NATIONAL TRANSPORTATION SAFETY BOARD

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RAILROAD ACCIDENT REPORT

Derailment of
TOLEDO, PEORIA and WESTERN RAILROAD COMPANY'S
Train No. 20 With Resultant Fire
and Tank Car Ruptures
Crescent City, Illinois

June 21, 1970

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20591
REPORT NUMBER: NTSB-RAR-72-2

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16. Abstract Train No. 20, an eastbound freight train of the Toledo, Peoria and Western Railroad Company, consisting of a four-unit diesel-electric locomotive and 109 cars derailed the 20th to the 34th cars, inclusive, at the west switch of the siding in Crescent City, Illinois, at about 6:30 a.m. on June 21, 1970. Included in the 15 derailed cars were nine tank cars loaded with liquefied petroleum gas. During the derailment one of the tank cars was punctured, and the leaking propane was immediately ignited, engulfing the other tank cars in the fire. A series of explosions of the remaining tank cars occurred, beginning about 1 hour following the derailment, resulting in the injury of 66 persons and the destruction of a number of buildings within the town of Crescent City.

The National Transportation Safety Board determines that the probable cause of this accident was the breaking of the L-4 journal of CB&Q 182544, the 20th car, due to excessive overheating, which permitted the truck side to drop to the track and derail the leading wheels of the car. The cause of the overheating could not be determined.

The cause of the initial fire was the puncturing of one tank during the derailment, jumbling of the derailed cars, and the large volume of propane released which immediately ignited and subjected the other tanks to impingement of fires.

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FOREWORD

This report of facts and circumstances and the determination of probable cause by the National Transportation Safety Board are based on facts developed in an investigation conducted by the Federal Railroad Administration and from observations at the scene of the accident by personnel of the Board's Railroad Safety Division. In developing its recommendations, the Safety Board has considered the suggestions of the Federal Railroad Administration, but the recommendations are those of the Safety Board.

TABLE OF CONTENTS

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20591
RAILROAD ACCIDENT REPORT

Adopted: March 29, 1972

DERAILMENT OF TOLEDO, PEORIA AND WESTERN RAILROAD COMPANY's TRAIN NO. 20 WITH RESULTANT FIRE AND TANK CAR RUPTURES CRESCENT CITY, ILLINOIS June 21, 1970

I. SYNOPSIS

Train No. 20, an eastbound freight train of the Toledo, Peoria and Western Railroad Company, consisting of a four-unit diesel-electric locomotive and 109 cars, derailed the 20th to the 34th cars, inclusive, at the west switch of the siding in Crescent City, Illinois, at about 6:30 a.m. on June 21, 1970. Included in the 15 derailed cars were nine tank cars loaded with liquefied petroleum gas. During the derailment one of the tank cars was punctured, and the leaking propane was immediately ignited, engulfing the other tank cars in the fire. A series of explosions of the remaining tank cars began about 1 hour following the derailment and resulted in the injury of 66 persons and the destruction of a number of buildings within the town of Crescent City.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was the breaking of the L-4 journal of CB&Q 182544, the 20th car, due to excessive overheating, which permitted the truck side to drop to the track and derail the leading wheels of the car. The cause of the overheating could not be determined.

The cause of the initial fire was the puncturing of one tank during the derailment, the jumbling of the derailed cars, and the large volume of propane released which immediately ignited and subjected the other tanks to impingement of fire.

The cause of the explosive rupture of several tanks was localized heating which weakened the steel of the tank so that it could no longer resist the pressure of the propane. Contributing to the explosive rupture were (1) the placement of a number of tank cars together in the train which permitted interaction between cars, (2) the speed of the train which tended to allow jumbling of cars to occur, and (3) the absence of heat insulation of the cars which was formerly required.

The injury to the firemen and spectators was due to the lack of appreciation by firemen of the large scope of fire and explosion which could occur in a fire of this type.

II. FACTS

A. Location and Method of Operation

This accident occurred at Crescent City, Illinois, 90.6 miles east of East Peoria yard, on the first subdivision of the Toledo, Peoria and Western Railroad (TP&W), which extends eastward from East Peoria to Effner, Illnois, a distance of 108.0 miles.

1. The Track

This is a single-track line over which trains are operated by timetable and train orders. There is no automatic block signal system in use.

The track for a distance of more than 5 miles west of Crescent City and extending eastward from Crescent City is straight. The grade is practically level.

The TP&W Railroad did not have hotbox or dragging material detectors installed on this section of the main track.

A siding, 2,560 feet in length, parallels the main track on the north side through the town. The west switch of the siding is located 703 feet west of the station point. This siding is designated as the elevator track. (See Figure No. 1.)

2. The Town of Crescent City

The town of Crescent City is built along each side of the railroad. The main street, which is also State Highway 24, extends east and west through the town about 100 feet south of the main track. Several industries are located between the railroad right-of-way and Main Street. Included in this area are the city building and a 50,000-gallon water storage tank, located immediately adjacent to the railroad about 559 feet east of the west switch of the siding. The buildings of several small businesses and apartments are located along the south side of the main street. Directly south of this area and also along the north side of the tracks are the residential areas of the town. The railroad bridges a stream at a point 1,576 feet west of the west switch of the siding. (See Figure 1.)

Illinois State Highway No. 49, extending north and south, crosses the railroad at grade at a point about 962 feet west of the west switch of the siding. This is a two-lane, undivided concrete highway. The crossing is 20 feet in width. The rails of the crossing are protected on each side by timbers, and the area between the timber is surfaced with bituminous material. (See Figure 1.)

The initial derailment occurred on the center of the road crossing on highway route 49, and the general derailment occurred at the west switch of the siding.

The speed limit for freight trains over this portion of the railroad was 49 miles per hour.

B. Description of the Accident

1. The Train

Train No. 20, an eastbound freight train, consisted of four diesel electric units, 108 cars, and a caboose. Most of the cars of this train had been received from other railroads and were assembled into train No. 20 in East Peoria Yard. The engineer and the train crew for train No. 20 were called for duty at 1:30 a.m. and 1:40 a.m., respectively, after being off duty the required length of time to comply with the Hours of Service Law. After the train had received a proper air brake test, it departed from East Peoria Yard at 3:30 a.m., destined for Effner, Illnois.

Beginning with the 20th Car, the following cars were part of train No. 20 when it departed from East Peoria Yard and were the cars involved in the accident.

Position in Train	Initial	Number	Type	Loaded With:
20th	CBQ	182544	Covered Hopper	Sand
21st	CBQ	181754	Covered Hopper	Sand
22nd	CBQ	181765	Covered Hopper	Sand
23rd	CBQ	89300	Flat	Empty

Position in Train	Initial	Number	Type	Loaded With:
24th	WP	160327	Box	Lead
25th	ACL	15287	Box	Paper
26th	NATX	32019	Tank	Propane
27th	NATX	32025	Tank	Propane
28th	SOEX	3252	Tank	Propane
29th	NATX	33990	Tank	Propane
30th	SCMX	3445	Tank	Propane
31st	NATX	33988	Tank	Propane
32nd	SOEX	3037	Tank	Propane
33rd	SOEX	3219	Tank	Propane
34th	NATX	32015	Tank	Propane
35th	NATX	31021	Tank	Propane
36th	NATX	31006	Tank	Propane
37th	SOEX	3150	Tank	Propane

2. The Operation of Train No. 20 from East Peoria Yard to Gilman, Illinois

Train No. 20 passed Forest, Illinois, the last open train order office, located 61.8 miles east of East Peoria Yard at 5:55 a.m. The office was located on the north side of the track, and the operator on duty inspected that side of the train as it passed the open station. He notified the crewmembers on the rear of the train, by an exchange of signals, that he had not observed any defects on the cars or any other unusual conditions on the train. The train continued eastward and at about 6:30 a.m. approached Gilman, Illinois, located 83.4 miles east of East Peoria Yard. At this point the Illinois Central Railroad (IC) tracks crossed the TP&W tracks at grade and the IC maintained an open interlocking station on the north side of the TP&W tracks. The operator's duties did not require the inspection of TP&W trains as they passed; however, as No. 20 passed the Gilman station on the day of the accident, the operator observed the train from his position inside of the station, and when the caboose passed, signaled to the members of the train crew that he had observed no defects. He did not receive an acknowledgment signal from the members of the traincrew when the caboose passed the station.

The train continued eastward through Gilman and moved over Illinois State Route 45 where several motorists were stopped on the north side of the crossing to permit the train to pass. One of the motorists observed smoke coming from a journal box on the north side of a covered hopper car which he believed to be located 7 to 10 cars ahead of a string of tank cars. He said that he observed a small amount of smoke and that there was no unusual odor or noise being emitted from the journal box. As the rear of the train passed the crossing, he attempted to signal the crew in the caboose, but received no acknowledgment to his signals. After the train passed, he drove to a restaurant which was located on the south side of Gilman, where he expected to advise a member of the Illinois State Police of his observations of the defective car on the train. When he arrived at the restaurant, he was informed that the state police officer already was en route to Crescent City where the accident had occurred.

3. The Derailment of the Train

Crescent City is 7.2 miles east of Gilman. After No. 20 passed Gilman, the speed of the

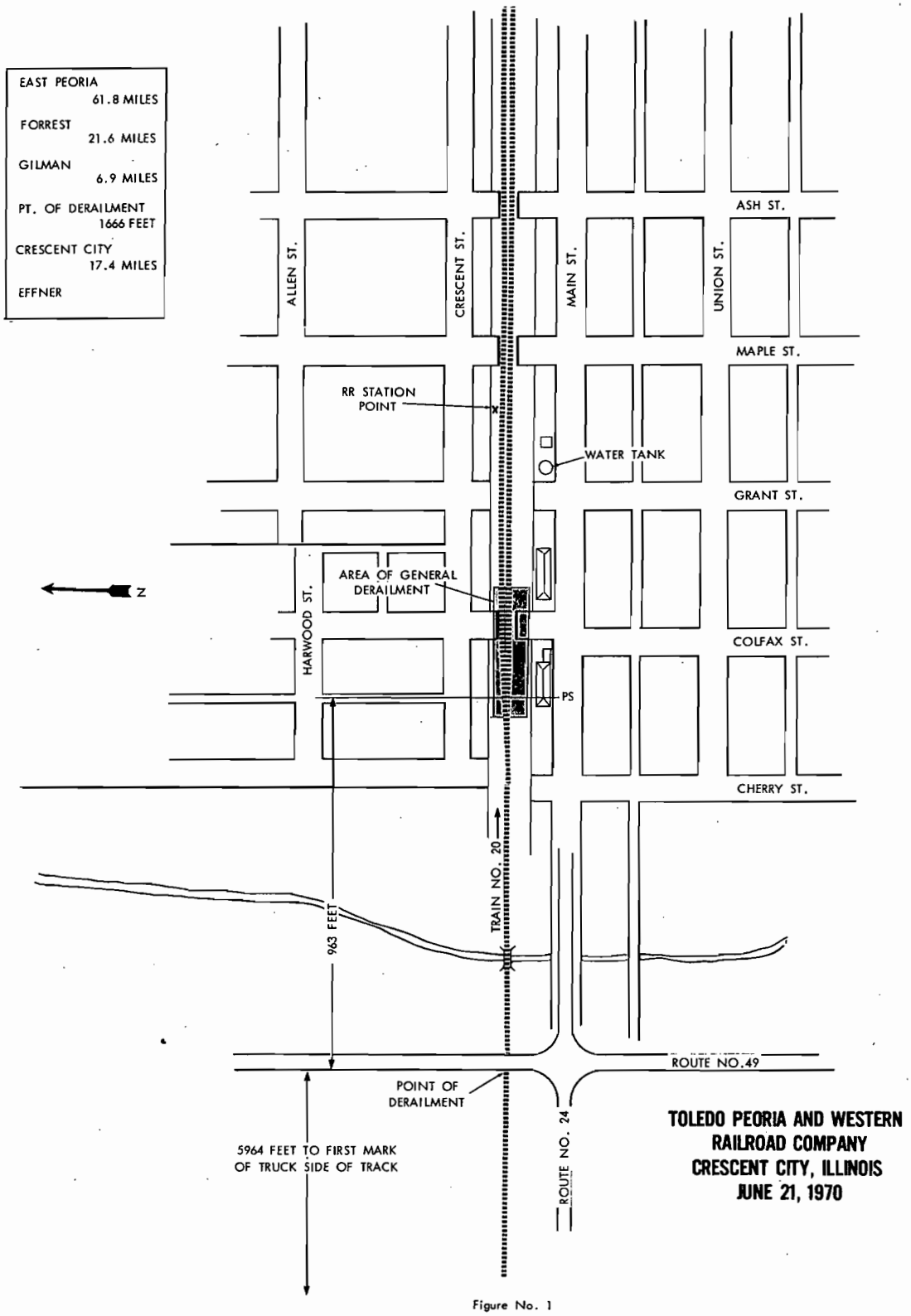

EAST PEORIA
61.8 MILES
FORREST
21.6 MILES
GILMAN
6.9 MILES
PT. OF DERAILMENT
1666 FEET
CRESCENT CITY
17.4 MILES
EFFNER
ASH ST.
ALLEN ST.
CRESCENT ST.
MAIN ST.
UNION ST.
MAPLE ST.
RR STATION POINT
WATER TANK
GRANT ST.
AREA OF GENERAL DERAILMENT
HARWOOD ST.
COLFAX ST.
PS
CHERRY ST.
TRAIN NO. 20
963 FEET
ROUTE NO.49
POINT OF DERAILMENT
5964 FEET TO FIRST MARK OF TRUCK SIDE OF TRACK
ROUTE NO. 24
TOLEDO PEORIA AND WESTERN RAILROAD COMPANY
CRESCENT CITY, ILLINOIS
JUNE 21, 1970

Figure No. 1

train increased from 30 to 43 miles per hour. As the train moved onto the grade crossing of Highway 49, just west of Crescent City, a pair of wheels on the 20th car (CBQ 182544) derailed toward the north side of the track. The derailed car continued eastward across the bridge spanning a creek to the west switch of the siding in Crescent City. Several residents of Crescent City observed the train as it entered the town. One observed smoke and fire under one car, while all observed a car bouncing up and down, apparently due to its riding on the ties. At the switch, the derailed wheels were diverted away from the main track and struck the rails of the turnout. The turnout and the track were destroyed, which permitted the 20th to the 34th cars, inclusive, to derail. The three covered hopper cars loaded with sand, the following flat car, two box cars, and nine loaded tank cars were separated and stopped in the jumbled positions as shown in Figure 2.

The front portion of the train separated from the 20th car and stopped. The rear of the 19th car was about 1,100 feet east of the area of the general derailment. The rear portion of the train remained coupled to the last derailed car.

The force of the derailment propelled the 27th car (NATX 32025) over the derailed cars ahead. The 27th car came to rest on the east end of the derailment with its east end on the track and its west end resting on the derailed cars, about 15 feet in the air. (See Figure 3.) As the 27th car was hurtling over the derailed cars, its coupler struck the tank of the 26th car (NATX 32019), puncturing the head of the tank. The released propane was ignited immediately by some unidentified source, possibly by sparks produced by the derailing cars or by the overheated journal. The initial ignition of the gas produced flames that reached a height of several hundred feet and extended into that part of the town surrounding the tracks. Several townspeople were injured by the initial flareup of the fire and several buildings were set on fire.

4. The Events Immediately Following the Accident

a. Actions of People in Crescent City

The residents of Crescent City, including the mayor and the fire chief, were immediately alerted to the accident by the noise of the derailment and by the flames of the ensuing fire. The fire alarm was sounded, and a number of the town's volunteer firemen reported for duty. They sprayed water on the fire from several positions, and after the initial fireball had subsided, the fire seemed to be confined within the center of the derailed cars. At this time, the fire appeared to be controllable, and the fire chief believed his department could control it. The firemen took positions close to the burning cars to better reach the fire with water. (See Figure 4.) The firemen attempted to extinguish the fires in the burning buildings and continued to pour water on the burning derailed cars.

An Illinois State Police sergeant at Watseka, 6.3 miles east of Crescent City, was notified of the accident shortly after it occurred, and he immediately proceeded to Crescent City to assist the local people in handling the situation. When he arrived at the scene about 6:45 a.m., he saw that tank cars were involved in the accident and were exposed to the fire. He also observed that the west end of a tank car located on the east end of the derailment was being heated by the fire. He immediately ascertained that the tank cars were loaded with propane, by contacting other police officers by radio, who in turn questioned the train's crew. On learning that the tank cars contained propane, he directed other police officers on the scene to start at once to evacuate the townspeople and to prevent unauthorized persons from entering the town. He also notified the firemen that the cars contained propane and instructed them to move back to a safer position to fight the fires. Shortly after the State Police sergeant had notified the firemen of the danger, the safety valves on the tank cars

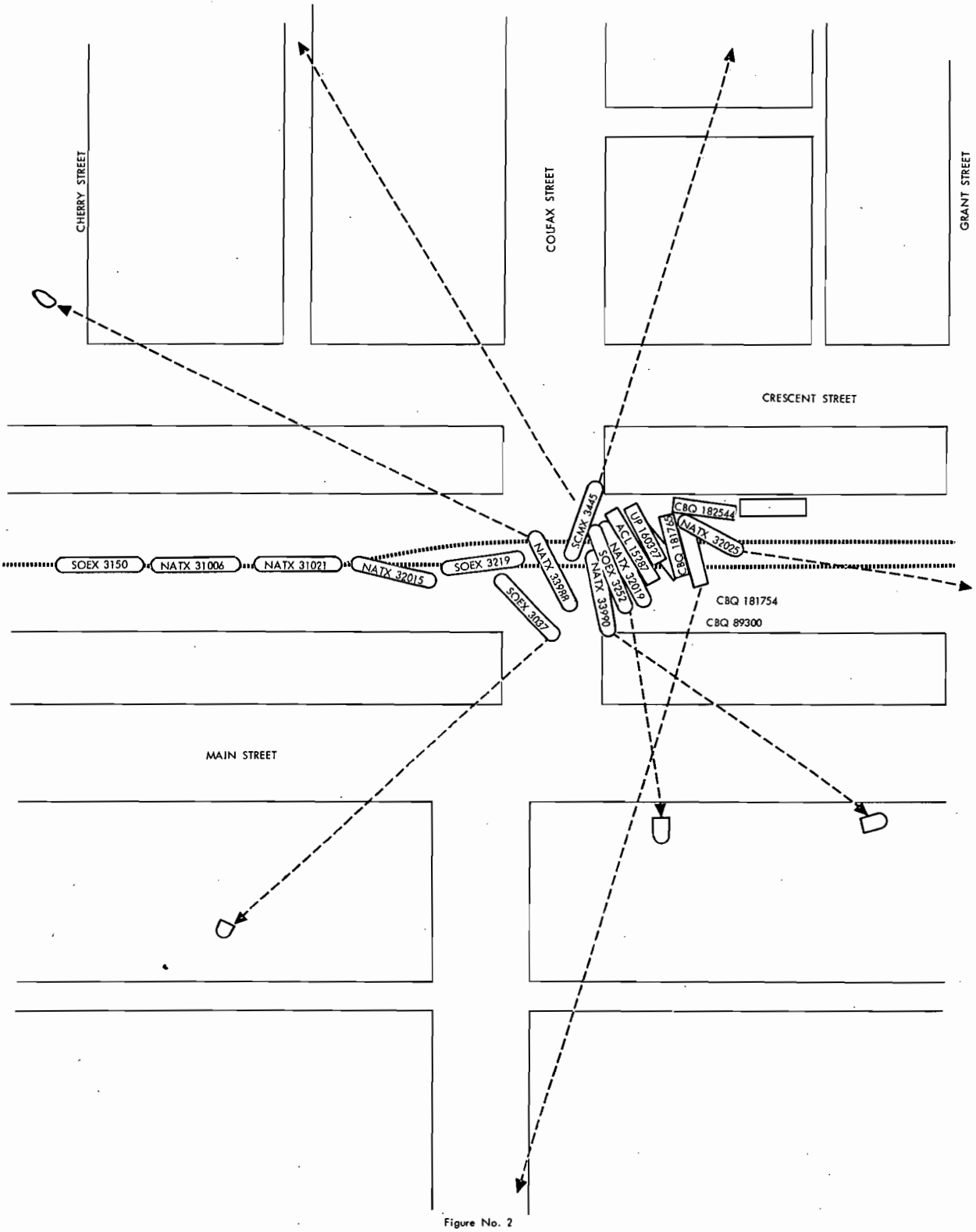

CHERRY STREET
COLFAX STREET
GRANT STREET
CRESCENT STREET
MAIN STREET
SOEX 3150
NATX 31006
NATX 31021
NATX 32015
SOEX 3219
SOEX 3097
NATX 33988
SCMX 3445
NATX 33990
SOEX 3252
NATX 32019
ACL 15287
UP 1803271
CBQ 181754
CBQ 182544
NATX 32025
CBQ 181754
CBQ 89300

Figure No. 2

Figure 3. Location of tank car NATX 32025 on the East End of the General Derailment

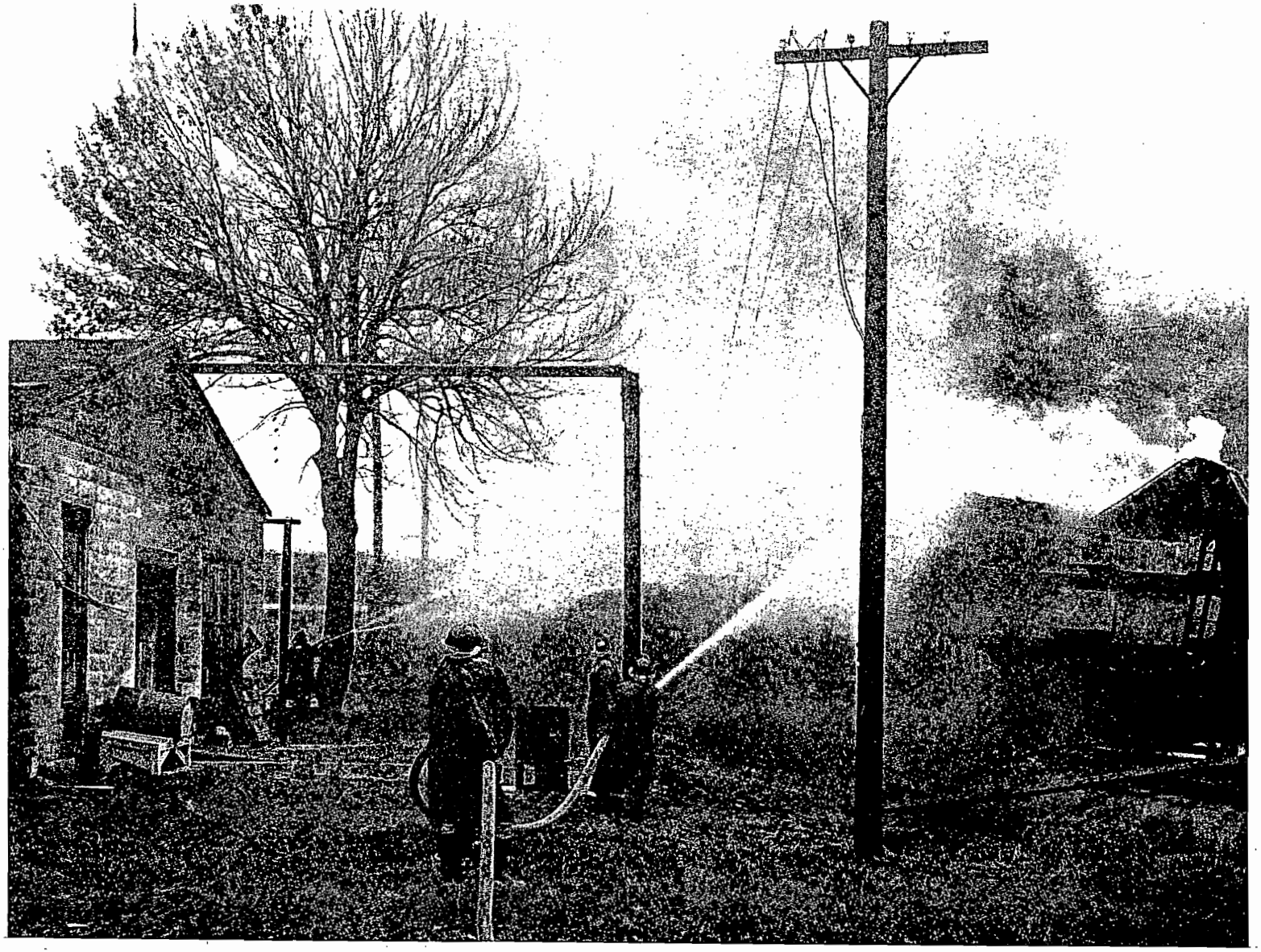


Figure 4. Location of Firemen before the Tank Cars Ruptured

operated due to the increased pressure in the tanks. This in turn provided additional fuel for the fire.

The intensity of the fire increased to the extent that the fire chief called for assistance from the surrounding communities.

A wooden pole carrying the electric power lines to Crescent City was broken by the derailed cars. The wires attached to the broken pole did not break but were exposed to the fire from the burning cars. An employee of the power company was notified, presumably by the Sheriff's office, of the fire and was told of the hanging wires. On the employee's arrival at Crescent City, he observed the situation and decided to deenergize the lines for the safety of the firemen. A 12,000 volt line and a 2,400 volt line, which were the main sources of power for Crescent City, were deenergized at 6:45 a.m. After the employee received permission from the power company's load dispatcher, a 69,000 volt line was deenergized at 7:05 a.m. When this was done, the water pumps for the town's water supply were shut down, and the only supply of water available to fight the fire was that fed by gravity from the overhead water tank. This source of water proved to be insufficient, and the fire soon increased in its intensity and forced the firemen to withdraw to a safer position.

b. The First Explosion of Tank Cars

The safety valves of the tank cars located within the fire area continued to operate, providing more fuel for the fire. More of the flames and heat were directed against the elevated portion of the 27th car, which increased the pressures within the car and heated the steel shell of the tank in the vapor area. At about 7:33 a.m., the 27th car in the train (NATX 32025) ruptured with an explosive force. (See Figure 5.) The east end of the car, which included the manway, dug a crater in the track structure and then was hurled about 600 feet eastward, where it stopped at the intersection of Maple and Main Streets. Fire in this section continued after it came to rest. (see Figure 6.)

The west end of the car was hurled in a southwesterly direction for a total distance of about 300 feet. This section struck and collapsed the roof of a gasoline service station. Two other sizeable portions of the tank were hurled in a southwesterly direction and came to rest at points 600 feet and 750 feet from the tank. (See Figure 7.)

When NATX 32025 ruptured, the force caused the next car (SOEX 3252) to rotate so that the manway was changed from a 2 o'clock position to a 4 o'clock position. The car was lying in a north-south direction, with the north end of the tank elevated about 10 feet higher than the south end. The fire was directed against the car.

On receiving the request for assistance from the fire chief at Crescent City, the fire companies from 32 surrounding towns and areas dispatched 53 pieces of equipment and 234 firemen to aid in the emergency. The fire companies arrived on the scene at various times from before the time of the first explosion throughout the following several hours. As each of these groups arrived at the scene, they took positions that they believed best suited the situation to fight the fires and were not directed by a central source to perform a particular function, or to assume a position. Water trucks from 13 industries in and around Crescent City were provided to supplement the depleted water supply.

c. The Second Explosion of Tank Cars

At about 9:40 a.m., the 28th car in the train (SOEX 3252) ruptured. The south end of the car was hurled about 200 feet southward across Main Street where it entered a brick apartment building.

The north end of the car was hurled through the air in a northwesterly direction over the

Figure 5. A Fireball Emitted from Ruptured Tank Car NATX 32025 Extended Upwards about 1000 feet.

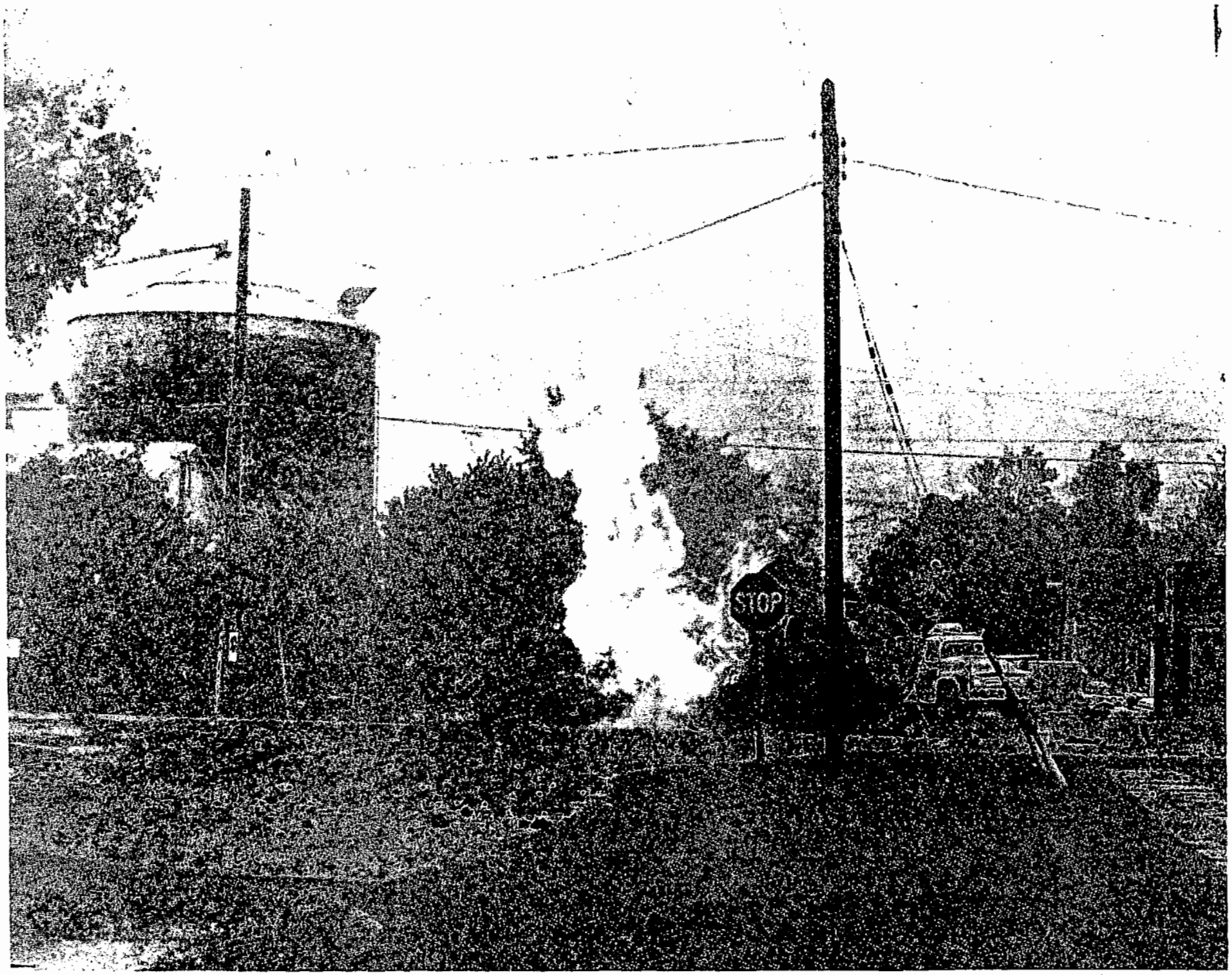


Figure 6. The East End of Tank Car NATX 32025, following its Rupture, was Propelled about 600 Feet to the Inter Section of Maple and Main Streets

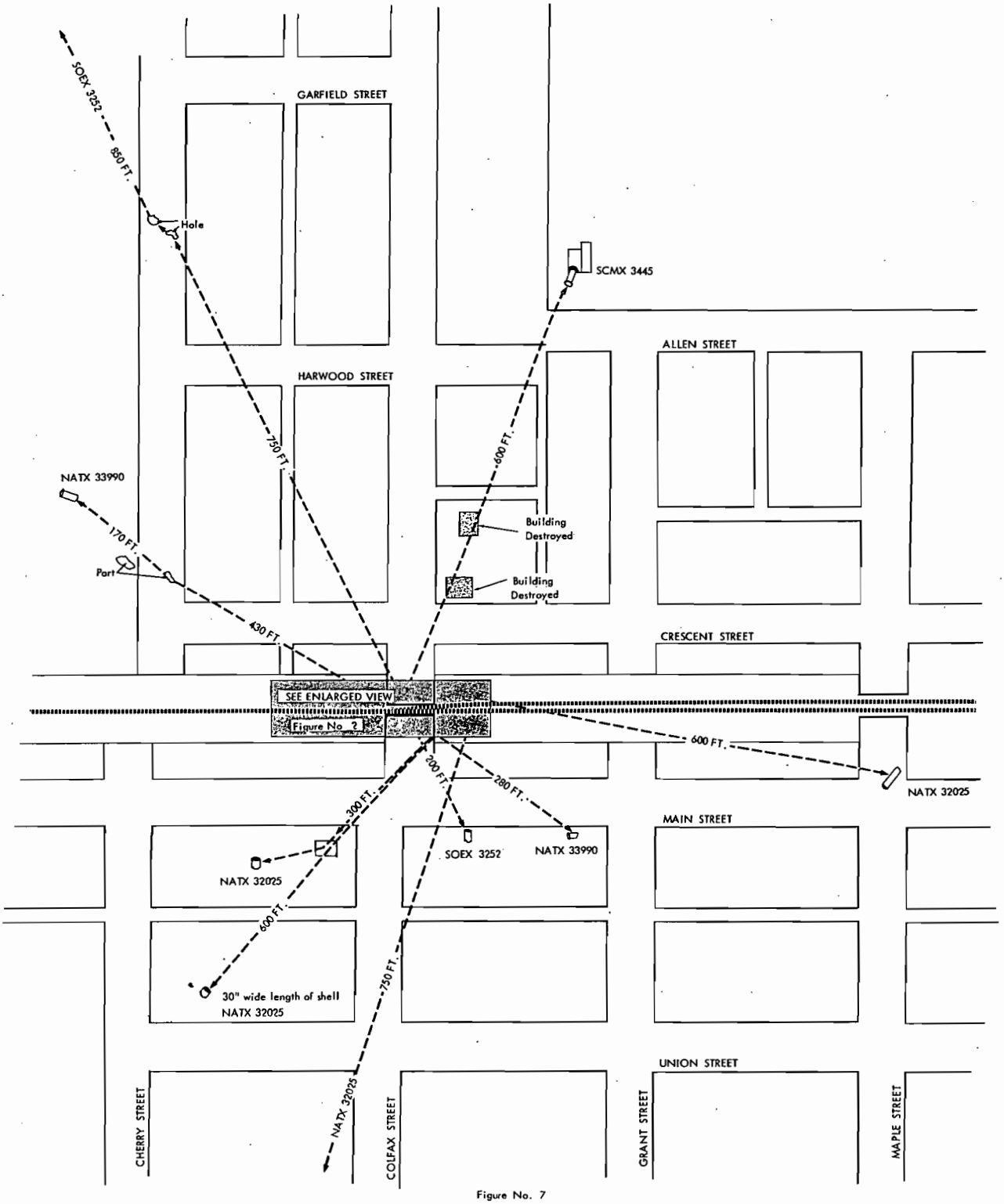

SOEX 3252
850 FT.
GARFIELD STREET
Hole
SCMX 3445
ALLEN STREET
HARWOOD STREET
750 FT.
600 FT.
NATX 33990
170 FT.
Part
Building Destroyed
Building Destroyed
430 FT.
CRESCENT STREET
SEE ENLARGED VIEW
Figure No. 2
600 FT.
NATX 32025
300 FT.
200 FT.
280 FT.
MAIN STREET
SOEX 3252
NATX 33990
NATX 32025
600 FT.
750 FT.
30" wide length of shell
NATX 32025
UNION STREET
NATX 32025
CHERRY STREET
COLFAX STREET
GRANT STREET
MAPLE STREET

Figure No. 7

roofs of several houses and landed in an open field. It continued to roll and finally stopped after traveling about 1,600 feet. (See Figures 7 and 8.)

Despite the efforts of the police, numerous persons including reporters, photographers, and sightseers got into Crescent City close to the accident site prior to the rupturing of the second car. When this explosion occurred, a number of firemen, sightseers, and a newspaper photographer were injured. The remaining firemen were extremely short of water and retreated to a safer distance.

d. The Third Explosion of the Tank Cars

About 5 minutes later, at approximately 9:45 a.m. the 30th car in the train (SCMX 3445) ruptured. This car had been lying in a generally north-south position. The north end of the car, which included about one half of the tank, was propelled along the ground in a northeasterly direction for about 600 feet. This portion of the tank passed through and completely destroyed two buildings and came to rest within the third. The other end of the tank stayed in the vicinity of the general derailment site. (See Figure 7.)

The rupturing of this car rearranged the remaining tank cars.

e. Subsequent Explosions of Tank Cars

At about 10:55 a.m., the 32nd car in the train (SOEX 3037) and the following car (SOEX 3219) ruptured almost simultaneously. SOEX 3037, however, split longitudinally and did not separate into hurtling pieces, as the other tank cars did when they ruptured. The west end of SOEX 3219 was hurled westward where it struck and punctured the head of the 34th car (NATX 32015). Propane released from the puncture ignited immediately.

The other end of the 33rd car was hurled through the air. It struck the 34th car, ricocheted, and then struck the protective housing of the 35th car (NATX 31021). The housing and valves of the 35th car broke off, which permitted propane to escape and become ignited.

On the advice of the Bureau of Explosives Agent, the 34th and 35th cars were permitted to burn until all of the propane was consumed. The 34th car burned until about 9 p.m. on Monday, June 22nd, for a total of 38½ hours and the 35th car until about 2:30 p.m. on Tuesday, June 23rd, a total of 56 hours.

After a number of firemen and other people were injured by the fire and by the rupturing of the tank cars, the State Police called all fire chiefs together and arranged for information to be made available from a police command post, which by then had been established. After this was done, much of the confusion was eliminated and the remaining fire was extinguished in a systematic manner.

After an examination of the area to ascertain that there was no further danger from an explosive mixture of propane, the residents of Crescent City were permitted to return to their homes after 2 p.m. on June 22nd.

C. Results of the Accident

1. Casualties

Sixty-six persons were injured as a result of the accident. Eleven of these persons were injured seriously and were admitted to the hospital. Fifty-five, including one employee of the railroad, sustained minor injuries. There were no fatalities as a result of the accident.

2. Damages

a. To Railroad Equipment

The 20th to the 33rd cars, inclusive, were destroyed, and the 34th and 35th cars were damaged. The lading in the cars was destroyed. The track structure in the area of general

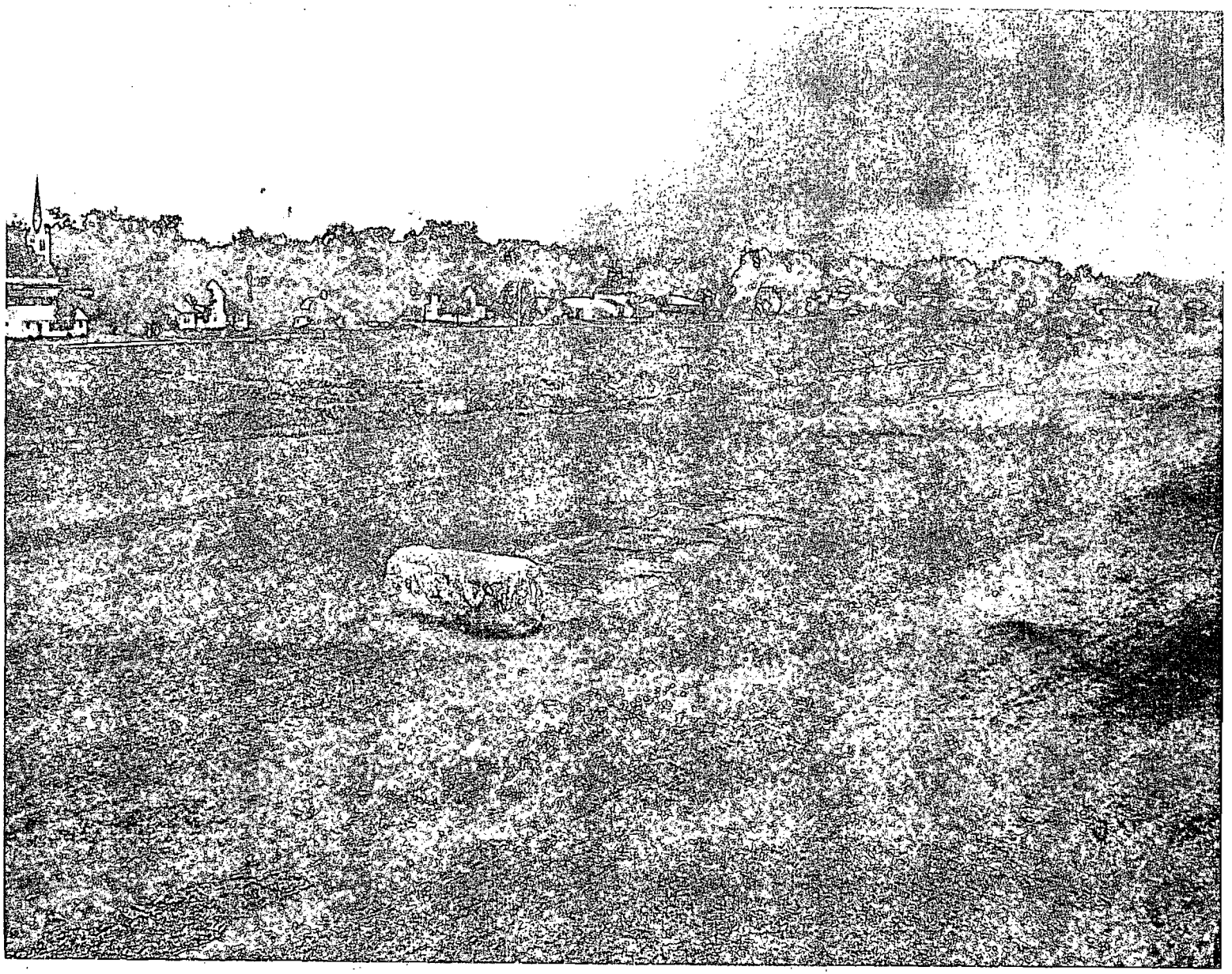


Figure 8. A large section of tank car SOEX 3252, weighing about 12 tons was hurled through the air a distance of about 700 feet where it landed in a field.

derailment was destroyed, and, from the point of the initial derailment to the area of the general derailment, was damaged. The total estimated cost of the damage to the railroad equipment and property was about $345,000.

b. To Property in Crescent City

Within Crescent City, 16 business establishments were destroyed and seven were damaged. Twenty-five residences were destroyed and a number of others were damaged extensively. (See Figure 9.) It is estimated that the cost of personal injuries and property damage will be about $1,700,000. Chanute Air Force Base personnel assisted the townspeople in repairing and purifying the water supply. Structural engineers assisted in surveying the damages which resulted from the accident.

The following damage was sustained by the fire-fighting companies which responded to the emergency.

Six fire trucks were damaged and the following truck equipment was destroyed.

3,050 feet of 2½ inch hose.
500 feet of 1½ inch hose.
Several sets of ladders.
Nine firemen's coats.
Seven firemen's helmets.

3. Fire Departments at the Accident

The State of Illinois, in 1927, established Fire Protection Districts. This was done, in part, to furnish standard methods of providing fire protection for the small towns and rural areas within the State. Through this system, certain standards are maintained for the individual fire companies and training for firemen is provided.

The investigation disclosed that the training is accomplished by having one member of each of the fire companies in the District meet about once each month to receive information on fire fighting procedures. It is then the responsibility of this member to transmit the information to the remaining members of the fire company.

Training sessions are held at the University of Illinois, in Champaign, Illinois, but participation in these courses is entirely dependent on available funds.

From interviews conducted with personnel of the fire companies, it was found that the members had received little training in fighting LPG fires. Any training that had been received involved tanks with much smaller capacities than the tank cars involved in this accident. Most of the firemen believed that as long as the safety valve on the tank was functioning, the tank would not rupture.

Many of the firemen who were injured either had lost or were not wearing parts of their protective clothing. Some protective clothing was destroyed by the fire.

D. Marks on the Track from Derailed Cars.

An examination of the track structure after the accident disclosed that the first marks of the derailment began at a point 6,936 feet west of the general derailment. A scuff mark was found on a rail joint bar on the field side of the north rail. Eastward from this point, for a distance of 4,280 feet, gouged marks were found along the field side of the north rail on a bituminous highway road crossing, on a dirt road crossing, and on several ties and joint bars. Marks then appeared regularly on the north end of the ties eastward to the road crossing at Highway 49. The roadway of this crossing was scored along the field side of the north rail. Flange marks appeared at the west side of the crossing on the north sides of the rails indicating that a pair of wheels had been derailed towards the north side of the track. The marks of the derailed wheels continued eastward along the north side of both rails and passed across the bridge over the creek located west of the town. The ties on the bridge were damaged, and the retaining plank along the north side of the ties was torn out. The marks of

Figure 9. Part of the extensive damage to Crescent City

the derailed wheels continued to the west switch of the siding where the general derailment occurred.

E. Examination of the Equipment

1. Description of Car CB&Q 182544

CB&Q 182544 was an all-steel covered hopper car built in November 1946. This car had been renumbered from CB&Q 180477. It was 35 feet 3 inches long over the striking castings, 12 feet 10 inches high, and 10 feet 1½ inches wide. The light weight, load limit, and nominal capacity were 51,300 lbs., 168,700 lbs, and 140,000 lbs, respectively. The car was provided with two 70-ton spring-plankless, self-aligning trucks. The trucks had cast steel side frames with integral journal boxes cast to Scullen Pattern No. 5916-B and bolsters cast to Scullen Pattern No. 5912-A. The truck wheelbase was 5 feet 8 inches. A spring arrangement consisting of five outer and inner coils having a travel of 1 5/8 inches was applied to each side of the truck. The carrier was unable to provide a history of the wheels applied to the car; however, the car did receive heavy repairs in February 1969 at which time the wheels were removed and turned to restore the tread contour. At the time of the accident, the car had one-wear, 33-inch wheels manufactured by the Edgewater Wheel Company in September 1952. During its overhaul in February 1969, the trucks were disassembled, cleaned, and repaired. The journal boxes were provided with new Economy journal stops, front and rear journal box seals, and Flo-Pak lubricator pads. The stencilling on the car at the time of the accident indicated that the journal boxes and airbrakes had received periodical inspection and tests on February 20, 1969. The photograph in Figure 10 shows the truck side and journal boxes.

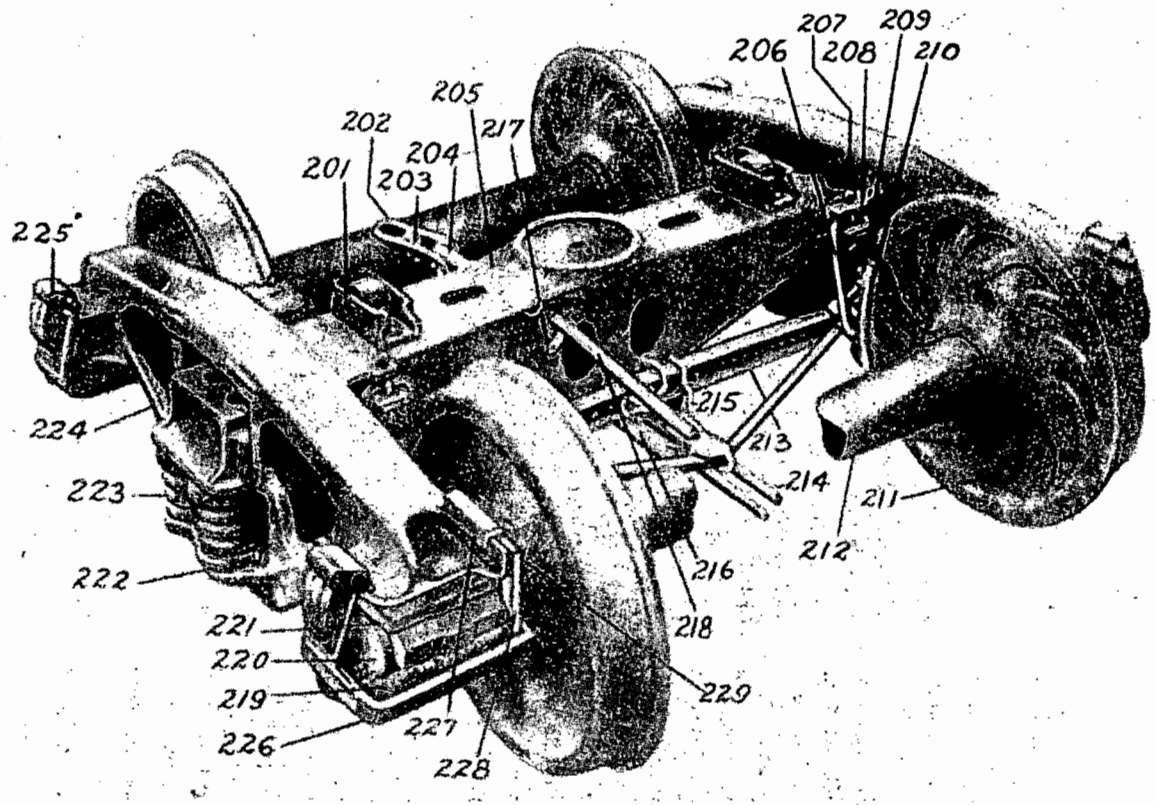
2. The Failed Journal Bearing

An examination of the equipment after the accident disclosed that the journal of the leading pair of wheels at L-4 position on the north side, east end of the 20th car (CB&Q 182544) had overheated and broken. This permitted the journal box at the forward end of the truck side to drop down and ride on the stub of the journal still attached to the axle. The stub end of the journal was worn to a point by contact with the truck side after the failure of the journal. The top of the journal box was worn and broken from contact with the stub end of the journal, which eventually permitted the truck side to drop to the track structure. Examination of the truck side revealed scored marks and deposits of bituminous material on the bottom of the journal box, indicating that it had been dragging. The portion of the journal which broke off was found in the journal box. The failed journal, when new, measured 6 inches in diameter and 11 inches in length.

It was not possible to determine the diameter and length of the journal prior to failure due to its distortion from heating. The diameter of the detached portion of the journal was 5-29/32 inches at the collar. Due to heating, the diameter began reducing at a point about 4 inches from the collar as follows:

diameter	inches from collar
5-7/8 inches	4
5-27/32 inches	5
5-25/32 inches	6
5-19/32 inches	7
5-13/32 inches	8

The collar thickness was seven-eighths of an inch. A longitudinal crack began at the fractured face and extended into the body of the journal a distance of 2 inches. Markings on the end of the broken journal indicated that the serial number was 735236, that it was manufactured in April 1952 from steel with a heat number of US4735. The journal on the opposite end of the axle, which would have been at location R-4, measured 5-15/16 inches in diameter by 11-1/8 inches in length.



A.A.R. self-aligning spring plankless double-truss truck.

Names of Parts

201	*Truck Side Bearing*	211	*Wheel*	221	*Journal Bearing Wedge*
202	*Dead Lever Guide*	212	*Axle*	222	*Truck Spring Plate*
203	*Dead Lever*	213	*Brake Beam*	223	*Truck Springs*
204	*Dead Lever Guide Bracket*	214	*Bottom Connection*	224	*Truck Side Frame*
205	*Truck Bolster*	215	*Bottom Connection Support*	225	*Journal Box Lid*
206	*Brake Hanger*	216	*Brake Beam Safety Support*	226	*Journal Box*
207	*Brake Hanger Key*	217	*Brake Pin*	227	*Dust Guard Retainer*
208	*Brake Hanger Wear Plate*	218	*Live Lever*	228	*Dust Guard*
209	*Brake Shoe Key*	219	*Journal Box Waste*	229	*Dust Guard Wedge*
210	*Brake Shoe*	220	*Journal Bearing*		

Figure 10. Freight Car Truck With Cut Away Journal To Show Parts

A microscopic examination of the broken portion of the journal was conducted by the Research Department of the Association of American Railroads (AAR) to determine the thermal history of the journal and to determine the soundness of the steel. The examinations disclosed that the entire journal was heated to a temperature in excess of 1,425° F. and that the failed end of the journal was heated to between 1,800° F. and 1,900° F. It also was determined that the steel in the journal contained normal flow lines with no observable internal defects. A microscopic examination of the grain structure of the journal disclosed that it was a heat-treated axle and that it compared favorably with the grain size specified as Grade F of AAR Specifications M-126.[1] Chemical analysis of the steel disclosed that it met the requirements for this class and grade of steels. The metallurgical examinations indicated that the steel met the requirements of specification M-126.

3. Examination of Car After the Accident

An examination of the wheel at L-4 location disclosed that it had less than a full flange but was not worn sufficiently to condemn it. The rim thickness was three-sixteenths of an inch. The mate wheel at R-4 location had a full flange contour with a rim thickness of two-sixteenths of an inch. Both wheels had a tape size of 141. The journal box lubricator pad at location L-4 was destroyed by fire; the journal bearing and wedge were missing. The front and rear journal box seals at this location were destroyed by the fire. The other wheels and axles on the car were examined and found to be within serviceable limits. The other journal boxes on the car contained a sufficient quantity of free oil to conform to the AAR Lubricating Requirements. No defective conditions other than the broken journal were observed on the trucks.

[1] 1. Association of American Railroads' Manual of Standards and Recommended Practices Mechanical Division - Specification M-126.

F. The Movement of CB&Q 182-544 Prior to Accident

CB&Q 182544 was loaded with 167,200 pounds of glass sand at Oregon, Illinois, and moved via the Burlington Northern Railroad (BN) and the Peoria and Pekin Union Railroad (P&PU) to East Peoria where it was interchanged to the TP&W RR on June 20.

After the car was loaded, it was first inspected and the journal boxes examined at Galesburg, Illinois, on the BN railroad. The car was inspected, but no examination was made of the journal boxes by the P&PU at Peoria.

At East Peoria, the TP&W forces inspected CB&Q 182544. This inspection included an examination of the journal boxes, but no records were maintained to indicate whether any oil was added to the journal boxes. There is no record of any exceptions having been taken during these inspections or of any repairs having been made as a result of the inspections. The car was then made ready for departure from East Peoria and was assembled in train No. 20. After car inspectors performed the prescribed airbrake test, CB&Q 182544 was dispatched from East Peoria in TP&W train No. 20.

G. The Tank Cars Involved in the Accident

1. Description of the Cars

The tank cars involved in the accident were of the type and classification shown in the table of Figure 11. Of the 12 tank cars, eight were of the type that have a larger diameter in the center of the tank than at either end, and four cars were of the type that have uniform diameter tanks. Nine of the cars had tanks with DOT specification of 112A340W and three with 112A400W. All of the cars had water capacities greater than 31,000 gallons and were provided with stubtype center sills which were welded to the tank at each end. The tank becomes the frame of the car. This design is referred as a "jumbo tank car."

Plans and specifications for the construction of the tank cars were approved by the AAR Tank Car Committee prior to construction. There is no evidence that the tank cars were not in full compliance with the specifications approved by the AAR.

These tanks were provided with a one-spring-type safety valve. The requirements for the setting of the safety valves for the start-to-discharge pressures for tank cars transporting liquefied petroleum gases is one that will prevent a buildup of pressure in the tank in excess of 90 percent of the tank test pressure. For cars carrying other liquefied gases, the requirement specifies that the safety valve must prevent a build up of pressure in excess of 82½ percent of the test pressure. The valves are also rated by the amount of flow of air from the tank when the valve is fully opened. The start-to-discharge pressures and the flow capabilities for the safety valves on each car are shown in the table of Figure 11.

Title 49 Code of Federal Regulations (CFR) 179.100-6 requires that the determination of the wall thickness for Class 112A-W tanks be based on a welded joint efficiency of 0.9. The tanks of cars SOEX 3219, SOEX 3252, and SCMX 3445, however, were built under a DOT Special permit allowing a welded joint efficiency of 1.0. The effects of this were to allow an increase in pressure without increasing the thickness of the tank walls and to allow a tank wall thickness about 10 percent thinner than would otherwise be required. The existing wall thickness requirements are based upon resistance to pressure in normal operations, rather than upon resistance to crash damage, resistance to effects of nearby fire, or to control the pattern of ruptures.

2. Requirement for Loading Liquefied Petroleum Gas

49 CFR 173.314 requires that the gas pressure at 115° F., in any uninsulated tank of the 112A-W class must not exceed three-fourths of the prescribed retest pressure of the tank. In addition, the liquid portion of the gas at 115° F. must not completely fill an uninsulated tank car of the 112A-W class. The amount of liquefied petroleum gas (LPG) loaded into each tank is determined by weight. The car may be weighed on track scales or the weight may be calculated by using the outage tables supplied by the tank-car owners and the specific gravity as determined at the plant while loading.

The CFR defines the filling density of liquefied gases as the percent ratio of the weight of gas in the tank to that of the weight of water that the tank will hold. For LPG, the maximum permitted filling density for both insulated and uninsulated cars is based on the specific gravity of the product at a temperature of 60° F. and the time of year when loaded.[2] Conversion tables are provided to convert this information to the existing temperature of the commodity. The number of gallons permitted to be loaded in the tank then can be computed. Tables have been made for each car according to its capacity to indicate the number of inches of outage necessary to provide the required number of gallons.

Since the actual capacity of each car may vary, it is necessary to have outage tables for each car that is loaded by the shipper.

3. Inspection of Tank Car Loading Facilities

Shortly after the accident representatives of the DOT inspected the Shell Oil Company's plant in Alton, Illinois, where the tank cars involved in the accident were loaded.

Cars of specification DOT 112A-W are provided in the dome with a 3-inch vent valve which is connected to the top inside of the tank and a 3-inch eduction valve connected to a pipe which extends downward inside of the tank to

[2] Appendix No. 1.

Initial	Number	Class	Gals Cap.	Type Steel	Inside Dia.	Surface Area Sq. Feet	Thickness Sheets – ins. Side Head	Safety Valve Start to Dis. Pressure –1ds	Safety Valve Flow Cap. Air CFM	Lt. Wt.	Sp. Per. No.	Date Bit
NATX	32019	112A340W	32722	A212GrB	102.6&120.3	1990	.73 25/32	280.5	39,300	102,000		8-63
NATX	32025	112A340W	32722	A212GrB	102.6&120.3	1990	.73 25/32	280.5	39,300	101,000		9-63
NATX	32015	112A340W	32750	A212GrB	102.6&120.3	1990	.73 25/32	280.5	39,300	102,900		8-63
NATX	31021	112A400W	31233	A212GrB	102 3/8-120 3/8	1885	13/16&.95. 77	300.0	42,200	108,900		2-63
NATX	31006	112A400W	31233	A212GrB	102 3/8-120 3/8	1885	13/16&.95. 77	300.0	42,200	108,900		–
NATX	33990	112A340W	33820	AAR M-128GrB	102.8-118.6	2054	.6&.69-.6	280.5	39,300	94,700		4-66
NATX	33988	112A340W	33820	AAR M-128GrB	102.8-118.6	2054	.6&.69-.6	280.5	39,300	94,200		4-66
SCMX	3445	112A400W	33593	TC128GrB	118.5	1961	.73 25/32	330	42,900	96,100		11-69
SOEX	3150	112A340W	33675	M-128GrB	119.0	1954	5/8 11/16	280.5	27,750	83,600		12-68
SOEX	3252	112A340W	33695	TC128GrB	119.0	1954	5/8 11/16	280.5	36,640	84,700		11-69
SOEX	3037	112A340W	33645	A212GrB	104 9/16-116 3/8	2028	— —	280.5	28,100	100,300		11-64
SOEX	3219	112A340W	33969	TC128GrB	118.0	1983	5/8 11/16	280.5	36,640	85,800		6-69

Figure 11. The Start-to-Discharge Pressures and the Flow Capabilities

within several inches of the bottom of the tank. Loading hoses can be attached to either of these valves. At this plant, the loading hoses were attached to the vent valve which provides a spray type loading process in the tank. The commodity is delivered to the car under a pressure of 180 to 200 pounds.

Several gauging devices may be used for determining the outage in the tank, but at this facility the "dip stick" gauge was used. This device consists of a small diameter tube which is extended a predetermined distance downward inside of the car. The outage establishes the distance between the top of the tank and the bottom of the tube. When the liquid is below the bottom of the tube, only vapor emerges from the tube, but as soon as the liquid reaches the bottom of the tube, the pressure in the tank will force liquid out of the tube, signifying that the desired depth has been obtained.

A railroad inspector examined each tank car before and after loading to ascertain if the car was in a suitable condition to move to its destination and whether it was properly placarded. He did not, however, check the loading procedures of the cars or check the data that was used by the shipper in determining the required outage.

4. Loading of the Tank Cars Involved in the Accident

The bills of lading for the tank cars involved in the accident indicate that they were loaded with the amounts as described in the chart of Appendix 1 and were consigned to the Shell Oil Company in Middletown, Ohio. They were released for movement on June 19, 1970. The bills of lading indicate that the same outage measurements were used for tank cars that had different capacities. This resulted in four of the cars being slightly overloaded. Computations made of the amount of LPG in each car, using the specific gravity and temperatures as recorded, indicates that the following cars were overfilled by the amounts shown:

SOEX 3252 - 279 pounds
SOEX 3150 - 440 pounds
SOEX 3219 - 300 pounds
SCMX 3445 - 557 pounds

The shipper stated that in the event a car is overfilled, the excess should be piped to an empty car.

5. Metallurgical Examination of the Tank Cars

The Railway Progress Institute - Association of American Railroads (RPI-AAR) Tank Car Research and Test Project Group took samples of the steel from the tank cars which had been separated into sections and propelled out of the confines of the general derailment area when the tank cars ruptured. The Federal Railroad Administration (FRA) took similar samples for testing by the National Bureau of Standards.

The RPI-AAR reported that the structure of the steel was similar to that specified for the construction of tank cars of this class. In one of the samples removed from SCMX 3445, it was found that the fracture was in the weld area for a short distance but that it then moved away from this area for the remaining length of the circumference of the tank. This indicated that the fracture was not the result of a defective weld.

A preliminary report received from the National Bureau of Standards indicates that the physical and chemical properties of the specimens tested by them appear to meet the tank-car material specifications. The weld efficiency was determined to be within the range of specifications. It was also found that the fractured surfaces of the Crescent City speci-

mens did not have the lamellar fracture tongues[3] which were found in specimens removed from tank cars involved in other similar accidents.

The samples were checked to determine the impact properties and the following Charpy V-notch properties were obtained:

	Longitudinal		Transverse	
	head	shell	head	shell
15 foot pounds	89½° F.	36° F.	87½° F.	57° F.
15 mil lateral expansion	67° F.	36° F.	65° F.	27° F.
50% sheer fracture	137° F.	85° F.	134° F.	87° F.

The results of the tests indicate that the steel used to manufacture the tank heads had a higher transition temperature and was more brittle than the steel used in the shell. The steel used for the shell was more brittle in the transverse direction than it was in the longitudinal direction. Lower transition temperatures are desirable in each case.

III. ANALYSIS

A. The Derailment

The examination of the failed journal and the marks on the track leading to the site of the derailment confirm that the failed journal subsequently allowed the truck side to drop to the track and initiate the derailment.

[3]The National Bureau of Standards reported that the fractured surfaces of samples taken from several tank cars, which had ruptured under similar circumstances to those cars at Crescent City, appeared to be lamellae, indicating that the fractures were produced as a series of failures of individual lamellae - Report of the NBS of the Metallurgical Analysis of a Steel Shell Plate Taken from a Tank Car Accident near South Byron, New York.

When the dragging truck side of the 20th car moved onto the highway crossing of Route No. 49, just west of Crescent City, the truck side and the wheel were raised sufficiently high by the bituminous material and the planks of the crossing to permit the L-4 wheel to derail toward the north side of the track. The derailed wheels were moved eastward from the crossing over the bridge spanning the small stream west of Crescent City to the switch leading to the siding in Crescent City. At this point the derailed wheels tried to follow the side track. This diverging movement produced sufficient force on the rails to tear out the track, which permitted the following cars to derail.

B. The Hot Journal of CB&Q 182544

1. The Material

When CB&Q was repaired in the owner's shops at Havelock, Nebraska, during the month of February 1969, the trucks were dismantled, and all parts cleaned, inspected, and repaired. When the trucks were assembled, new seals were applied at the front and rear of the journal boxes, together with other new parts. The journal boxes had been provided with all of the devices recommended by the Mechanical Section of the AAR. The axle was manufactured from steel which complied with all of the chemical and physical requirements specified by the AAR. Even though the journal of the axle was slightly worn, it did not approach the condemning limit. The axle apparently had not been overheated previously.

The measurements made of the diameters of the broken portion of the axle at various lengths from the collar indicated that the journal was reduced in size by the excessive heat produced before the journal broke. The spiral type of break found on the fractured surface of the broken journal is typical of that due to overheating with the final failure resulting from the twisting action of the turning axle.

The Research Department of the AAR, which tested the failed journal, concluded that:

1. Check chemical analysis met the requirements of M-126-52, Grade F.
2. A dimensional study showed that the "G" and "A" dimensions met road service and shop limit requirements for plain bearing raised wheel seat freight car axles as outlined in the "Wheel and Axle Manual Standards, Recommended Practices and General Information", Figure 2a.3PB. The "A" dimension also met the requirements for a new axle.
3. The metallurgical microscopic examination showed that this was a heat-treated axle presumably M-126, Grade F. A comparison of grain structure showed that the grain size met the specification requirements.
4. A metallurgical macroscopic examination showed that the steel was of acceptable quality.
5. The failure can be attributed to an excessive heat input to the journal resulting from high frictional forces.
6. The presence of a copper base material adhering to the journal stub was possibly the result of the journal rotating in contact with the brass backing metal of the bearing after lining had melted.

The surface of the journal was destroyed due to the excessive friction and heat which was developed by the original failure of the bearing. The component parts of the bearing assembly were destroyed. The top surface of the journal box was destroyed by contact with the stub end of the journal. Examination of other journal boxes on this car disclosed that they were provided with sufficient oil and apparently had been maintained in accordance with instructions of the AAR and of the carrier. Due to the destruction of the parts of the journal bearing assembly, it was not possible to determine the causes of the initial overheating of the journal box.

2. Inspection

CB&Q 182544 did not receive an inspection nor was any attention provided the journal boxes when the car was loaded with sand by the shipper. After the car was moved to Galesburg, Illinois, by the BN Railroad such attention was provided. The movement of the car to East Peoria yard apparently did not develop any visible defects in the journal boxes nor in the car in general. On arrival at East Peoria yard, the car was inspected and the journal boxes examined to determine if there were any defects present or, if any additional oil was required. The other journal boxes contained sufficient lubrication, indicating that the car had received attention at some recent time. The carrier stated that the inspectors at East Peoria yard were competent and capable of carrying out their assigned duties, and there is no evidence to the contrary.

3. Failure to Detect the Overheated Journal Before the Journal Broke

A witness observed the emission of fire and smoke from a journal box on a car as the train moved through Gilman, about 7 miles west of Crescent City. This witness was seated in his automobile, which was stopped at the highway crossing of route 45 to permit the train to pass. As no other overheated journals were found during the investigation, it is almost certain that the overheated journal observed by the witness was the one that eventually broke after the train passed Gilman. The witness signalled to the members of the train crew in the caboose to warn them of the defective condition but received no response to his signals.

The IC operator at Gilman, who observed the north side of the train as it passed the tower, signaled his observations to the train crewmembers in the caboose, but observed no response from the crew. The operator did not observe the defective journal. However, this could have occurred if no smoke was being

emitted at that time. He had no other means of detecting the heated journals.

As there were no curves in the track between Gilman and the point of the accident to give the crewmembers a chance to observe the condition of the train, the crewmembers should have been maintaining a lookout for trackmen and other employees who could relay information to them on the condition of the train. It is obvious that such surveillance was not being maintained.

It is doubtful whether the conductor or the flagman riding in the caboose would have been able to detect a hot journal on the 20th car of a 109-car train while it was moving on a straight track. Because the crew on the locomotive normally would not look back to inspect their train for defects, except when moving around curves, there was little chance that they would have detected the hot journal.

During the past several years journal boxes on freight cars have been provided with better seals in the lids and at the rear to exclude dirt and other foreign matter from entering the boxes. This also tends to prevent the emission of smoke and fire from the box when it becomes overheated, until the seals have been destroyed by the heat. Journal boxes now are provided with lubricating pads which replace the waste used in the past. When heated, the oil and pads do not provide the amount of smoke and fire that was once produced by the waste. This may account in part for the fact that the railroad personnel did not observe the overheated journal.

4. Improvement of the System of Surveillance

The TP&W railroad between East Peoria, and Effner, has few curves which would give the traincrews a good opportunity to observe the condition of the train. There are also fewer operators and other employees along the route now than there were in the past who would be able to inspect the trains. This means that there are areas where trains are not adequately inspected and defective conditions such as those in this accident go undetected until an accident occurs.

There are devices available to the industry to monitor and detect hot journals on passing trains. When a defect is detected, the information can then be given quickly to the traincrew either by a signal indication, by radio, or by other means of communication. On receiving the information, the crew then can take the necessary corrective or preventive action.

C. The Record of Accidents Caused by Hot Journals

The AAR collects hot box and mileage data and reports the ratio of car miles to freight cars set out of trains between terminals due to hot boxes. A comparison of the mileage for various periods will establish the quality of performance for the journal assembly. During the years 1954 to 1960, inclusive, the average yearly mileage fluctuated between 231,813 and 314,500. Improvements in the design and maintenance of the journal assembly were begun by the railroad industry, through the AAR, following this period. In 1961, the mileage per hot journal set off increased. The improvement continued each year until reaching a high yearly average in 1967 of 1,834,922 miles per hot journal set off.

Despite the high rate of improvement in the incidence of hot journals, the number of accidents which have been caused by the defective condition has not been reduced in a similar manner. In 1955, there were 595 accidents caused by the failures of overheated journals, and in 1969 there were 495. This fact was brought to the attention of the Federal Railroad Administration in the Safety Board's Safety Recommendation R-71-1 dated March 9, 1971.[4]

[4] Appendix No. 2 Safety Board's Recommendation R-71-1

This lack of reduction in the number of accidents when compared to the decrease in the number of incidences of hot journals, may result in part from more difficulty in detecting the defect now than during previous periods. Fewer employees now are located along the tracks between the terminals to inspect the trains, and the design of the journal assembly has been changed—including the use of better seals to make more difficult the detection of a hot journal. Due to the reduction of the frequency of hot journals, traincrews may have become somewhat less attentive in their observation of trains en route. The percentage of hot journal failures resulting in accidents is higher now than during the period prior to 1960.

D. The Handling of the Emergency

When the action of the forces resulting from derailments has ceased, and no spilling of hazardous materials results, there is relatively little risk to bystanders or emergency personnel until the cleanup operation begins. When hazardous material is spilled, the risks increase substantially. At Crescent City, the propane was spilled during the derailment, immediately ignited, and resulted in several injuries to bystanders.

Immediately following the ignition of the propane, the volunteer firemen of Crescent City responded to the emergency and attempted to control the fires. After the first flareup, the flames died down and appeared to be confined in the areas of the general derailment. Because the firemen assumed at this time that the fire could be contained within the general derailment area, they proceeded to extinguish fires in the surrounding buildings which had been started during the initial flareup. In doing this, the firemen took positions which were very hazardous if the tanks had exploded. (See Figure 4.)

The firemen could have determined what was loaded in the tank cars by reading the name of the commodity on the cardboard placards placed on the side of the tank cars or by obtaining the information from the traincrew. However, the intensity of the fire probably precluded the reading of the placards or destroyed them, and the traincrew was not readily available to provide the information. If the first explosion had occurred before the State Police sergeant had warned the firemen to move back to a safer position, and before he had started the evacuation of the town, many more of the firemen and the townspeople could have been injured seriously. The photograph in Figure 12 was taken after the first explosion and shows the devastation to the area where the firemen were located prior to the explosion, as shown in figure 4.

As long as propane was being released from the punctured tank car, there was little chance that the fire could be extinguished by the method employed in controlling the fire. It is not recommended to extinguish such fires, because a more severe hazard can be created by the formation of a gas cloud of propane which easily could have been ignited at a later time with disastrous results. The recommended practice would have been to permit the escaping propane from the punctured tanks to burn and to keep the surrounding tanks cool by pouring large quantities of water on them. The decision to deenergize the powerlines in the fire zone was made to remove an apparent hazard from the drooping wires, but its effect was to shut off power to the town water system and thus to disable firefighting efforts by greatly reducing the water pressure. It cannot be said with certainty that the fire could have been controlled, had the water pressure remained normal. It is possible that the drooping wires would have fallen later and caused a power loss. Nevertheless, the decision did contribute to an increase in the intensity and scope of the fire. The available evidence did not indicate whether it was known that these powerlines fed the water plant or

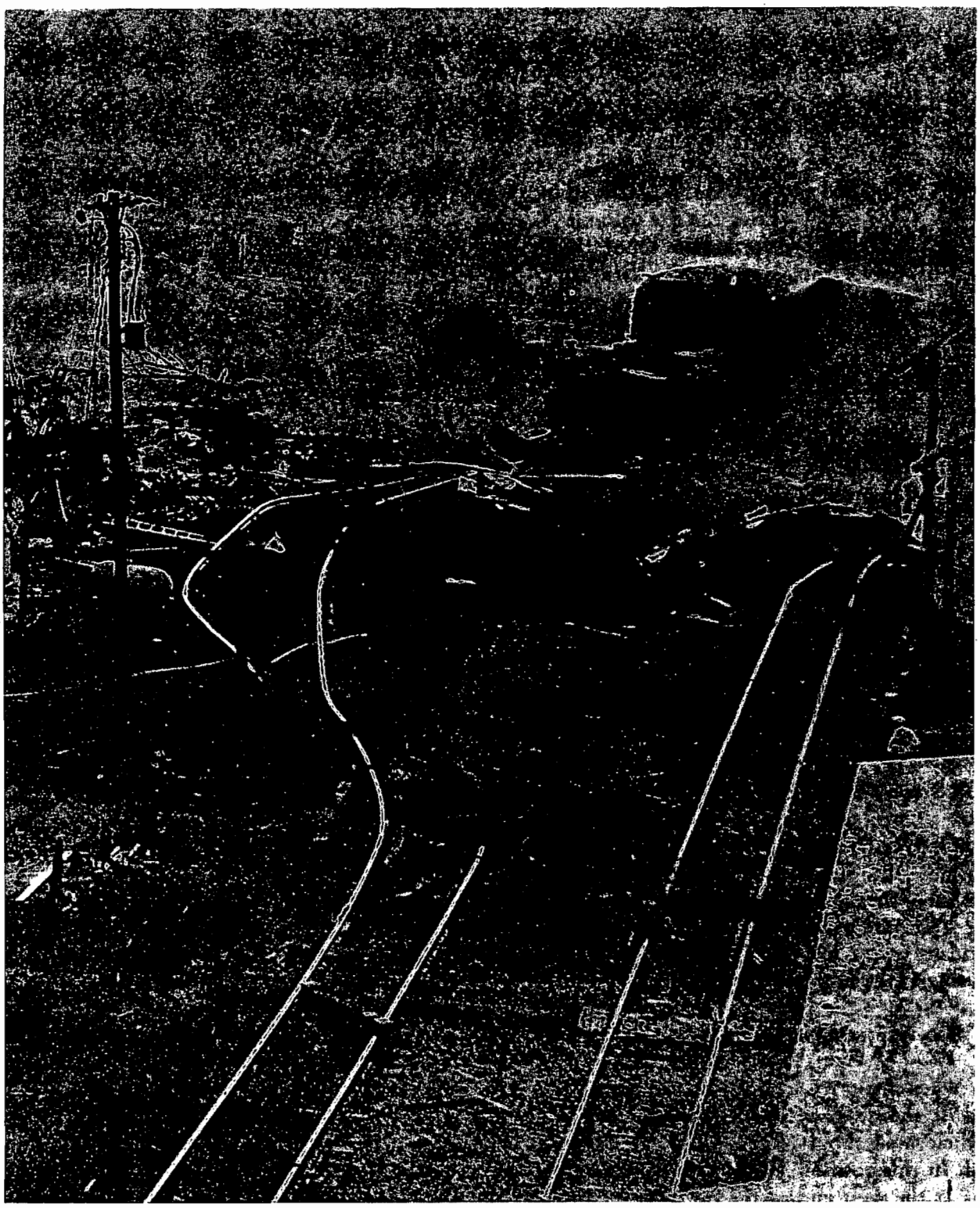


Figure 12. Area at East End of the General Derailment following the Rupture of NATX 32025

whether the consequences of cutting the power were considered.

Numerous companies from the surrounding communities responded to the call for assistance from the Crescent City Fire Chief. As these companies arrived on the scene, they moved into position to assist in fighting the fire without first obtaining complete information about the situation, because there was no place available at that time to provide the information. As a result, the firemen were placed in hazardous positions and some were injured in subsequent explosions. There apparently were no means of directing the activities of the various fire departments from one command point until after the explosions had occurred. The State of Illinois apparently has the nucleus established through the State Fire Protection Districts to coordinate properly the activities of the various rural volunteer fire companies, when they are called to assist each other. Even though the Fire Protection District provides some basic training for the volunteer companies and requires certain minimum standards, overall supervision also could be provided by this source when more than one company is required to answer an emergency.

A State Fire Protection District could be a good source for providing information and training for the local firemen on transportation hazards, both on rails and on the highway. In this case, the individual firemen apparently had not been instructed regarding the hazards of an accident of this size, or what to expect from the heating of the tank cars.

E. The Rupturing of the Tank Cars

When the 27th car came to rest at the east end of the derailment, the west end of the car was elevated about 15 feet higher than the east end. In this position, the vapor space in the tank was at the west end of the car. This end of the car was subjected to the burning propane being emitted from the ruptured car and from the safety valves. Heating of the metal plates of the tank in the vapor space transmitted very little heat to the liquid in the car, thereby preventing the liquid from expanding to the extent where the car would become "liquid full." The heat transfer characteristics of metal-to-vapor is much lower than that of metal-to-liquid. Therefore, the steel sheets were heated to a point where they approached the flow state. The steel sheets began to thin and continued to do so until the thickness of the metal was reduced to a point where the pressure in the tank exceeded the bursting pressure of the thinned sheets. At this point, the tank ruptured. When the ruptures occurred in most of the tanks, the fractures extended circumferentially—dividing the tanks into sections. In a few cases, the tanks split longitudinally. The sudden release of the propane and its ignition produced sufficient energy to propel the sections of tanks as previously described.

F. The Construction of the Tank Cars May have Contributed to the Failure of the Tanks

Tests made of the samples taken from the sections of tank cars which were propelled from the derailment area indicated that the steel met the specifications for chemical and physical properties for tank cars of Class 112-A-W. The CFR specifications, however, do not contain any impact requirements. The National Bureau of Standards developed impact data on the samples that were tested and found that there was a tendency for the steel used in the shells of these tanks to have better impact properties in the longitudinal direction than they did in the tranverse direction. If this is so, then when stresses were sufficiently high to cause a fracture, the break would be in a tranverse direction rather than longitudinally. This could account in part for the tanks breaking into tubular sections or tubs as they did in this accident, and in accidents in the past. This subject will be pursued to a definite conclusion

in research being conducted by the RPI-AAR Research Group.

The information developed by the NBS in the Charpy V-notch tests disclosed that the transition temperatures of the steel used in the shells of the tanks were high, which could account in part for some of the fractured surfaces having a combination of ductile and brittle fractures. A high transition temperature means brittleness at low temperatures.

This accident was still another in the long list of accidents in which the derailing cars mechanically punctured a tank releasing its contents. If the lading is flammable, as was the propane in this accident, it is often ignited immediately, exposing the other derailed cars to a fire environment and subjecting the surrounding area to an intense fire. If the lading is hazardous but not flammable, the surrounding area is still subjected to hazards of almost equal or even greater intensity.

Tank cars of class 1121-A-W are not provided with insulation, and, when exposed to a fire environment, are subjected to stresses of sufficient magnitude to cause them to fracture. If the tank breaks into sections, the released flammable lading when ignited produces more fire which increases the danger to the surrounding area. Transverse failures, such as found here tend to produce a closed tube shape of the tank car which is subjected to reaction propulsion or rocketing.

Both of these problems are being pursued by the RPI-AAR tank car research committee and by the FRA. It is hoped that in the very near future solutions to each will be forthcoming.

G. Description of the Loading Procedures and the Effect they had on the Accident

The "dip stick" method for gauging the outage space in tanks is entirely dependent on the operator's observing the liquid when it is first expelled from the tube. If he were otherwise occupied when the liquid first appears, there is a possibility that he would not detect the indication as soon as required, and the car could be overfilled. As the cars are not weighed after loading, they could be dispatched with an excessive amount of lading which would reduce the outage space.

If the improper outage table is used, or if no tables are available and the tables for other cars are substituted, the cars can be overloaded and dispatched without this being detected. It would appear that the four overloaded cars involved in this accident were loaded by using the outage tables for other cars. This can be assumed from the fact that the same outage figures were used for these cars as for other cars, even though they had different capacities.

The overfilling of the tank could create the situation that as the temperature and pressure increased, the tank could go "liquid full" at a temperature lower than the permitted 115° F. In this accident the car (SCMX 3445) which contained the largest excess of LPG was actually only 132 gallons overloaded. This represents 0.4 percent of the total gallons. This average probably would have caused the car to go "liquid full" at about ½° F. of temperature less than if it had the proper required space. In this accident the ½° F. of change would have represented only a small difference in time. The overloading of the four cars, therefore, did not materially affect the severity of the accident.

H. Action Taken by the Safety Board Immediately Following the Accident

Immediately following this accident, the Chairman of the Safety Board wrote to the president of the AAR, and the presidents of most railroads, calling to their attention the disastrous consequences resulting from the burning and exploding of tank cars in this and similar

accidents and requested that they take immediate action to minimize the results of accidents to trains carrying hazardous materials.[5]

The reply received from the AAR, in which most railroads concurred, stated in part that to provide additional protection to trains transporting hazardous materials, the railroads would:

"1. Accelerate installation of hot box detectors on routes where there are heavy movements of flammable compressed gas and experience and studies show such devices are needed.
2. Expedite installation of dragging equipment detectors.
3. Increase rail inspection with flaw detection equipment.
4. Inspect axles by ultrasonic means with reflectoscope.
5. Expand educational programs for railroad officers and employees in various aspects of handling flammable compressed gas under emergency conditions. Also, increase cooperative programs with local fire departments and other civic groups, to assure proper and coordinated effort during emergencies, (using, for example, kits similar to the one prepared by Southern Railway on this subject, and Bureau of Explosives Bulletin 7-A.
6. Continue research by AAR-RPI in tank car equipment design, with tests to develop improved tank car steels, safety relief devices, impact resistance for tank car heads, car insulation, heat input from fire, and shock input from hurtling metal objects. Further studies should be progressed in the phenomena associated with tank car failures when subjected to thermal and mechanical loads in certain derailment environments.
7. Inaugurate similar research on tank car design by other interested groups, on both long and short term basis. One immediate area of study should be the practical development of safety straps as an anti-rocketing device. Further research should also be conducted in other areas – wheels, running gear, couplers, track, and train dynamics."

* * *

"We also recommend that the following additional performance standards be adopted by the railroad industry.

8. Visual track inspection in accordance with "Recommended Minimum Track Inspection Standard" (attached hereto).
9. Visual inspection and adjustment of all switches and frogs by competent personnel in accordance with "Recommended Minimum Track Inspection Standards" (attached hereto).
10. Strict enforcement of:
   –inspection by trainmen of passing trains;
   –Walking inspection of trains by trainmen when delayed for "meets" or "passes," with critical inspection of running gear and any unusual condition on any car in the train;
   –inspection of passing trains by other railroad personnel who are near the track.
11. Insistence on high quality inspection and maintenance of rolling equipment by qualified personnel at inspection and maintenance points.

[5] Appendix No. 3 - Letter dated July 7, 1970, to presidents of the Association of American Railroads and of the individual railroads from John H. Reed, Chairman, National Transportation Safety Board.

12. Greater participation in the A.A.R. "Early Warning System," an information network designed to monitor and detect incipient accident hazards involving locomotives and cars, and alert all railroads. This system was established as a means of assuring improved safety and control over the mechanical condition of rolling stock. A railroad experiencing a mechanical problem or defect that may have national implications will immediately inform the A.A.R., which evaluates the incident in light of similar known problems on other roads, to determine if there is potential trouble. Where a pattern is found to exist, warnings are given to all railroads to take necessary corrective action.

13. Improve train handling by additional education of employees in the dynamics of train operation, and implement research findings as rapidly as they are developed."

The Association of American Railroads, in their reply, recommended that in a number of areas, assistance could be given in alleviating the dangerous situation which has developed in the movement of hazardous materials by rail. The AAR reply recommended that the increased use of detecting devices to aid in the finding of defective material before an accident occurred would greatly improve the situation. The Safety Board concurs that some improvement would result, but the Board has not been advised as to what extent, if any, the railroads have increased the installations or started to use the recommended devices.

The AAR reply also recommends the education of railroad personnel in the various aspects of handling hazardous materials under emergency conditions. It also recommended that the railroads establish cooperative programs with local fire departments and other civil groups to assure proper and coordinated efforts during the emergency. The Safety Board has made similar recommendations to the railroad industry at the conclusion of investigations of previous accidents, dating from 1969. The Board is aware of three railroads which have implemented the previously recommended action by the AAR or by the recommendations of the Safety Board.

Items 6 and 7 recommend that research on railroad cars be continued, particularly on tank cars. The Safety Board has followed closely the research program initiated by the RPI-AAR Tank Car Research Committee as well as that of the Department of Transportation, and agrees that many benefits will be forthcoming from these endeavors. As an example, at the present time both the Federal Railroad Administration through a contract with the Naval Ordnance Laboratory, and the RPI-AAR are engaged in testing insulating material for coating the outside surfaces of tank cars. The efforts appear promising, and it is hoped that in the near future, a suitable material will be found to increase the life of a loaded tank car in a fire environment. The Safety Board agrees that there is an immediate need for additional research in the areas of wheels, running gear, couplers, and track and train dynamics. Similar action has been recommended by the Safety Board in previous investigations.

The additional inspection and education programs referred to in the remaining items, if properly implemented, would assist in providing safer transportation of hazardous materials by rail. Little information, however, is available to indicate to what extent or means these suggested improvements have been started.

I. Fail-Safe Design of Car Trucks

The Safety Board has noted that a fail-safe feature of truck design might have prevented this journal failure from developing into a full-scale derailment. In other modes of transportation, the running gear is so designed that failures of a single unit do not develop into a single catastrophe. For example, the Boeing 747 aircraft can land on three of its four main landing gear trucks. Most of the tires on a typical tractor-trailer truck are double in mounting so that one blowout can be sustained without causing loss of control. In certain instances, a six-wheel truck on a railroad passenger car can sustain a major failure without causing a derailment.

This general principle of safe design has for some reason not been used in freight car trucks. Several major accidents involving hazardous materials reported by the Board, could have been prevented if freight car trucks had been designed so that the function of a failed component would be carried by some secondary method. These accidents include those at Laurel, Mississippi, at Sound View Connecticut, and this accident at Crescent City.

IV CONCLUSIONS

1. CB&Q 182544, the 20th car of train No. 20, on June 21, 1970, was loaded with sand within its carrying capacity and without prior inspection or servicing of the journal boxes.
2. No exceptions were taken to the condition of the car during inspections made at various points between the loading and the accident points.
3. The journal boxes of CB&Q 182544 were serviced en route, but the adequacy of the servicing could not be determined.
4. There was sufficient time between the beginning of the overheated journal and the derailment in which to detect the defective journal, if some method of surveillance had been in use.
5. The lack of curves on the track made observations of the train by the crewmembers more difficult.
6. Increased use of hot box detectors could have detected the defective journal before it broke.
7. The journal at L-4 location of CB&Q 182544 broke, due to excessive overheating.
8. The cause of the overheating of the journal could not be determined.
9. The placement of the 12 tank cars loaded with propane, coupled together, greatly increased the severity of the accident by allowing flames from one car to play upon another.
10. The separations of the tank cars on derailment resulted in the puncturing of one tank, escape of propane, and fire.
11. The jumbling of the tank cars after they separated exposed the tanks to excessive heating which, in turn, resulted in their exploding.
12. The overloading of several of the tank cars did not increase the severity of the accident nor materially reduce the time between the accident and the explosion of the tanks.
13. Information as to the lading in the derailed cars was not readily available to the firemen and to the other emergency crew.
14. The absence of a properly protected power source, or the failure to provide an emergency source of power for the town's water supply, resulted in a reduction of water to combat the fire.
15. The lack of a central source of command to oversee, advise, and direct the activities of the assisting fire departments resulted in confusion and might have caused injuries to some of the firemen.
16. The lack of adequate training for the firemen who were called to fight this fire resulted in their being exposed unnecessarily to danger.

17. Some of the firemen's protective clothing was not adequate to resist the impingement of fire.
18. The fire-fighting forces in this case were not provided with adequate equipment to handle fires of this type and size.
19. The evacuation of the town and the warnings to firemen of the hazard in fighting the fire were given by the Illinois State Police. This warning resulted in substantially lower casualties than otherwise would have occurred.

V. PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was the breaking of the L-4 journal of CB&Q 182544, the 20th car, due to excessive overheating, which permitted the truck side to drop to the track and derail the leading wheels of the car. The cause of the overheating could not be determined.

The cause of the initial fire was the puncturing of one tank during the derailment, the jumbling of the derailed cars, and the large volume of propane released which immediately ignited and subjected the other tanks to impingement of fire.

The cause of the explosive rupture of several tanks was localized heating which weakened the steel of the tank so that it could no longer resist the pressure of the propane. Contributing to the explosive rupture were (1) the placement of a number of tank cars together in the train which permitted interaction between cars, (2) the speed of the train which tended to allow jumbling of cars to occur, and (3) the absence of heat insulation of the cars which was formerly required.

The injury to the firemen and spectators was due to the lack of appreciation by firemen of the large scope of fire and explosion which could occur in a fire of this type.

VI. RECOMMENDATIONS

The National Transportation Safety Board recommends that:

1. The Federal Railroad Administration conclude the proposed rulemaking regarding the transportation of liquefied flammable gases in tank cars of DOT Specifications 112A and 114A having capacities exceeding 25,000 gallons. This rulemaking was initiated with the Hazardous Materials Regulations Board's "Request for Public Advice on Speed Restriction on Tank Cars," Docket No. HM-60, published in the Federal Register on October 15, 1970.
2. The Association of American Railroads and the Federal Railroad Administration encourage the expeditious completion of the testing of insulating materials for the coating of the outside of tanks, and, if a satisfactory material is found, require its use on all tank cars transporting flammable liquids (liquefied flammable gases).
3. The Federal Railroad Administration encourage the expeditious completion of the RPI-AAR Railroad Tank Car Safety Research and Test Project and take steps to insure that the results of the research are applied to enhance the safety of transportation of hazardous materials.
4. The Federal Railroad Administration promptly publish their current study of the failure of freight car journals, and if necessary, continue such studies so that regulations can be promulgated to establish standards for freight car journals and their maintenance.
5. All railroads which proposed action in response to the July 7, 1970, letter of the Chairman of the National Transportation Safety Board advise the Federal Railroad Administration of the action taken by them and that these railroads and all others who transport liquefied flammable gas in DOT Specification 112A and 114A tank cars

having capacities exceeding 2,500 gallons, as a minimum precaution, initiate such additional action for full compliance with the recommendations of the General Committee, Operating Transportation Division, Association of American Railroads, made in response to the above letter.

The Safety Board reiterates and emphasizes the following recommendations made in previous accident reports:

Railroad Accident Report, Pennsylvania Railroad Company Dunreith, Indiana, January 1, 1968:

8. The Board recommends that the Department of Transportation study means of improving the training methods available to local fire departments so that they can upgrade their skills in their handling of emergencies created by the increasing transportation of hazardous materials. The problems of controlling such accidents are especially troublesome because of the daily introduction into commerce of numerous new kinds of hazardous materials. The Board believes that local emergency organizations cannot be expected to be conversant with necessary procedures to handle situations involving the many possible emergencies involving the transportation of hazardous materials unless some form of assistance in training is provided such as a model type training course.

Railroad Accident Report, Southern Railway Company, Laurel, Mississippi, January 25, 1969:

5. The Safety Board recommends that the Association of American Railroads and the American Short Line Railroad Association develop plans that will result in the fire chief of each community through which the track of a member road passes knowing where immediate information can be obtained, describing the location and characteristics of all hazardous materials in any train involved in a train accident that affects a community. This recommendation can be accomplished in a relatively short time regardless of the level of training which may be achieved later by fire departments.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/JOHN H. REED
Chairman

/s/OSCAR M. LAUREL
Member

/s/FRANCIS H. McADAMS
Member

/s/LOUIS M. THAYER
Member

/s/ISABEL A. BURGESS
Member

March 29, 1972

INFORMATION OBTAINED FROM THE BILLS OF LADING

	Capacity	Gross Gallons	Temperature	Specific Gravity	Gallons @ 60° F	Weight	Outage in Inches
NATX 32015	32750	30437	78	.507	29524	138765	14¼'
SCMX 3445	33593	31353	78	.507	30412	142996	14¼
NATX 31021	31233	29032	78	.507	28161	132357	14¼
NATX 33988	33800	31309	78	.507	30370	142739	14¼
NATX 32025	32722	30588	83	.507	29426	138302	13½
NATX 32019	32722	30411	78	.507	29499	138645	14¼
NATX 31006	31251	29105	80	.507	28145	132282	14
SOEX 3219	33969	31737	80	.507	30690	144243	14
SOEX 3037	33645	31341	80	.507	30307	142443	14
SOEX 3150	33675	31497	80	.507	30458	143153	14
NATX 33990	33820	31913	88	.507	30413	142941	12
SOEX 3252	33695	31999	88	.507	30438	143059	12

APPENDIX NO. 2

UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

ISSUED: March 9, 1971

Adopted by the NATIONAL TRANSPORTATION SAFETY BOARD
at its office in Washington, D. C.
on the 13th day of January, 1971.

FORWARDED TO:
Honorable Carl V. Lyons
Acting Administrator
Federal Railroad Administration
Department of Transportation
Washington, D. C. 20591

SAFETY RECOMMENDATION R-71-1

One of the major factors in derailment attributed to equipment failures is the overheating of journals (hotboxes). The National Transportation Safety Board has conducted a special study of the performance of freight car journals and the relationship of this performance to accidents caused by the failure of overheated journals. During the period 1955 to 1969, inclusive, the failure of overheated journals accounted for from 25 to 43 percent of the derailments caused by equipment failures. During this period, the number of cars set out of trains between terminals because of overheated journals (hotboxes) declined significantly, and the number of car-miles per car set out between terminals because of hotboxes increased dramatically. These occurrences reflect improved lubrication and application of roller bearings.

In 1955, the freight car-miles per car set out between terminals because of hotboxes was 314,500 and, during the next 5 years, there was a slight decline. In 1961, the mileage per hotbox set out between terminals began to increase, reaching a high of 1,834,922 in 1967 and 1,720,668 in 1969; an increase of 483.4 percent and 447.1 percent, respectively .

In 1955, the number of freight cars set out of trains between terminals because of hotboxes was 142,051 (4.13 per million car-miles). This figure declined to 20,069 (0.59 per million car-miles) cars set out because of hotboxes in 1969, a decline of 85.8 percent in the number and 85.7 percent in the rate.

During this same period, total freight car-miles has varied in an irregular pattern between 31,198,000,000 in 1955 and 30,344,000,000 in 1969, with a low of 27,226,000,000 in 1961.

In 1955, the number of accidents caused by the failure of overheated journals was 595 and has varied in an irregular pattern between a high of 821 in 1956 and a low of 360 in 1962. The rate of accidents due to the failure of overheated journals per million train-miles follows a similar pattern. Detailed figures are shown in the attached chart.

It is evident from the available figures that the decline in the number of cars set out of trains because of hotboxes and the big increase in miles per car set out of trains between terminals because of hotboxes has not been reflected in a decline in the number of accidents attributed to the failures of overheated journals. The figures indicate that the ratio of undetected overheated journals (those which failed and caused accidents) to detected hot journals (those set out between terminals) increased drastically. For example, the ratio of "undetected" to "detected" in 1955 (595:142,051) increased from 0.0041 to 0.0246 (495:20,069) in 1969. If the ratio of "undetected" to "detected" had remained at 0.0041 until 1969, one would have expected only about 82 accidents due to the failure of overheated journals ("undetected" hotboxes), rather than the reported 495 accidents.

Generally, accidents caused by the failure of overheated journals occur when trains are operating at moderate to high speeds and result in considerable damage. The extensive damage from this type of accident makes it more important that it be determined why the number of accidents remains relatively high. The Safety Board realizes that the Federal Railroad Administration has been aware of the hotbox problem over the years.

Therefore, The Safety Board recommends that:

> The Federal Railroad Administration determine why there has been no decrease in the number of train accidents attributable to hotboxes in the period 1955 to 1969, inclusive, when there was a significant decrease in the number of hotboxes. The Board believes that the answer to this question may suggest corrective action.

Representatives of our Bureau of Surface Transportation Safety will be available for consultation in connection with this matter if desired.

This recommendation will be released to the public on the issue date shown above. No public dissemination of the contents of this document should be made prior to that date.

Reed, Chairman, Laurel, McAdams, Thayer and Burgess, Members, concurred in the above recommendation.

/s/John H. Reed
By: John H. Reed
Chairman

Attachment

HOTBOX PERFORMANCE

Year	Derailments[1]		Accidents Due to Failure of Overheated Journals[1]			Millions of Car-Miles[2]	Cars Set off Between Terminals Because of Overheated Journals[2]			Mileage Per Car Set off Between Terminals Because of Overheated Journals[2]	
	Total Number	Due to Equipment Failures	Total Number	Per Million Car-Miles	Per Hot Box Detected		Total Number	Percent Change Over 1955	Per Million Car-Miles	Total Miles	Percent Change Over 1955
1955	4857	2149	595	0.019	0.0041	31,198	142,051		4.13	314,500	
1956	5369	2486	821	0.025	0.0048	31,595	169,395	+19.2	4.78	266,018	−15.4
1957	2684	1496	550	0.017	0.0029	30,678	187,033	+31.6	5.48	231,813	−26.2
1958	2579	1498	560	0.019	0.0035	28,077	156,470	+10.1	4.99	257,767	−18.0
1959	2850	1565	659	0.023	0.0041	28,605	157,471	+10.8	4.94	234,223	−25.5
1960	2918	1484	639	0.022	0.0046	28,170	138,695	− 2.3	4.43	262,200	−16.6
1961	2671	1268	471	0.017	0.0060	27,226	77,373	−45.5	2.54	450,450	+43.2
1962	2830	1258	360	0.012	0.0109	27,772	32,809	−76.9	1.06	959,031	+204. 9
1963	3170	1427	422	0.014	0.0135	28,153	31,088	−78.1	0.98	1,017,340	+223.4
1964	3399	1419	465	0.016	0.0167	28,912	27,744	−80.4	0.85	1,182,425	+275.9
1965	3869	1499	470	0.016	0.0193	29,336	24,267	−82.9	0.73	1,391,333	+342.3
1966	4447	1550	393	0.012	0.0192	30,374	20,364	−85.6	0.59	1,710,247	+443.7
1967	4960	1611	385	0.012	0.0209	29,661	18,402	−87.0	0.55	1,834,922	+483.4
1968	5487	1747	436	0.014	0.0219	30,086	19,865	−86.0	0.59	1,721,454	+447.3
1969	5960	1864	495	0.016	0.0246	30,344	20,069	−85.8	0.59	1,720,668	+447.1

SOURCE: [1] Accident Bulletin No. 137
[2] Association of American Railroads

APPENDIX NO. 3

NATIONAL TRANSPORTATION SAFETY BOARD

DEPARTMENT OF TRANSPORTATION

WASHINGTON, D.C. 20591

7-7-70

OFFICE OF THE CHAIRMAN

The National Transportation Safety Board has been conducting an investigation of the accident on June 21, 1970, in which 12 tank cars of liquefied petroleum gas were involved in the derailment of a Toledo, Peoria, and Western freight train at Crescent City, Illinois. In this accident, 10 of the cars burned and/or exploded, rocketed long distances, destroyed much of the town of Crescent City, and injured more than 65 persons. The Safety Board believes prompt corrective action is required to reduce the probability of similar catastrophic accidents, and to mimimize the resultant casualties and damage.

All of the tank cars involved in the Crescent City accident were of similar construction: a type of car having a capacity exceeding 25,000 gallons, designed without a center sill frame so that the tank itself serves as supporting frame of the car. These tanks are approved by the Department of Transporation under DOT Specifications 112A and 114A for the transport of liquefied flammable gas by rail.

The accident at Crescent City is at least the fourth in which tank cars of this design exploded and rocketed long distances. This and similar accidents prove that this type of car can explode or rocket when loaded with othe; liquefied flammable gases. In the Crescent City accident, the puncturing of one tank caused a fire which spread to other tanks jammed together by the derailment. Some tanks exploded as a result of the heat of nearby burning cars and produced enormous fire balls. Some of the tanks ruptured circumferentially, cutting the car in half near the center since there was no separate frame. The expanding gas then propelled the two ends by the jet reaction of the expanding gas, as much as 2,000 feet from the tracks. One section, estimated to weigh 15 tons, produced a fire trail more than 50 feet wide over one and one-half blocks before the 10-foot diameter tank finally crashed through the wall of a house.

Similar behavior of this type of tank car is described in the Safety Board's report of the accident at Laurel, Mississippi, on January 25, 1969. The Laurel accident also occurred in a residential area and resulted in two fatalities, 33 serious injuries, destruction of 54 residences, and damage to more than 1,350 residences. Other accidents involving this type of tank car in large scale explosions and rocketing occurred in open country near Battelle, Alabama, in January 1969, and near Pringle, Texas, in March 1969. In the Laurel and Crescent City accidents, major parts of tank cars, weighing in excess of 15 tons, were propelled long distances at great heights. The maximum trajectories in these accidents were: Laurel, Mississippi, 1,600 feet: Crescent City, Illinois, 2,000 feet; and Battelle, Alabama, 1,900 feet.

The accident causes in the railroad derailments are varied; however, the factors which brought catastrophe to Crescent City and Laurel, are quite similar. First, the violence of the derailments jammed a number of high capacity propane tanks together so that fire effects from one tank could spread to an adjoining tank, producing a fire which could not be approached safely. The large amount of propane released in the explosions produced rapid spread of the fire near the railroad tracks. At Laurel, Mississippi, the speed at derailment was 30 m.p.h.; at Crescent City, the speed was 49 m.p.h. These speeds tend to pile up adjacent cars. Second, the rocketing phenomenon is almost unique to this type of tank. Because there was no underframe (center sill), the tank ends could separate completely, so that they were free to be propelled by the jet reaction effect.

Cars carrying other liquified flammable gases such as vinyl chloride and butadiene have also exhibited this same explosion phenomenon at Dunreith, Indiana; East Germantown, Indiana; and Glendora, Mississippi. Although there are no examples of large scale catastrophes involving large numbers of these cars, they are susceptible to involvement in this type accident. They are potentially as dangerous as those carrying liquefied petroleum gas.

The Safety Board, in its October 6, 1969, report of the accident at Laurel, Mississippi, recommended that the Department of Transportation develop a cooperative program with the Association of American Railroads, manufacturers of tank cars, and producers and shippers of hazardous materials to develop a full range of technical improvements to completely resolve the problems noted above. We are aware that the Railway Progress Institute, the Association of American Railroads, and major tank car builders and lessors recently jointly announced the launching and funding of a joint research program to find ways to improve the protection level for tank cars under abnormal conditions such as at Crescent City. Even though this work is in process, the accident at Crescent City indicates that interim solutions to prevent the hazards posed by this type tank car are urgent while studies and research are pursued and more permanent solutions are sought.

In addition, the Crescent City disaster resulted in severe burns to firefighters who were fighting the initial fire at close range when the tanks of propane exploded. It was noted that the evacuation of persons near the track prevented an even larger number of casualties. The Board believes that this type of accident requires immediate evacuation and that the need for such evacuation should be made known to public authorities throughout the Nation. In its report of the accident which occurred at Dunreith, Indiana, on January 1, 1969, the Safety Board recommended to DOT that special training should be provided for local fire departments. Additional similar recommendations to the Association of American Railroads were made in the Safety Board's report of the accident at Laurel, Mississippi. The Crescent City accident once again demonstrates that when such large-scale accidents occur, local firefighters are still exposed to a high degree of risk due to their lack of immediate knowledge as to the best procedures for fighting the fire.*

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*An example of commendable voluntary action taken in his regard is the creation by the Southern Railway Company of hazardous materials "GO TEAMS" with special training and equipment to combat hazardous materials accidents. These teams are touring their entire system, informing fire departments of the problems involved in the release of hazardous materials.

We understand that the General Committee of the Operating - Transportation Division of the Association of American Railroads will consider these problems as part of their agenda at their regular meeting on July 9, 1970. The Board hopes that a positive program for prompt corrective action will result from this meeting. The long-term correction of this explosion and rocketing tendency depends on research and development, including full-scale testing such as the Board recommended in its report of the Laurel accident. We recommend to the Association of American Railroads and to all railroads, that the following interim and long range actions be considered:

1. Appropriate control of the speeds of trains containing DOT Specifications 112A and 114A tank cars exceeding 25,000 gallons when such cars transport liquefied flammable gases. Southern Railway limited speeds to 15 miles per hour through towns after the Laurel accident.

2. When practicable, cars of DOT Specifications 112A and 114A exceeding 25,000 gallons capacity carrying flammable liquefied gases, should be separated by cars containing commodities not regulated under 49 CFR 171-179, inclusive, or noncombustible commodities regulated under 49 CFR 171-179, inclusive.

3. As feasible, reduce the use of the above type cars in transporting liquefied flammable gases.

4. Steps be taken to advise local firefighters of the hazards when they are combatting fires in the vicinity of burning tank cars containing liquefied flammable gases and of the need for the evacuation of persons.

5. Modification of DOT Specifications 112A and 114A for tank cars exceeding 25,000-gallon capacity so that they can safely carry liquefied flammable gases.

The Board wishes to commend the Association of American Railroads for establishing a full time director of safety in their Safety Section. We are confident that industry leaders recognize the critical nature of the problem described in this letter and we are hopeful that positive corrective action will be taken at your meeting this week. We would appreciate being advised of the interim and permanent steps proposed to be taken by the Association of American Railroads, the General Committee, and the individual railroads.

Sincerely yours,

/s/John H. Reed
Chairman