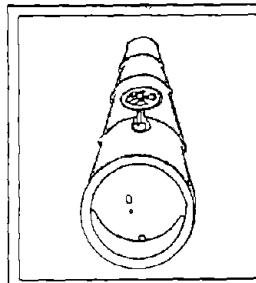
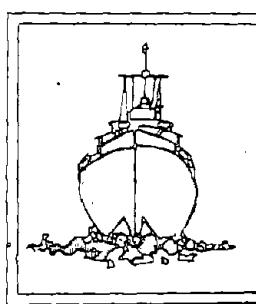
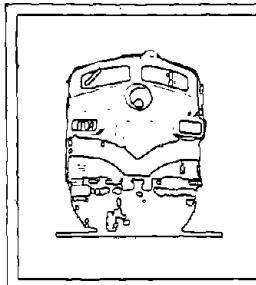


PB 283 476



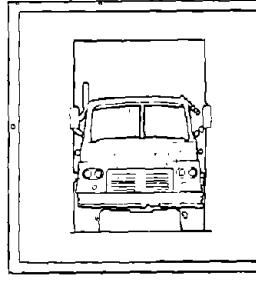
NATIONAL TRANSPORTATION SAFETY BOARD



RAILROAD/HIGHWAY ACCIDENT REPORT

COLLISION OF A
LOUISIANA & ARKANSAS RAILWAY
FREIGHT TRAIN AND A L.V. RHYMES
TRACTOR-SEMITRAILER AT
GOLDONNA, LOUISIANA
DECEMBER 28, 1977

REPORT NUMBER: NTSB-RHR-78-1



UNITED STATES GOVERNMENT

REPRODUCED BY: **NTIS**
U.S. Department of Commerce
National Technical Information Service
Springfield, Virginia 22161

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB-RHR-78-1	2. Government Accession No.	3. Recipient's Catalog No. PB283476	
4. Title and Subtitle Railroad/Highway Accident Report Collision of a Louisiana & Arkansas Railway Freight Train and a L.V. Rhymes Tractor-Semitrailer at Goldonna, Louisiana, December 28, 1977		5. Report Date June 8, 1978	
7. Author(s)		6. Performing Organization Code	
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594		8. Performing Organization Report No.	
12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594		10. Work Unit No. 2378	
		11. Contract or Grant No.	
		13. Type of Report and Period Covered Railroad/Highway Accident Report December 28, 1977	
15. Supplementary Notes		14. Sponsoring Agency Code	
<p>16. Abstract</p> <p>About 2:15 p.m. c.s.t., on December 28, 1977, Louisiana & Arkansas Railway freight train Extra 4102 North collided with a log-laden tractor-semitrailer on the Vine Street crossing in Goldonna, Louisiana. The 2 diesel locomotive units and 22 cars of the train were derailed. A "jumbo" tank car loaded with about 31,000 gallons of liquefied petroleum gas was ruptured and the cargo ignited. The resultant fireball enveloped an area 1,200 feet wide including parts of Goldonna's business and residential districts. Two train crewmembers were killed; the truckdriver, a train crewmember, and eight bystanders were injured. Total damage was estimated to be \$1,256,000. About 900 persons were evacuated from the Goldonna area.</p> <p>The National Transportation Safety Board determines that the probable cause of the accident was the excessive speed of the train, the failure of the truckdriver to approach the railroad at a speed which would allow him to stop short of the approaching train, and the obstructions which reduced the truckdriver's field of vision. Contributing to the cause of the fatalities to train crewmembers were the ignition of LPG which escaped from head punctures to a 112A340W tank car, deformation of the locomotive operating compartment, and location of the LPG tank car near the locomotive in violation of Federal regulations.</p>			
17. Key Words Grade crossing accidents; freight train; single-main operation; other locomotive; vehicle crashworthiness; train order operation; hazardous materials rules; crossing protection; human judgment; car spacing; pole tandem logging trailer; sight distance; liquefied petroleum gas (LPG).		18. Distribution Statement This document is available to the public through the National Technical Information Service, Springfield, Virginia 22151	
19. Security Classification (of this report) UNCLASSIFIED	20. Security Classification (of this page) UNCLASSIFIED	21. No. of Pages 29	22. Price 403-401

CONTENTS

	Page
SYNOPSIS	1
INVESTIGATION	1
The Accident	1
Injuries to Persons	5
Damage to Property	5
Vehicle Information	8
Vehicle Operator Information	9
Method of Operation	11
Meteorological Information	12
Survival Aspects	12
Tests and Research	14
Other Information	15
ANALYSIS	16
The Accident	16
Survivability Aspects	17
CONCLUSIONS	19
Findings	19
Probable Cause	20
RECOMMENDATIONS	20
APPENDIXES	23
Appendix A - Excerpts from Operating Rules of the Louisiana & Arkansas Railway	23
Appendix B - Excerpts from 49 CFR 174.91	25
Appendix C - Excerpts from State of Louisiana Motor Vehicle Laws	26

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD/HIGHWAY ACCIDENT REPORT

Adopted: June 8, 1978

COLLISION OF A LOUISIANA &
ARKANSAS RAILWAY FREIGHT TRAIN AND A
L.V. RHYMES TRACTOR-SEMITRAILER
GOLDONNA, LOUISIANA
DECEMBER 28, 1977

SYNOPSIS

About 2:15 p.m. c.s.t., on December 28, 1977, Louisiana & Arkansas Railway freight train Extra 4102 North collided with a log-laden tractor-semitrailer at the Vine Street crossing in Goldonna, Louisiana. The 2 diesel locomotive units and 22 cars of the train were derailed. A "jumbo" tank car loaded with about 31,000 gallons of liquefied petroleum gas was ruptured and the gas ignited. The resultant fireball enveloped a 1,200-foot-wide area including parts of Goldonna's business and residential districts. Two train crewmembers were killed; the truckdriver, a train crewmember, and eight bystanders were injured. About 900 persons were evacuated from the Goldonna area. Total damage was estimated to be \$1,256,000.

The National Transportation Safety Board determines that the probable cause of the accident was the excessive speed of the train, the failure of the truckdriver to approach the railroad at a speed which would allow him to stop short of the approaching train, and the obstructions which reduced the truckdriver's field of vision. Contributing to the cause of the fatalities to train crewmembers were the ignition of LPG which escaped from head punctures to a 112A340W tank car, deformation of the locomotive operating compartment, and location of the LPG tank car near the locomotive in violation of Federal regulations.

INVESTIGATION

The Accident

At 1:40 p.m. c.s.t. on December 28, 1977, Louisiana & Arkansas Railway Company (L&A) freight train Extra 4102 North, consisting of 2 locomotive units and 79 cars, departed Carla, Louisiana, on the single-track line of the Minden Subdivision. The train had originated in Alexandria and was en route to Minden, 66 miles north of Carla. Inspections and brake tests at Alexandria disclosed no defects, and the train functioned properly en route. The locomotive's headlight was illuminated when the train left Carla.

The engineer was operating the train from the right, or north, side of the lead unit as the train approached the Vine Street crossing (Louisiana State Route 479) at Goldonna, 15 miles west of Carla. ^{1/} The head brakeman was seated on the left side of the lead unit, the flagman was in the cab of the trailing unit, and the conductor was in the caboose at the rear of the train. When the train reached the whistlepost 1,725 feet east of the Vine Street crossing, the engineer began to sound the standard crossing whistle signal of two long blasts, a short blast, and a long blast. The last blast was sounded continuously until the locomotive occupied the crossing.

A tractor-semitrailer loaded with about 55,000 pounds of 30- to 35-foot-long pine logs was moving south on Vine Street about 25 mph in third-high gear on a 3 percent downgrade. Although the left truck cab window was opened slightly and there was no radio in the cab, the truck-driver did not hear the train's whistle before he saw the approaching train. There were no automatic signals at the crossing to warn him of the train's approach and, because of trees, a building, and other obstructions, he could not see the train until the front end of the truck was only 88 feet from the crossing. When he realized that he could not stop his vehicle short of the crossing, the driver did not apply the vehicle's brakes, but shifted into a higher gear in an effort to accelerate.

According to witnesses, the train was moving about 50 mph as it approached the crossing; the railroad's maximum authorized speed on this section of track is 40 mph. The engineer and head brakeman could not have seen the truck because of the obstructions until their train was within 250 feet of the crossing. When he saw the truck, the brakeman shouted a warning and the engineer immediately applied the train brakes in emergency, which did not materially reduce the train's speed before the collision.

The lead locomotive unit struck the semitrailer near the middle of the load of logs, immediately ahead of the lead trailer axle. The deck of the locomotive unit went under the logs and severed the connecting pole of the semitrailer. The tractor, which had cleared the crossing, jackknifed to the left 160° and came to rest upright about 20 feet from the crossing.

The front truck of the lead locomotive unit derailed about 50 feet west of the crossing when it struck logs which had fallen across the track. The derailed wheels struck a facing-point turnout 211 feet west

^{1/} Actual compass direction is used throughout this report. The Louisiana & Arkansas timetable designates direction on the Minden Subdivision as north-south.

of the crossing, where the trailing truck derailed. Straddling the main track and siding, the unit traveled 440 feet beyond the turnout before it stopped. During the derailment the unit's fuel tank was ruptured by a rail. Both trucks of the trailing locomotive unit derailed, and the unit separated from the lead unit. The train stopped 75 feet east of the lead unit.

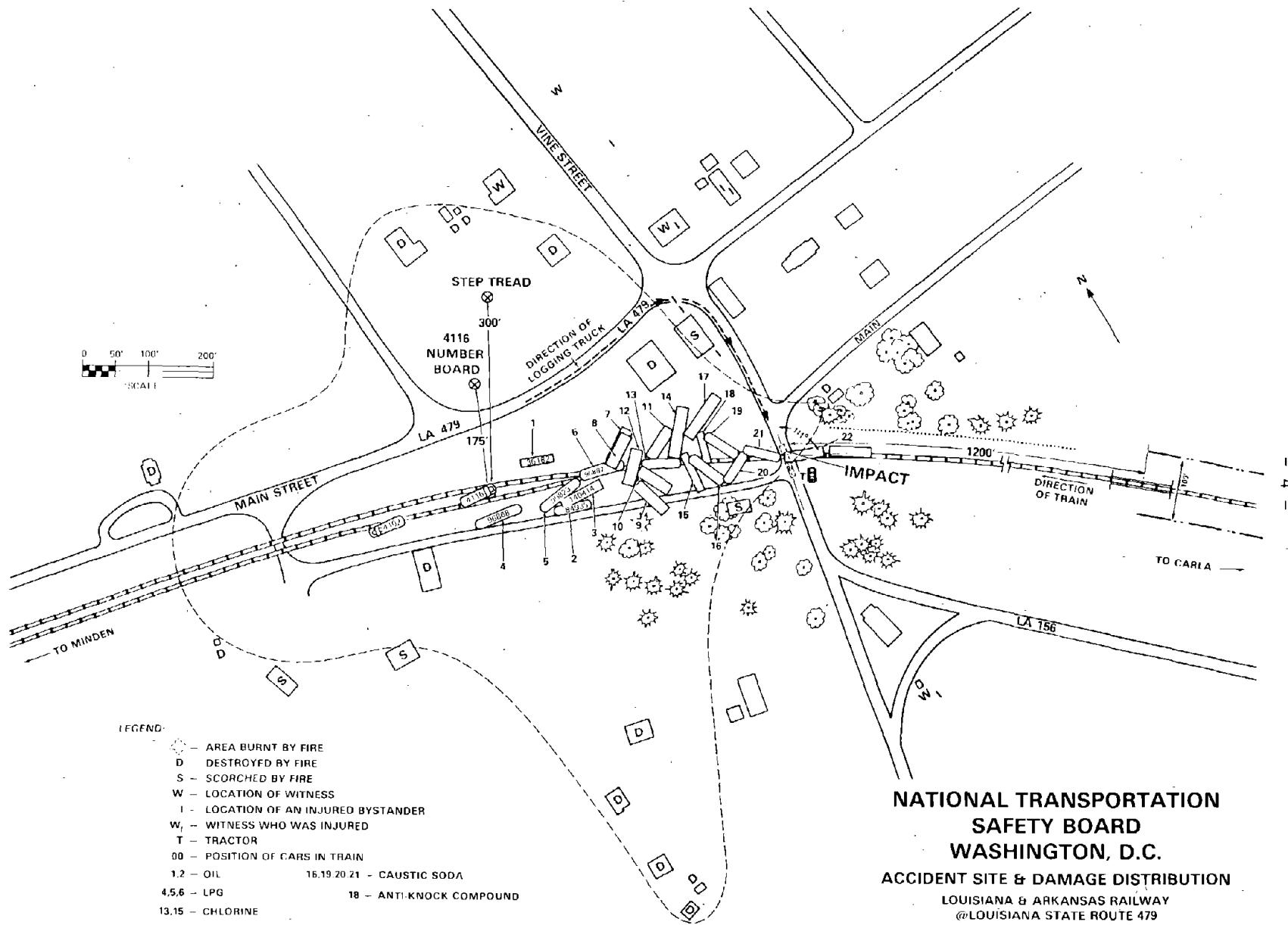
The first 22 cars of the train derailed between the turnout and the crossing, and all but the last two derailed cars became separated. The first car veered to the north and the next two cars derailed to the south. The fourth car, a tank car loaded with liquefied petroleum gas (LPG), left its trucks at the turnout, and had its rear tank head punctured by the coupler of the following car. The tank car continued to slide forward along the main track and rammed the rear of the trailing locomotive unit which was still moving westward. The impact punctured the front head of the tank and ignited the gas. The resultant fireball covered an elliptical area about 1,200 feet long on a north-south axis. (See figure 1.) Fire completely enveloped the trailing unit, killing the flagman in the cab. Fuel that escaped from the ruptured tank of the lead locomotive unit was ignited and killed the engineer and severely injured the head brakeman. The truckdriver was burned slightly as he fled his truck. Sixteen buildings in the area were burned and eight persons were injured when caught in the open after the LPG ignited.

As it approaches the crossing, a westbound train moves from a tangent into a 2°00' left-hand curve which begins 1,333 feet east of the crossing and ends 767 feet beyond the crossing. The grade ascends westbound at the rate of 0.78 percent. The main track is elevated about 5 feet above the surrounding terrain east of the crossing and is about level with terrain west of the crossing. A train approaching from the east can be seen from the crossing when it reaches a point 1,200 feet from the crossing.

The State-maintained road runs north and south, is 20 feet wide, and has a bituminous surface. Although considered a part of Route 479, Vine Street serves as a connecting link between Route 479 west of Goldonna and Route 156 east and south of Goldonna. The road is about 475 feet long and ends 165 feet south of the crossing at the intersection with Route 156. The posted speed limit is 25 mph. A southbound vehicle descends an average grade of 3 percent over the entire 310-foot approach from the north. The crossing is 16 feet wide and consists of timber guards on both sides of each rail with asphalt paving between the inside timbers.

The first unobstructed view that the driver of a southbound vehicle had of the track east of the crossing was from a point 96 feet north of

Figure 1. Plan view of accident site and wreckage distribution.



the crossing. (See figures 2 and 3.) Angle of intersection in the northeast quadrant is 111°. Standard crossbuck warning signs with reflectorized faces were located in the northwest and southeast quadrants. There was a standard advance warning sign for southbound traffic located on the right shoulder of the road 106 feet north of the crossing.

Goldonna is located in the Kisatchie National Forest and pulpwood logging is the principal commerce in the area. Louisiana State Routes 156 and 479 form the only route that can be used to haul forest products by truck from logging sites to pulp and chip mills east of Goldonna. Vine Street forms part of this route. The crossing is the only one at Goldonna and must be used by all traffic entering the town from the south and east, and by all east-west traffic passing through the town. It is used twice daily by five of the six schoolbuses operated by the Goldonna public schools. The Louisiana Department of Transportation and Development advises that when surveyed in October 1973, traffic volume averaged 1,000 vehicles daily. A 1977 traffic count indicated that the volume had risen to 1,088. The State estimated that in both years about 10 percent of the traffic was heavy trucks.

Injuries to Persons

<u>Injuries</u>	<u>Driver</u>	<u>Traincrew</u>	<u>Bystanders</u>
Fatal	0	2	0
Nonfatal	1	1	8
None	0	1	

Damage to Property

The lead locomotive unit's short hood compartment and cab were heavily damaged by the collision. Fire from the fuel tank completely burned out the unit. The trailing locomotive unit was extensively damaged when it was rammed by the tank car. Additional damage was caused by the explosion of the gas and the resultant fireball. Both locomotive units and 9 of the 22 derailed cars were destroyed. All but 2 of the remaining 13 cars were heavily damaged and much of their lading was lost. About 1,000 feet of track and a turnout were destroyed. (See figure 4.)

The tractor was not damaged; the semitrailer and its load were destroyed.

Fire destroyed a frame combination store and residence and its contents; a warehouse; four frame dwellings and their contents; a dwelling that was under construction; 10 small outbuildings; 7 automobiles; and a motorboat with trailer and motor. Seven buildings and three automobiles were scorched or burned.



Figure 2. View of track to east from 96 feet north of the crossing - truckdriver's first, unobstructed view across northeast quadrant.

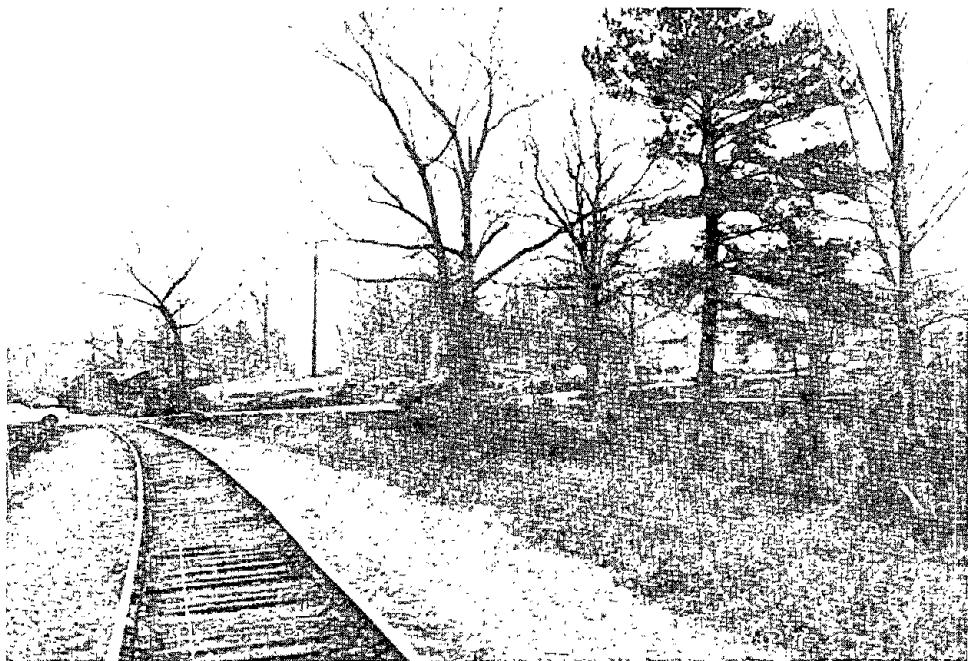


Figure 3. View of north approach to the crossing from the track 300 feet to the east. Fire defoliated the trees and destroyed a small building located in this quadrant.

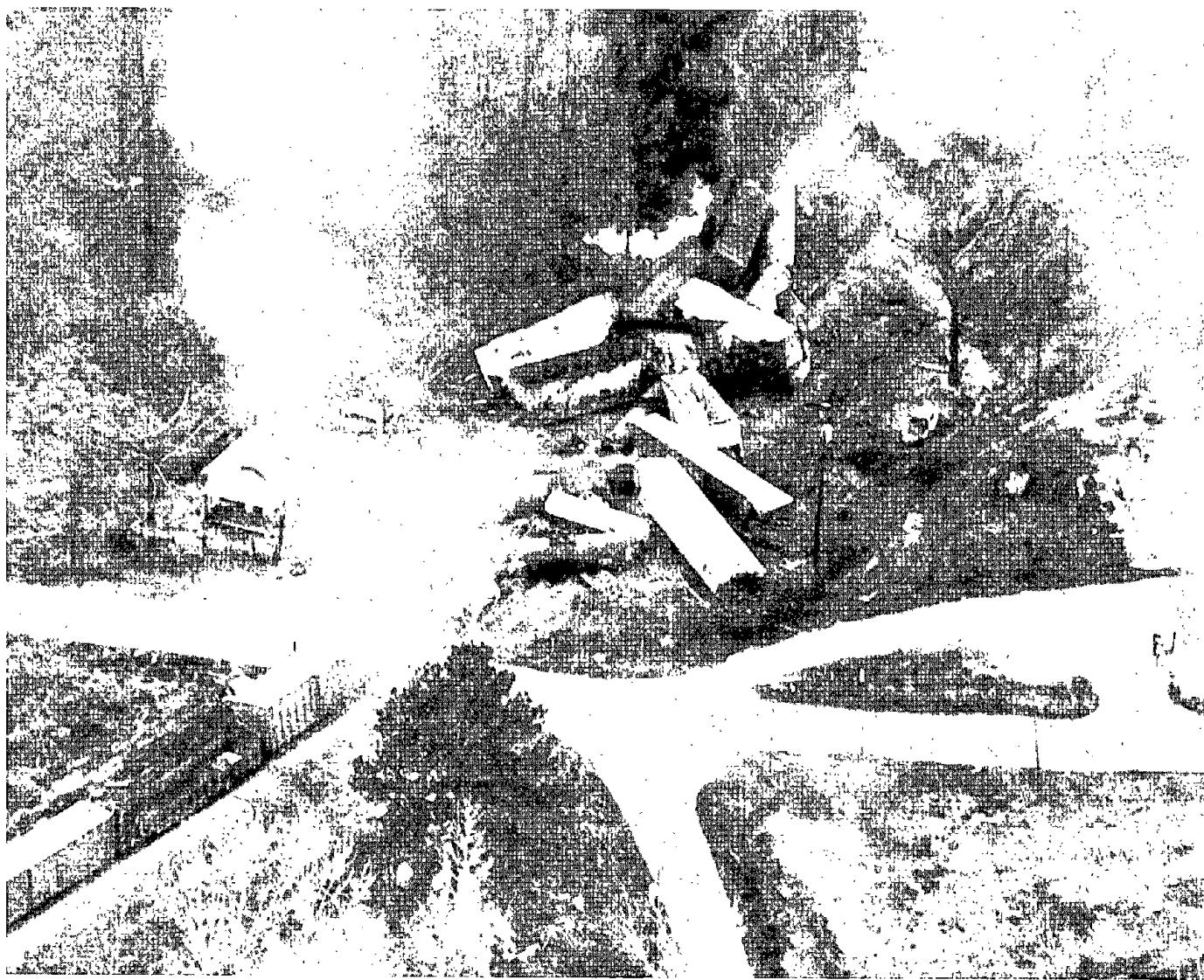


Figure 4. Aerial view of accident area taken from the east.

Damage was estimated as follows:

Train equipment	\$879,000
Semitrailer and lading	3,200
Train lading	45,000
Track and crossing	30,000
Private property	215,000
Salvage and wrecking	58,800
Firefighting and rescue	<u>25,000</u>
	\$1,256,000

Vehicle Information

The tractor was a 1974 Ford Model F-750 with 391 CID-HD V8 gasoline engine, 5-speed Spicer transmission, and single 2-speed rear axle with dual wheels. The vehicle had a functional 2-tank airbrake system and had rearview mirrors on both sides. The muffler and exhaust pipes were in good condition and the owner had installed a new engine in the tractor in August 1977.

The trailer was a pole-type, tandem-axle logging trailer manufactured by the W. C. Nabors Company about 1949. The trailer was rebuilt in 1959 and certified by the State of Louisiana as homemade. The trailer consisted of tandem dual axles with front and rear bolsters connected by a 30-foot coupling "pole" of 5-inch heavy-duty steel pipe. The bolsters were horizontal 8-foot "H" beams mounted laterally. Attached to the ends of the bolsters were 6-foot vertical pipe stakes forming two U-shaped brackets 24 feet apart. These brackets served to support and hold together the load of logs.

The tractor-semitrailer combination was about 46 feet long. The load consisted of loblolly pine logs 30 to 35 feet long with maximum diameter of about 1 foot at the butt ends. The logs were stacked in the trailer brackets with the butts placed alternately front to rear making a relatively uniform mass with nearly even distribution of weight between the trailer axles and the rear tractor axle. Chains were used to bind the logs together and to secure them to the brackets. The load was about 35 feet long, 7 feet wide, and 8 feet high; the bottom of the load was about 4 1/2 feet above the road surface. Based on the average load handled during December 1977, the gross vehicle weight was about 69,000 pounds; the vehicle had been certified by the State to carry a maximum weight of 50,000 pounds based on highway weight restrictions. The estimated 69,000 pounds were within the design capability of the combination vehicle.

Locomotive units were General Motors Model GP30. The train consisted of 37 loaded cars, 41 empty cars and a caboose. Gross tonnage was about 4,900 tons. Of the 19 tank cars loaded with hazardous materials, 10

were in the lead 21 cars. The 4th, 5th, and 6th cars were loaded with LPG; the 13th and 15th with chlorine; the 16th, 19th, and 21st with caustic soda; and the 18th with Ethyl anti-knock compound. All of these cars derailed. Originally, when the train was made up at Alexandria, its rear 72 cars were to be carried through to Minden and the head 13 cars were to be set off en route. When the train left Carla, all but three cars had been set off. Those remaining were the LPG tank cars. En route to Carla, the train had picked up three cars which were added ahead of the LPG cars.

The locomotive units were positioned back to back with the short hood end of the lead unit forward and the corresponding end of the trailing unit to the rear. Both units had low-profile style hood compartments ahead of the cab. The lead unit had a single sealed-beam headlight mounted at the top of the forward cab wall and a 5-chime Nathan air horn mounted on the cab roof; three trumpets faced forward and two faced rearward. The unit was also equipped with a speed indicator, a speed recorder, radio, and an alerter-type safety control. These devices were all destroyed by fire and it was not possible to determine that they were functioning at the time of the accident. However, the conductor stated the radio and speed indicator were functional before the train left Carla.

The three loaded tank cars coupled together near the head end of the train were DOT Specification 112A340W, provided with standard Type E couplers. Each was loaded with about 31,000 gallons of LPG and was placarded "Flammable Gas." The tank heads of these cars were of 11/16-inch plate steel. None of the cars were fitted with head shields or top and bottom shelf couplers. (See figure 5.)

Vehicle Operator Information

The 40-year old truckdriver held an unrestricted class D chauffeur's license renewed by the State of Louisiana in May 1977. His recent driving record included two convictions for speeding. In June 1976, he was arrested for driving his personal vehicle 70 mph in a 55 mph zone, and again, in February 1977, he was arrested after driving a logging truck 30 mph in a 20 mph zone. The truckdriver did not need glasses and was not wearing sunglasses.

The truckdriver had been driving combination logging vehicles for 20 years and had a reputation for skill and competence. According to records he had never been involved in a traffic accident. Before December 1977, the truckdriver's working experience was outside the Goldonna area. Since taking the Goldonna job, he had taken 35 loads over the Vine Street crossing. The truckdriver had previously encountered a westbound train at the crossing about noon another day; he estimated the train's speed at 50 mph.



Figure 5. Punctured head of LPG tank car GATX 96868.

The truckdriver's normal work day was from 6 a.m. to 2 p.m., Monday through Friday. He was paid for 8 hours work and was required to make two 60-mile roundtrips from the logging site to the mill daily. He was not paid for overtime or extra production.

Because of the Christmas holiday, the truckdriver had last worked on December 23. On December 28, he reported for work about 5:30 a.m.; he carried his lunch and had eaten on the job. Since the logging crew was cutting smaller trees than usual, there was a delay in gathering enough logs for a truckload. As a result, the truckdriver was about 2 hours behind his normal schedule when he reached Goldonna. Since 1:30 p.m. he had been working on his own time.

Following the accident, the truckdriver was arrested by Louisiana State Police on charges of failure to yield the right of way and negligent homicide. Since the arresting officer took no exception to the man's condition, no postaccident sobriety test was given.

The truckdriver was employed by a local contractor who owned only the truck involved in the accident. In addition to the truckdriver, he had only two employees. There were no written rules or instructions. The contractor reportedly hired only experienced men with good reputations.

The 50-year old engineer entered railroad service as a student fireman in 1948 and was promoted to engineer in 1955. He had a total of 24 years of broken service. The engineer's service record indicates he was hospitalized during 1964 and 1965 for tuberculosis. Since 1972 he had been twice discharged and subsequently reinstated. The first discharge followed his admission of drinking intoxicants while running a locomotive which was involved in a crossing accident. The second instance followed the collision of his train with a track machine in 1976. The engineer was last examined by a railroad doctor on January 19, 1973. The examination revealed "calcification of the abdominal aorta without aneurism" and no active tuberculosis. The engineer was last examined on railroad rules on July 31, 1975. As with the physical examination, this did not result in any restrictions. No postmortem examination was possible because of the effects of the fire.

The 42-year old conductor was hired as a student brakeman in 1956 and left L&A service in 1962. In the interim he had less than 2 years actual service. He was rehired as a conductor in August 1963 and worked as such to the time of the accident. Since 1973, the conductor had been disciplined following seven accidents. As with the engineer, he was discharged in 1976 and later reinstated. The conductor was last examined on the rules on August 16, 1976. He had never received a company physical examination.

All members of the traincrew were regularly assigned and had been off duty for more than 84 hours before reporting for their assignments on December 28. At the time of the accident, they had been on duty 9 1/2 hours.

Method of Operation

Trains are operated in this area by timetable and train orders. Crews are also directed in their operation by verbal instructions from the dispatcher which are transmitted by radio. As his train approaches a railroad/highway grade crossing, the engineer is required by rule 14-L to begin sounding the prescribed whistle signal at the whistlepost and to continue sounding the signal until the locomotive has occupied the crossing. Rule 17 requires that the white headlight be "displayed brightly to the front of every train by day and by night." Another rule stipulates that general orders supersede all rules and special instructions with which they conflict and that train and engine employees must familiarize themselves with general orders before they begin each trip or day's work. (See appendix A.) Two local freight trains, one in each direction, are operated daily over this line. Normally both pass over the crossing between 10:00 a.m. and 3:00 p.m.

Federal regulations (49 CFR 174.91) require that a loaded tank car placarded other than "combustible" cannot be placed in a moving or standing train closer than the 6th car from the engine or occupied caboose when the train's length permits. This regulation was embodied in the carrier's General Order No. 2 dated January 1, 1977. (See appendix B.) A copy of this general order had been pasted in the bulletin book at the Alexandria yard office, where the traincrew had reported on the day of the accident.

According to his testimony, the conductor had been furnished waybills for the cars in his train, as well as a consist list showing the cars as they were placed in the train. He stated he knew where the placarded LPG tank cars were in the train and understood the requirements of the L&A general order concerning the placement of such cars. The conductor also stated that he took no action to assure that a sufficient number of cars separated the LPG cars and the locomotive before the train left Carla.

The L&A operates 756 miles of railroad. The superintendent and both trainmasters--the employees responsible for direct supervision of train operations--are headquartered in Shreveport, 128 miles from Alexandria and 50 miles from Minden. The superintendent of transportation advised that the trainmasters were largely occupied with derailments and other problems. Employees interviewed could not recall the names of their supervisors. The surviving brakeman of Extra 4102 North could recall only one instance--about 2 months before the accident - when a supervisor had ridden with the crew.

Louisiana motor vehicle law requires the operator of a motor vehicle to stop within 50 feet of, but not closer than 15 feet from, a railroad crossing, and to proceed only when safe to do so, whenever, (a) an approaching train is plainly visible and in hazardous proximity to the crossing, and (b) a train is within about 900 feet of the crossing, emits a signal, and by reason of its speed or nearness, is a hazard. (See appendix C.)

Meteorological Information

Witnesses reported that the temperature was about 40°F and it was dry and overcast. There was no atmospheric restriction to ground visibility. According to the truckdriver and other witnesses, the road surface was dry. The nearest weather station, 15 miles east, recorded a high of 41°F and a low of 34°F during the 24-hour period ending at 6 p.m., December 28. Winds were southeasterly and light.

Survival Aspects

The truckdriver was able to exit from the tractor's cab without difficulty.

Since the lead locomotive unit's deck passed under the truck's load of logs, most of the collision impact was absorbed by the unit's forward hood compartment and cab face. (See figure 6.) The two T-type collision posts inside the hood compartment were butt-welded to the frame and the welds were not sufficient to withstand the impact force. The hood was driven back displacing 90 percent of the cab area. The cab roof partially collapsed and the floor supports on the right side were torn loose permitting the engineer's control stand to be moved back to within 7 inches of the back cabinet wall. Because of this deformation of the cab, the engineer and head brakeman could not escape. Both were trapped on their respective sides of the cab with the brakeman pinned between the hood and the left side seats. The cab of the trailing unit was within a few feet of the ruptured tank car when its cargo of LPG ignited. The force blew in the cab windows on the south side, passed through the cab, blew out the windows on the north side, and scattered parts of the locomotive unit as far as 300 feet to the north. The brakeman inside the cab was killed. There were no other persons within the area affected by the fireball; those bystanders who were injured were outside the fireball's perimeter.

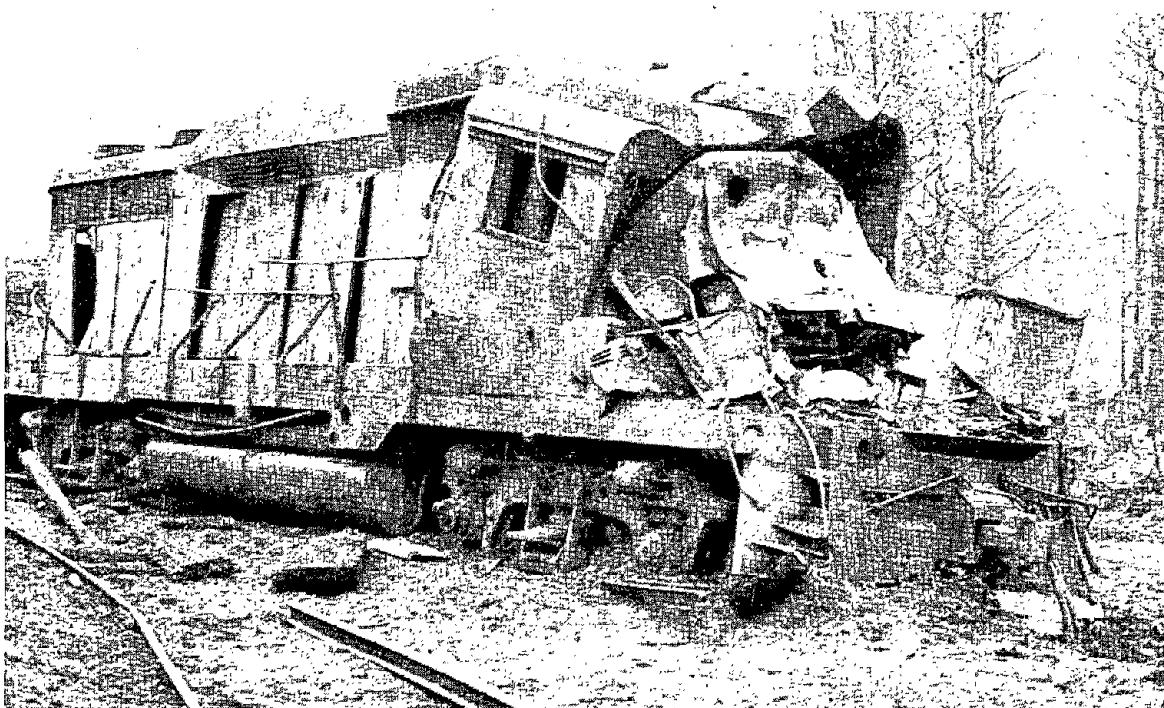


Figure 6. Front end of lead locomotive unit 4102.

Although Goldonna owned a firetruck, there was no organized fire department. The community relied upon Natchitoches, the parish seat 25 miles away, for its fire protection. Response by this fire department and others in the area was prompt but had no effect on the damage or injuries which occurred. Several passersby successfully extricated the head brakeman from the lead locomotive unit. Only these gallant efforts in the face of great personal danger saved the brakeman from certain death.

Tests and Research

Following the accident, the tractor was thoroughly inspected, statically tested, and road tested by an NTSB automotive engineer and a Ford Motor Company design analysis engineer. Because of accident damage, the semitrailer could not be tested, but was partially dismantled and thoroughly inspected.

The overall condition of the tractor was good. The airbrake system was fully functional with leakage and pressure restoration capability well within permissible tolerances. All tractor and trailer tires had good tread depth and proper inflation. Foundation brakes on the tractor and forward trailer axle were in good condition. At the time of the accident both brake units on the rear trailer axle were not functional because of a defective brake assembly on the left side and a disconnected air hose on the right side. As a result, the combination vehicle was calculated to have had 75 percent effective braking capability at the time of the accident. The probable gross vehicle weight was within the design capability of the vehicle and did not materially alter the vehicle's stopping distance.

The vehicle was in fourth-low gear following the accident and its maximum speed in this gear was 30 mph. The automotive engineers determined that the vehicle's upset speed in the curve at the north end of the northerly approach to the crossing was about 25 mph. From a probable speed of 18 to 20 mph in the curve, the truckdriver shifted to third-high gear exiting the curve and accelerated the vehicle to 25 mph--the maximum attainable speed in this gear--at a point about 118 feet north of the crossing. This speed was maintained until the vehicle was in the immediate vicinity of the crossing where the truckdriver intended to shift into fourth-low gear.

On dry pavement, the vehicle moving at 25 mph down the 3-percent grade had a calculated stopping distance of 120 feet, taking into account a 1.35-second perception and reaction time. ^{2/} Actual sliding distance

2/ The calculations are based on a .50 coefficient of friction in line with findings contained in Department of Transportation Study HS 801-141, December 1976.

would have been 49 feet. With 100 percent braking capability, the minimum stopping distance would have been 104 feet, 44 feet of which was actual sliding distance.

The sliding distances were calculated from friction factors determined by postaccident dry skid tests performed by the Louisiana Department of Transportation and Development. Temperature and surface conditions at the time of the tests were virtually the same as those existing at the time of the accident.

At 25 mph, the tractor-semitrailer required 3.8 seconds to travel the 139 feet between the point where the driver could first see the train and the point where the vehicle would be fully clear of the crossing. At 50 mph, the train required 3.4 seconds to travel the 250 feet from its location when the truckdriver could first see it and the crossing. Had the train been moving at 40 mph, it would have needed 4.3 seconds to reach the crossing and the collision would not have occurred.

In October 1973, the Village of Goldonna asked the State of Louisiana to widen and improve the crossing. The State Project Control Engineer responded promptly by having a thorough survey made of the crossing. A hazard index number was determined based on average daily use by 1,000 vehicles and 3 trains and on the fact the crossing had no train-activated warning devices. In addition to the hazard index number, quadrant sight distances were considered. Based on a 30-mph highway speed and a 50-mph train speed, the sight distances in three of the quadrants were judged to be below minimum standards. On January 9, 1974, the Project Control Engineer wrote the railroad recommending the installation of train-activated signals as well as a wider crossing. The railroad agreed to participate and requested an implementing agreement on January 20, 1975.

By January 1975, Louisiana had begun establishing priorities for initiating crossing improvement projects in line with the 1973 Federal Highway Safety Act. However, the State adopted the "New Hampshire" grade crossing hazard index formula which considers highway traffic volume, train volume, and existing protection. Sight distances, train speeds, and type of vehicular use are not parameters in this formula. Under the formula, the Goldonna crossing was not scheduled for improvement. No agreement was forwarded to the railroad and no improvements were made to the crossing or to the quadrant sight distances.

Other Information

Louisiana has 5,018 public railroad/highway grade crossings and, of these, 841 have train-activated warning devices, 3,372 have signs or other passive protection, and 805 have no protection. About one-third

of the crossings have advance warning signs. Since 1974 the State has spent \$5,933,823 of Section 203 Federal funds on crossing improvements. 3/

From 1975 through 1977, the State undertook 246 Section 203 projects for installation of active warning devices. However, from 1974 through 1977, Louisiana received Federal Highway Aid general funds, \$53,374,000 of which could have been used for grade crossing improvements. In common with some other States, Louisiana uses such funds only in connection with new highway construction, and only \$253,721 was actually spent on grade crossings.

Louisiana law permits the installation of standard stop signs at grade crossings. The State posted the speed limit on Vine Street and has the power to change the limit as well as to post an advisory safe speed for heavy vehicles. Prior to the accident, Louisiana had not participated in "Operation Lifesaver," the national program to reduce grade crossing accidents through driver education, law enforcement, and improved engineering.

ANALYSIS

The Accident

Although the truckdriver was complying with the posted 25 mph speed limit, his vehicle's speed was, nevertheless, too fast to permit him to stop it short of the crossing in the available sight distance. Since there was no other means of warning, the driver had to depend on his ability to either see or hear the approaching train. The truckdriver was experienced and skilled, and had no physical or mental impairments. He understood the capabilities of the vehicle and he was familiar with the crossing. Since he had encountered a fast moving train at Goldonna in the past, he should have approached the crossing prepared to stop. Although the truckdriver was behind schedule and intent on reaching his destination, he approached the crossing no differently than he had at any other time.

Because of a small building, trees, and other vegetation, the truckdriver did not have a clear view of the track east of the crossing until the front end of his vehicle was about 88 feet from the crossing. Postaccident analysis showed that even with maximum braking capability, the vehicle required 104 feet to stop short of the crossing.

3/ Funds granted under the authority of Section 203 of the 1973 Federal Highway Safety Act that can be used only for "elimination of hazards of rail-highway grade crossings." Subject to Federal Highway Administration approval, the States decide how and where this money is spent.

Witnesses located inside houses more than 600 feet north of the crossing heard the train's whistle as it approached the crossing. However, neither the truckdriver nor a witness in a following vehicle heard the whistle. Probably, the same obstructions that restricted the truckdriver's view to the east also masked the sound of the whistle.

In addition to the short sighting distance in the northeast quadrant of the crossing, the train's angle of approach was nearly dead ahead as seen from the point of first clear view. The driver would have had great difficulty judging the speed of the approaching train when viewing it dead ahead. After seeing the train, a driver of a heavy vehicle must instantly decide what action to take. Louisiana law requires him to stop and yield the right of way only when, in his judgment, the train's speed and location represent a hazard to him.

In 1973, the crossing was judged hazardous based on the formula used by the State of Louisiana at that time. Unfortunately, because the State changed its formula for hazard assessment before the recommended action was taken, improvements to this crossing were deferred and nothing was done to minimize the known hazards. Had Louisiana embraced "Operation Lifesaver" and its promotion of improved engineering, this crossing's hazards could have been thoughtfully analyzed to develop the best course of intermediate remedial action. Such action might have involved improving sight distances by clearing obstructions, reducing highway and/or train speeds, or installing highway stop signs. Any or all of these improvements might have been justified until train-activated warning signals could be installed. However, 4 years passed after the hazards were recognized and no action was taken.

Survivability Aspects

The three train crewmembers on the locomotive units should have survived the collision without serious injury. The severity of the casualties was attributed to the rupture and ignition of the LPG tank car, the proximity of this car to the locomotive units, and the inability of the engineer and head brakeman to escape because the operator's compartment was so badly deformed.

The LPG tank car was punctured in both heads after it became uncoupled from the cars ahead and behind. Had the car been equipped with top and bottom shelf couplers instead of conventional Type E couplers, the cars probably would not have separated. Had the car been fitted with head shields, the head shields would have prevented the punctures and subsequent ignition of LPG.

After setting out cars at Carla, the traincrew failed to provide the minimum five-car spacing between the locomotive units and the LPG tank car as prescribed by Federal regulations and L&A general order.

Proper placement would have at least put the lead locomotive unit outside the fireball's perimeter and would have assured the survival of both crewmen. As it was, the fireball ignited fuel leaking from the locomotive unit's tank and the burning fuel killed the engineer and severely injured the brakeman. The force of the LPG ignition caused the windows in the trailing locomotive unit to be blown in and allowed the fireball to pass through the operator compartment. The brakeman inside had no chance of survival. Had the LPG ignited elsewhere, the force would have been greatly diminished before it struck the locomotive unit. Cars behind the ruptured tank car tended to deflect the fireball upward. Had these cars been ahead of the LPG car, they might have shielded the locomotive in the same manner.

The conductor was aware of the improper location of the LPG cars in the train and he was familiar with the requirements concerning their placement. He failed to assure that the requirements were complied with before his train left Carla.

Both conductor and engineer had been disciplined for numerous rules violations, but only when the violations resulted in accidents. Although the L&A had standard rules in effect and had properly posted the general order, these employees were not subject to any active supervision on a regular basis.

Because the lead locomotive unit's collision posts were inadequate, the operator compartment was so severely deformed that the men inside were trapped and unable to escape. The inability of locomotive cabs to withstand collision impacts was originally pointed out by the Safety Board in its report on an accident at Sound View, Connecticut, in 1970. ^{4/} The Safety Board recommended in 1971 that the FRA:

"... continue to a conclusion its initiated efforts in the matter of the improvement of the design of locomotive operator compartments to resist crash damage, and in conjunction with the Association of American Railroads undertake a review of modern design crashworthiness concepts in an effort to identify areas of applicability in the railroad industry."

The recommendation was reiterated in 1972 following an accident at Sheridan, Wyoming. ^{5/} In response, FRA advised that an industrywide committee had been formed to make an all inclusive study of cab crashworthiness. Since that time, this committee has not produced any significant improvement in cab design.

4/ "Railroad Accident Report: Penn Central Transportation Company Freight Train Derailment and Passenger Train Collision with Hazardous Material Car, Sound View, Connecticut, October 8, 1970." (NTSB-RAR-72-1)

5/ "Railroad Accident Report: Burlington Northern, Inc., Derailment of Extra 5701 East at Sheridan, Wyoming, March 28, 1971." (NTSB-RAR-72-4)

CONCLUSIONS

Findings

1. Since there were no train-activated warning devices at the crossing, the truckdriver had to either see or hear the approaching train.
2. Trees and other obstructions prevented the truckdriver from seeing the train until his vehicle was about 88 feet from the crossing. Although the truckdriver was operating the vehicle about the posted speed limit, it was moving too fast to be stopped within this distance.
3. Because of defective foundation brakes on the trailer's rear axle, the vehicle had only 75-percent effective braking capability. However, even with 100-percent braking capability, the vehicle could not have stopped within the available sight distance from the posted 25-mph speed limit.
4. The engineer of Extra 4102 North sounded the whistle as required by L&A rule, but the same obstructions that blocked the truckdriver's view probably also masked the sound of the whistle.
5. When the truckdriver first saw the train, it was approaching him at a nearly dead-ahead angle and he could not accurately judge its speed. Forced to make an instantaneous decision, he elected to proceed across the track.
6. The train was moving about 50 mph, 10 mph faster than the maximum authorized speed. Had the train been moving at 40 mph, the tractor-semitrailer would have cleared the crossing before the train reached it.
7. The State of Louisiana had surveyed the crossing in 1973 and had concluded that the crossing's quadrant sight distances were inadequate and warranted the installation of train-activated warning devices. The railroad concurred with the recommendation. The State later deferred the improvements and nothing was done to minimize the crossing's hazards.
8. The current hazard assessment formula used by the State of Louisiana does not consider quadrant sight distances at crossings which lack train-activated warning devices.
9. L&A General Order No. 2 concerning placement of hazardous materials tank cars complies with applicable Federal regulations. Although the general order had been properly posted where the traincrew reported for duty and the conductor was aware of its provisions, he did not comply with them.

10. The traincrew violated Federal regulations and L&A General Order No. 2 by failing to have the minimum number of cars between the locomotive and hazardous materials tank cars.
11. The number of traincrew casualties resulted from the proximity of the locomotive units to the LPG tank car when its cargo ignited.
12. Shelf couplers and head shields would have prevented the head punctures to the LPG tank car and subsequent ignition of the gas.
13. Inability of the lead locomotive unit's collision posts and operator compartment to withstand the impact of the collision prevented the timely escape of the crewmembers from the unit.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the excessive speed of the train, the failure of the truckdriver to approach the railroad at a speed which would allow him to stop short of the approaching train, and the obstructions which reduced the truckdriver's field of vision. Contributing to the cause of the fatalities to train crewmembers were the ignition of LPG which escaped from head punctures to a 112A340W tank car, deformation of the locomotive operating compartment, and location of the LPG tank car near the locomotive in violation of Federal regulations.

RECOMMENDATIONS

As a result of this accident investigation, the National Transportation Safety Board made the following recommendations...

...to the State of Louisiana Department of Transportation and Development:

"Improve quadrant sight distances at the Vine Street crossing in Goldonna so that they will permit heavy vehicles operating at the posted speed limit to stop within such distances, and install train-activated warning devices at this crossing. (Class II, Priority Action) (H-78-46)

"Include in its grade crossing safety criteria the evaluation of existing quadrant sight distances. Include in its grade crossing safety program provision for intermediate remedial action to eliminate hazards at crossings where there are no train-activated warning devices. (Class II, Priority Action) (H-78-47)

...to the Louisiana & Arkansas Railway Company:

"Assure that traincrews are properly supervised and comply with speed restrictions and other instructions. (Class II, Priority Action) (R-78-25)

...to the Federal Railroad Administration:

"Assure that the Louisiana & Arkansas Railway Company complies with the requirements of 49 CFR 174, Transportation of Hazardous Materials. (Class II, Priority Action) (R-78-26)

"Quickly conclude its study of improvements to the design of locomotive operator compartments to minimize crash damage, and promulgate necessary regulations to assure the adoption of appropriate findings. (Class II, Priority Action) (R-78-27)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

/s/ ELWOOD T. DRIVER
Member

June 8, 1978

6

APPENDIX A

Exerpts from Operating Rules of
The Louisiana & Arkansas Railway Company

6. General Orders and Special Instructions.—General orders will be numbered consecutively beginning with January first of each year; will be issued and cancelled by the superintendent or other designated officer, and will expire with the calendar year. They supersede any rule or special instructions with which they conflict.

Circulars will cover such instructions as do not conflict or modify General Orders, Special Instructions or Rules.

Train, engine and yard employes, train dispatchers, and other employes whose duties require, must familiarize themselves with general orders and other notices before commencement of each trip or day's work.

Conductors, engineers and engine foremen must record information on prescribed form indicating that they have read and understand general orders and are responsible for compliance therewith. Location of general orders will be designated by special instructions.

Special instructions in the timetable, or when issued in pamphlet form, supersede any rule with which they conflict.

14. Engine Horn or Whistle Signals.—The horn or whistle must be sounded as prescribed by rule or law. Horn or whistle must not be used unnecessarily.

In case of horn or whistle failure, speed must be reduced and bell rung continuously when approaching and passing through stations, yards, over public crossings at grade and around curves.

NOTE.—The signals prescribed are illustrated by "o" for short sounds; "—" for longer sounds. The sound of the horn or whistle should be distinct, with intensity and duration proportionate to the distance signal is to be conveyed.

SOUND.	INDICATION.
(1) ——o——	Approaching public crossings at grade. (Standard sign will designate point at which signal must begin.) To be prolonged or repeated until crossing is occupied by engine or car.

17. Headlights.—The standard white headlight must be displayed brightly to the front of every train by day and by night.

30 MINDEN SUBDIVISION — L&A RY.

SOUTH ↓	Mile Post	STATIONS	Capacity of:			NORTH ↑	
			Sidings		Aux. Trks. Cars		
			Feet	Cars			
78.8	MINDEN 0.4	ORSWY				Yard	
79.2	SOUTH WYE SWITCH 4.0					Yard	
83.2	SIBLEY 6.1		3306	66	15	Conn.	
	ICG CROSSING						
89.3	HEFLIN 8.8		1965	39	13		
98.1	JAMESTOWN 7.0		1760	35	15		
105.1	CASTOR 9.2		1660	33			
114.3	ASHLAND 7.9		1882	37	22		
122.2	CHESTNUT 7.6		1787	35	14		
129.8	GOLDONNA 9.1		1752	35			
138.9	CALVIN 8.9		2987	59			
147.8	WINNFIELD 9.9		2966	59		Yard	
157.7	PACKTON 8.6	Y	1495	29	8	Conn.	
166.5	WILLIANNA 7.4		2399	47		Conn.	
173.9	DRY PRONG 4.7		3020	60	7		
178.6	BENTLEY 9.8		2270	45	16		
188.4	TIOGA 0.5		3837	76	9		
188.9	MP CROSSING 4.9						
193.8	PINEVILLE JUNCTION Y					Yard	

Tracks and/or Industries	MP	Car Cap.	Dir. of Entry	Tracks and/or Industries	MP	Car Cap.	Dir. of Entry
Aero Pres.	82.3	5	N	Intl. Paper Co.	114.4	14	S
Bodaw Wood Yard	82.9	15	S	International Paper Co.	130.6	19	S
Intl. Paper	97.8	12	N	Placid Oil Co.	131.5	21	N&S
Anderson	104.0	20	N	Carla	144.9	Conn.	N
Roy	107.4	83	N				

MINDEN SUBDIVISION SPECIAL INSTRUCTIONS

1. SPEED RESTRICTIONS MPH

1.1 MAXIMUM AUTHORIZED SPEED 40

Except:

City Limits Minden	8
Over ICG Crossing MP 83.2	20 Eng. only
Between MP 114.6 and MP 120.5	35
City Limits Winnfield	8
Over MP Crossing MP 188.9	20
Between Melrose St. Extension MP 192.7 and Pineville Jct.	20

1.2 All tracks other than main track, through turnouts and crossovers 5

1.3 Speed Restrictions, SD 40 Units

SD 40 Units are restricted to main track and may be used in detour movements only.

Between Minden and Pineville Jct.	25
Through West Leg of Wye, Minden, entire train	5

2. RAILROAD CROSSINGS AT GRADE.

Railroad	Mile Post	Type of Protection
ICG	83.2	Automatic Interlocking
MP	188.9	Automatic Interlocking

APPENDIX B

Title 49 - Transportation
Ch. I - Materials Transportation Bureau

Subpart D—Handling of Placarded Cars

**§ 174.91 Position in train of loaded
placarded tank car other than car
placarded "COMBUSTIBLE".**

Except for a tank car placarded "COMBUSTIBLE", a loaded placarded tank car in a moving or standing train may not be nearer than the sixth car from the engine, occupied caboose, or passenger car. However, when the length of the train will not permit a loaded placarded tank car to be so placed, it must be placed as near the middle of the train as possible and not nearer than the second car from the engine, occupied caboose, or passenger car.

[Amtd. 174-26, 41 FR 16092, Apr. 15, 1976,
as amended by Amtd. 174-26A, 41 FR 40685,
Sept. 20, 1976]

APPENDIX C

Excerpts from State of Louisiana Motor Vehicle Laws

Sub-Part F, RAILROAD GRADE CROSSING

✓ § 171. OBEDIENCE TO SIGNAL INDICATING APPROACH OF TRAIN

A. Whenever any person driving a motor vehicle approaches a railroad grade crossing under any of the circumstances stated in this Section, the driver of such vehicle shall stop within fifty feet but not less than fifteen feet from the nearest rail of such railroad, and shall not proceed until he can do so safely. The foregoing requirements shall apply when:

- (1) A clearly visible electric or mechanical signal device gives warning of the immediate approach of a railroad train;
- (2) A crossing gate is lowered or when a human flagman gives or continues to give a signal of the approach or passage of a railroad train;
- (3) A railroad train approaching within approximately nine hundred feet of the highway crossing emits a signal in accordance with R.S. 45:561, and such railroad train, by reason of its speed or nearness to such crossing, is an immediate hazard;
- (4) An approaching railroad train is plainly visible and is in hazardous proximity to such crossing.