under the hinge) would not catch the gasket when the cover was opened or closed. Proper use of the slotted-hinge prevented the gasket from being damaged or becoming misaligned with the manway seat. Many features of a tank car cannot be inspected except during construction; however, the manway attachments and the exterior portion of the manway are easily viewed after removal of a locking pin installed through a hinged access cover in the steel jacket.

Examination of the manway revealed that the manway was not constructed in accordance with AAR-approved drawings that are referenced on and made part of the AAR-approved application. (See appendix D.) Comparison of the AAR-approved application certificate drawings and the bottom manway with its attachment features revealed several discrepancies: the clamping brackets were of a different design; cotter pins were not inserted through the retaining bolts below the retaining nuts; all retaining bolt nuts were not the prescribed "hex elastic stop nuts"; and the clamping ring was not fabricated on the manway cover. The manway clamping L-shaped brackets installed on this tank car appeared to be of the same design shown on an AMF Riley Beaird, Inc., drawing, but it was not included as a part of the application approved by the AAR.

Tank Car History.--From May through October 1966, NATX, an AAR-approved tank car fabricator, built 99 Interstate Commerce Commission (ICC) 114A340W tank cars, including NATX 34014 (later became GATX 55996) with bottom manways and L-shaped securement brackets.[20] This was one of the first production tank cars designed with a bottom manway. The bottom manway was incorporated into tank cars at this time because it was anticipated that owners of these tank cars would use them for more than one product. When the product being transported was changed, the tank car normally had to be cleaned which required someone to enter the tank. The bottom manway design was introduced to facilitate the cleaning of the tank should a product change be made. At that time, it was anticipated that there would be seasonal changes in the product transported by a specific tank car; however, this did not occur.

Even though the bottom manway design was new to the tank car industry, neither NATX nor the Tank Car Committee (TCC) required the new design to undergo any special testing or other evaluation. The ICC, which then had responsibility for tank car safety, had incorporated design requirements for self-energizing bottom manways in its regulations.[21] The standards, like most other standards for rail equipment at that time, were developed by the industry and then incorporated into Federal regulations.

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[20]AMF Riley-Beaird, Inc., built the tanks under their "original" design drawings which specified an L-type bracket for the bottom manway.

[21]The ICC regulations provided in Paragraph 79.103 for use of self-energizing manways in tank cars. Similar devices were used in steam boilers and on highway cargo tanks.

The AAR procedures at that time allowed a manufaturer to build or assemble a previously approved specification tank car before the AAR Application for Construction (AAR Form 4-2) had been approved. When these tank cars were built, for reasons now unknown by NATX, the design of the securement brackets and their associated attachments on the bottom manway were changed in April 1966. In November 1966, NATX revised its Application for Construction incorporating the the change for the "flat" bracket design for the bottom manway and sent it to the TCC for approval. In March 1967, the TCC approved the NATX revised Application for Construction as being, in their opinion, in compliance with AAR and Federal requirements. One month later, NATX provided the TCC a certification endorsement for NATX 34003 through 34101 stating that these tank cars "conform to the above approved description and to all applicable ICC and AAR requirements, including specifications, regulations, rules of interchange and the U.S. safety appliance standards." (See appendix D.) It could not be determined if the initial NATX application submitted before April 1966 had been disapproved by the TCC.

In 1978 and 1979, these bottom manway tank cars, including NATX 34014, were equipped with E-type shelf couplers, insulation, and 1/2-inch thick steel head shields. In September 1979, NATX 34014, along with 28 similar bottom manway tank cars, was sold to Phillips Petroleum Company which renumbered this tank car PSPX 34510.

In November 1981, tank car PSPX 34510 was changed from anhydrous ammonia service to LPG service at Berwind Railway Service in Kansas and a 1/8-inch by 19 1/4-inches by 20 1/4-inches JM76 asbestos gasket[22] was installed. In November 1984, PSPX 34510 was cleaned and repaired at Phillip's Elkhart shop in preparation for making a commodity change. The lead carman who was assigned to this car, noted that precut 18-inch asbestos gaskets to fit the manway were not available at the Elkhart shop. She believed that her helper, who was being trained for car cleaning and testing, fabricated a replacement gasket; the maintenance record contained the notation "3/16" rubber gasket - Stock Number 723-1340-ONW?"[23] The helper stated that he could not recall ever cutting or fabricating a rubber gasket.[24]

The lead carman stated that both she and her helper were instructed by another car repairman to seat the gasket using silicone sealant on the flange of the manway cover and then to lift and lower the cover in place.[25] She also stated that she did not always monitor the helper when the tasks being performed had previously been performed by the helper. It was the practice at that time to monitor the work of a helper only when performing a new task, but after a helper had satisfactorily performed a task, further monitoring was not performed. When questioned about this work, the helper could not recall any details about servicing PSPX 34510.

In November 1986, the Phillips Railcar Maintenance Shop at Elkahrt, Texas, cleaned PSPX 34510 in preparation for performing a pressure test. The shop carman[26] reported that he had removed and inspected a rubber gasket on the tank car and since the existing gasket appeared to be in good condition or "like a new gasket" without any defects or deterioration, he reinstalled the gasket using silicone sealant[27] The carman stated that he was aware that certain tank cars are required to

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[22]The design drawing, 21-1C 420-B, for the tank car gasket material specifies a 1/8-inch thick by 18-inch by 20-inch compressed asbestos gasket - JM61.

[23]In the current Phillips inventory, this stock number does not exist.

[24]After this accident, FRA inspectors searched the Phillip's Elkhart shop records to determine if other tank cars may have been fitted improperly with a nonasbestos-type gasket. No similar incident was identified.

[25]Phillips reported that they do not have written procedures specifically directed to the opening and closing of bottom manway tank cars.

[26]This is a third carman at the Elkhart shop who serviced GATX 55996 from 1984 through 1986.

have asbestos gaskets, and that the presence of a rubber gasket was unusual on high-pressure tank cars. The carman noted that according to the shop's procedures:

> If a tank car showed up with a rubber gasket, I would install, if needed, a rubber gasket for replacement of same. . . .I was always taught to remove and replace gaskets in kind and. . .if the gasket was already in there, it must be. . .an approved gasket and there was [no] need to raise a question.

The carman stated that he would wire-brush the manway seat and to clean off any residue or scale on the gasket before reinstallation. Before mounting the gasket, the carman stated, "I would put a little bit of sealant on my fingers and just run the gasket through my fingers and kind of make it kind of sticky to hold itself in place [on the manway seat]." Further, the carman reported he would lift the cover to prevent the heel of the cover plate from catching the gasket and then lower the cover in place. Next, he would inspect to see if it was misaligned with the seating surfaces, and if necessary, he would again pick the cover up to align the gasket with the manway seat. Following installation of the gasket, the carman reported that he routinely pneumatically tested the tank for leaks.[28] The carman stated that he did not specifically recall his work on tank car PSPX 34510 and that he did not frequently perform work on tank cars with bottom manways.

After cleaning but before sale, the tank car was sent to El Reno, Oklahoma, for storage. In December 1986, Phillips sold PSPX 34510 along with 29 other bottom manway tank cars to GATC. In March 1987, the cars were routed to the ICG tank car shop in Destrahan, Louisiana, where GATC renumbered these cars and stenciled each "BUTADIENE." Tank car PSPX 34510 became tank car GATX 55996.

Tank Car Certification.--The bottom manway cars were built and approved by the AAR at a time when a record number of tank cars were being built and when the regulatory responsibility for railroad safety was being transferred by the U.S. Congress from the ICC to the DOT.[29] Because of the large number of new applications for tank car construction, repair, and modification, the AAR's TCC permitted car builders to undertake construction before AAR approval with the understanding that should it require changes to the application, the affected tank cars would be modified to incorporate these changes. Consequently, in 1966, NATX began building the NATX 34000 series tank cars before the final engineering drawings were approved by the TCC. In November 1966, NATX submitted the final design drawings with revisions to the manway design to the AAR. When the cars were ready to enter service, NATX submitted the certificate of construction attesting that the tank car met the AAR-approved drawings. However, this action was taken without checking the cars against the drawings. Later, when these cars were sold (in 1979 and again in 1986), the purchasers required the sellers to furnish only the certificate of construction in accordance with Rule 88 of the AAR *Office Manual of the Interchange Rules* No purchaser had all of the approved design drawings, and therefore, they were unable to ensure that the cars had a proper certificate of construction or that the certificate matched the actual construction of the car. As a result, the fact that the NATX bottom manway tank cars did not comply with the AAR-approved drawings was not discovered

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[27]According to the FRA investigator who interviewed Phillips Elkhart car facility personnel, the shop supervisor was not aware at the time of the accident that silicone sealant was being used routinely by its carmen for gasket manway installation on tank cars.

[28]Leak testing included a 50 psi air pressure test for at least 10 minutes during which time liquid soap was applied to the bottom manway as a bubble indicator for finding leaks.

[29]In April 1967, the ICC relinquished its oversight authority for tank car safety to the DOT. This oversight authority included the delegations to the AAR as the approval authority for tank car design, construction, or alteration.

during its more than 20 years of service because each subsequent owner had relied first on the builder's certification and then on the previous owner to provide a proper tank car.

On October 30, 1987, the Safety Board requested that the AAR provide the following information pertaining to their involvement with the NATX bottom manway certification:

- the original application for construction submitted by NATX for bottom manway tank cars and subsequent revisions;
- records of inspections performed when the NATX 34000 series cars changed ownership;
- total number of bottom manway car in service; and
- AAR requirements as to the type of asbestos gaskets and sealant compounds used for tank car fittings.

In its December 9, 1987, reply to these Safety Board requests, the AAR stated in part:

> Prior to 1985, the AAR Mechanical Division maintained tank car application files only for the five-year duration of time that the active drawings could be referenced as precedents for future applications. In other words, the files were maintained to serve the approval process. A comprehensive file of certificates and Exhibit R-1 forms was and is maintained by the AAR's Bureau of Explosives. Whenever a problem arose, we would retrieve certificates from the Bureau and then request the builder or owner to provide drawings as necessary.
>
> We do not have the original application and can only speculate that the chronology for the application is as listed at the bottom of this form; i.e. new drawings submitted on August 25, 1966 and November 11, 1966.
>
> Likewise, the only information we have on the modifications is the information that is listed in that drawing's revision block. For example, on revision C, item 16 was added to the drawing.
>
> The AAR Interchange Rules do not require inspection of cars that are sold, unless they are over 20 years old or have structural weakness or damage which would cause an unsafe operating condition. We have no record of inspections performed when NATX 34003-34101 changed ownership.
>
> GE Railcar (formerly North American Car Corp.) has advised that NATX 34003 - 34101 were the only cars built by North American with the bottom manway arrangement, which is authorized under 49 CFR 179.103. An additional 45 cars were built to this design by Davie Shipbuilding, Ltd. for North American Car Corporation's Canadian affiliate. Union Tank Car built one prototype that was retired. General American has five 120J600W cars in hydrogen sulfide service and one prototype that is in a museum. We are aware of no other bottom manway-equipped cars. Most of the NACCO/Davie cars remain in service, owned by GE, GATC, and PLM Financial Services, Inc.
>
> The Tank Car Committee has struggled unsuccessfully for years on concepts for developing listings of approved gasket materials. Repeatedly, the conclusion is that only the shipper knows his commodity and that he should, having this knowledge, specify the gasket materials. This is reflected in M-1002, paragraph

> A3.02 wherein it is stated that it is the shipper's responsibility to assure that material used for gaskets or valve seals is compatible with the lading and the service temperature. This philosophy is also evidenced in 49 CFR 173.31 wherein the shipper is required to use gaskets of "suitable materials."
>
> In 49 CFR 179.102-3, gaskets of asbestos type, or approved high-temperature resistant equivalant, are specified for certain fittings on tank cars used to transport liquefied flammable gases. Since asbestos may be unavailable in the future, the Tank Car Committee is studying alternative materials, as well as a possible definition for "high- temperature resistant" materials; however, it is not expected that the results of this study will comprise Tank Car Committee "requirements."

Federal Gasket Regulations.--Title 49 CFR 179.102-11 states that cars used in transport of LPG, anhydrous ammonia, and butadiene must have manway gaskets of asbestos or an approved high-temperature equivalent. Although the CFR specifies "an asbestos type" gasket for tank cars carrying liquefied petroleum products and other hazardous materials, this regulation does not provide:

- criteria or other direction on the manufacture, composition, or thermal performance of gaskets;
- the types of gasket materials which are high-temperature equivalents to asbestos; or
- direction as to the acceptability of using sealants for installing gaskets.

After the Safety Board provided the FRA with all factual information obtained during its investigation of this accident, the only formal action taken to date has been a March 4, 1988 letter from the FRA associate administrator for safety to the AAR mechanical division which advised, in part:

> A preliminary investigation has revealed the potential source of the incident to be an improperly applied gasket on the self-energizing manway. In addition, it was determined that the self-energizing manway was not constructed in accordance with the original Certificate of Construction Application (D-16735-A, submitted by NATX) approved by the Tank Car Committee on March 8, 1967.

Even though an inspection in October 1987 disclosed that the bottom manway tank cars presently in the GATC fleet deviated from the AAR-approved design and that a design problem which could cause gasket displacement was apparent in all cars inspected, the FRA letter stated:

> It is our understanding that TCC has identified an additional 150 tank cars constructed with a similar type of self-energizing manway. FRA is concerned that some of these tank cars might have been built in noncompliance with the original TCC approval.

Tests and Research

During the fire on September 9, 1987, emergency personnel observed fire at other locations on the tank car besides the bottom manway; therefore, it was necessary to determine if there were other leaks. On September 14, 1987, after tank car GATX 55996 was flushed with water and drained at the accident site, an external visual inspection was conducted. The tank car jacket, directly adjacent to the tank car bottom manway, sustained extensive damage as a result of exposure to fire and heat. Also, in the two center quadrants of the car, the jacket metal had cracked, melted, and/or stretched. On September 17, 1988, the tank car was transported by rail to GATC plant at Hearne, Texas. At the plant, the jacket and exterior insulation were steam cleaned to remove any residual butadiene. To provide access into the tank without disturbing the bottom manway, a large rectangular area was cut from the top of the tank jacket and a smaller circular area was cut from the tank shell. An internal visual inspection of the tank car shell indicated that the only source of leakage from the tank was through the bottom manway. This fact was later confirmed by a hydrostatic test.

Manway and Gasket.--After opening the manway access cover, it was evident that approximately 40 percent of the manway gasket was displaced from the manway gasket ring. The manway gasket ring was welded to the tank car shell and served as a seat for the manway cover. (See figure 8.) The manway cover, including portions of the exposed gasket, disclosed no charring or deterioration of the gasket from exposure to heat and flame. Examination of the securement fittings for the bottom manway revealed a wide variance in the type, length, composition of the manway securement bolts and nuts, and the number of spacing washers used.

Next, the bottom manway was opened and an examination was conducted of the manway and gasket. Inside the tank car near the manway flange, substantial amounts of silicone sealant were prevalent. The sealant was identified by the Phillips 66 representative as Dow-Corning 732 Sealant which was used in the Elkhart, Texas, facility and commonly used by its other tank car repair shops. A representative of Dow-Corning Customer Services stated, in part:

> Under normal conditions of room temperature, pressure, and humidity, the sealant has a 24-hour total cure time, which cures fast at first, then progressively slower, from the outside. Exposure to moisture or higher humidity will accelerate the cure rate significantly, possibly to less than 3 hours. The sealant will develop a "skin" quickly and is subject to move under force or pressure until fully cured, especially after application. The sealant will move to fill voids under pressure not unlike the coating on the inside of self-sealing tires. The cured sealant retains its characteristics from -85° to 450°F. Sealant tensile strength is 350 psi with an elongation of 500 percent. In its cured state, the sealant has excellent elasticity and will deform to plug.[30]

When the Safety Board conducted a physical examination of the gasket material which was freshly lubricated with silicone sealant, it was noted that the silicone sealant would act as a lubricant, especially with a "rubber" gasket. Until the sealant had completely set, its lubricity would further aid in the lateral displacement of the gasket material.

There were deposits of sealant which filled gaps and crevices between the manway cover and the manway ring. One continous piece of sealant 9 inches long and up to 1/4 inch thick was recovered

[30]Dow-Corning routinely conducts "plug" tests using a restricted orifice, approximately 1/4 inch in diameter at pressures of around 50 psi to test and evaluate the "plugging" characteristics of various sealants.

Figure 8.--Exterior view of the bottom manway of GATX 55996 as seen from the outside of the jacket housing.

after opening the manway. Additional quantities of sealant were found inside the manway all the way around the manway cover with the sealant filling the crevice between the cover and the manway ring.

When the manway was opened, approximately 25 percent of the manway gasket was internally displaced at two locations: 1) directly under the manway cover hinge bracket; and 2) diagonally opposite the cover hinge bracket at the handle for the manway cover. (See figure 9.) There was no evidence of blistering, softening, or swelling of the gasket or any evidence that it was incompatible with butadiene.

The gasket was found to be displaced internally from its seat and there were arched, parallel lines impressed on the flat surface of the gasket described as "phonograph record grooving." Similarly shaped machined grooves, fabricated in the manway gasket seat were found. (For more detailed information, see appendix E.) The radii of the grooves on the manway gasket seat appeared to be smaller than and not concentric with those impressed on the gasket which suggested a reinstallation of the gasket.

Three curved separations were found in the gasket along with areas which had been compressed to the point of breaking. It was not possible to determine whether these separations were due to pressure or were from shearing action between the manway cover and the gasket seat.

A sample of the gasket from GATX 55996 was removed and sent to the U.S. Customs Service Laboratory, Department of the Treasury, for detailed analysis. The sample was crescent shaped, approximately 4 inches long and 1 inch wide. The laboratory chemist reported that the gasket material had the characteristics of a silicone polymer (silicone rubber) consisting of 23.8 percent carbon, 61.5 percent polymer, and 14.7 percent inert material.

The Customs Service Laboratory also conducted a thermal analysis[31] of the gasket material and reported that no degradation of the gasket material was noted up to 360°C, but above this temperature, the sample degraded fairly rapidly. On exposure to an open flame, the gasket material would not support combustion and resisted the effects of heat and flame. Although liquid butadiene was not readily available for compatability testing of the gasket, solvent testing[32] was performed. Based on the solvent tests, the Customs Service Laboratory surmised that the gasket would not degrade in the presence of butadiene.

When the Safety Board conducted a physical examination of the gasket material, it was noted that, over time, it would permanently compress under sufficient pressure and could retain a "memory" of an impression. Further, after the material is permanently compressed, the material becomes brittle and can be easily "pinched" or squeezed to the point of breaking. It was also noted that if the material was cut by a sharp object such that relatively smooth edges were formed by the cut, the material was difficult to tear. However, once the smooth edge was breached by a notch, the material could be easily torn and the tear would propagate by applying only a small force.

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[31]A differential thermal analysis and thermal graviometric analysis determine the change in temperature and weight of a sample as a function of the rise in the furnace temperature.

[32]Laboratory solvent testing disclosed that "the main body of the gasket was unaffected by overnight soaking in various solvents: chloroform, xylene, o-dichlorobenzene, or dimethylformamide."

Figure 9.--View of bottom manway from inside of GATX 55996.

Postaccident Inspection of Similar Tank Cars.--In addition to GATX 55996, GATC operated 28 other tank cars built by NATX to the same design specification. Immediately after the accident, GATC removed its bottom manway tank cars from service. Inspections conducted by GATC and AAR revealed that none of the other cars were equipped with rubber gasket material.[33] (See table 1.)

Table 1.--Summary of inspections conducted on GATX 5500 and 5600 bottom manway tank cars

GATX #	HYDROSTATIC LEAKAGE	GASKET CENTERED	GASKET MATERIAL	GASKET SIZE(inches) THKx10x0D	TYPE OF SEALANT	FITTINGS NO./TYPE	TORQUE (foot-lbs)
55986	no	yes	asbestos	1/8x18x19	none	6-1&1/16lck nut	160-280
55987	yes-valve	yes	asbestos	1/8x18x19	unknown	6-1&1/4 std nut	130-340
55988	no	yes	asbestos	1/8x19X20	permatex	6-1&1/16 lck nut	90-280
55989	no	yes	asbesots	1/8x18x19	silicone	6-1&1/8 std nut	40-160
55990	no	yes	asbestos	1/8x18x19	permatex	6-1&1/8 std nut	140-350
55991	no	no	asbestos	1/8x18x19	unknown	3-1&1/8 std nut 3-1&1/16 std nut	250-320
55992	no	no	asbestos	1/8x18x19	silicone	6-1&1/8 std nut	200-410
55993	no	yes	asbestos	1/8x18x19	unknown	6-1&1/4 std nut	125-290
55994	yes-manway	yes	asbestos	3/16X18X20	silicone	6-1&1/16 lck nut	60-240
55995	no	no	asbestos	1/8x18x19	permatex	6-1&1/16 std nut	75-300
55996	yes-manway	no	rubber	3/16x18x20	silicone	3-1&1/8 std nut 3-1&1/16 lck nut	65-400
55997	no	yes	asbestos	1/8x18x19	permatex	6-1&1/8 std nut	40-160
55998	no	yes	asbestos	1/8x19.5x20.3	silicone	6-1&1/8 std nut	150-260
55999	no	yes	asbestos	1/8x17.8x20	permatex	6-1&1/16 lck nut	280-350
56000	no	yes	asbestos	1/8x18x19	silicone	1-1&5/16 std nut 5-1&1/8 std nut	300-435
56001	no	yes	asbestos	1/8x18x19	none	6-1&1/16 lck nut	75-290
56002	no	no	asbestos	1/8x18x19	silicone	1-1&5/16 std nut 5-1&1/8 std nut	300-435
56003	no	yes	asbestos	1/8x19x20	silicone	6-1&1/16 lck nut	170-350
56004	no	no	asbestos	1/8x18x19	permatex	6-1&1/4 std nut	275-500
56005	no	yes	asbestos	1/8x17.5x20.5	silicone	1-1&1/8 lck nut 5-1&1/16 lck nut	330-350
56006	no	no	asbestos	1/8x18x19	permatex	6-1&1/16 std nut	100-325
56007	no	no	asbesos	1/8x18x19	permatex	6-1&1/4 std nut	225-350
56008	yes-valve	yes	asbestos	1/8x17.5x20.5	permatex	12-1&1/4 std nut	200-400
56009	yes-manway	yes	asbestos	1/8x17.4x20.4	permatex	6-1&1/16 lck nut	130-300
56010	no	yes	asbestos	1/8x17.8x20	permatex	6-1&1/4 std nut	200-500
56011	no	yes	asbesots	1/8x17.8x20.5	permatex	6-1&1/4 std nut	325-350
56012	no	yes	asbestos	1/8x19.3x20.3	permatex	6-1&1/16 lck nut	180-350
56013	no	yes	asbestos	1/8x17.8x20.5	unknown	6-1&1/4 std nut	25-170
56014	no	yes	asbestos	1/8x17.8x19.8	unknown	6-1&1/16 lck nut	270-550
TOTAL	3-manway leaks	8 gaskets not centered		20-undersized gaskets	27 manways with sealant	17-improperly secured manways	

These inspections confirmed that none of the bottom manway attachments on these tank cars matched the approved design drawings of the Certification for Construction. Besides not being "standard" to the certificate drawing, the cars were not "standard" even among each other. This was true not only in gasket width, but manway bracket bolts and nuts, washers, and especially in the

[33]Results of these follow-up inspections were summarized in AAR internal letters dated October 1987,from E. G. Ernewein, Inspector-Hazardous Materials Systems, Bureau of Explosives, AAR to N. Antle, Director-Rules and Inspection, and D. Healy, Senior Inspector, AAR to A. Maty, Manager-Field Operations.

quantity and types of sealants. One car, GATX 56008, even had a 12-bolt bottom manway closure arrangement.

After being returned by GATC from hazardous materials service, all of the 28 tank cars were initially hydrostatically tested, and bottom manway leaks were found on two additional tank cars. Even though subsequent GATC cars were equipped with rigid asbestos gaskets, there were variances in the amount of gasket area that made contact with the manway sealing surfaces on at least 25 percent of the cars examined. Specifically, the following exceptions were noted:

- variance in gasket material widths; even though the design specification required 1-inch width gasket material, manway gaskets were found to have appreciably different widths ranging from 1/2 to 1 1/2-inches;

- variance in gasket area making contact between manway sealing surfaces; 25 percent of the gaskets examined were found displaced somewhat on the manway seat with some having only a 1/4-inch contact area with the manway seat;

- varied use of sealants; both a clear silicone sealant and a black permatex type sealant were used to seat the gasket; in several instances the use of sealant was extensive, and sealant was found dripping from the manway ring; and

- varied types of bracket nuts, bolts, and washers, and there were large variations in the locking torques values and gasket seating pressures.

In the absence of the gasket retainer or guide in the manway ring, one AAR inspector noted, "The design almost seemed to guarantee the gasket would be somewhat off center when the manway was closed." Another inspector noted:

> It would appear that the original design specifications may have required a gasket of 1 1/2-inch width. Also, it was noted that the gaskets seem to be taking on an oval shape, as if the cover pressure maybe distorting the gasket shape. On the gasket for GATX 56003, for example, in some locations on the gasket the cover impression covered only half of the surface area in some locations , indicating that only 1/4 of the gasket was in full manway contact.
>
> Taking out all variables which we can, AT THIS TIME, the likely cause of the incident was not improper gasket material but improper gasket application. If this is the case, it may be necessary to inspect the gaskets on every existing 114J340 tank car of this design specification to insure that the gasket has been correctly seated and is of the proper material and size.
>
> A final note, we noticed that two different sealants were applied to the gasket, in some instances, a clear silicone sealant was used, while on other gaskets, a black permatex-like substance was applied. Judging from the lack of these sealants on the surface of the gaskets, in some instances it looked almost as if the tank car repairman had "caulked" the manway nozzle [manway ring] at the gasket to prevent leakage. Judging from the slight dripping from one car in hydrostating, that may have been the idea in the mind of the shop to apply the "permatex" to the nozzle, and in effect, serving as a pressure retaining gasket for the car.

In reviewing the inspections of the 29 bottom manway tank cars that showed that nearly half of these tank cars were equipped with 1/2-inch width gaskets, the NATX spokesperson stated that a 1-inch width gasket material would allow for a 50 percent margin for error when seating the gasket and the gasket would still be expected to hold pressure.

Previous Safety Board Recommendations

The Safety Board has made several recent safety recommendations for improving the safety standards for tank cars. As a result of an investigation of a hazardous materials accident on December 31, 1984, at a railyard in North Little Rock, Arkansas,[34] the Safety Board recommended that the FRA:

R-85-99

Institute an inspection program to verify that tank cars intended to be in hazardous materials service are manufactured in compliance with Department of Transportation standards.

The FRA's December 2, 1986 response to this reccommendation advised that the FRA had developed a plan for the inspection of new and repaired tank cars to assure that they are being manufactured and repaired in compliance with the DOT regulations. The plan included provisions for: 1) the review of the records and procedures currently being employed at the AAR's Washington office; 2) the inspection of at least two facilities each covering new construction, welded repairs, and alterations of tank cars to determine compliance with AAR authorized approvals; and 3) the inspection of two major car builders to review their procedures on submitting applications, repairs, and alterations to the TCC. On February 17, 1987, the Safety Board acknowledged that the plan, as currently invisioned, was in line with its recommendation. Thus, it advised the FRA that it would classify the recommendation "Open--Acceptable Action" pending an update on actions taken, and it requested that the FRA inform the Safety Board on the dates the program would be implemented and completed. On April 28, 1987, the FRA advised the Safety Board that its inspection plan had been implemented on January 28, 1987, the planned review of the AAR records and procedures had been completed, and the planned plant inspection had been completed. Further, the FRA advised that the planned inspection of TCC records should be completed by the end of May 1987 and that its report of this efforts would be published by September 1, 1987. On July 27, 1987, the Safety Board advised the FRA that this recommendation would remain classified "Open--Acceptable Action" pending receipt and review of the FRA's report. The Safety Board still is awaiting the FRA's report.

As a part of its investigation into a train derailment and release of hazardous materials at Miamisburg, Ohio, on July 8, 1986,[35] the Safety Board documented and then assessed the adequacy of the implementation of the FRA's delegations to the AAR for rail tank car safety. Based on this assessment, the Safety Board issued recommendations to the FRA to:

R-87-47

Define explicitly those authorities concerning tank car safety delegated to the Association of American Railroads and establish procedures governing the implementation of these delegated authorities.

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[34]Special Investigation Report--*Hazardous Materials Release, on Missouri Pacific Railroad Company's North Little Rock, Arkansas Railroad Yard, December 31, 1984* (NTSB/SIR-85/03).

[35]Hazardous Materials Accident Report--*Hazardous Materials Release, Baltimore and Ohio Railroad Company Train No. SLFR, Miamisburg, Ohio, July 8, 1986,* (NTSB/HZM-87/01).

R-87-48

Require the Association of American Railroads to report on all actions taken under the authorities delegated for tank car safety.

R-87-49

Develop and implement a program for effectively reviewing and evaluating all actions taken by the Association of American Railroads, tank car repair facilities, and tank car manufacturers under the authorities delegated to them to determine that all actions comply with Federal requirements for tank car design, construction, modification, operation, and repair.

R-87-50

Evaluate annually the Assocication of American Railroads tank car specifications to determine that the instructions and guidance provided on tank car design and construction are consistent with Federal requirements.

On March 15, 1988, the FRA responded to the Safety Board's recommendations by acknowledging that each related to the functioning of the TCC and the nature of the DOT's delegation of authority to that committee. Further, the FRA advised that it had begun its assessment of the committee's functions and operations several months before receiving these recommendations, that the field work now was complete, and that the report on this assessment was in the draft stage. The FRA advised that its actions were prompted by the same general concerns that prompted the Safety Board's recommendations and that the issues raised by the Board will be covered in the report. The FRA has yet to issue its report.

ANALYSIS

The Accident

When rail tank car GATX 55996 was released from Phillips 66's rail repair shop at Elkhart, Texas, it contained a noncomplying gasket in the bottom manway. The rubber gasket used to seal the bottom manway was not properly positioned between the manway cover and the manway flange. When the carman re-installed the gasket, he used a liberal amount of sealant to hold the gasket in position on the manway cover while he closed the manway. However, he apparently did not lift the manway cover into the slot before rotating it to the closed position. As the carman closed the manway cover, the portion of the manway cover nearest the hinge contacted and pulled on the gasket in a digging motion. The portion of the gasket near the hinge was pulled from its proper position and the gasket moved over the ridge of the ring seat. The flexible gasket material and the lubricating effect of the sealant allowed the gasket to warp slightly into an elliptical shape and to become further displaced in the direction of the manway hinge. When the securement bolts were tightened, the gasket was compressed and elongated progressively away from the hinge which caused portions of the gasket that had folds or that were caught between the edge of the manway cover and the ridge of the ring seat to be cut and torn. Excess sealant previously applied to the gasket then filled the gaps, and as it cured, it temporarily sealed the manway.

Tank car GATX 55996 (PSPX 5510) reportedly was pressure tested to 50 psig before it was released from the Phillips 66 rail repair shop, and if the test was not successful, the manway would have been reopened and repaired. The repair shop records do not indicate that there were any problems; thus, if the pressure test was performed in accordance with Phillips 66's practice, the sealant must have cured sufficiently before the test was performed to have provided a complete seal capable of withstanding 50 psig pressure. The exact disposition and thickness of the sealant applied and the precise location of the leak origin could not be determined.

The evidence developed during this investigation indicates that tank car GATX 55996 did not begin leaking before it was moved to track 3 of the Gentilly terminal junction yard. Although GATXT personnel did not inspect the manway seal on this tank car after it was loaded, GATXT personnel reported that they saw no indications or detected any unusual odors that may have indicated a leak. Employees of the ICG, who on several occasions had been near the tank car, did not report any leaks. Additionally, employees of the NOT, who over 3 days, also reported no unusual observations despite having been near the tank car during inspections and during movement within NOT facilities.

The first indication of any unusual odor in the general area of the tank car was at 9:30 p.m. on September 8, 1987, when a Sathers employee detected an odor at the rear of the Sathers building. At 10:30 p.m., a NOT engineer also detected an unusual odor that he dismissed as the odor of a dead animal.

Soon after these initial indications of an unusual odor within the general area of track 3, the intensity of the odor and the extent of the area in which the odor was detectable increased and continued to intensify. Therefore, the Safety Board concludes that the bottom manway remained sealed from the time it left the Phillips 66 repair shop until the evening of September 8, 1987. It is likely that the combination of the liquid head pressure and the increase in the vapor pressure in the tank car, due to absorbtion of ambient heat during the 3 days after being loaded, was sufficient to gradually increase the internal pressure beyond the pressure containing capability of the sealant. Dynamic forces imposed on the interior displaced gasket by the movement of butadiene during transportation also may have contributed to the initial weakening of the manway seal. Once begun, the initial area of leakage was enlarged by the forces imposed by the flowing liquid on the gasket and the sealant.

Liquid butadiene released from the tank car manway flowed into the railroad bed and along drainage paths. As the butadiene vaporized, the vapors remained close to the ground. The atmospheric inversion in the area at that time and heavier-than-air property of butadiene combined to minimize the rate at which the vapors spread into the adjoining areas. However, the butadiene vapors did spread slowly into the adjoining residential and business areas and through storm drains until, about 1:50 a.m. on September 9, 1987, it ignited as a flammable mixture when it reached a source of ignition. Many ignition sources common to residential and commercial areas were present in this area, including gas hot water heaters located outside houses.

Emergency Response

Identifying the Emergency.--New Orleans was not notified in a timely manner about the escape of butadiene from the tank car. Timely notification would have provided increased opportunity for the NOFD to evacuate the citizens in the threatened area and then to initiate action for minimizing the spread of the butadiene and for eliminating sources of ignition. The first indication of a leak in the area was detected more than 4 hours before ignition occurred, but it was not reported because the unusual odor detected was considered insignificant. About 2 hours before ignition occurred, the odor had increased, but because it was believed that escaping natural gas was the source of the odor, a report was made to the local natural gas company (NOPSI). The NOPSI did not immediately dispatch an employee to investigate the odor, nor did it notify the NOFD of the report and seek assistance even though it had a direct telephone communication link with the NOFD for such purposes.

The NOFD initially received notice of a "possible gas leak" in the general area of the tank cars about 25 minutes before the ignition occurred. Although this was a report of a gas leak, the NOFD did not advise the NOPSI of the report or request the gas company to use its detection equipment to aid in the search for the reported gas leak. Had either the NOPSI or the NOFD coordinated with the other at this time, it might have become evident that a dangerous situation was occurring, particularly after the NOFD received its second report. With the three complaints of gas being reported within minutes of each other and with knowledge of the wind direction, the Safety Board believes it is reasonable to expect that with an early response, the NOFD and/or NOPSI could have identified the source of the leak. However, it is not possible to conclude that the ignition could have been prevented given the time of the ignition and the uncertainty about the amount of butadiene being released initially. However, early recognition of the problem would have provided time for the NOFD to begin evacuating citizens from the area. The Safety Board concludes that the lack of coordination between the NOFD and NOPSI relative to the reports of gas leaks clearly indicates that New Orleans and the NOPSI need to improve their procedures for handling complaints of gas leaks and for communicating with each other when assistance is needed. The NOFD should routinely notify NOPSI of any gas odor reports it receives.

After the butadiene was ignited, reports of the fire were quickly reported to city response agencies, 911, the NOFD, and the NOPD. Emergency operators performed their duties well for most of the calls they received. However, after receiving several calls and recognizing that they all were reporting the same event, 911 and NOFD operators should have questioned callers to gather additional information about the emergency which might have been of assistance to responding NOFD personnel. Additionally, at least for one call made to the NOPD, the caller was told to hang up and then to call the NOFD by using 911. The emergency response operators should have recognized that the Sathers employee, who attempted to tell the operator that he was in view of the fire and attempted to report that rail cars were on fire, would have been a source of specific information for the emergency in progress that could have been useful to the NOFD before personnel arrived on scene. Also, city personnel receiving a report of an emergency should be aware that emergency information should be recorded and then passed to the appropriate agency rather than directing a caller to dail another emergency response agency. The Safety Board recognizes that during an

emergency operators are very busy; yet each call must be answered since another emergency may occur. These operators must be alert to identify and question those callers who may be able to provide specific, essential information that can affect the safety of responding emergency personnel. Appropriate information gathering by emergency operators could have identified, before any NOFD personnel arrived on scene, the specific location of the emergency and that tank cars were involved in the fire. The Safety Board believes that operators of city emergency agencies should be trained to identify and question callers who can provide useful information to responding emergency personnel.

Initial Response.--The Safety Board considered the following actions taken by NOFD personnel during the early minutes of the response to be deficient:

- the district chief had information about the emergency that was not disseminated to arriving firefighters;
- a single command was not established;
- the area adjacent to the emergency was not evacuated promptly; and
- the evacuation was not commensurate with the potential threat to life and property.

The district chief knew before he directed firefighters to fight the fires on the west side that the fire was adjacent to a railroad and that the fire was close to some rail cars, but he failed to provide this information to the firefighters. Had he done so, there would have been no surprise when the tank car was seen through the flames; but more importantly, these firefighters would have been alerted that the danger posed was potentially greater than that of grass fires.

The district chief stated that he did not establish a command post; yet others stated that a command post existed on the east side, and the NOFD dispatcher records indicate that there was a command post on the east side during the first hours of the emergency. In fact, records show that this command post was relocated after the unmanned monitors had been established. The district chief also stated that when the deputy chief arrived on scene, the deputy chief became the on-scene commander. While such action would have conformed to the NOFD procedures, the events of the early minutes of the emergency response indicate that the east side operations were under the command of the district chief, while the west side operations were under the command of the deputy chief. The district chief and the deputy chief appear to have made independent decisions during the early minutes as to actions to be taken on the east and west sides of the emergency. The independence of the command on the east and the west side of the emergency resulted in the firefighters on the east side of the emergency continuing to fight the fire after the deputy chief ordered all firefighters to pull back when he became aware that an LPG-type car was on fire and that the identity of the product was unknown. Additionally, it appears that the district chief and the deputy chief independently decided that the first response action to take would be to install unmanned monitors and to cool the burning tank car.

Initial decisions made by the district chief and by the deputy chief relative to their command post locations, the location of fire vehicles, and the evacuation of areas adjacent to the burning tank car were not commensurate with the threat they believed the burning tank car posed nor with the guidance received by the deputy chief from emergency response guidelines. Fire equipment was placed within 50 yards of the burning tank car because they initially believed they were fighting trash fires and made a forward lay of hoses. The positions of the fire equipment were not changed despite the fact that there was opportunity to have done so on the west side when all firefighters were pulled back. While each chief recognized that the emergency posed threats to life, the minimal

evacuations ordered would indicate that neither believed that the threat extended more than a few hundred feet. Their assessment of the hazard range also was reflected by the locations of the command posts on the east and west sides of the emergency.

Initially, the NOFD personnel recognized the burning tank car to be a pressure-type tank, but could not determine if the tank was jacketed and/or insulated. This knowledge coupled with their observations of the flame impingement should have been sufficient to have resulted in the immediate evacuation of all persons within a 1/2-mile radius of the burning tank car. Whether or not a tank car is insulated, when it is exposed to fire, emergency responders always should initially assume that it will violently rupture and action should immediately be taken to evacuate the endangered area. Such action would have been consistent with the recommendations of the DOT's *Emergency Response Guidebook* which the NOFD uses. For this type of emergency, the guidebook recommends, as initial response action, the evacuation of persons within a 1/2-mile radius of the tank car.

The insulation of pressure-type tanks has provided additional time for emergency response personnel to protect public safety if they evacuate the threatened area as a first action. Results of previous accidents have demonstrated the effectiveness of insulation for delaying the violent rupture of tank cars and thereby providing time for response personnel to implement actions for reducing risks to lives and property. However, the use of insulation has not eliminated the potential for violent ruptures of pressure-type tanks when exposed to fire; consequently, an initial objective of emergency response actions must be to be to reduce the exposures should a violent rupture occur. This can best be accomplished through prompt evacuation of the endangered area. In this emergency, action to achieve this objective was not timely.

The most effective action taken by both the district and the deputy chiefs was to install unmanned monitors so that water could be directed on the burning tank car to cool it and thereby, possibly to prevent a BLEVE. Given the limited knowledge they had regarding the condition of the burning tank car, those firefighters who worked close to the burning tank car while establishing and readjusting the unmanned monitors accepted considerable risk to their safety. The Safety Board believes, however, that the risks incurred by these firefighters were greater than necessary because the NOFD did not provide appropriate protective equipment, and all firefighters were not required to use self-contained breathing equipment. Also, other firefighters, who were not being used to install the unmanned monitors, were not evacuated from the danger area. The Safety Board recommends that the city provide training to all fire department personnel who respond to hazardous materials emergencies. In addition to training provided since this accident, fire personnel training should include guidance, as appropriate to each position, on evacuation procedures, when to use self-contained breathing apparatus, and hazardous materials accident management.

Overall Command and Control.-- It is clear that the response actions of the NOFD were under one command after the NOFD superintendent arrived. However, there is some evidence that the NOFD superintendent could have served more effectively as an overall incident commander. During the early hours of the emergency, agencies responding to the emergency were aware of the NOFD command post, but they had difficulty in obtaining information about the type and extent of the threat posed, and they did not recognize anyone as being the overall incident commander. Some of these difficulties resulted because all city agencies were not familiar with the city's policy that the on-scene commander of the NOFD was to be the overall incident commander; consequently, all responding city agencies did not report first to the NOFD command post on arrival. Command and control problems likely were adversely affected by the lack of early, effective communications as to the location of the overall command post and the lack of a meeting facility for representatives of all responding agencies. Command and control problems appeared to have diminished after the mobile command post was brought to the scene and used; however, this move occurred several hours after the emergency became known. Additionally, the NOFD superintendent diminished his

effectiveness as the incident commander by not establishing an effective incident command management system. Enacting an incident command system would have limited access to the NOFD superintendent to those persons to whom he had assigned specific responsibilities, and it would have allowed him the opportunity to perform the duties of an incident commander. The NOFD superintendent further diminished his effectiveness as the incident commander when increasing the risk to his safety on several occasions, he approached the burning tank car.

The lack of early, effective overall command of the city's response to this emergency was also evident in that the NOFD superintendent did not quickly recognize as inadequte the actions being taken to evacuate the public, to keep firefighters not needed for response activities from the area of danger, and to locate safely the command post. As the incident commander, his first actions at that time should have been to remove all residents, bystanders, and firefighters not required for establishing or maintaining the unmanned monitors from the area threatened by the burning tank car.

Statements by both the mayor and the NOFD superintendent provide further evidence as to the overall management of the city's emergency response to this accident. The mayor's arrival on scene 5 hours into the response did much to improve the on-scene command effectiveness. Shelters were established and food was provided for the evacuees. Also, it was not until this time that effective, coordinated use was made of available technical expertise. Even though the mayor was not knowledgeable about city plans for handling a hazardous materials emergency, he caused the implementation of many actions that already should have been implemented by an incident commander. Also, the NOFD superintendent stated that he, the city's chief administrator, and the mayor jointly made decisions during the emergency; however, the mayor reserved for himself decisions about actions to be taken regarding the tank car. On review of the management activities during this emergency, the Safety Board concludes that the NOFD superintendent performed the duties of a fire chief while the mayor performed as the on-scene incident commander. The Safety Board believes that whoever functions as the on-scene incident commander must be specifically trained to perform this management responsibility and that all agencies must be made aware through planning and training as to this individual's responsibilities. The city needs to review its emergency response policy and plans with respect to the management of hazardous materials emergencies and provide appropriate management training.

Most of the actions taken by the incident commander demonstrated effective management procedures and worked to minimize the potential effects of the hazard posed by the burning tank car. However, the Safety Board questions the wisdom of using an outside emergency response company (WES) as a major decision-maker when neither of the railroads involved nor the city had previous knowledge of its experience or qualifications for safely handling the emergency. The Safety Board believes that the actions WES took in approaching the burning tank car while accompanied by NOFD firefighters, placed the firefighters in an unnecessary life-threatening situation. The risks to life posed by the still burning tank car justified early evacuation of all persons within 1/2-mile radius of the burning tank car. Given the unknown condition of the tank car, further risk taking should not have been permitted.

Emergency Preparedness

Preparedness for handling hazardous materials transportation emergencies must begin with effective planning. The city, through the NOFD superintendent, recognized in the early 1970s that it was a major transportation center through which hazardous materials are transported by rail, highway, and marine vehicles. However, it was not until 1982 that the city began to assess the hazards posed to its citizens by such transportation and how it would develop a coordinated, effective response for minimizing the threats presented by the transportation of hazardous materials. This initial effort was supported by a Federal grant of $53,000 from the DOT as one of

seven demonstration projects it funded for hazardous materials contingency planning.[36] The city's Hazardous Materials Advisory Council was appointed to support this effort and the city's HMIR Plan was a product of this effort.

The NOFD's HMIR Plan and related plans developed by other city agencies were a result of the initial planning actions. However, city management never analyzed or tested through drills if the plans were adequate for providing an efficient, coordinated response to hazardous materials emergencies. Additionally, the planning efforts of the city and the use of its Hazardous Materials Advisory Council have been ineffective for identifying special needs for specialized equipment and specific training of personnel who respond to hazardous materials emergencies or who perform overall command management of such emergencies. Furthermore, since the city was not aware of the CSXT and the NOT emergency response plans for handling emergencies in railyards and were not aware of the response capabilities of each, it is obvious that the city has not performed an effective assessment of available technical resources that could be used to assist the city during responses to hazardous materials emergencies.

Since this accident, the city has made new commitments for developing and funding increased capabilities for it to respond to hazardous materials emergencies and to train more of its personnel on effective incident command management and response to hazardous materials incidents.

The Safety Board was pleased to learn that the city has placed new emphasis on hazardous materials accident preparedness and has initiated a new program that will provide a state-of-the-art hazardous materials response team. It advised on June 15, 1988, that a two-man, first response unit to handle small incidents by itself and a fully equipped six-man main unit had been added. These new units will be staffed by personnel trained to the technician and specialist levels described in the National Fire Protection Association's proposed standards 471 and 472. These units will have protective clothing, decontamination equipment, computers, and a full complement of specialized equipment for virtually all chemical emergencies.

Also, the city reported that a byproduct of the tank car accident is a new spirit of cooperation among State and local agencies, the U.S. Coast Guard, and railroads and that response units of these agencies now routinely train together. There have been several planning meetings held, and fire department personnel have visited area railyards to learn the problems they may encounter during firefighting. As a result of these actions, prefire plans on all area railyards are now being prepared.

Additionally, the city has established a Local Emergency Planning Committee consisting of representatives of most city, State, and Federal agencies and of representatives of several major industries. This committee will develop plans for handling hazardous materials emergencies and establish an Incident Command System. The plan will establish specific responsibilities for each agency, will designate one incident commander, and will provide for better use of available resources.

While the Safety Board believes this action is commendable, it also believes that it is necessary to revise its initial planning document to better define the command and control functions, to define the training required of the person assigned overall command responsibility, to determine the emergency response capabilities and technical assistance available from local transportation entities, and to assign responsibility to and provide authority for carrying out periodic assessments and tests

[36] *Lessons Learned: A Report of the Lessons Learned From State and Local Experiences in Accident Prevention and Response Planning for Hazardous Materials Transportation, DOT and EPA*, December 1985.

of individual city agency plans and capabilities for supporting the city policy on response to hazardous materials emergencies.

New Orleans recognized that it needed to prepare for handling hazardous materials emergencies including those that occur in railyards. The city should initiate communication with the railroads to solicit cooperation in handling emergencies that involve hazardous materials. New Orleans, like most large cities, has several railyards operated by different companies in its boundaries that may endanger the lives and health of adjacent populations should an accident occur. Each railyard generally has a different operating procedures for carrying out the interchange and movement of rail cars, each has different physical plant and configuration, and each has different capabilities and planning for handling hazardous materials emergencies. For cities that have multiple railyards in their boundaries, individual coordination by railyards with city emergency response officials likely would be a less effective and efficient means of preparing for handling an emergency in a railyard. Individual coordination with each railyard also would be ineffective for identifying areas where railyards could provide mutual assistance during hazardous materials emergencies and for maintaining emergency preparedness current with changes that occur in the individual railyards. The Safety Board continues to believe that operators of railyards have a primary responsibility for mitigating the harmful effects to lives and property that may occur should hazardous materials be released from rail cars; however, where multiple railyards are present within a city, the most effective preparedness level could be achieved by bringing together into a common planning effort representatives of all railyards and of all affected city response agencies. The Safety Board believes that this can best be accomplished by the cities rather than by the individual railyards. Had this been achieved before this accident, it is likely that the question of responsibility for the burning tank car would not have presented any problem during the emergency.

Further, the Safety Board recommends that the city's Office of Emergency Management plan and conduct emergency preparedness exercises with appropriate city agencies and local industries involved with the manufacture and transportation of hazardous materials. In addition, the procedures of each city agency for responding to hazardous materials emergencies should be reviewed to determine if they are consistent with the HMIR Plan.

The Safety Board's 1985 report on railyard safety reviewed the status of emergency preparedness for handling releases of hazardous materials in railyards and concluded that much work remained to be accomplished. On April 30, 1985, it issued the following recommendations:

--to all railroads which operate railroad yards (the Southern Railway System and the Chessie System Railroads were excluded as they already had established a corporate policy for meeting the objective of the recommendation):

> R-85-53
>
> In coordination with communities adjacent to your railroad yards, develop and implement emergency planning and response procedures for handling releases of hazardous materials. These procedures should address, at a minimum, initial notification procedures, response actions for the safe handling of releases of the various types of hazardous materials transported, identification of key contact personnel, conduct of emergency drills and exercises, and identification of the resources to be provided and the actions to be taken by the railroad and the community.

--to the FRA:

R-85-54

Develop in coordination with the railroad industry and the Federal Emergency Management Agency, criteria for emergency planning and response guidelines for use by operators of railroad yards that handle bulk shipments of hazardous materials, and incorporate these criteria into applicable sections of Title 49 Code of Federal Regulations. These criteria should address, at a minimum, emergency plan content, initial notification procedures, the conduct of emergency drills and exercises, and the coordination of planning and response activities with local emergency response officials.

--to the Federal Emergency Management Agency:

R-85-55

Develop emergency planning and response guidelines for use by communities and operators of railroad yards that handle bulk shipments of hazardous materials and by communities adjacent to railroad yards, and incorporate these guidelines into pertinent Federal Emergency Management Agency-sponsored training programs and manuals.

The Norfolk Western Railroad did not respond to the Safety Board's recommendation. It was merged into the Norfolk Southern as was the Southern Railway System, and the railyard preparedness policies of the Southern Railway System, while modified, became the policy of the Norfolk Southern. The Seaboard System Railroad advised the Safety Board on July 21, 1985, that it was working with its partner, the Chessie System Railroads, to ensure an appropriate and adequate response to a hazardous materials emergency in a railroad yard, including the coordination of its plans and procedures with local emergency responders. On February 8, 1988, the CSXT advised the Safety Board that the Seaboard and the Chessie had merged their operations under the name of CSX Transportation, Inc., and this merger included the establishment of a single organization of hazardous materials specialists and adoption of the best features of both programs. It advised that the Prevent Accidental Chemical Exposure program for yards and terminals had become a reality and that this plan included the coordination of the emergency response plans and procedures with those in the community.

The preparedness of the CSXT and the NOT for effectively responding to a hazardous materials emergency in their railyards and the coordination of the related planning with the affected community was deficient. Specifically, local management employees of the CSXT and the NOT had not carried out effectively management's policy for the coordination of local planning activities with community officials. Also, the managements of the CSXT and the NOT should have been more vigilant and recognized that its policies on coordinating and cooperating with the city had not been implemented fully.

The Safety Board has recommended to all railroads that they work closely with communities adjacent to their railyards for planning and coordinating emergency response preparedness. Almost all the railroads indicated to the Safety Board that they were performing this responsibility or that action was being taken to achieve this objective. Even with these positive indications for the railroads, there remains much to be accomplished for achieving an adequate level of preparedness for handling hazardous materials emergencies in railyards.

On January 27, 1988, the senior vice president of transportation for the CSXT distributed a newly developed phamplet to each of the CSXT divisions that:

> . . .intended to augment existing CSXT emergency response procedures, and is specifically designed to serve as a Hazardous Materials Railyard Contingency Plan to assist CSXT personnel in the proper and safe handling of hazardous materials incidents at our railyards, terminals, agencies, and rip tracks.

The senior vice president's letter specifically emphasized:

> One of the most important factors to the success of this program is for Division supervisory personnel to invite local emergency agencies to our facilities to review CSXT's emergency procedures and predesignate a meeting place on our property in the event of an accident. In this way, local emergency agencies can preplan for certain requirements, such as access and escape routes, evacuation concerns, water hydrant needs, etc. Supplying local agencies with a detailed drawing or map of the facility would be very helpful. Division hazardous materials supervisors should be contacted to assist in these preplanning activities.

This letter also emphasized the necessity for division personnel to review frequently the emeregency response procedures and to maintain up-to-date appropriate emergency telephone numbers. On March 14, 1988, the CSXT issued a letter announcing that a training program to provide basic emergency response training to all CSXT supervisors would be conducted at 40 locations throughout its system. The program would include CSXT's emergency response and notification procedures, recognition and identification of hazardous materials, CSXT's hazardous materials contingency plans, tank car identification, design and damage assessment, site health and safety plans, and environmental protection procedures.

The Safety Board has received no information as to corrective actions taken by the NOT nor is it aware of any action taken by the CSXT and the NOT for mutual assistance when an accident occurs at locations where different railroad company facilities interface. At such locations, there may be valid reasons for a railroad to question if it legally has possession of a rail car; however, such questions should never be allowed to adversely affect the response to an emergency that threatens the lives of the public, of emergency response personnel, or of railroad employees. In this accident, the CSXT, although uncertain as to its legal responsibility, recognized the untenable situation presented to the mayor in that WES would contract only with one of the railroads, but neither railroad would accept responsibility for the burning tank car. Consequently, CSXT took the initiative to provide the necessary assistance by contracting with WES. The Safety Board has not been involved in railroad accident investigations that have exhibited this interface problem; however, the events of this accident demonstrate that such contingencies must be considered by the management of railroad companies and that a plan of mutual assistance should be incorporated into each company's written emergency response plan.

The FRA responded to Safety Recommendation R-85-54 on December 18, 1987, advising that it shared the Safety Board's view that advance planning is the key to limiting the impact of a major hazardous materials accident at railyards even though the probability of such an event was low. It advised that it had devoted significant resources over the previous 30 months to ensuring both the existence and the quality of such planning by railroads. The FRA reported that it had performed an in-depth review of the emergency planning activities on all 74 carriers that move the bulk of the hazardous materials. Its review determined that 59 of the 74 carriers had systemwide emergency response plans and advised that the remaining 15 carriers were working directly with the FRA's Office of Safety to construct plans patterned on the model of those adopted by the other carriers. Further, the FRA advised that it has funded a project to evaluate the needs of short line railroads and

the communities they serve in responding to and planning for emergencies that may be created by railroad accidents involving hazardous materials, and under an interagency agreement, it has cooperated with the Federal Emergency Management Agency (FEMA) and the Department of Energy on emergency planning studies. However, it advised that it had decided against the development and issuance of general criteria on the content of emergency response plans for operators of railyards because it believed that the railyard environment is too complex to be treated the same as nuclear power plants and interstate natural gas systems where the hazards are common to all participants and the local demographics are the primary factor differentiating one situation from another. The FRA acknowledged that it was aware that the rail industry had not moved as quickly into the field of emergency response planning as some other industries and that it believed very strongly that absent individual company-by-company attention, meaningful results were less likely to come about in the time frame it considered acceptable.

On March 21, 1988, the Safety Board responded to the FRA advising that, through individual railroad company responses to R-85-53, it already had been made aware of some emergency response planning efforts. However, the Safety Board took exception to the FRA's contention that criteria type regulations would not be appropriate for the railroad industry or railroad yards in particular. It advised the FRA that in its view, railyards were similar to other fixed-site facilities that handle large quantities of hazardous materials in that the hazards, the exposures, and the emergency responders are easily identifiable. The Safety Board's special investigation report on this subject found no major difference in developing emergency preparedness for railyards or chemical plants and in terms of emergency response planning, chemical plants are now performing the planning and coordination which the Safety Board believes should be done by operators of railyards. The Safety Board took note of the reviews which the FRA stated it had performed of rail carriers and noted that the FRA response was unclear as to what the review entailed. The Safety Board questioned whether the review was limited to the written procedures or included onsite inspections, if the review revealed any shortcomings and if it resulted in any corrective action, and whether the FRA had established any criteria by which it evaluated the adquacy of the various plans. The Board believes that if the FRA's review was complete and comprehensive, then it should be a fairly easy task to now develop regulations that would require the railroads to establish emergency response capabilities for their railyard operations and to establish in the CFR specific criteria compliance. The information the FRA gathered during its review of the carrier's plans should be useful in accomplishing this objective. The Safety Board urged the FRA to reconsider it position regarding accomplishment of the full intent of Safety Recommendation R-85-54 and advised that this recommendation will be classified "Open--Unacceptable Action" pending further consideration by the FRA.

On May 29, 1986, the FEMA responded to Safety Recommendation R-85-55 advising that it had placed the issue on the National Response Team agenda for discussion and identification of additional considerations that should be included in the Preparedness Committee's criteria for assessing State and local emergency preparedness. It also advised that future FEMA guidance would specifically include railyards among the risks that local emergency managers should examine in developing preparedness plans. The FEMA also has initiated a project to identify and evaluate the applicability of existing guidance to railyards and the adjacent communities, to define what additional guidelines, if any, are needed, and to develop such additional guidance in a manner that is responsive to the Safety Board's recommendation. The Safety Board acknowledged FEMA's efforts as being responsive to the recommendations and advised that Safety Recommendation R-85-55 would be classified "Open--Acceptable Action" pending receipt of a report on final actions taken.

Emergency Technical Assistance

Mitsui's waybill contained no information for contacting the shipper for product-specific information needed by emergency responders for determining the toxic threats to public safety and

the threats posed should the butadiene polymerize. Had an emergency telephone number for a person with detailed knowledge of the hazardous characteristics of the butadiene been on the waybill, essential information useful to emergency responders could have been obtained promptly.

The Research and Special Programs Administration (RSPA) of the DOT issued on March 16, 1984, an advance notice of proposed rulemaking (ANPRM) (Docket HM-126C, Notice 84-2) that sought comments on the need for improving the communication of accurate information on hazardous materials when they are involved in transportation incidents. This rulemaking questioned the adequacy of many present requirements including the reliance on CHEMTREC for providing technical information on hazardous materials beyond that contained in emergency response guidelines. In reponse to this rulemaking notice, the Chemical Manufacturer's Association acknowledged that "In some cases, personnel at the scene of an incident need more information than is provided in the DOT's Emergency Response Guidebook (ERG)." It stated, "That is precisely why CHEMTREC was established and why DOT recommends a call to CHEMTREC for detailed information and assistance."

On July 11, 1984, the Safety Board commented on the ANPRM advising that during the early minutes of an emergency, many critical decisions must be made about the adequacy of evacuation zones, whether or not to continue actions directed toward the hazardous materials incident, and what specialized actions and materials should be used in any continuing efforts. To aid in making these critical, early decisions, material-specific information is often necessary. The Safety Board also advised that CHEMTREC is unable to provide from its "Chem Cards" certain of the urgent information needed by emergency responders and that the greatest value of CHEMTREC is and will continue to be its ability to gain rapid access to product-specific technical specialists, to bridge communications among several response and private sector agencies, and to rapidly alert private sector and government hazardous materials response teams. The Safety Board encouraged RSPA to consider how and by what manner improved product-specific information can be made available immediately to responding emergency agencies.

On August 20, 1987, after reviewing comments to the ANPRM, the RSPA issued a notice of proposed rulemaking (NPRM) (Docket HM-126C, Notice 87-10) proposing, in part, a requirement that persons offering hazardous materials for transportation provide a 24-hour telephone number of a person having detailed knowledge, or having immediate access to a person with detailed knowledge, of the hazardous characteristics of the hazardous materials being shipped. As proposed, a telephone number such as CHEMTREC could be used on the shipping paper to satisfy this requirement if the shipper has previously provided CHEMTREC with information on the properties and hazards of the hazardous materials being shipped.

On September 22, 1987, the Safety Board commented on the NPRM advising, in part, that the Safety Board supported the proposed requirements for immediate emergency reponse information and emergency response telephone numbers on shipping papers. The Safety Board cited a previous accident report that involved the inability of local response personnel to immediately obtain product-specific information.[37] In that report, the Safety Board stated:

> The circumstance which separates any hazardous materials transportation accident from other accidents is the immediate need for specialized information, expertise, and equipment. No matter how extensive the Federal or State response

[37]Hazardous Materials Accident Report--*Overturn of a Tractor-Semitrailer Transporting Torpedoes, Denver, Colorado, August 1, 1984*, (NTSB/HZM-85/02).

> network may be, it always will be the local emergency response network that must deal initially with the uncertainties of the threat. Local emergency response personnel must be able to assess quickly the threat posed to public safety by the materials involved and to acquire the appropriate resources to mitigate the threat.

On April 11, 1988, the RSPA advised the Safety Board of the NPRM it had published on August 20, 1987, and explained that it proposed requiring:

> that a person offering hazardous materials for transportation (originating shipper) provide a 24-hour telephone number of a person having detailed knowledge, or having immediate access to a person with detailed knowledge, of the hazardous characteristics of the material being shipped. This person must have the knowledge and ability to communicate and assist in the mitigation of an incident to a much greater degree than the immedate information carried on a vehicle or placed in a facility. As proposed, the shipper will have the option of using his name and number or using a telephone number such as that of CHEMTREC to satisfy this requirement if the shipper has previously provided CHEMTREC with information on the properties and hazards of the materials being shipped. This option will provide the shipper with flexibility in selecting a name and number which will ensure 24-hour availability of knowledgeable assistance.

CHEMTREC assisted emergency responders during this accident by providing general emergency response information, by providing basic information on the properties of butadiene, by advising that the early product identification likely was in error, and by assisting in the identification of the shipper and consignee. Although CHEMTREC was able to locate a person knowledgeable of product-specific information on butadiene, this could not be accomplished timely because CHEMTREC did not have a telephone number for Mitsui. CHEMTREC does and can continue to provide several important services to assist communities, the chemical industry, and the transportation industry; however, it is not now able to provide promptly the product-specific information often needed during the early minutes after a release of hazardous materials.

As proposed, the RSPA rule for providing on the shipping paper a 24-hour emergency telephone number does not state that the use of the CHEMTREC number would satisfy the requirement; however, the RSPA states in its discussion of the rule that the use of the CHEMTREC number would satisfy the requirement if the shipper had provided CHEMTREC with information on the properties and hazards of the materials being shipped. The RSPA establishes no criteria or standards to identify the types, format, or detail of the information which must be provided to CHEMTREC and it does not require that CHEMTREC be provided an emergency telephone number for each shipper submitting information to CHEMTREC.

The Safety Board agrees with the proposed rule and encourages the RSPA to progress expeditiously this proposal to a final rule. However, it has serious reservations relative to the RSPA's statement that use of the CHEMTREC telephone number would satisfy the intent of the rule. As demonstrated in this accident, CHEMTREC had some product-specific information on butadiene and it had some information on the hazards posed by butadiene; but the information available to CHEMTREC was not sufficient to meet the needs of emergency responders. When CHEMTREC was unable to provide the type of information requested, it was unable to contact the shipper because it did not have an emergency telephone number. The Safety Board believes that if the CHEMTREC telephone number is permitted on shipping papers to satisfy the intent of the 24-hour emergency telephone number requirement, then RSPA must define the types, format, and detail of information required to be filed with CHEMTREC and that CHEMTREC be provided with a 24-hour telephone number for the shipper.

Shipper Inspections

Shippers and persons performing loading functions for shippers normally do not maintain technical engineering staff to determine if packaging, especially cargo tanks and tank cars, meet DOT construction specification requirements. Instead, they rely on markings on packagings and on the representations of persons offering packagings to determine if packagings meet DOT requirements. The DOT, in apparent recognition of shipper reliance on persons providing packagings, prohibits anyone from representing, marking, or certifying a packaging as meeting DOT requirements unless the packaging is manufactured, fabricated, marked, maintained, reconditioned, repaired, or retested in accordance with DOT requirements (49 CFR 172.2(c)).

While several parties had opportunities to inspect tank car GATX 55996 and to determine if the tank car met DOT requirements before it was filled with butadiene at Goodhope, Louisiana, only the tank car owner(s) could be expected realistically to have had the opportunity to determine that the tank car it had purchased as a DOT specification 114J340W tank car did, in fact, meet the DOT specification requirements. By failing to compare the tank car it purchased to the tank car manufacturer's drawings of the tank car, GATC was unable to identify discrepancies in the manway assembly and gasket specifications before providing it to Mitsui for use in the transportation of hazardous materials.

Instead of inspecting the tank car to ensure that it met all specification requirements, GATC contractually shifted inspection responsibility to the lessee, relied on the lessee to identify any safety deficiencies after it received the tank car, and required the lessee to report any defect promptly to GATC. However, neither lessees nor persons performing loading operations for shippers have the capability to compare tank car construction drawings and material specifications to tank cars provided them by lessors. Instead, they must rely on tank car markings and representations made by the lessors. Tank car users must rely on tank car markings and representations that tank cars meet DOT specification requirements. It is apparent, due to the absence of any AAR requirements, that tank car owners, in particular NATX (GERCS), Phillips, and GATC, need to ensure that all tank cars are inspected thoroughly and determined to meet DOT specification and AAR certification requirements before providing the tank cars to lessees as DOT specification tank cars. Had GATC done so, the fact that the bottom manway did not comply with the AAR-approved drawing would have been discovered and GATC then would not have purchased the bottom manway tank cars from Phillips 66. Also, Phillips 66 then would have known of the noncomplying tank cars and it would have had to keep them out of service until appropriate modifications were made.

Even though GATC had the primary responsibility to ensure that tank car GATX 55996 met all DOT specification requirements before representing it to Mitsui as a DOT specification tank car, Mitsui also should have conducted as a minimum a superficial examination of its leased tank cars before offering them for transportation. By failing to inspect the tank car, Mitsui missed an opportunity to identify and correct any visible safety deficiencies before it made the tank car available for the shipment of butadiene. However, unless the manway assembly gasket was noticeably displaced, Mitsui probably would not have identified any problem with the tank car during a visual inspection. Consequently, this incident might not have been prevented even if Mitsui had visually inspected the tank car. Nevertheless, because of the serious consequences that can result when tank cars fail to contain hazardous materials properly during transportation, Mitsui should take immediate action to ensure that all its tank cars are sufficiently inspected to detect any visible safety deficiencies and to correct any deficiencies found before the tank cars are permitted to transport hazardous materials.

Finally, in accordance with normal operating procedures, GATXT personnel inspected tank car GATX 55996 both before and after the car was loaded with butadiene. During the preloading inspection of the tank car, GATXT personnel relied on information provided by markings on the tank

car to determine that it met DOT requirements for butadiene. The terminal personnel did not inspect the bottom manway assembly because they were not aware of the tank car's unusual construction and because the terminal inspection checklist did not specifically address tank cars with bottom manway openings. However, even had the terminal personnel opened the manway jacket housing closure during its inspections of the car, it is not certain that the gasket, at this time, was sufficiently displaced to have caused an inspector to reject the car. While it is possible that the manway closure gasket was displaced to some extent before loading the tank car, there is no evidence to suggest how far the gasket may have been displaced or if the severity of any displacement could have been recognized during a visual inspection. Nonetheless, the Safety Board believes that it is necessary that GATXT inspection procedures be revised to ensure that tank car inspectors visually inspect all gaskets and closure assemblies to ensure that all tank car openings are secured properly.

Bottom Manway Performance

Tank car GATX 55996 was one of approximately 150 tank cars manufactured primarily during the 1960s that incorporated a bottom manway in its design. This innovative design for tank cars had no precedent in the rail transportation industry upon which to base its performance or to assess its relative safety; yet it was approved by the TTC without requiring service trials or other evaluation before it was allowed to be placed into hazardous materials service. During the more than 20 years bottom manway-type tank cars have been in service, the Safety Board could find no record of any major failure of the bottom manway design.

NATX's bottom manway incorporated several unique and critically important safety features in its manway design; however, NATX took no specific action to make known to others essential operating and maintenance information about these unique features. The NATX engineer who approved this design stated that the slotted hinge closure design would be easier to close improperly. Proper closure requires that the closure plate be dropped squarely on the gasket seat before starting to tighten the holddown nuts. He noted that the gasket specified on the AAR-approved drawings constituted the one which NATX believed necessary for providing safe service during transportation. He stated that anyone desiring to use a gasket other than the one specified should have performed some engineering analysis or other evaluation to determine if a gasket of different material or of different dimension would provide an adequate seal. To his knowledge neither NATX nor any other person had performed any analysis, either initially or later, to define the specific dimensions or range of dimensions required of any type of gasket material to seal the manway safely. NATX did not provide any written maintenance procedure for future owners or tank car repair shops for the proper closing of the manway or the necessity to use a specific gasket. Moreover, the specifications for the gasket were not stenciled or otherwise noted on the tank car to require use of a specific type and size gasket. The lack of this specific knowledge by the tank car owners is responsible for the variations in the gasket sizes and the gasket misalignments found during the inspections performed after the accident. The Safety Board believes that in order to maintain the integrity of the tank cars, special procedures or material specifications on dimensions be permanently and conspicuously affixed to the tank car.

It is unlikely that a hazardous materials leak through a bottom manway during transportation could be stopped. During the Safety Board's investigation involving many parties (including the FRA, the AAR, three tank car owners each of which has had an employee serve on the TCC as a representative of the Railway Progress Institute, and two shippers), views were expressed that the bottom manway tank car design was more susceptible to a catastrophic release similar to the New Orleans incident than other tank car designs. The FRA associate administrator's March 4, 1988 letter to the AAR did not address the safety implications of a similar accident nor did it express any urgency for taking prompt remedial action. Rather, this letter simply requested the AAR to provide information whether the present owners of tank cars with bottom manways had been notified or

had their cars inspected, and what action the TCC planned to take concerning the noncomplying cars. The Safety Board believes that the bottom manway should have been designed to require at least a double failure before any product could escape, and it should have provided a ready means for identifying when one of the sealing devices had failed. Each of the bottom manways on the tank cars inspected after the accident contained only one sealing mechanism; consequently, any failure of the sealing mechanism would be catastrophic since no effective action to stop a leak could be taken. The Safety Board is concerned that no action has been taken to prevent these tank cars from continued service in transporting high-risk hazardous materials, such as flammable or poisonous gases, that can endanger large areas when released. The Safety Board urges that FRA to act immediately to prohibit the use for transportation of hazardous materials tank cars that have a manway opening located below the liquid level of the material transported.

Tank Car Manufacture and Approval

Generally, the AAR's Bureau of Explosives (BOE) maintains records on AAR Form 4-2 and their related drawings for approximately 5 years, although tank car "life" in active interchange service is frequently 20 years or more. There is no requirement for the AAR or the tank car builder to maintain reference forms or drawings for tank cars. The CFR states that a copy of an approved certificate (AAR Form 4-2) shall be furnished to the AAR BOE and the owner, but it says nothing about keeping, updating, or maintaining such records. Consequently, the history of this tank car is not well documented and the available documentation provides little understanding of the actions taken for its initial design and modification.

The accident car, GATX 55996, originally built as NATX 34014, does not appear to have a valid AAR Form 4-2. This same observation would apply to all of the tank cars in the original series, NATX 34003-34101. The drawings that are listed as an integral part of the only existing "4-2" (D-16735-A) do not match the manways of the tank cars as constructed. Since the basis of tank car approval rests on the cars being constructed according to approved designs and drawings, it is doubtful if any of the 114 tank cars with a bottom manway was ever approved.

It appears that the cars were built in accordance with the unapproved "original" AAR Form 4-2, and the tank cars were subsequently released and accepted into service by the modified AAR Form 4-2. Nothing prohibited a manufacturer from building or assembling a previously-approved specification car before the AAR Form 4-2 was approved by the TCC. It appears that NATX did not check the cars against the approved drawings of the modified AAR Form 4-2. These unapproved tank cars were erroneously allowed to remain in service because the approved design drawings were not required to be given to subsequent owners. Thus, each new owner was placed in the position of relying first on the builder to have taken appropriate actions and, second on previous owners to have taken appropriate actions. The Safety Board believes that all documentation for tank cars should be provided to purchasers before a transfer of ownership is made. Also, a thorough inspection should be required to determine that the tank car conforms to all approved drawings and to applicable Federal regulations. Further, the FRA should establish quality control requirements for tank car manufacturers and operators of tank car repair shops to ensure that their actions comply with Federal regulations and conditions established in AAR approvals for manufacture, repair, or modification of tank cars.

The AAR BOE is currently attempting to microfiche its tank car records; however, there is no guarantee that its library file is complete, up-to-date, or accurate. Tank cars beyond 5 years-old cannot with certainty be proven to meet certification requirements for interchange unless owners have maintained a current certificate. Since the AAR is the proponent for tank car approval, it should also maintain an accurate, complete, and up-to-date file on its actions, approved certificates, and related drawings as a minimum.

Performance of Tank Car Repair Shops

Phillips 66's tank car repair shops, like all approved repair shops, are inspected and certified by the AAR. This inspection is an indication that the facility has the capability to perform work in accordance with Federal and AAR requirements, but it does not determine if the facility follows Federal and AAR requirements. A certification inspection, intended to verify data submitted to the AAR by the applicant, is performed with respect to welding procedures and qualifications, supervision, quality control, radiography, postweld heat treatment, and other equipment and/or practices employed by the repair facility. If the facility passes that inspection, the facility becomes certified to perform repairs of tank cars for 5 years before another inspection is required. The inspection process was discussed by the Safety Board in its report on the December 31, 1984, accident at North Little Rock, Arkansas, and the Safety Board pointed out that the FRA performed no routine inspections of tank car repair facilities. Since that time, the FRA has begun to perform some inspections of tank car repair facilities.

NATX and GATC advised the Safety Board that, unlike Phillips, they do not recommend the use of sealants for seating gaskets. Further, without a written policy prohibiting the use of sealants, Phillips carmen have routinely used sealants to aid in sealing manways and have reused gaskets that may not have been in compliance with the design requirements for bottom manways. Phillips has advised that sealant use on gaskets has now been discontinued. Moreover, in January 1987, Phillips revised its shop procedures for servicing manways by directing carmen to remove and replace all gaskets with asbestos gaskets rather than follow the previous procedure of "replace gaskets if necessary."

While these actions will minimize the possibility of using incorrect gasket material, these steps alone will not ensure that the approved gasket size is installed. Unless tank car shops are provided with the proper gasket dimensions from the approved drawings, a carman normally will try to find a close match to the gasket being replaced, which may or may not be the approved size. Consequently, carmen still will not know what size gasket to install unless the tank car manufacturer provides repair shops with the actual gasket dimensions.

As demonstrated in this accident, while Phillips has made modifications to its shop procedures, many of the procedures being followed were not current and were not being monitored routinely to ensure that the repairs met DOT and AAR requirements. Furthermore, it was noted that Phillips' shops have previously been inspected and approved by the AAR without disclosing any procedural deficiencies. None of the deficiencies identified during the Safety Board's examination of the 114 bottom manways or during the review of Phillips shop procedures were addressed by the AAR shop certification inspections conducted at Phillips' Railcar Maintenance Shop in Elkhart, Texas, before and after the New Orleans incident.

The FRA presence at tank car repair facilities apparently did not affect the operations of the Phillips 66 repair facilities. In 1984, Phillips 66 repair shops had written procedures in the form of various memoranda inserted in a notebook for some of the work performed by its employees. However, it did not have specific procedures for working on tank cars with bottom manways nor did it have procedures that discussed sealant materials. Its employees gained their knowledge about specific procedures primarily through on-the-job training. Since this accident, Phillips 66 has undertaken an evaluation of the various memoranda that constituted its shop procedures and has developed a procedures manual specifically to guide the work of its employees.

There are no Federal requirements for written procedures that detail the manner for performing maintenance work and inspections critical to the continued safe operation of tank cars, and there are no requirements for the qualification and training of persons who perform these critical functions. The Safety Board believes that the lack of sufficient guidance for the tank car repair personnel resulted in tank car GATX 55996 being equipped in 1984 with a gasket not suitable for use

in the bottom manway and in this gasket not being replaced when the manway was again inspected in 1986. Additionally, this lack of specific guidance apparently was also responsible for the use of various sealants to hold gaskets in place while a closure device or fitting was tightened as well as for sealing a closure when a gasket was damaged or misaligned. The Safety Board believes the FRA should require tank car repair shops to develop and maintain procedures for performing work on tank cars and to train its employees in those procedures.

FRA Delegations of Authority for Tank Car Safety

Following an investigation of a hazardous materials release accident in Miamisburg, Ohio, on July 8, 1986, the Safety Board identified several improvements that the FRA should undertake with respect to the management and monitoring of this delegated authority. During the time this report was being developed, the FRA associate administrator for safety stated that the FRA was completing its own review of AAR actions taken under its delegated authority and that its report would be completed by September 1987. Consequently, the FRA believed it premature of the Safety Board to issue its report before it had opportunity to review the FRA's report. To date, the FRA has not made its report public.

The Safety Board believes that the events reviewed during this investigation further support the overall procedural and monitoring improvements recommended to the FRA. First, design drawings and other documentation submitted to the TCC as part of an application for construction, modification, or repair should be made a part of the approved certificate, and it should be required that these documents be furnished to and maintained by the current owner of applicable tank cars. This action is necessary since the present certificate required to be transferred to future owners does not contain sufficient information to determine if a tank car complies with the design, modification, or repair approved by the TTC. Consequently, as in this case, the tank car owner had no information to determine if the tank car complied with applicable AAR and FRA requirements.

The Safety Board believes that the FRA also should establish specific performance criteria for gaskets, especially those that must be heat resistant. Such criteria must also address the use of sealants on gaskets including the types of sealants, the amount of sealant, and the conditions under which sealants may be used. Evidence developed during this investigation indicates that various sealants and amounts were routinely used for purposes other than holding the gasket in place while closing the manway; they were used to repair defective gaskets and to seal leaking manways.

CONCLUSIONS

Findings

1. The failure of some area residents and the NOT engineer to report their observations prevented an early opportunity to identify the leak of butadiene.

2. The failure of the NOPSI to advise the city of a reported leak to which it was unable to respond promptly and the failure of the city to advise the NOPSI of reported "gas leaks" prevented early recognition of an area problem.

3. The NOFD did not initially know that rail cars were involved in the reported fire because city personnel who answered the many early reports about the fire did not obtain specific information from callers who were nearest the fire.

4. The NOFD's initial response to the fire was timely and the specific problem was quickly identified even though the responding district chief failed to communicate to responding firefighters his knowledge that a train was involved in the fire.

5. The first responding chiefs of the NOFD quickly identified that the tank car on fire was a pressure-type tank, improperly assessed the threat the tank posed, and initiated action for cooling the tank car.

6. The extent of the overall threat posed by the burning pressure-type tank car was not fully recognized by the NOFD and consequently command posts were located within the danger area, fire vehicles were positioned close to the burning tank car, firefighters not essential to the establishment of unmanned monitors for cooling the tank were allowed to enter the danger area, and early, complete evacuations of area residents were not performed.

7. Command and control of the fire scene during the early minutes was fragmented by the establishment of two command posts and by the inability of responding agencies other than the NOFD to learn where they should report to determine the type emergency involved and the hazards it may pose to their personnel.

8. After the arrival of the NOFD superintendent, a single command post was established but its location remained within the danger area and its location was identified primarily to those who had access to the NOFD radio frequency.

9. The NOFD command post, although twice moved farther from the burning tank car, remained within the danger area throughout the emergency.

10. The evacuation of area residents was belated and ordered only after recommendations by outside technical experts, and the evacuation fell short of the area recommended in available emergency response guides.

11. The NOFD superintendent commanded the NOFD and with the mayor, assessed various actions recommended by others for mitigating the emergency conditions.

12. The mayor performed many of the functions of an overall incident commander by arranging for technical expertise, arranging for shelter and other needs of evacuees, coordinating the actions of other city agencies, and reserving to himself the final decision as to action to be taken relative to the tank car.

13. The city's HSHRP was not used to guide the response actions of the city because the mayor, as incident commander, was not aware that it existed and because the NOFD superintendent had no confidence in it as a guideline.

14. CHEMTREC was unable to promptly provide product-specific information on butadiene needed by emergency responders.

15. Shipping papers are not required to contain a 24-hour telephone number of a person having detailed knowledge of the hazardous characteristics of the hazardous materials being shipped.

16. The NOT's and the CSXT's early refusal to accept responsibility for the burning tank car created unfavorable conditions for coordinating response activities during the early hours of the emergency. This encouraged the mayor to use a private response company whose experience and capabilities were not known by anyone at the scene.

17. Railroad personnel provided early identification of the hazardous material contained in the burning tank car.

18. Entry of persons into the area of the burning tank car was not limited to those equipped with proper protective clothing or to those who were capable of assessing the status of the emergency condition.

19. The multiple entries of the WES personnel unnecessarily posed increased threats to the safety of firefighters and of WES personnel.

20. The combined protection provided by the tank car insulation and jacketing and the application of cooling water minimized the potential for a BLEVE.

21. Tank car GATX 55996 and other tank cars built to the same design drawings are not AAR-approved tank cars even though they have been used to transport hazardous materials for more than 20 years.

22. There is no final independent check in the tank car approval system to ensure that a finished tank car complies with the AAR-approved certificate.

23. Neither the FRA nor the AAR has an effective inspection program to ensure that tank car manufacturing or tank car repair work performed complies with applicable rules and regulations.

24. The self-energizing bottom manway design incorporates a single-failure design feature which demands greater care and attention during maintenance than tank cars equipped with a top manway.

25. The bottom manway design of GATX 55996 and other similar tank cars require specific closure procedures and a specifically designed gasket to assure proper closure; yet, none of these unique characteristics were made known to tank car repair shops nor to subsequent owners.

26. The gasket installed by Phillips 66 in 1984 in tank car GATX 55996 did not comply with the requirements of 49 CFR 179.102-3(3).

27. The noncomplying gasket in tank car GATX 55996 was inspected but was not replaced in 1986 because the carman was not aware that the gasket was incorrect.

28. Phillips 66's training and procedures were insufficient to qualify its carman for determining that the gasket on tank car GATX 55996 was incorrect.

29. The manway cover on tank car GATX 55996 was not lifted properly when the cover was closed and this caused the gasket to become misaligned.

30. Even with the misaligned gasket, a seal was accomplished through the use of large amounts of silicone sealant.

31. The Phillips 66 carman failed to detect the misaligned gasket.

32. The silicone sealant had sufficiently cured within the manway to withstand the 50 psig shop pressure test.

33. The Federal regulations and the AAR requirements for tank cars did not provide adequate standards on tank car bottom manway closures, on criteria for gaskets, on use of sealants, on maintenance of design documents, and on dissemination of procedures essential for correctly maintaining and operating unique features of tank cars.

34. At the times of purchase, the tank car buyers believed that GATX 55996 met the Federal requirements because it was stenciled with a DOT specification number. Neither Phillips 66 nor GATC researched tank car GATX 55996 sufficiently to reveal that it did not conform to the provisions of the AAR approval.

35. GATC, by leasing a tank car with a DOT specification stenciled on it, represented to Mitsui that tank car GATX 55996 was constructed and maintained to meet DOT specification requirements even though it had never inspected the tank car sufficiently to make this determination.

36. Mitsui did not inspect tank car GATX 55996; instead, it relied upon GATC's representation that the tank car met DOT specification requirements.

37. Mitsui did not have sufficient information to determine that the tank car GATX 55996 did not comply with DOT specifications.

38. GATXT personnel did not inspect the bottom manway assembly because they were not familiar with the car design and because the GATXT checklist did not provide specific guidance for its inspection.

39. Tank car GATX 55996 did not begin leaking butadiene until September 8, 1987.

40. Mitsui was correctly identified on the shipping papers as the shipper of GATX 55996, but it did not list on the shipping paper a 24-hour emergency response telephone number.

41. Deficiencies in installation of the bottom manway gasket by Phillips 66 and in emergency preparedness procedures by the City of New Orleans, NOT, and CSXT resulted in no fatalities or serious injuries in the butadiene fire involving tank car GATX 55996.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the uncontrolled release of butadiene from the bottom manway of tank car GATX 55996 was the misalignment and subsequent tearing of the gasket when the manway cover was improperly closed. Contributing to the improper closing of the manway cover were the lack of established procedures by both the North American Tank Car Corporation and Phillips 66 for correctly using the uniquely designed cover hinge and the insufficient training of the carman who performed the work. Contributing to the length of the emergency and the increased risk to life and property were the lack of any means to stop the flow of butadiene from the bottom manway of the tank car and the failure of responding personnel to comprehend the extent of the danger posed by the burning tank car and to promptly evacuate the area threatened.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board issued the following recommendations to:

--the city of New Orleans:

In coordination with local railroads, review and revise emergency response procedures to make them applicable for handling releases of hazardous materials from railroad vehicles. At a minimum, these procedures should address initial notification procedures, response actions for the safe handling of releases of the various types of hazardous materials transported, identification of key contact personnel, conduct of emergency drills and exercises, and identification of the resources to be provided and of actions to be taken by the railyard operators and the community. (Class II, Priority Action) (R-88-55)

Establish a procedure between the city's police and fire departments and between the city and public utility companies for coordinating reports of emergency conditions that may involve the release of hazardous materials. In addition, operators who receive reports of emergencies should be trained to identify and question callers who are capable of providing information useful to emergency personnel. (Class II, Priority Action) (I-88-3)

Revise the *Hazardous Materials Incident Response Plan* to clearly define the role of all agencies expected to respond to hazardous materials emergencies; to define explicitly the duties and authority of the incident commander; to require appropriate, periodic training for all personnel responsible for implementing the plan; to incorporate an Incident Command System to aid in providing unity of command and making optimum use of available resources; to require periodic emergency preparedness exercises that involve all affected city agencies and appropriate, local hazardous materials transportation-related companies; and to require the evaluation of preparedness exercises with the resultant data being used to modify and refine procedures. (Class II, Priority Action) (I-88-4)

--to the Norfolk Southern:

Review each railyard's implementation of the company procedures for emergency preparedness, including the coordination with communities adjacent to the railyard of the provisions of its emergency plans, and require immediate correction of all deficiencies. (Class II, Priority Action) (R-88-56)

Implement a procedure for periodically determining that its railyard management maintains up-to-date emergency notification listings for local emergency response agencies and that employees required to have these lists have current information and know when and how to use them. (Class II, Priority Action) (R-88-57)

--to the New Orleans Public Service, Inc.:

Communicate to and coordinate with the New Orleans Fire Department Communications Center about any reported gas odors or leaks to which it is unable to investigate expeditiously and about any reports of gas odors or leaks which may pose immediate threats to persons or property. (Class II, Priority Action) (I-88-5)

--to the Federal Railroad Administration:

Prohibit from hazardous materials service the use of tank cars that have a manway opening located below the level of the liquid being transported. (Class II, Priority Action) (R-88-58)

Establish performance standards for determining the acceptability of heat-resistant gaskets required to be used on tank cars. (Class III, Longer Term Action) (R-88-59)

Evaluate the effect on gasket compatibility and heat-resistance performance of sealants used for installing gaskets on tank cars, and if the use of sealants is allowed, establish performance criteria to determine which sealants are acceptable and the conditions for their use. (Class III, Longer Term Action) (R-88-60)

Where special procedures or material specifications or dimensions are required for maintaining the integrity of tank cars, require such information to be permanently and conspicuously affixed to the tank car. (Class III, Longer Term Action) (R-88-61)

Require tank car owners to be provided with a copy of design drawings and other documentation which is a part of the tank car certification, modification, or repair and require that these documents be maintained for the life of the tank car. (Class II, Priority Action) (R-88-62)

Establish quality control requirements for tank car manufacturers and tank car repair shops sufficient to ensure that actions taken comply with Federal regulations and with any conditions established in Association of American Railroads approvals for manufacture, repair, or modification of rail tank cars. (Class III, Longer Term Action) (R-88-63)

Require that tank car repair shops develop and maintain current written procedures to guide their employees in performing work on tank cars and that their employees be trained on those procedures. (Class III, Longer Term Action) (R-88-64)

--to the General American Transportation Corporation:

Require that all design drawings approved by the Association of American Railroads Tank Car Committee be obtained on all tank cars that are purchased and/or are provided for transporting hazardous materials and that the tank car conforms to the approved drawings and to applicable Federal regulations. (Class II, Priority Action) (R-88-65)

--to the Mitsui & Company (USA) Inc.:

Implement procedures to ensure that all tank cars are inspected to identify any visible safety deficiencies and that any deficiencies are corrected before the tank cars are permitted to transport hazardous materials. (Class II, Priority Action) (R-88-66)

Enter on its shipping papers for hazardous materials a 24-hour telephone number where detailed knowledge of the hazardous characteristics of the materials being shipped can be obtained. (Class II, Priority Action) (R-88-67)

--to the GATX Terminal Corporation:

Revise inspection procedures to ensure that tank car inspectors inspect all accessible gasket and closure assemblies to determine that all tank car openings are secured properly before allowing them to be placed into transportation. (Class II, Priority Action)(R-88-68)

--to the Research and Special Programs Administration:

Define explicitly in the final rule of Docket HM-126C the information that must be provided to CHEMTREC before a shipper of hazardous materials can list on its shipping documents the CHEMTREC emergency telephone number in lieu of the shipper listing its 24-hour emergency telephone number. (Class II, Priority Action) (I-88-6)

--to the National League of Cities:

Advise its membership of this accident and urge its members in coordination with railyard management to develop and implement emergency response procedures for handling releases of hazardous materials from railroad vehicles. (Class II, Priority Action) (R-88-69)

--to the National Governors' Association:

Advise its membership of this accident and urge its members in coordination with railyard management to develop and implement emergency response procedures for handling releases of hazardous materials from railroad vehicles. (Class II, Priority Action) (R-88-70)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES L. KOLSTAD
Acting Chairman

/s/ JIM BURNETT
Member

/s/ JOSEPH T. NALL
Member

/s/ LEMOINE V. DICKINSON, JR.
Member

John K. Lauber, Member, did not participate.

September 30, 1988

APPENDIXES

APPENDIX A

INVESTIGATION

Investigation

The National Transportation Safety Board was notified ofthe accident at 7:05 a.m. on September 9, 1987, and dispatched an investigative team from Washington, D.C., to the scene. Individual groups were established for shipper operations, tank car performance, and emergency response.

Public Hearing

The Safety Board convened a public hearing as part of its investigation of the accident on December 14, 1987, in New Orleans, Louisiana. Parties to this proceeding included the city of New Orleans, the State of Louisiana, the Federal Railroad Administration, CSX Transportation, Norfolk Southern Corporation, Phillips 66 Company, General American Transportation Corporation, General Electric Rail Car Services Corporation, and the Association of American Railroads.

APPENDIX B

ACCTG WAYBILL COPY

* D A N G E R O U S *
************************ 350 - ILLINOIS CENTRAL GULF RAILROAD - 350

JMM NT 2676 1 0

GATX055996 L1 N/A 09/04/87 555450

CHATTANOOGA TN 9165 GOOD HOPE LA

NEW ORLEANS LA

ICG -NOLA -CSX1 MITSUI CO USA INC

S

GOOD HOPE LA

POLYSAR LATEX CO
PLANT NO 2

CHATTANOOGA TN

PN0095

DO NOT WEIGH-TARIFF WGT

CHATTANOOGA TN

FOR CHEM EMERG NOTIFY CHEMTREC
AT 800 424 9300 & SHIPPER
CHARGES ASSESSED ON EST. WTS. COLLECT

09/09/87 JMM

4905704

1 T/C	154530	1.50	2317.95
BUTADIENE INHIBITED	TOTAL	HUNDRED	
/BUTADIENE INHIBITED/			
FLAMMABLE GAS UN1010			
PLACARDED FLAMMABLE GAS			
********************** TOTAL OF CHARGES			2317.95

SEAL1: 6750
GROSS GALLONS
LOADING TEMP 60F
WT/GAL @ 60F 5.2
NET GALLONS 29552

** RATE AUTHORITY ** SFA 4673 IT00008360

APPENDIX C

TANK CAR GATX 55996 BILL OF LADING

STRAIGHT BILL OF LADING—SHORT FORM—ORIGINAL—NOT NEGOTIABLE

RECEIVED, subject to the classifications and tariffs in effect on the date of issue of this Original Bill of Lading,

the property described below, in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Straight Bill of Lading set forth (1) in Official, Southern, Western and Illinois Freight Classifications in effect on the date hereof, if this is a rail or a rail-water shipment, or (2) in the applicable motor carrier classification or tariff if this is a motor carrier shipment. Shipper hereby certifies that he is familiar with all the terms and conditions of the said bill of lading, including those on the back thereof, set forth in the classification or tariff which govern the transportation of this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

From Mitsui & Co. (U.S.A.), Inc. **SINGLE TRIP LEASE AGREEMENT**

At ~~XXXXXXXXX~~ GOOD HOPE, LA. 9/4 1987 BY (DESIGNATE WITH AN (X)) TRUCK ☐ FREIGHT ☐ Shipper's No.

By I.C.G. R.R. Company Carrier's No.

(Mail or street address of consignee — for purpose of notification only.)

Consigned to POLYSAR LATEX "PLANT NO. 2.

Destination CHATTANOOGA State of TENN. County of

Route ICG-NOLA -CSX

Delivering Carrier Vehicle or Car Initial GATX No. 55996

No. Packages	Kind of Package, Description of Articles, Special Marks, and Exceptions	*Weight (Subject to Correction)	Class or Rate	Check Column
ONE(1)	TANK CAR LOAD BUTADIENE INHIBITED FLAMMABLE GAS			
	29,552 NET GALS @ 60 o 5.2 LBS/GAL			
	P.O. NO. 150874 CONTRACT NO. 25069803	153,670#		
	SEAL NO. 6750			
	ITEM 2165 SUPPLEMENT 32 TO SPFFC TARIFF 1021-K EFFECTIVE 9/1/68			
	ASTM VOLUME @ 5.229 LBS/GALS	154,530#		
	HAZARDOUS MATERIAL CODE UN 1010			
	THIS IS TO CERTIFY THAT THE ABOVE NAMED MATERIALS ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED, & LABELED AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORATION.			
	PLACARDED FLAMMABLE GAS			
TOTAL PIECES				

Subject to Section 7 of conditions of applicable bill of lading, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement:

The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

Mitsui & Co. (U.S.A.), Inc.
Per (Signature of Consignor.)

If charges are to be prepaid, write or stamp here, "To be Prepaid."
COLLECT

Received $ to apply in prepayment of the charges on the property described hereon.

Agent or Cashier.

Per (The signature here acknowledges only the amount prepaid.)

Charges Advanced: $

* If this shipment moves between two ports by a carrier by water, the law requires that the bill of lading shall state whether it is carrier's or shipper's weight.

NOTE—Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding

IMPORT CERTIFICATE

We hereby certify that the property covered by this receipt was imported in the from arriving at this port on and has not been in any private warehouse, but is transferred to railroad station direct from

Signed

C.O.D. SHIPMENT
C.O.D. Amt.
Collection Fee
Total Charges

Mitsui & Co. (U.S.A.), Inc. Shipper, Per S.J. CRESPO Agent, Per POR ICG 9/4/87

Permanent post office address of shipper 200 Park Ave., New York, N.Y. 10017

APPENDIX D

AAR APPLICATION FOR CONSTRUCTION AND DRAWING OF BOTTOM MANWAY

.35354.

APPLICATION FOR APPROVAL AND CERTIFICATE OF CONSTRUCTION

AAR APPLICATION NO. D-16735-A

TO: ☒ ☒ ☒ ☐

APPLICATION FOR APPROVAL OF ☒ ☐ ☐ ☐ ☐

NATX 34003-34101 — November 23, 1966

100-114A340W — 99

L.P.G. Cr ANHYDROUS AMMONIA — 4.21

33,900 — NONE

A.A.R. M-128 GRADE B Heads 0.667" Shell 0.654"

NONE

111.662 — ELLIP — ELLIP — 340

NONE

MIDLAND A-3160-X — CXE — 280.5

32,300 — 27,397 — 2040

44.5 — 91,200 — 66.79

263,000 — 100 — 5.07

Cover	F-554-F	11-21-66	Submitted
Sheet #1	21-31D1-F	11-16-66	Submitted
	F-554-F	11-21-66	Submitted
Sheet #2	21-31D1-F	11-16-66	Submitted
Sheet #2	21-31D1-F *	11-16-66	Submitted
Sheet #1	21-31D1-F	11-16-66	Submitted
	21-1C419-B	3-30-66	Submitted
Sheet #2	21-1D354	11-16-66	Submitted
	D-534	6-27-62	D-14766
NEW DWG	C-539-A	11-18-66	Submitted
	NONE		
12-21-66 MEM #183	Sht.1(Part 1 & 2)	Sheet 1A(Part 2 & 3)	Submitted
	NONE	—	—
	FOR LIQUIFIED GAS ONLY		
	F-554-F	8-25-66	Submitted
	NONE		
Bolster Assembly	21-1D336-B	3-25-66	Submitted
Draft Sill	21-1D319-B	3-30-66	Submitted
Yard Rail Opening	B-1666	5-15-64	Submitted
42.Self Energizing Manway	21-1C420-B	3-30-66	Submitted
43.Clamping Bracket	21-1A370	4-22-66	Submitted
*Locking Bolt Retainer	21-1A363-A	2-10-66	Submitted

APPLICATION OF * PRESSED STEEL CAR CO. R.A. Boucke TITLE General Manager

APPROVAL

☐ SECRETARY, ☒ MEMBER EXECUTIVE COMMITTEE ☐ TANK CAR COMMITTEE — DATE APPROVED March 9 1967 — H.H. Stevens (ac)

THE CARS ENUMERATED BELOW CONFORM TO THE ABOVE APPROVED DESCRIPTION AND TO ALL APPLICABLE A.A.R. AND CARRIER REQUIREMENTS, REGULATIONS, RULES OF INTERCHANGE AND THE U.S. SAFETY APPLIANCE STD.

CERTIFICATE OF CONSTRUCTION

45.Vapor Line Check Valve Mod. New.Drwg. C-559(Submitted) 8-25-66
46.Protective Housing Assembly Sheet #1 21-1D354(Submitted) 11-16-66 April 18, 1967

INITIALS & CAR NUMBERS

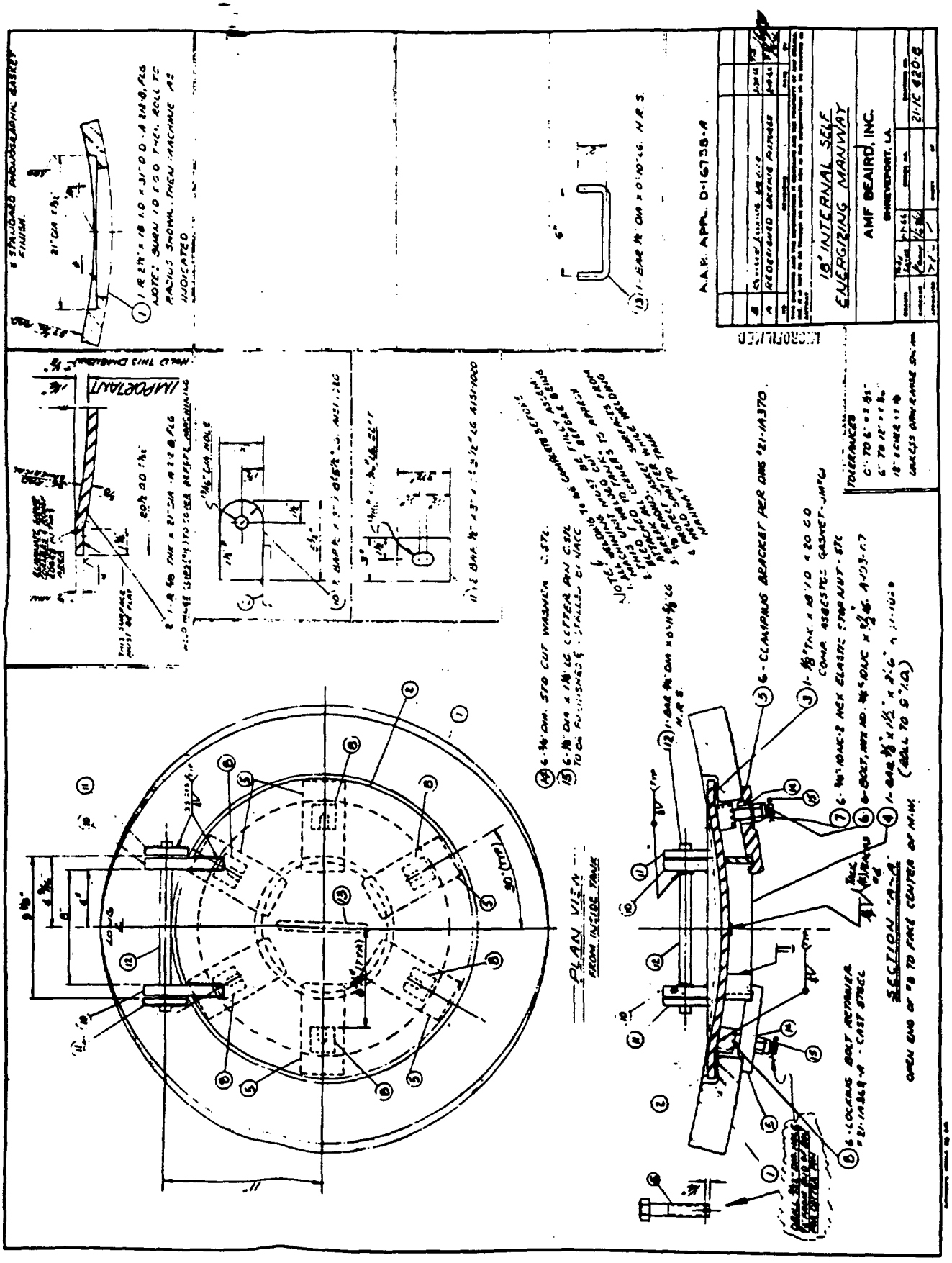
NATX 34003 THRU 34101

R.A. Boucke

TITLE Vice President-Engineeri

PAGE 1 OF ____

FORM AAR 4-2


A.A.F. APPL. D-16738-A
18' INTERNAL SELF ENERGIZING MANWAY
AMF BEAIRD, INC.
SHREVEPORT, LA.
PLAN VIEW
FROM INSIDE TANK
SECTION "A-A"
OPEN END OF "B" TO FACE CENTER OF MIN.
IMPORTANT
TOLERANCES

APPENDIX E

SAFETY BOARD METALLURGICAL REPORT No. 88-42 EXAMINATION OF GATX 55996 BOTTOM MANWAY GASKET

NATIONAL TRANSPORTATION SAFETY BOARD
Bureau of Technology
Washington, D. C. 20594

February 9, 1988

Materials Laboratory
Report No. 88-42

METALLURGIST'S FACTUAL REPORT

A. ACCIDENT

Place : New Orleans, Louisiana
Date : September 9, 1987
Vehicle : Tank Car, GATX 55996
NTSB No. : DCA 87-H-Z001
Investigator: Russell Quimby (TE-40)

B. COMPONENTS EXAMINED

Bottom Manway Gasket

C. DETAILS OF EXAMINATION

The gasket, shown in figure 1, was a rubber like compound in the form of a ring approximately 1.125 inches wide by about 0.2 inches nominal thickness with an approximate 20 inch inner diameter (ID). The gasket had three approximately equal spaced separations. One separation had completely severed the gasket along a length of 7 inches (see arrow "1" in figure 1). The separation ran from the outer diameter (OD) of the ring to the inner diameter in a counterclockwise direction when viewed from the bottom. The other two separations only partially severed the gasket. The partial separation at arrow "2" in figure 1 ran from the ID of the gasket toward the OD in a clockwise direction (viewed from the bottom) for 4.5 inches. The longer partial separation, 14.5 inches, at arrow "3" figure 1, ran from the OD to near the ID then along the middle of the gasket ring.

Microscopic examinations revealed that the majority of the separation surfaces were relatively flat and featureless with no recognizable indicators of separation modes or directions. For the most part, the separations were also perpendicular to the surfaces of the gasket ring.

Considerable variations in the thickness was noted at different locations on the gasket. The maximum measured thickness was approximately 0.20 inches and a minimum of 0.085 inches was measured. The thickest was found in the region between the severed location and the short separation, as indicated by bracket "N" in figure 1. The thinnest area (shaded red near arrow "1" in figure 2) was in the outboard leg of

the complete separation. Within this thin area, an arced pattern of parallel lines (resembling the grooves in a phonograph record) were impressed into both gasket surfaces. The radius of these lines appeared to be smaller than and not concentric with the radius of the gasket. Other areas of "record grooving" are noted by arrows "RG" in figure 2. Another area of reduced gasket thickness was found in the region between and inclusive of portions of the two partial separations, shaded red at left in figure 2. The boundary between this thin area and the ID of the gasket ring was arced and formed a crescent shaped area of thicker material. It was also noted that the intersection of this boundary appeared correspond to the ID location of the short partial separation.

The gasket had taken permanent out-of-plane sets in the three areas, indicated by the blue shaded lines at arrows "S" in figure 2. At arrows "S1" and "S2" the deformations were upward bends of the gasket material adjacent to boundaries between thicker and thinner gasket material. At arrow "S3" the set was a downward bend in a thicker gasket area.

Also noted, was a slight crease line on the upper gasket surface and a zone of radial scuff marks on the lower surface, denoted by green line "L" and green area "M", respectively in figure 2.

Joe Epperson
Metallurgist

Attachments

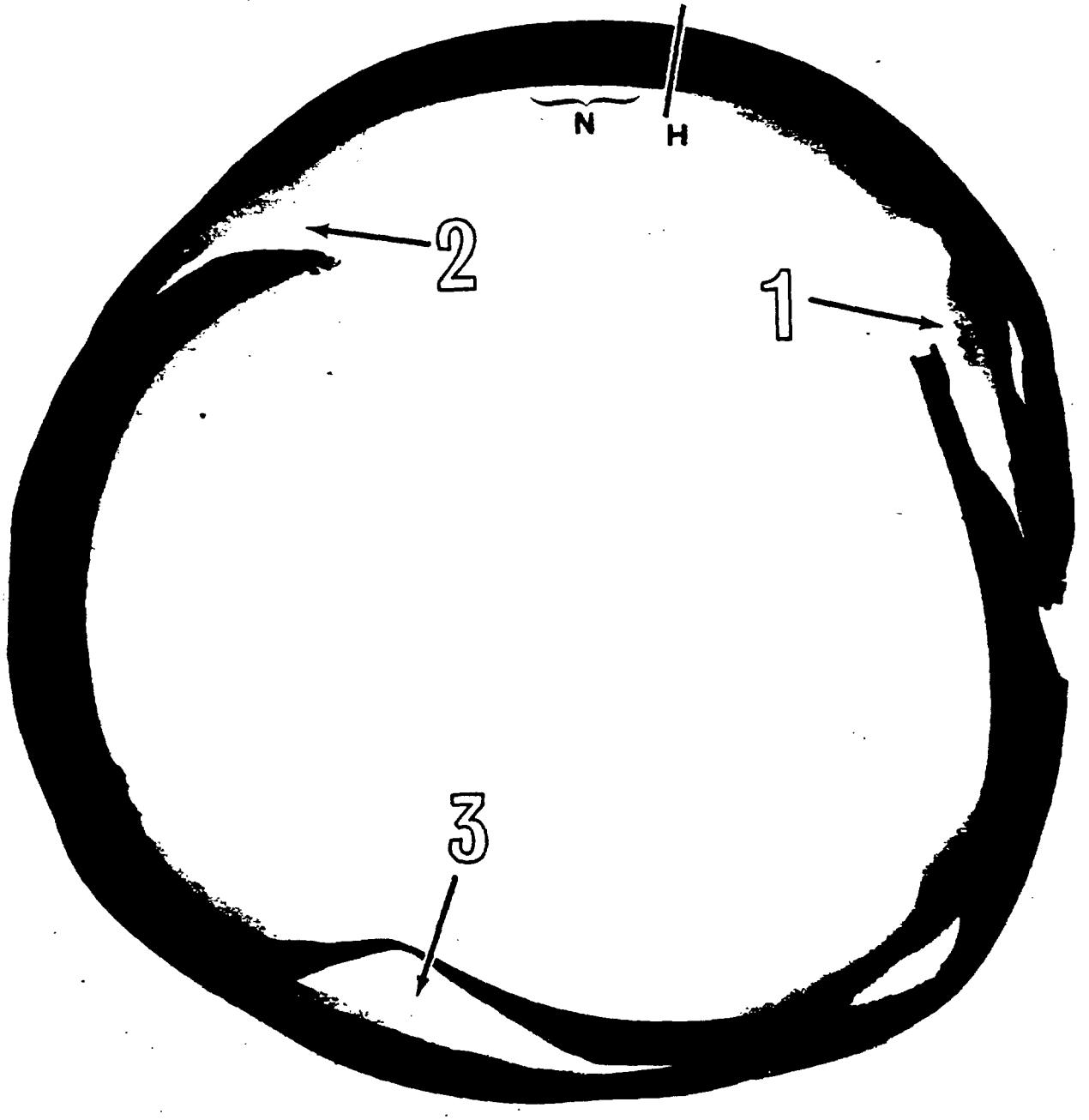
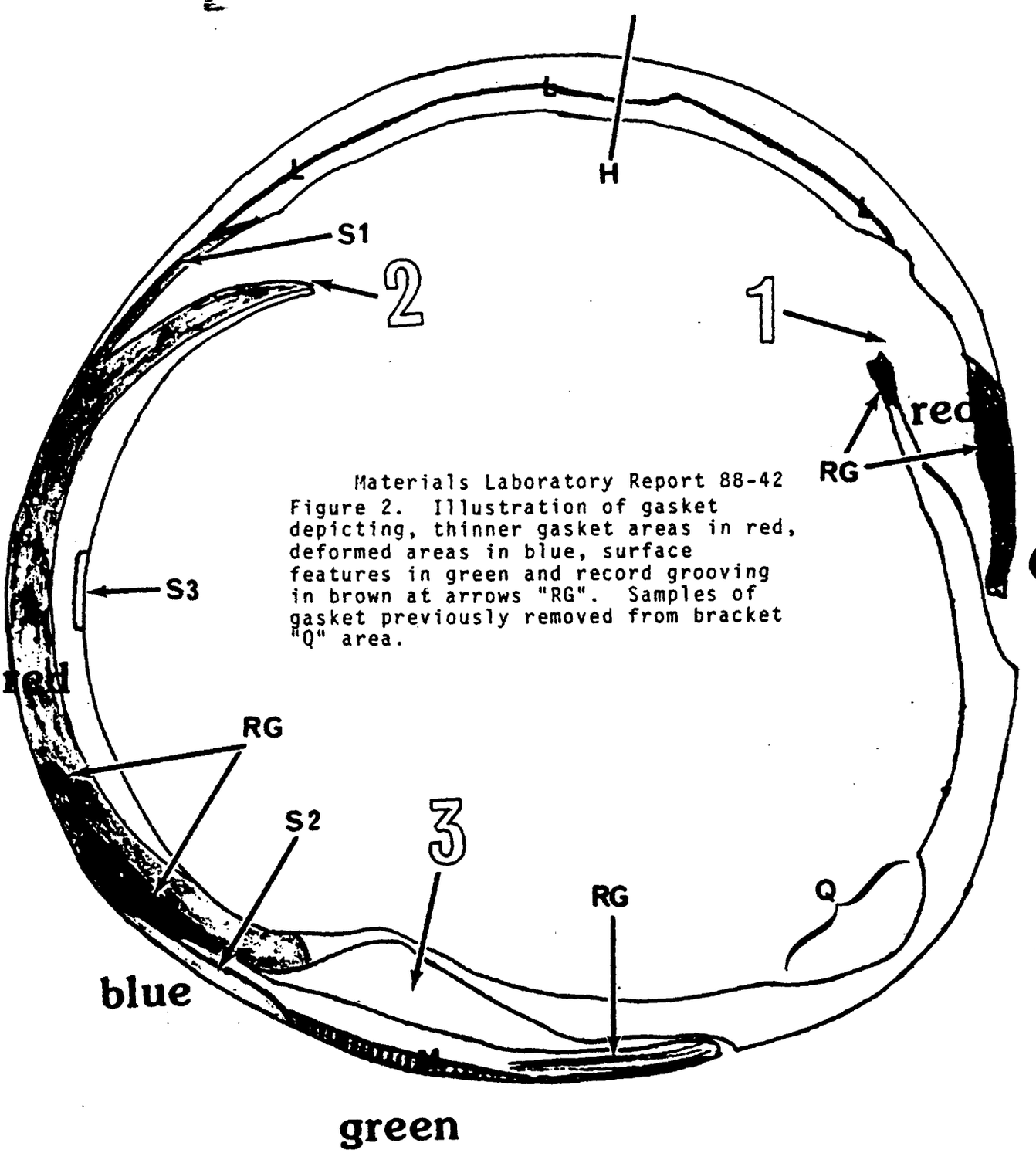


Figure 1. A reduced size (50 percent) photograph showing the lower surface of the as-received gasket with corresponding manway handle location marked at line "H."



Materials Laboratory Report 88-42
Figure 2. Illustration of gasket depicting, thinner gasket areas in red, deformed areas in blue, surface features in green and record grooving in brown at arrows "RG". Samples of gasket previously removed from bracket "Q" area.

APPENDIX F

CSX TRANSPORTATION'S INITIAL RESPONSE PLAN - "PACE"

PREPLANNING FOR HAZARDOUS MATERIALS INCIDENTS

1. Yard or terminal officers should meet with Fire Department personnel to review planned responses for hazardous materials incidents.
   (a) Review access roads
   (b) Identify populated areas
   (c) Locate and inspect fire hydrants
   (d) Identify available equipment
2. Identify tracks where leaking rail cars may b from habitation, highways and employee activn,
3. Obtain and enter 24 hour telephone numbers of res, agencies, suppliers, and contractors in the spaces pro Verify these numbers at least annually.

WHEN A HAZARDOUS MATERIALS INCIDENT OCCURS

1. Take steps to protect public safety, fellow employees and the environment. Preventing injuries is always the first priority.
2. Eliminate all ignition sources, such as lanterns, torches, flares, fusees, open flames, and smoking materials, from the immediate area. Motor vehicles should be prevented from entering the site.
3. Avoid contact with leaking materials.
4. Caution personnel not to enter the area.
5. Immediately report damaged and/or leaking rail cars to the ranking yard or terminal officer.
6. Determine the car's contents. This information can be obtained from the waybill or shipper's bill of lading. Do *not* attempt to repair a leaking car before its contents and associated hazards have been identified.
7. Notify the fire department immediately if there is:
   - Fire or smoke
   - A hazardous material release requiring their assistance
   - A potential release of a poisonous or flammable gas

   Supply the fire department with details of the incident including directions to the scene. Arrange to meet all emergency personnel at a designated location. Provide waybill and hazardous material information to the Fire Chief upon arrival.
8. If possible and safe to do so, isolate the leaking car, taking into consideration wind speed and direction. Use buffer cars and caution personnel to stay a safe distance upwind to avoid chemical exposures.

NOTIFICATION PROCEDURES

1. Promptly report all hazardous material incidents (derailments, leaking cars, etc.) to the CSXT Operations Center in Jacksonville at (904) 359-1592. Provide the Operations Center with the following information when possible:
   - Exact location of incident
   - Time incident occurred
   - Car numbers and types
   - Commodities involved
   - Status of cars (load/empty)
   - Disposition of cars, including damage to car (e.g. outer jacket torn), evidence of leakage (e.g. wetness on side of car, vapor cloud, odors), location of leakage (e.g. bottom, dome), and estimated rate of leakage (e.g. one gallon per minute, car only leaks when moved, etc.)
   - Environmental concerns such as threatened waterways, culverts, drainage ditches, etc.
   - Prevailing weather conditions (rain, wind direction and speed, etc.)
   - Public exposure potential (nearest habitation)
   - Nature and extent of any injuries
   - Action taken (leaking car isolated, etc.)
   - Name, title, and call back number of the person making the report
2. The CSXT Operations Center will in turn contact CSXT's Hazardous Materials Department.
3. CSXT's Hazardous Materials Department will provide information concerning the chemical, physical and toxicological properties of the material(s) involved, and the proper safety precautions to be followed.
4. The Hazardous Materials Department will notify CHEMTREC and the appropriate state and federal regulatory agencies when required by law, and will coordinate shipper response when necessary.
5. Notify the CSXT Operations Center of the time and nature of any repairs made. This action should take place after leaking tank cars have been repaired or the incident has been safely mitigated.

ENVIRONMENTAL CONSIDERATIONS

1. All yards and terminals should have 24 hour accessibility to sorbent materials and limestone.
2. Consult CSXT's Hazardous Materials Department prior to undertaking cleanup or containment actions.
3. When advised safe to do so, contain leaking materials and prevent them from entering waterways, culverts, sewers, and drainage ditches by erecting dikes, dams, and/or trenches ahead of the flow, or by placing buckets underneath leaking rail cars.
4. The Hazardous Materials Department must be contacted when an environmental pollutant (e.g., corn syrup, fertilizer, fuel oil, etc.) is released. The Hazardous Materials Department is accessible 24 hours a day through the CSXT Operations Center in Jacksonville.

REMEMBER: YOUR SAFETY AND THAT OF YOUR FELLOW EMPLOYEES DEPENDS UPON THE RECOGNITION AND PROMPT REPORTING OF ALL HAZARDOUS MATERIALS INCIDENTS.

*U.S.GOVERNMENT PRINTING OFFICE:1988-242-320:81028