NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

DERAILMENT OF LOUISVILLE & NASHVILLE RAILROAD COMPANY'S TRAIN NO. 584 AND SUBSEQUENT RUPTURE OF TANK CAR CONTAINING LIQUEFIED PETROLEUM GAS WAVERLY, TENNESSEE FEBRUARY 22, 1978

UNITED STATES GOVERNMENT

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16. Abstract

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The National Transportation Safety Board determines that the probable cause of the loss of life and substantial property damage was the release and ignition of liquefied petroleum gas from a tank car rupture. The rupture resulted from stress propagation of a crack which may have developed during movement of the car for transfer of product or from increased pressure within the tank. The original crack was caused by mechanical damage during a derailment, which resulted from a broken high-carbon wheel on the 17th car which had overheated.

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SYNOPSIS

About 10:25 p.m., on February 22, 1978, 23 cars of a Louisville & Nashville Railroad Company train derailed at a facing point switch in Waverly, Tennessee. At 2:53 p.m., on February 24, 1978, a derailed tank car containing liquefied petroleum gas ruptured, releasing the product which ignited with an explosive force. As a result, 16 persons died and 43 were injured; property damage was estimated at $1,800,000.

The National Transportation Safety Board determines that the probable cause of the loss of life and substantial property damage was the release and ignition of liquefied petroleum gas from a tank car rupture. The rupture resulted from stress propagation of a crack which may have developed during movement of the car for transfer of product or from increased pressure within the tank. The original crack was caused by mechanical damage during a derailment, which resulted from a broken high-carbon wheel on the 17th car which had overheated.

INVESTIGATION

The Accident

At 6:32 p.m., on February 22, 1978, northbound Louisville & Nashville Railroad Company (L&N) train No. 584 departed Radnor Yard, near Nashville, Tennessee, en route to Bruceton, Tennessee. The train consisted of 3 diesel-electric locomotive units, 92 cars, and a caboose. At Colesburg, 39.5 miles north of Nashville, 1 car was set out of the train and 5 others were added behind 14 cars which remained coupled to the locomotive. L&N 171228, a gondola loaded with wooden crossties, was one of the cars added to the train and became car No. 17. Train No. 584 departed Colesburg without its brakes being properly tested; a brake test is required by Federal regulations. The crewmembers made only an application and release test on the rear car. (See Appendix A.)

About 14 miles north of Colesburg, Train No. 584 received a "no defect" indication from a hot journal detection device. At 10:25 p.m., while the train was being operated in compliance with a 35-mph speed restriction through the city of Waverly, Tennessee, the train's brakes were applied in emergency automatically. The rear brakeman, who was riding in the cab of the lead locomotive unit with the front brakeman and engineer, detrained and walked rearward to determine the cause of the brake application. He saw that the train had separated when the 17th car through the 39th car had derailed.

Included in the derailed cars were two tank cars--UTLX 83013 and UTLX 81467--loaded with liquefied petroleum gas (LPG.) An inspection of the tanks disclosed no leakage. Because the tank cars were damaged, L&N management involved in clearing the wreckage decided to move the tank cars from their positions in the wreckage to a position alongside the track structure, where the lading could be transferred into highway tank trucks. The derailed freight cars, which were obstructing the tank cars as a result of the derailment, were removed before the tank cars could be relocated. Cable slings were placed around the north end of tank car UTLX 83013 and, using the opposite end as a pivot, it was moved about 12 feet eastward. Wooden crossties supported the north end of the tank while the remainder of the tank rested on the ground. The other tank was similarly moved, and the relocations were completed by 2:15 p.m., February 23. Gas detection devices indicated no leakage of product following the moves.

The L&N's wrecking crew continued to remove the derailed cars, and the main track was opened to rail traffic by 8:00 p.m., February 23. Tank trucks were ordered to unload the LPG from the relocated tank on the south end, since that car appeared to be the most severely damaged. An empty tank car was ordered so that the second tank could be unloaded on Friday morning, February 24. (See figure 1.)

A semitrailer/tank motortruck arrived at Waverly about 1:00 p.m. on February 24. A supervisor from the truck firm, who was familiar with handling LPG, and the truckdriver were on site but had not started the transfer, when about 2:53 p.m. UTLX 83013, the northernmost tank car, ruptured and allowed LPG to enter the atmosphere. Seconds later, the cloud of vaporized LPG was ignited by an undetermined source and burned explosively.

Injuries to Persons

	Railroad and Contractor Employees	Local and State Officials	Bystanders and Residents
Fatal	7	6	3
Nonfatal	19	5	19
Total	26	11	22

Figure 1. Location of tank cars immediately before rupture.

Damage

Of the 23 cars derailed in Train No. 584 and 4 cars that were standing on the siding at Waverly, a total of 15 cars were destroyed and 12 others sustained damages ranging from slight to severe. In addition, about 400 feet of track was destroyed.

The fire resulting from the ruptured tank destroyed 18 buildings and 26 motor vehicles within the city of Waverly. The damaged structures included both commercial and residential buildings. (See figure 2.)

Estimated Property Damage:

Nonrailroad	-	\$1,400,000
Railroad	-	400,000
Total		\$1,800,000

Traincrew Information

All crewmembers of Train No. 584 were qualified by L&N standards. Each member had reported for duty at the carrier's Radnor Yard at 5:30 p.m. on February 22, 1978, and were in compliance with Federal Hours of Service Regulations. The L&N operating rules place responsibility for the fitness of the crew for duty on the conductor. The conductor did not take exception to the condition of any crewmembers. (See Appendix B.)

The rear brakeman was employed in train service by the L&N in March 1969. His training consisted of 21 trips as a trainee, accompanying working traincrews. He had also spent some time with a car inspector who explained air brakes and general car information. This person was qualified as a conductor. The rear brakeman inspected the five cars added to the train at Colesburg.

Train Information

Gondola car L&N 171228 was built in April 1961. This 57-foot-long car was mounted on 4-wheel trucks at each end; each truck was equipped with roller bearings and 33-inch wheels, and was designed for cast iron brakeshoes. Except for the right and left No. 1 (R&L-1) pair of wheels, all of the car's wheels were Southern AAR CS-1-70T ALT wheels, manufactured between May 5, 1958, and January 1, 1964. The car had a load limit of 154,000 pounds. The rear wheel on the west side of this car first derailed 6.9 miles south of the general derailment.

The rear pair of wheels on the gondola car had been manufactured by the Southern Wheel Company with a higher carbon content than previously cast steel wheels, in order to improve the wearing quality of the wheel. However, when this high carbon wheel was exposed to above-normal heat,

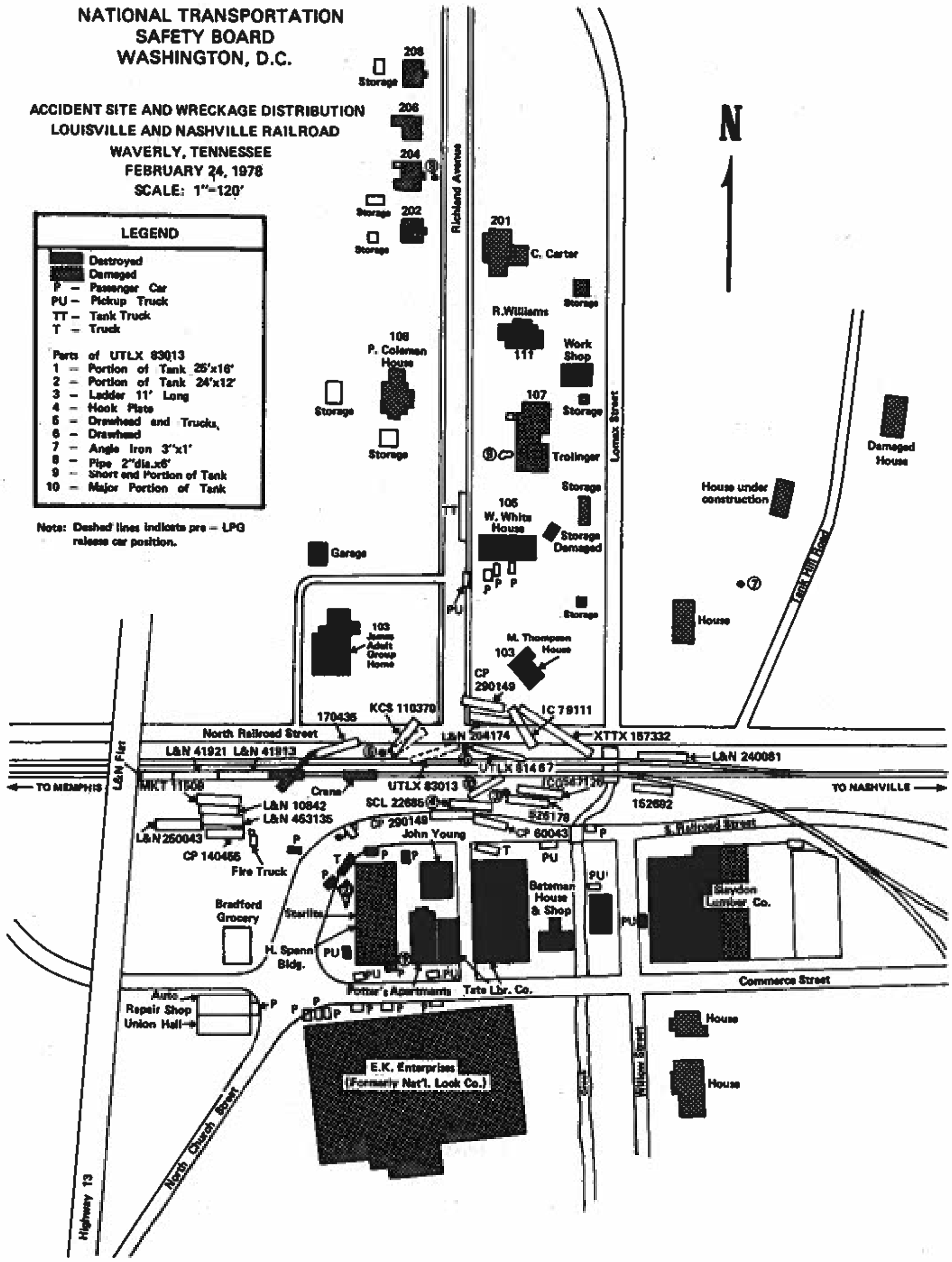

Figure 2. Plan view of accident site and wreckage distribution.

such as that produced by dragging or sticking brakes, the wheel tends to crack, break, and derail. This condition had become prevalent in the railroad industry, and the Association of American Railroads (AAR) initiated a program to remove these types of wheels. These wheels had been mounted on tanks cars hauling hazardous materials and on other types of cars which were often placed in trains that hauled hazardous materials.

The broken wheel cracked through the rim, plate, and hub, allowing the wheel to loosen and move inward on the axle. This wheel and the remaining wheels on the car showed signs of thermal abuse. Several types of brakeshoes were found on the car's three brake beams recovered from the wreckage. A high friction composition shoe was found at the L-2 location. Only one brake beam from the "A" end truck was recovered. This brake beam had a cast iron shoe that was badly burned on one end and only the backing plate of a composition shoe that had been disintegrated by heat at the other end. The damage to the brake beam indicated that the composition brakeshoe had been at the position of the broken wheel.

Since composition brakeshoes have a higher coefficient of friction than cast iron shoes, railroad equipment designed to use the composition shoes provides less force for the same braking capabilities than for other brakeshoes. Since there are no differences in the backing plates of the two types of brakeshoes nor differences in the method of attaching the shoes to the brake head, a composition brakeshoe may be installed on a car that is not designed for its use. If a composition brakeshoe is so installed, excessive friction and heat are produced between the composition shoe and the wheel and can cause high heat inputs into the wheel.

UTLX 83013, a DOT 112A400W specification tank car, was built in 1961 by the Union Tank Car Company. The car was leased to AMOCO Oil Company for LPG service. The tank had an inside diameter of 97 3/8 inches and an external surface area of 2,119 square feet; its liquid capacity was 30,149 gallons. The tank was constructed of 25/32-inch-thick steel manufactured to ASTM Specification A-212 Grade B BPSFQ. The tank was last hydrostatically tested in April 1971 at a pressure of 400 psig. During March 1976, the safety relief valve was tested for operation at 300 psig. The rated capacity of the tank car was 200,000 pounds. The car was designed with stub draft sills at each end of the tank. Draft and buff forces are transmitted between stub sills through the tank. The car was not equipped with head shields or shelf couplers, and it was not insulated or provided with a jacket.

Enterprise Products Company of Petal, Mississippi, loaded the car for AMOCO. Shipping papers indicated that the tank's capacity was 30,161 gallons and that it was loaded with 27,871 gallons of LPG adjusted at 60°F. The weight of product totaled 130,994 pounds. Four and a half pounds of ethyl mercaptan were added as a malodorant at the time of loading. Placards were applied in accordance with Federal Hazardous Materials Regulations.

During derailment, this car received a gougelike scrape and indentation on the lower right side, which extended from the leading head to the center of the tank. The scrape had visibly altered the exterior bead of a weld between the second and third tank sheets. The fracture originated in and propagated in the axial direction of the tank from the damaged girth weld for about 5 feet in each direction along the gouge. The fractures then changed directions and resulted in circumferential fractures. These fractures caused the tank to separate into four major segments. When the product was ignited, the north-facing tank head was propelled about 350 feet to the east of the ruptured tank's original position. A second piece, which measured 24 feet by 12 feet, landed about 150 feet northwest of the tank's original location. A third section was propelled about 250 feet and came to rest against the west side of a building. This section evidently was propelled with high trajectory, because the only damage noticed on a building was at the roof line over which the section passed. The largest portion of the tank, about 60 percent of it, was propelled about 50 feet southwestward where it rolled on its side.

Tank car UTLX 81467 was manufactured to DOT 112A340W specification. Although not equipped with head shields, the car was provided with shelf couplers, which functioned as designed and prevented the two adjacent tank cars in the derailment from severe head damage. The trailing end of this tank was indented spherically during the derailment. The car was properly placarded, but bore stenciling indicating that it was in anhydrous ammonia service, when in fact it was loaded with LPG.

Method of Operation

Trains are governed by signal indications of a traffic control system. An ordinance of the city of Waverly restricted train speeds to a maximum of 35 mph while operating within its corporate limits.

L&N's air brake instructions require that employees determine that the brakes apply and release on the rear car of a train whenever the locomotive or caboose is changed or where one or more cars is set out at an intermediate terminal. The carrier has no requirements for cars added to a train, nor do they require a brake-pipe leakage test. For this reason the carrier's rule did not comply with the requirements of the Federal Railroad Administration's (FRA) regulation contained in 49 CFR 232.13(d) (1). (See Appendix A.)

The rear brakeman stated that he released two hand brakes and made a safety inspection of the five cars added to the train at Colesburg. This inspection disclosed no defects on the wheels, brakes, couplers, or airbrakes on any of the cars.

Meteorological Information

At the time of the derailment the ambient temperature was near freezing, and it did not change appreciably during the night or early morning of February 23. Daytime temperatures increased slightly, and it snowed in the area. By the morning of Friday, February 24, the skies had cleared. Since there were no clouds, solar radiation heated the area. Temperatures rose from a morning low in the upper teens to a midday temperature in the midfifties.

Fire

The central dispatcher for the city of Waverly's Police and Fire Departments was notified of the derailment at 10:46 p.m. He immediately notified the appropriate city officials. A deputy fire chief was the first to arrive on the scene, and with the aid of the train's conductor who had a list of the cars in the train, he determined that two cars loaded with LPG were among the derailed cars. Simultaneously, the deputy fire chief was provided with the L&N's printed information regarding LPG emergency control measures. At 11:00 p.m., a group of four firefighters entered the derailment area to check for gas leaks. They were not equipped with gas detection devices and used only their sensory abilities to determine if LPG was leaking from either car. Later that night, city fire and police officials decided to keep a vigil over the tanks to watch for leaks and to evacuate a 200-yard area around the derailed cars. City fire officials had assumed that the tanks were constructed with double walls and that the damage had affected only the outer wall.

At 5:10 a.m. on February 23, the Waverly Police and Fire central dispatcher notified the State Civil Defense headquarters in Nashville that tank cars loaded with LPG had derailed. As a result, State of Tennessee Hazardous Material Emergency Response (HAMER) team was dispatched to the scene in a communications van. The Civil Defense Area Coordinator was in charge of the three-man team. On arrival at 8:30 a.m., the Coordinator used a gas-detection device to determine positively that the tanks were not leaking. He recommended that area within a one-quarter-mile radius be evacuated and that gas and electric service be shut off during the uprighting and movement of the tank cars.

On February 24, about 20 minutes before tank car ruptured, the gas detector disclosed no leaks on either car. LPG vapor was observed coming from the tank immediately before it was ignited.

The rupture and resultant fires disabled the majority of on-scene Waverly Fire Department personnel and rendered hoses and other fire-fighting equipment useless. Fires burned close to the second and still intact tank car of LPG. Several fire engines from nearby communities were brought to the scene within an hour of the rupture and primary efforts were focused on preventing the second tank from exploding. By 3:45 p.m., deluge guns poured water onto the tank cars. By 5:00 p.m., all fires in the vicinity of the tank were extinguished and at 7:00 p.m., all significant fires in the area were under control. Sixty-four fire units with over 200 firemen were on site by 9:00 p.m. All personnel and 11 pieces of fire equipment remained on site until the second tank car of LPG was unloaded. (See figure 3.)

Survival Aspects

A hospital located about 1 mile south of the accident site became the primary center for emergency medical treatment immediately after the explosion. The hospital's disaster plan was put into operation at 3:00 p.m. Almost immediately, patients began arriving by private vehicle, ambulance, and police car.

The first four ambulances at the scene were from the Waverly area. Later, at least 49 ambulances supported by 31 rescue squads from 39 surrounding counties arrived in Waverly.

The Military Assistance to Safety and Traffic (MAST) Air Ambulance Platoon from Fort Campbell, Kentucky, sent four UH-1 medivac-configured helicopters to the accident site; they arrived at 4:15 p.m. The aircraft transported 12 of the most critically injured patients to Nashville hospitals. Approximately 15 other military regular and reserve helicopters transported medical supplies and personnel to Waverly. Later, U.S. Air Force C-9 jet transport craft transferred victims from local hospitals to regional burn centers.

The town of Waverly, which has a population of 4,700, had a well defined disaster plan, which, when correlated with the State Civil Defense agency, provided excellent care for the public following the accident.

Tests and Research

Tests of the airbrake control valve of the gondola car to determine if it malfunctioned disclosed no defects. In addition, the control valve was installed on another freight car and the airbrakes functioned as intended.

Under contract to the Safety Board, The Battelle Columbus Laboratories performed metallurgical tests on the ruptured tank car. They concluded that:

> "The results of this study indicate that the mechanical damage to tank car UTLX 83013 consisted of a dent and a severe cold-working or gouging of the weld metal reinforcement in the

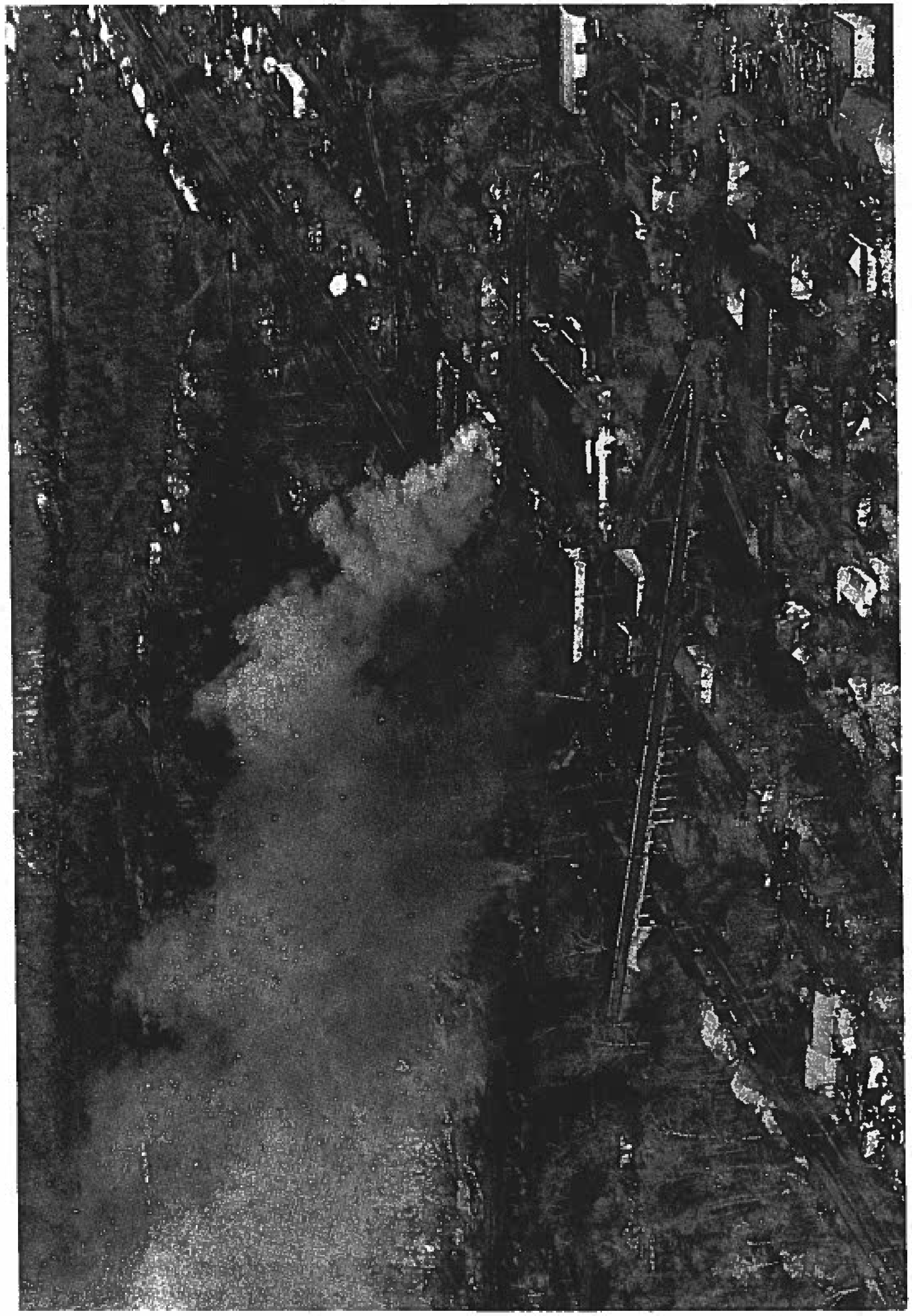

Figure 3. Accident site following the tank car rupture.

cylindrical portion of the tank and the introduction of a shallow surface crack in the coldworked structure. This defect failed some 40 hours after it was introduced through either an increase in the ambient temperature or was initiated from the continued creep of the material at the root of the surface crack in the weld or some combination thereof. The significant factor is the fact that a dent was associated with the gouge, thus causing a significant reduction in the size of gouge which the tank car could tolerate without rupture.

"The mechanical damage on the surface on the ruptured tank car was significantly greater at the origin than the other areas that were sectioned and examined in this study. The other tank car UTLX 81467, which did not rupture received only mechanical damage to the heads of the tank car. Dents and gouges on the heads are not as severe and thus rupture would be less likely.

"No defects were found in the portions of the tank car examined which contributed to the failure of the car. The fracture toughness properties of the materials examined were within scatterbands of expected properties. The yield and tensile strengths of the tank shell material were below the specification values and this is relatively common in older cars due to the stress-relief thermal treatment applied to the entire car after fabrication."

In a previous accident a tank car ruptured similarly on the Chicago and Northwestern Railroad near Cumming, Iowa, in 1969. The derailed DOT 112A tank car loaded with anhydrous ammonia had been righted by wrecking crews in preparation for transfer of the lading. Two days after the derailment, the tank car ruptured. This car had also been exposed to mechanical damage beginning in a girth weld. This and the car at Waverly are the only cars investigated that displayed this phenomenon.

ANALYSIS

Derailment

The Safety Board concludes that the handbrake was applied on the gondola car when it left Colesburg. If at Colesburg the brakeshoes on the gondola car had been in a condition similar to that found after the derailment in Waverly, the experienced trainman who performed the required safety inspection probably would have taken exception to their condition. Had a proper train air brake test been conducted in compliance with Federal Regulation 49 CFR 232, the trainman probably could have ascertained the condition of the car's brakes. Although Train No. 584 passed the hot box detector, 14 miles north of Colesburg, without a defective indication, the wheels on this car could have been heated above normal temperatures. A similar hot box detector may have detected hot wheels caused by applied brakes on cars but only on those that had traveled greater distances, causing the wheels to be heated to the point where the journal temperature would activate the indicator. Since the control valve of the air brake system on the gondola car was tested successfully, the Safety Board does not believe that the valve caused any problems.

Since the handbrake on the gondola car was observed in the applied position the day after the derailment and since the truck was destroyed, it is unlikely that anyone would have applied the handbrake after the derailment. Therefore, the Safety Board concludes that the handbrake was previously applied and was not released when the car was placed in the train at Colesburg.

Had the handbrake been applied on the gondola car when the car was added to the train at Colesburg, sufficient heat could have been generated between the composition brakeshoe and the wheel to have caused above-normal heating. In fact, the heat probably would have been great enough to have caused the high carbon steel wheel to crack through the tread. The crack would have quickly propagated through the rim and plate, and into the hub; this propagation would have permitted the wheel to loosen and move inward on the axle. Then this one wheel would have derailed and run on the track structure. Marks indicated that this occurred over a distance of 6.9 miles until the derailed wheel struck the switch in Waverly, starting the general derailment.

If the fractured wheel had been of lower carbon content, it probably would not have cracked. Industry experience with similar failures of this class of wheels supports this conclusion. Since the presence of this wheel creates a high risk for serious accidents, the Safety Board has recommended that the FRA use its emergency powers to quickly remove the wheels of this type from service. As a result, FRA has issued Emergency Order No. 7.

Apparently, tank car UTLX 83013 was damaged mechanically when it was side swiped by another derailed car. The side damage to the tank appeared to have been inflicted by a wheel or other truck component. Head shields or shelf couplers on this tank car probably would not have prevented the tank damage. The consensus of railroad officials, Waverly Fire Department Officers, and representatives of the State Civil Defense who examined the damage was that this tank appeared to be the least damaged of the two.

Raising one end of the loaded tank car while using the opposite end as a pivot to move the car from the track structure could have provided additional stresses in the damaged area of the tank, causing the crack in the weld area to propagate. Any unequal support of the tank after being moved also could have stressed the damaged area. This pivoting method is the conventional method used by many railroad wrecking crews, however, if a method which produces less stress in a tank can be employed, it should be used.

The rupture of the tank before the safety valve operated indicated that the failure occurred at a pressure below 300 psig, well below the bursting pressure of 1,000 psig. This definitely indicated a failure in the steel of the tank. Calculations of pressure and temperature increases indicated that, from the time of the derailment to the time of rupture, there could have been as much as a 50 percent increase in pressure, but still pressure remained well below 300 psig. The additional pressure was, however, sufficient to pop out the indentation of the tank to some degree, and could cause the crack in the weld to propagate, and finally the tank to rupture.

Since LPG vapor was seen coming from the fractured tank before the ignition, the failure did not result from fire. Fires in the area were caused from both thermal radiation and liquefied product being propelled about the area. Conventional firefighting procedures could not control the fires resulting from the spilled LPG. Also, the fire could not be controlled because many of the firemen were injured and much of their equipment was destroyed by the violent ignition of the LPG. These incidents indicate that the knowledge required to make judgment decisions regarding the condition of damaged tank cars is not generally available at the local level in the public or private sectors.

This accident again points out the need for training of all persons involved with hazardous materials accidents. The all-volunteer Waverly Fire Department's training sessions regarding the availability and location of the train's consist and waybills show some degree of preparation. The lack of ability to differentiate between an insulated tank and an uninsulated tank illustrates the need for additional knowledge in analyzing a derailment involving hazardous materials. The inability of anyone at the scene to properly assess the mechanical damage sustained by tank cars also indicates a need for additional knowledge. The L&N had not obtained assistance from the AAR's Bureau of Explosives before the LPG ignited. To thoroughly train all fire department and railroad personnel who may become involved in accidents involving hazardous materials so that they will be able to make sound decisions is almost an impossible task. The Safety Board believes that groups of experts, trained in assessing mechanical damage and the handling of hazardous materials after accidents, such as those in the AAR's Bureau of Explosives, would be a more viable approach to the problem and the one in which a certain degree of success may be attained. Although State agencies could set up the groups, the better approach would be for the railroad industry and the Federal government to do so, since they could achieve the best results with the fewest persons.

Quick implementation of the nearby hospital's emergency plan or preliminary treatment and classification of the injured, along with a well coordinated transportation effort by regional military units, worked to minimize loss of life.

CONCLUSIONS

Findings

1. The L&N's Special Rules for the testing of train airbrakes were not in compliance with Federal Regulations regarding airbrake tests at intermediate terminals.

2. The handbrake of the gondola car was in the applied position when the car was moved from Colesburg to Waverly.

3. The crew did not detect the applied handbrake on the gondola car when it was added to the train at Colesburg.

4. The broken wheel of the gondola car, the 17th car, had derailed about 7 miles before the general derailment at Waverly and the derailment was not detected by the traincrew.

5. The wheels on the gondola car had been exposed to above-normal temperatures.

6. The composition brakeshoe at the broken wheel location produced above-normal heating on the wheel.

7. The high carbon steel wheels on the gondola car were more susceptible to cracking than other wheels subjected to the same degree of heating.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the loss of life and substantial property damage was the release and ignition of liquefied petroleum gas from a tank car rupture. The rupture resulted from stress propagation of a crack which may have developed during movement of the car for transfer of product or from increased pressure within the tank. The original crack was caused by mechanical damage during the derailment, which resulted from a broken high-carbon wheel on the 17th car which had overheated.

RECOMMENDATIONS

As a result of this investigation, the National Transportation Safety Board recommended on March 9, 1978, that the Federal Railroad Administration:

> "Use emergency powers to prohibit the use of cars equipped with Southern Wheel Company high carbon wheels from carrying hazardous materials or from being placed in trains moving hazardous materials. (Class I, Urgent Action) (R-78-11)
>
> "Use emergency powers to expedite the replacement of Southern Wheel Company high carbon wheels 70T and UI. (Class I, Urgent Action) (R-78-12)
>
> "Promulgate regulations to establish adequate service records so that similar wheel problems will be promptly detected in the future and corrective action taken. (Class I, Urgent Action) (R-78-13)"

In addition to the above recommendations, the National Transportation Safety Board recommended that the Louisville and Nashville Railroad Company:

> "Correct your air brake special instructions to comply with the regulations of the Power Brake Law 49 CFR 232. (Class II, Priority Action) (R-79-3)
>
> "Determine that all freight cars are provided with the proper brakeshoes before they are dispatched in trains. (Class II, Priority Action) (R-79-4)"

To the Association of American Railroads:

> "Provide guidelines to railroad employees to aid them in an assessment of tank car damage and procedures for proper handling of tank cars. (Class II, Priority Action) (R-79-5)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B KING
Chairman

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

February 8, 1979

APPENDIX A

LOUISVILLE AND NASHVILLE RAILROAD COMPANY

RULES AND REGULATIONS

Governing Train Handling, Air Brake and Dynamic Brake.

Effective April 1, 1975

Approved
C. N. Wiggins, Vice-President, Operations

The rules and instructions set forth in this manual govern employees of the Louisville and Nashville Railroad Co. whose duties require they be familiar with train handling, air brakes, dynamic brake, and their related operation.

This manual must not be defaced in any manner and must be kept up to date as replacement instructions are issued. This manual must be readily accessible while on duty.

W. A. Rice,
System General Road Foreman of Engines

1124 (4-75)

Louisville and Nashville Railroad Company

SPECIAL RULES

Governing Train Handling, Air Brakes And Dynamic Brakes

V. ROAD TRAIN AND INTERMEDIATE TERMINAL TRAIN AIR BRAKE TEST

1. At a point other than initial terminal where locomotive or caboose is changed, or where one or more consecutive cars are cut off from rear end or head end of train brake system is charged to within 15 pounds of the regulating device on the locomotive but not less than 75 pounds as indicated at rear of freight train, and on a passenger train to at least 95 pounds, a full service reduction must be made and it must be determined that brakes on rear car apply and release properly.

VI. INBOUND BRAKE EQUIPMENT INSPECTION

1. At points where inspectors are employed to make a general inspection of trains upon arrival at terminals, visual inspection must be made of brake equipment and appurtenances including retaining valves and retaining valve pipes, release valves, release valve rods, brake rigging safety supports, hand brakes, hose and position of

UNITED STATES

SAFETY APPLIANCE STANDARDS

AND

POWER BRAKE REQUIREMENTS

"232.13 Road train and intermediate terminal train air brake tests.

(d)(1) At a point other than a terminal where one or more cars are added to a train, and after the train brake system is charged to not less than 60 pounds as indicated by a gauge at the rear of the freight train and on a passenger train to not less than 70 pounds, tests of air brakes must be made to determine that brake pipe leakage does not exceed five (5) pounds per minute as indicated in the brake pipe gauge after a 15 pound brake pipe reduction. After the leakage test is completed, brake pipe reduction must be increased to full service, and it must be known that the brakes on each of these cars and on the rear car of train apply and release. . ."

APPENDIX B

PERSONNEL INFORMATION

Locomotive Engineer George L. Brown, 31, was employed on January 15, 1971, as a brakeman, and promoted to conductor on May 4, 1973. Between the dates of September 4, 1974, and November 3, 1974, he was enrolled in the L&N Apprentice Engineer Training Program. Mr. Brown has been employed as a locomotive engineer since November 30, 1974. His last physical examination of record was December 15, 1978. He was orally examined regarding operating rules on October 4, 1977. He had been on duty about 3 1/2 hours at the time of the general derailment.

Conductor John H. Redman, 59, was employed on March 1, 1941, as a trainman and promoted to conductor on June 14, 1944. Mr. Redman served 3 years in a U.S. Army Railway Operating Battalion during World War II. He has been employed in train service since returning from the military in October 1945. His last physical examination of record was October 24, 1945. He was orally examined regarding operating rules on April 6, 1977. He had been on duty about 4 hours at the time of the general derailment.

Front brakeman Robert H. Lee, 37, was employed on March 31, 1963, as a brakeman, and promoted to conductor on February 8, 1965. He received two weeks of on-the-job training by working with other brakemen. His last physical examination of record was on March 31, 1963. He was orally examined regarding operating rules on February 14, 1978. Mr. Lee had been on duty about 4 hours at the time of the general derailment.

Rear brakeman L. T. Dameworth, 35, was employed on March 31, 1969, as a brakeman, and promoted to conductor on November 12, 1970. He made 21 trips on freight trains as a trainee, working with other brakemen. Mr. Dameworth was also given instruction on airbrake and general car information by a car inspector employed by the L&N. His last physical examination of record was March 31, 1969. He was orally examined regarding operating rules on September 29, 1977. He had been on duty about 4 hours at the time of the general derailment.