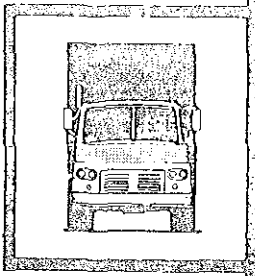
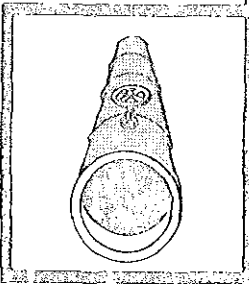
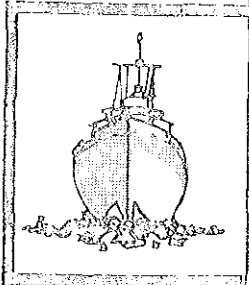
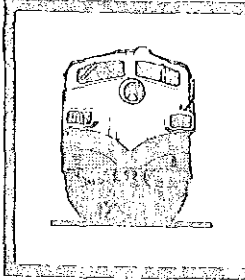
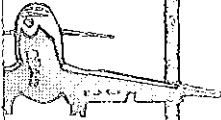


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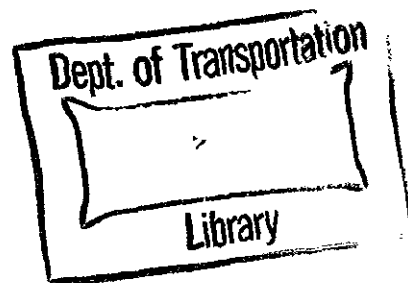


NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

ST. LOUIS SOUTHWESTERN RAILWAY COMPANY
FREIGHT TRAIN DERAILMENT AND
RUPTURE OF VINYL CHLORIDE TANK CAR
LEWISVILLE, ARKANSAS
MARCH 29, 1978



UNITED STATES GOVERNMENT

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16. Abstract <p>About 12:10 a.m., on March 29, 1978, 4 locomotive units and 43 cars of St. Louis Southwestern Railway Company freight train SRASK derailed when they entered an 8° curve in the wye track at Lewisville, Arkansas. The body of the 13th car struck and ruptured the tank head of the 12th car, releasing vinyl chloride into the atmosphere. The vinyl chloride subsequently ignited and buildings within a 1,500-foot radius of the ruptured car were damaged. About 1,700 residents of Lewisville were evacuated. The engineer and two head brakemen were injured. Property damage was estimated to be \$2,189,000.</p> <p>The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer and other crewmembers to slow train SRASK for the 10-mph speed restriction through the wye track as required by the railroad's general orders. As a result of the train's high speed and consequent emergency brake application, the high rail in the curve moved laterally, allowing the locomotive to derail, and subsequently turn over, and the following cars to derail. The release and ignition of vinyl chloride from the ruptured tank car caused extensive damage to the train equipment and the adjacent industrial plant and buildings.</p>					
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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

Adopted: December 7, 1978

ST. LOUIS SOUTHWESTERN RAILWAY COMPANY
FREIGHT TRAIN DERAILMENT AND RUPTURE OF
VINYL CHLORIDE TANK CAR
LEWISVILLE, ARKANSAS
MARCH 29, 1978

SYNOPSIS

About 12:10 a.m., on March 29, 1978, 4 locomotive units and 43 cars of St. Louis Southwestern Railway Company freight train SRASK derailed when they entered an 8° curve in the wye track at Lewisville, Arkansas. The body of the 13th car struck and ruptured the tank head of the 12th car, releasing vinyl chloride into the atmosphere. The vinyl chloride subsequently ignited and buildings within a 1,500 foot radius of the ruptured car were damaged. About 1,700 residents of Lewisville were evacuated. The engineer and two head brakemen were injured. Property damage was estimated to be \$2,189,000.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer and other crewmembers to slow train SRASK for the 10-mph speed restriction through the wye track as required by the railroad's general orders. As a result of the train's high speed and consequent emergency brake application, the high rail in the curve moved laterally, allowing the locomotive to derail, and subsequently turn over, and the following cars to derail. The release and ignition of vinyl chloride from the ruptured tank car caused extensive damage to the train equipment and the adjacent industrial plant and buildings.

INVESTIGATION

The Accident

About 9:50 p.m., on March 28, 1978, St. Louis Southwestern Railway Company (SSW) train SRASK 1/, a northbound freight train consisting of 4 locomotive units and 116 cars, departed Shreveport, Louisiana, for Pine Bluff, Arkansas. Originating in Strain, Texas, on the Southern Pacific Transportation Company, SRASK was being operated as a run-through train at Shreveport, where a roll-by inspection disclosed no defects. A test for brake leakage was not performed.

1/ The letter "K" in the train identification indicates the presence of hazardous material cars in the train consist.

Shortly after leaving Shreveport, the engineer closed the cab windows because of the cold weather. He later checked the train's speedometer and found it functioning properly. At Alden Bridge, 42 miles from Lewisville, Arkansas, a satisfactory stop was made by using the train's automatic air brakes. About 24 miles from Lewisville, the engineer radioed the conductor that they were passing a "hot box" detector. The conductor acknowledged the transmission and, after passing the detector, replied that it indicated a satisfactory journal box condition.

At 12:02 a.m., when 6 miles from Lewisville, the rear brakeman in the caboose radioed the Lewisville operator to inform him that SRASK would arrive in Lewisville about 12:15 a.m. He also asked if the train would be able to continue through the Lewisville siding and onto the main track for Pine Bluff without stopping. About a minute later, the operator, after checking with the dispatcher in Pine Bluff, radioed that train SRASK could continue through Lewisville if it arrived before 12:15 a.m. The rear brakeman then radioed the information to the engineer and, receiving no reply, immediately repeated the message. This time, the head brakeman in the locomotive cab answered and said he understood the Lewisville operator's instructions. The engineer later said that he had been busy and, consequently, let the head brakeman operate the radio to respond to the rear brakeman. The engineer also stated that since he had 13 minutes to travel the 6 miles to Lewisville, he was in no hurry.

According to the engineer, as SRASK approached the milepost sign indicating 1 3/4 miles to the Lewisville wye, the train was moving at 35 mph and he made a 6-pound service application of the brakes. This was the first brake application in about 23 miles, since near the hot box detector. While passing the Lewisville yard limit sign, about 1 mile from the wye, the train entered some ground fog; however, the engineer said he did not become disoriented. Believing the train was not slowing adequately for the 10-mph maximum authorized speed for the upcoming curve in the Lewisville wye, the engineer said he increased the brakepipe reduction to 15 or 20 pounds as the train passed a road crossing 3/5 mile from the wye. The engineer said that he made an emergency brake application about 1/2 mile from the wye but that a simultaneous emergency brake application had occurred automatically because of an explosion before the train derailed.

The head brakeman stated that, as the train entered the patch of ground fog, he became disoriented and was not able to see the track until SRASK passed out of the fog about 1/5 mile from the wye. Estimating the speed at this point to be over 30 mph, which was too fast to safely traverse the wye curve, he immediately reached for the emergency brake valve. The train went into emergency before he could activate the valve, so he braced himself in anticipation of the locomotive rolling over. After the lead locomotive unit passed the wye switch and entered the 8° curve, the head brakeman felt the locomotive tip onto its left side and slide for about 50 feet. (See figure 1.) While trying to get out of the locomotive, the head brakeman

heard an explosion. The concussion knocked him and the engineer to the bottom of the cab. The two men escaped from the cab by climbing through a window, and they made their way through heavy fire and smoke to safety. The head brakeman looked back for the swing brakeman, who was riding in the second locomotive unit, but did not see him; the unit was engulfed in flames.

The swing brakeman in the second locomotive unit said that although he thought the train was moving too fast at the road crossing to adequately slow for the speed restriction in the wye, he did not act to slow the train because he believed the engineer was "cautious" and would act properly to slow the train. The brakeman also thought he may have been mistaken about the train's location. He estimated that the train's speed entering the wye was more than 35 mph. When he saw the lead locomotive unit begin to tip over, the brakeman braced himself. He escaped from the cab of the second unit as it filled with mud, rock, and intense heat. He said he did not hear a whistle being blown for the road crossing and did not hear an explosion before the derailment.

In the caboose, the conductor and rear brakeman felt the brakes apply and the train slow when the engineer made the initial 6-pound service brake application. Because they were unable to determine their exact location in the darkness, they took no exception to the lack of additional braking as the train approached the wye. Before the emergency brake application, they did not feel any unusual motion or slack action in the caboose. After the train stopped, the rear brakeman saw the fire ignite near the head end of the train. The conductor noted the time as 12:10 a.m., then radioed the Lewisville operator that SRASK had stopped and they could not contact the engineer. The operator responded that he would go to the scene. The conductor then began inspecting the train and found eight cars near the rear had derailed. When he reached the middle portion of the train, which was blocking the road crossing, he obtained a ride to the Lewisville station with a truck driver who had been waiting for the train to pass. The rear brakeman later was instructed by radio to walk to the road where he would be met by someone and driven to the Lewisville station.

The initial derailment occurred about 100 feet into the wye curve near the southwest edge of the city. (See figure 2.) The J&P Petroleum Products, Inc., Company (J&P) was adjacent to the wye on the east side of the track. The business district and main residential areas began about 1,000 feet northwest of the wye.

As the lead locomotive unit turned over, the following 3 locomotive units and 16 cars derailed. The 20th to 23rd, 26th to 42nd, and 86th to 94th cars also derailed. The body of the 13th car struck and ruptured the head of the 12th car, a tank car containing vinyl chloride. Escaping vinyl chloride ignited with an explosive force, engulfing the locomotive, the 1st through 16th cars, and a J&P shed and storage area. The 29th car, a tank car containing tetrahydrofuran, was also leaking at an underbody valve. Its contents poured into an adjacent swampy area without igniting.

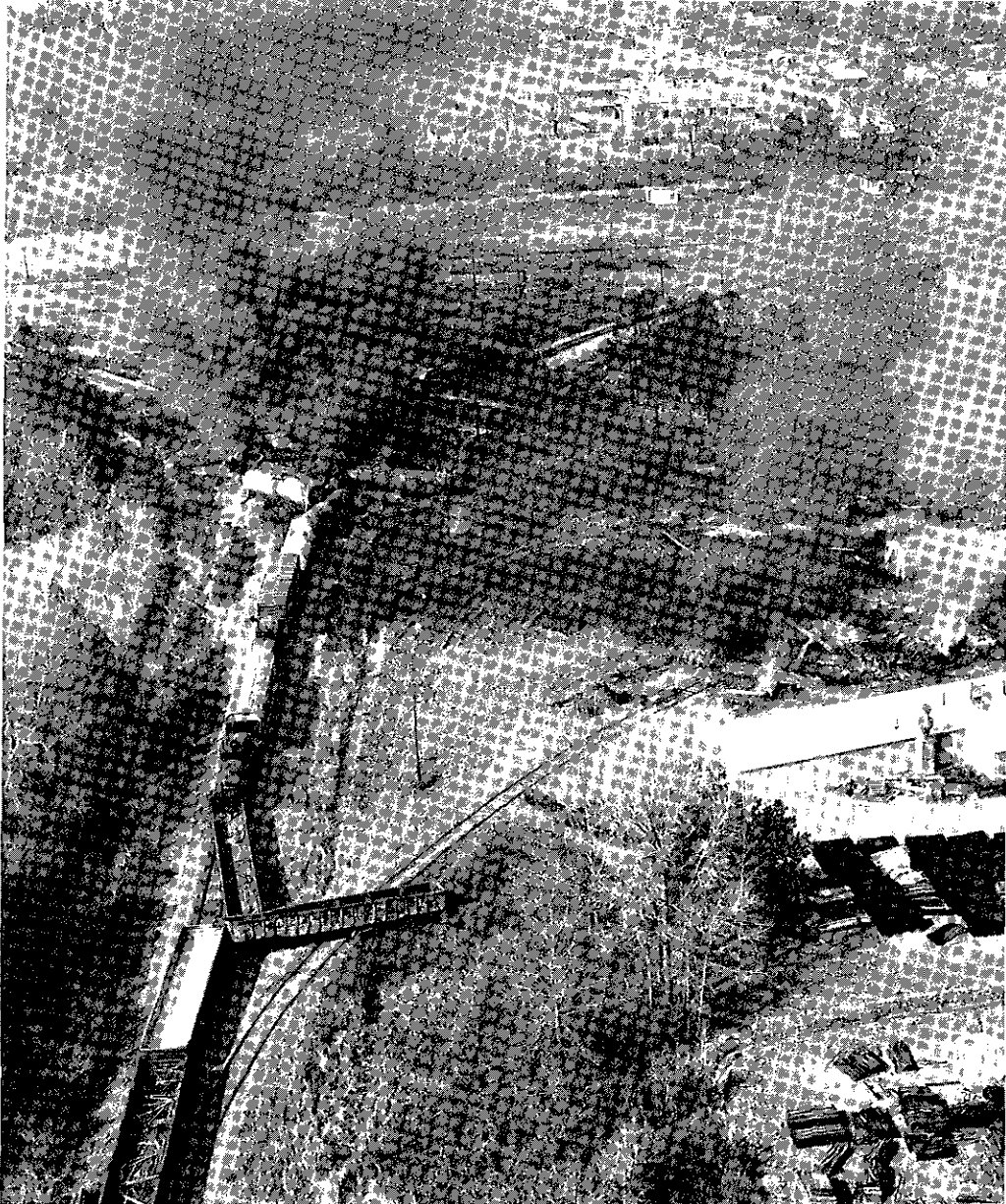


Figure 2. Aerial view of accident site.

A northbound train arriving at Lewisville moves on nearly straight track for more than 2 miles approaching the wye. There is an average 0.10 percent descending grade in the first mile and an average 0.13 percent ascending grade in the second mile approaching the wye and point of derailment from the south. The 8° curve at the wye had an elevation of 1 inch.

Injuries to Persons

	<u>Crewmembers</u>	<u>Passengers</u>	<u>Other</u>
Fatal	0	0	0
Nonfatal	3	0	0
None	2	0	

Damage

Two of the four locomotive units were destroyed, and two were heavily damaged. (See figure 3.) Twenty-two of the 43 derailed cars were destroyed and the others were damaged. The 12th car's trailing head was dented and its tank torn on the left side at the junction of the trailing head and shell. The tear was 82 inches long at the weld line between the 7 and 10 o'clock positions. (See figure 4.) About 500 feet of track, including one switch, were destroyed. An additional 1,070 feet of track were damaged.

One J&P building and a materials storage area were destroyed. Several other buildings within the explosion concussion area were damaged.

The cost of damages was estimated to be:

Equipment	\$1,648,000
Track	65,000
Lading	240,000
Property	<u>236,000</u>
Total	\$2,189,000

Traincrew Information

The 61-year-old engineer's last physical examination, in December 1976, disclosed no defective physical condition. He had been operating locomotives for 21 years and had made about 400 trips over the Shreveport-to-Lewisville territory. His fellow employees considered him a good engineer.

The 47-year-old head brakeman, who was in the lead locomotive at the time of the accident, had been a brakeman for 10 years. The 32-year-old swing brakeman had been a brakeman for 11 years. Both men were found fit for duty when last given a physical examination.

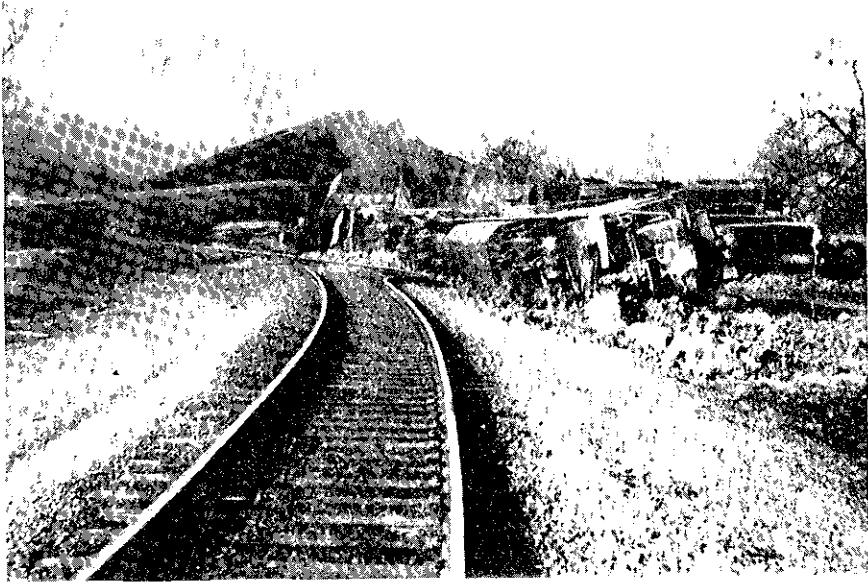


Figure 3. Track and lead locomotive unit.

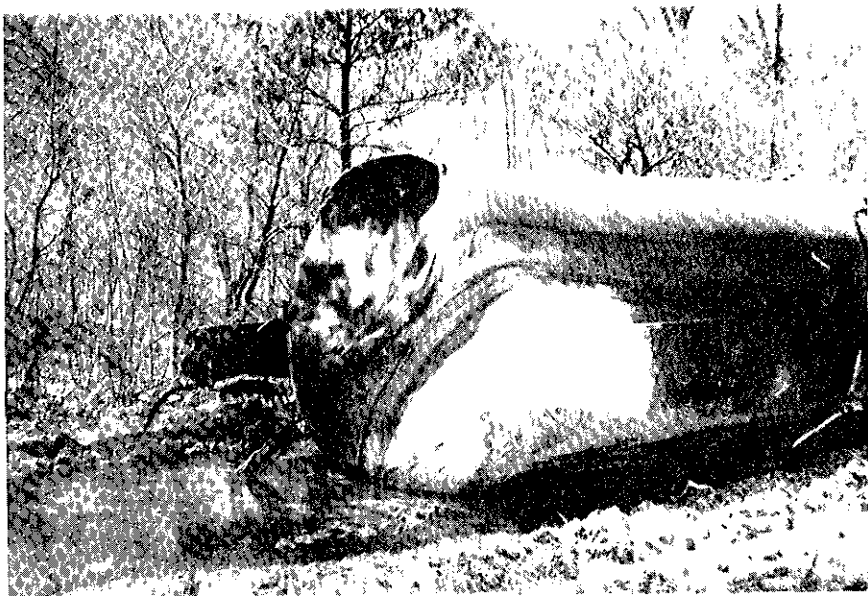


Figure 4. Ruptured end of tank car.

The conductor was 60 years old and his last physical examination, in July 1974, indicated he was fit for duty. He had been a conductor for 15 years. The rear brakeman was 35 years old. He had been a brakeman for 11 years. His last physical examination indicated he was fit for duty.

On March 28, 1978, when the crewmembers of the train reported for work in Shreveport at 9 p.m., they had been off duty for 9 hours. The number of hours of rest or sleep each had could not be determined. Their off-duty hours, however, complied with Federal regulations for hours of service. (See appendix B.)

Train Information

The 10th and 11th, 12th through 15th, 28th and 29th, 35th through 41st, and 54th through 57th cars of the train were tank cars loaded with butadiene, vinyl chloride, tetrahydrofuran, propylene oxide, and butadiene, respectively. The cars complied with U.S. Department of Transportation (DOT) specifications for transport of the liquids and gases. The ruptured 12th car had a capacity of 25,000 gallons and complied with DOT specifications for DOT 112A340W tank cars. None of the tank cars was equipped with headshields or top and bottom shelf-type couplers.

The locomotive consisted of four units with the following specifications:

<u>Type</u>	<u>Weight (pounds)</u>	<u>Axle</u>	<u>Equilibrium Speed</u>	<u>8° Curve, 1 inch Elevation Overturning Speed</u>
U33C	413,000	6	14 mph	68 mph
U33C	411,000	6	14 mph	68 mph
GP35	265,000	4	14 mph	70 mph
SD40	394,000	6	14 mph	70 mph

The locomotive units were equipped with dynamic brakes, No. 26-L airbrake systems, automatic emergency brake sanding, wheel slip-slide detectors, speed indicators, fixed and oscillating headlights, and radio with which the locomotive crewmembers could communicate with crewmembers on the caboose, on other trains, and with the dispatcher and operators. The locomotive was not equipped with an operable safety control device or speed or event recording equipment.

Method of Operation

Trains operate from Shreveport to Lewisville by timetable and train orders; an automatic signal system is not used. The maximum authorized speed for most trains is 40 mph; trains carrying hazardous materials are restricted to 35 mph. Speed through the 8° curve at the point of derailment is restricted to 10 mph. Normal daily traffic consists of four freight trains in each direction. No passenger trains operate over this line.

As a northbound train approaches the wye, its engineer generally will apply the brakes with about a 6-pound brake pipe reduction. To slow the train to the required 10 mph, he then will have to reduce the throttle to idle and further reduce the brake pipe pressure by about 10 pounds.

If the dispatcher cannot allow the train to continue through Lewisville, the operator will so notify the engineer by radio, so the train will be stopped before entering the wye. This keeps grade crossings in Lewisville clear.

Crewmembers for the trains are assigned from a job pool on a first-in, first-out basis. Their home terminal is Pine Bluff, Arkansas. The SSW provides hotel accommodations at Shreveport, 198 miles from Pine Bluff, for crewmembers that lay over.

The crewmembers of train SRASK were provided with information regarding the contents and location of all hazardous material cars in the train when they reported for duty at 9:00 p.m., March 28, 1978. No supervisory personnel were required to meet and evaluate the crew's fitness for duty.

Meteorological Information

At the time of the accident it was dark, humidity was about 50 percent, and the temperature was about 53° F. The sky was clear; however, patches of localized ground fog affected visibility. The wind was southerly at about 4 mph.

Fire

The vinyl chloride vapor cloud from the punctured tank car immediately ignited, causing an explosion and a fireball which extended about 1,000 feet in diameter. Its concussion was felt as far as 1,500 feet from the car. Local fire department personnel responded to the fire; the first firefighters at the scene thought the explosion and fire had started in the J&P Petroleum Products company. Unaware in the smoke and darkness that the train had derailed and was burning, they directed their initial efforts to extinguishing the burning buildings and storage area next to the track.

About 20 minutes after the gas ignition, railroad officials advised the firefighters that three additional tank cars of vinyl chloride and two of butadiene were among the derailed cars in the fire area. Because of the threat of additional ruptures, the firefighters left the scene. State and local police and civil defense authorities evacuated the 1,700 residents of Lewisville.

The intensity of the fire decreased during the following 24 hours when the other commodities involved in the derailment and fire, such as newsprint, plastic pellets, and carbon black, were consumed. Residents were allowed to return to their homes during the morning of March 30, 1978.

Medical and Pathological Information

The engineer and head brakeman sustained scratches, bruises, and third-degree burns on the hands. The swing brakeman sustained abrasions and contusions on the face and second-degree burns on both hands. They were hospitalized for treatment of their injuries.

Survival Aspects

The vinyl chloride was being shipped as a flammable compressed gas. The ignition of the escaping gas caused a fireball that burned trees and stored building material within a 500-foot radius of the ruptured tank car. No residents of Lewisville lived within the fireball area and none was injured. The three injured train crewmembers were protected by the locomotive cabs and other derailed cars from direct contact with the fireball. Residents were evacuated as a precautionary measure in the event other hazardous material tank cars in the train ruptured.

Tests and Research

An airbrake test of the train's 73 remaining cars conducted immediately after the accident disclosed 4 cars with inoperative airbrakes and 4 cars with excessive piston travel. Mechanical inspection of the 43 derailed cars disclosed no defects that would have contributed to the derailment.

The locomotive also was inspected immediately after the accident. The throttle was in the No. 8, full-power position, the automatic brake valve was in the emergency position, and the independent brake was fully applied. All control levers on the trailing units were in their proper positions. The speedometer in the lead unit was tested and found to work properly.

The locomotive sanding system on train SRASK was tested and found to work properly. When the train brakes were applied in emergency, the locomotive's sanding system would have automatically deposited sand on the track to improve stopping ability. Sand was found on the track only over the area of the derailed locomotive.

The track in the 8° curve was constructed of 113-pound continuous welded rail (CWR) manufactured in 1951. Each rail had 16 anchors per 39 feet of track and rested on 7 3/4 by 11 3/4-inch, double-shoulder tie plates laid on 24 7 by 9-inch by 8-foot 6-inch crossties per 39 feet of track. The rail was secured by three trackspikes per tie plate. The track was ballasted with crushed granite rock and last surfaced in

August 1976. A track inspector riding a motorcar inspected the track in the area the day before the accident and found no defects.

Inspection of the track structure and switches in the derailment area disclosed no defective conditions that would have contributed to the derailment. The J&P and wye switches were secured and locked in their proper alignment for the main track. The high rail of the curve in the area of the derailed locomotive was moved outward laterally and had a large S-bend in the area of the lead locomotive unit's truck (see figure 4). All broken rails had broken under stress from the derailment, and no internal defects were evident. Measurements taken of the undestroyed track structure disclosed the following: gage varied from 1/4 to 3/4 inch more than standard; alignment varied from 3/4 inch less to 1 inch more than design; and superelevation of the high rail varied from 5/8 to 1 1/4 inches.

Inspection of the hotbox detector 24 miles south of Lewisville disclosed no defective condition; however, its timeclock was running 2 minutes fast. The time stamped on its tape for the passing of train SRASK was 11:43 p.m., March 28, 1978.

Other Information

When train SRASK arrived at Shreveport via the Southern Pacific, it was operating as a run-through train and was required to comply with Federal regulation 49 CFR 232.19 (see appendix A), which requires certain airbrake tests on run-through trains.

ANALYSIS

Train SRASK did not comply with Federal power brake regulations before leaving Shreveport. The satisfactory stop made at Alden Bridge indicated that the brakes on the train were functioning properly, however, and after the accident, the train's brakes were not found to be defective. However, the SSW should review its operating procedures at Shreveport to insure that both its car department employees and train crewmembers properly comply with Federal power brake regulations.

Postaccident inspection of the track and switches in the derailment area disclosed no defective conditions that could have contributed to the cause of the derailment. Postaccident inspection of train SRASK's locomotive and cars revealed no mechanical defects that could have contributed to the cause of the derailment. When the rear brakeman radioed the Lewisville operator at 12:02 a.m., train SRASK had traveled the 18 miles from the hotbox detector in 21 minutes. This would require an average speed of about 51 mph, a speed 16 mph faster than that authorized. The train was still 6 miles from the wye and would have needed to travel at an average speed of only 30 mph to be in Lewisville before 12:15 a.m. However, since the following 4 miles of track approaching the yard limit

sign contained only minimal grades and curves, the train speed would not have changed much until the engineer made a brake application and reduced the throttle. Consequently, when the engineer took the minimum braking action 1 3/4 miles from the wye, the speed of his train must have been more than the maximum authorized speed of 35 mph.

The fact that the crewmembers in the caboose felt the brakes apply and the train begin to slow after they had radioed the Lewisville operator confirms that the engineer did make an application of the automatic brakes when the train was about 1 3/4 miles from the wye. Though this braking could have reduced the speed of the train to below 51 mph, it still was greater than the 35 mph estimated by the swing brakeman as the locomotive passed over the road crossing 3/5 mile from the wye. Also, lack of additional braking or throttle reduction would have allowed the train to continue at a speed, as recalled by both the head and swing brakemen, of over 35 mph through the J&P switch and out of the fog 1/5 mile from the wye.

The maximum authorized speed through the 8° curve was 10 mph. The theoretical overturning speed for the lead locomotive unit on an 8° curve with 1-inch elevation was 68 mph; the train did not attain that speed as it entered the curve. Had the train been moving over 68 mph, the lead locomotive unit probably would have overturned without destroying the track, and the turning action of the wheels would have marked the field side of the high rail. Such marks were not found in this accident. However, the high lateral forces produced by the wheels of the lead locomotive unit as it entered the curve at a speed greater than 35 mph were sufficient to overcome the holding power of the three trackspikes, thus permitting the high rail to move outward. The emergency brake application as the train entered the curve also would have increased the lateral forces induced on the high rail. The outward movement of the high rail permitted the locomotive to derail. The excessive speed and derailment caused the lead locomotive unit to leave the track area, turn onto its left side, and slide along the ground. The S-bend found in the outside rail of the curve resulted from the excessive lateral forces and could have been the initial point of derailment.

The conductor and brakeman said the explosion occurred after the train had stopped, and the investigation disclosed that the initial point of derailment was in the curve. Sand, which would have been released during an emergency brake application, was found only in the area of the derailed locomotive. Therefore, the emergency brake application and explosion could not have occurred 1/2 mile before the point of derailment, as claimed by the engineer.

Since the locomotive was not equipped with an events recorder, investigators had to depend upon each SRASK crewmember's recollection of how the train was handled before the derailment. However, not expecting an accident to occur, the crewmembers did not keep a constant mental note

of every facet of the trip, and what they did note, they did not relate to as an event preceding an accident. For example, when the conductor noted the lack of additional braking required approaching the wye, he thought the problem was his incorrect estimation of their location. When the brakeman riding in the second locomotive unit felt the speed over the road crossing was excessive, he thought the problem was his disorientation as to their location. The head brakeman in the lead locomotive unit also believed the smoke or fog disoriented his conception of the train's exact location. All three examples indicate factual events in which these crewmembers unwittingly failed to take action to control the train. Each crewmember believed his own judgment was in error and trusted the engineer to act to properly control the speed of the train. This situation highlights an emergency response problem for conductors and brakemen working with an engineer they trust and consider to be efficient, such as the engineer on train SRASK at the time of this accident.

The lack of an operable safety control device, which would automatically apply the brake, also allowed any possible inattentive moments of the engineer, who claimed he was not disoriented, to pass undetected. In its report on the collision of two Penn Central freight trains at Herndon, Pennsylvania, on March 12, 1972, ^{2/} the Safety Board recommended that the Federal Railroad Administration (FRA) study locomotive cab environmental conditions. In response, the FRA advised that it would conduct a study and, when completed, would promulgate regulations to correct undesirable conditions as deemed necessary. However, the study has not yet been completed and consequently Federal requirements concerning cab environmental conditions have not yet been established.

The factors of this accident indicate that the engineer was not responsive after he made the initial minimal setting of the brakes about 1 3/4 miles from the Lewisville wye, and that he made none of the additional and necessary brake applications and progressive throttle reductions before making the emergency brake application after entering the wye. To offset problems caused by crewmember inaction, the Safety Board also recommended in report RAR-73-3 that the FRA promulgate regulations to require the installation, use, and maintenance of a fail-safe device to stop a train if the engineer becomes incapacitated. The FRA responded that when its human factors study was completed, it would promulgate regulations to correct undesirable conditions as deemed necessary. Since the study has not been completed, Federal requirements concerning a fail-safe device to stop a train if the engineer becomes incapacitated have not yet been established.

When the body of the 13th car struck the unprotected tank head of the 12th car, the flammable, compressed vinyl chloride quickly pressure-vented through the 82-inch tear in the tank. A head shield may have

^{2/} "Railroad Accident Report--Head-on Collision of Two Penn Central Freight Trains, Herndon, Pennsylvania, March 12, 1972" (NTSB-RAR-73-3).

prevented the tear by reducing the impact on the tank made by the following car. If the cars had been equipped with top and bottom shelf couplers, they might have stayed in line, further reducing the probability of collision. The Safety Board discussed these safety corrections--head shields and top and bottom shelf couplers--in its report entitled "Analysis of Proceedings of the National Transportation Safety Board Into Derailment and Hazardous Materials, April 4-6, 1978" issued June 23, 1978. This accident further substantiates the need for expeditious completion of the retrofit for DOT 112A and 114A tank cars under the deadlines imposed by the Materials Transportation Bureau's Docket HM-144 published July 13, 1978.

In the darkness, smoke, and fire following the derailment and explosion, firefighters were unable to immediately determine the exact location and cause of the explosion. Consequently, the danger of additional explosions was unknown to the first firefighters on the scene because they had voluntarily responded when hearing the initial explosion. This problem arose from the unusual circumstances of the derailment occurring next to a petroleum products company and the inability of the railroad to alert the quickly responding firefighters before or upon their arrival at the scene. Once the railroad did alert the firefighters to the potential dangers, evacuation and wreckage clearing were performed extremely well. However, a more expeditious procedure was needed to enable both railroad and firefighter personnel to immediately contact each other to exchange information about the train's consist and all potential dangers.

CONCLUSIONS

Findings

1. Train SRASK did not comply with Federal power brake regulations at Shreveport.
2. The automatic brakes were functioning properly on train SRASK as it approached Lewisville.
3. Postaccident inspection of the track and switches in the derailment area disclosed no defective conditions that contributed to the cause of the derailment.
4. Postaccident inspection of train SRASK's locomotive and cars revealed no mechanical defects that contributed to the cause of the derailment.
5. Train SRASK was exceeding the maximum authorized speed of 35 mph approaching the wye at Lewisville, and entered the 8° wye curve faster than the 10-mph maximum authorized speed for the curve.

6. Because he failed to properly slow the train, the engineer applied the emergency brakes of train SRASK after entering the 8° curve of the Lewisville wye.
7. The vinyl chloride tank car was ruptured and its contents ignited after the train derailed.
8. If the tank car had been equipped with head shields and top and bottom shelf couplers, it might not have been ruptured.
9. If the locomotive of train SRASK had been equipped with a safety control device, the engineer probably would have been more attentive at all times approaching the Lewisville wye.
10. Firefighters were unaware of the danger of possible explosion from additional hazardous material tank cars involved in the derailment because of their voluntary response to the explosion before contact with railroad officials.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer and other crewmembers to slow train SRASK for the 10-mph speed restriction through the wye track as required by the railroad's general orders. As a result of the train's high speed and consequent emergency brake application, the high rail in the curve moved laterally, allowing the locomotive to derail, and subsequently turn over, and the following cars to derail. The release and ignition of vinyl chloride from the ruptured tank car caused extensive damage to the train equipment and the adjacent industrial plant and buildings.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board reiterates the following recommendations which were made to the Federal Railroad Administration as a result of similar train accidents:

". . . in cooperation with the Association of American Railroads, develop a fail-safe device to stop a train in the event that the engineer becomes incapacitated by sickness or death, or falls asleep. Regulations should be promulgated to require installation, use, and maintenance of such a device. (R-73-8) (Issued March 14, 1973)

". . . include in its present investigation of the safety of locomotive-control compartments a study of environmental conditions that could distract crews from their duties or cause them to fall asleep at the controls. Regulations should be promulgated to correct any undesirable conditions disclosed. (R-73-9) (Issued March 14, 1973)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

December 7, 1978

APPENDIX A

Excerpts from Code of Federal Regulations
Airbrake Tests

§ 232.1 Power brakes; minimum percentage.

On and after September 1, 1910, on all railroads used in interstate commerce, whenever, as required by the Safety Appliance Act as amended March 2, 1903, any train is operated with power or train brakes, not less than 85 percent of the cars of such train shall have their brakes used and operated by the engineer of the locomotive drawing such train, and all power-brake cars in every such train which are associated together with the 85 percent shall have their brakes so used and operated

* * *

§ 232.12 Initial terminal road train airbrake tests.

(a) Except for run-through and unit run-through trains covered under § 232.19, each train must be inspected and tested as specified in this section at points—

(1) Where the train is originally made up (initial terminal);

(2) Where train consist is changed, other than by adding or removing a solid block of cars, and the train brake system remains charged; and

(3) Where the train is received in interchange.

(b) Each carrier shall designate additional inspection points not more than 500 miles apart where intermediate inspection will be made to determine that—

(1) Brake pipe pressure leakage does not exceed 5 pounds per minute;

(2) Brakes apply on each car in response to a 20-pound service brake pipe pressure reduction; and

(3) Brake rigging is properly secured and does not bind or foul

(c) Train airbrake system must be charged to required air pressure, angle cocks and cutout cocks must be properly positioned, air hose must be properly coupled and must be in condition for service. An examination must be made for leaks and necessary repairs made to reduce leakage to a minimum. Retaining valves and retaining valve pipes must be inspected and known to be in condition for service. If train is to be operated in electropneumatic brake operation, brake circuit cables must be properly connected.

(d) (1) After the airbrake system on a freight train is charged to within 15

pounds of the setting of the feed valve on the locomotive, but to not less than 60 pounds, as indicated by an accurate gauge at rear end of train, and on a passenger train when charged to not less than 70 pounds, and upon receiving the signal to apply brakes for test, a 15-pound brake pipe service reduction must be made in automatic brake operations, the brake valve lapped, and the number of pounds of brake pipe leakage per minute noted as indicated by brake pipe gauge, after which brake pipe reduction must be increased to full service. Inspection of the train brakes must be made to determine that angle cocks are properly positioned, that the brakes are applied on each car, that piston travel is correct, that brake rigging does not bind or foul, and that all parts of the brake equipment are properly secured. When this inspection has been completed, the release signal must be given and brakes released and each brake inspected to see that all have released.

(2) When a passenger train is to be operated in electropneumatic brake operation and after completion of test of brakes as prescribed by subparagraph (1) of this paragraph the brake system must be recharged to not less than 90 pounds air pressure, and upon receiving the signal to apply brakes for test, a minimum 20 pound electropneumatic brake application must be made as indicated by the brake cylinder gage. Inspection of the train brakes must then be made to determine if brakes are applied on each car. When this inspection has been completed, the release signal must be given and brakes released and each brake inspected to see that all have released.

(3) When the locomotive used to haul the train is provided with means for maintaining brake pipe pressure at a constant level during service application of the train brakes, this feature must be cut out during train airbrake tests.

(e) Brake pipe leakage must not exceed 5 pounds per minute.

(f) (1) At initial terminal piston travel of body-mounted brake cylinders which is less than 7 inches or more than 9 inches must be adjusted to nominally 7 inches.

(2) Minimum brake cylinder piston travel of truck-mounted brake cylinders must be sufficient to provide proper brake shoe clearance when brakes are released. Maximum piston travel must not exceed 6 inches.

(3) Piston travel of brake cylinders on freight cars equipped with other than standard single capacity brake, must be adjusted as indicated on badge plate or stenciling on car located in a conspicuous place near brake cylinder

(g) When test of airbrakes has been completed the engineman and conductor must be advised that train is in proper condition to proceed.

(h) During standing test, brakes must not be applied or released until proper signal is given.

(i) (1) When train airbrake system is tested from a yard test plant, an engineer's brake valve or a suitable test device must be used to provide increase and reduction of brake pipe air pressure or electropneumatic brake application and release at the same or a slower rate as with engineer's brake valve and yard test plant must be connected to the end which will be nearest to the hauling road locomotive.

(2) When yard test plant is used, the train airbrakes system must be charged and tested as prescribed by paragraphs (c) to (g) of this section inclusive, and when practicable should be kept charged until road motive power is coupled to train, after which, an automatic brake application and release test of airbrakes on rear car must be made. If train is to be operated in electropneumatic brake operation, this test must also be made in electropneumatic brake operation before proceeding.

(3) If after testing the brakes as prescribed in subparagraph (2) of this paragraph the train is not kept charged until road motive power is attached, the brakes must be tested as prescribed by paragraph (d) (1) of this section and if train is to be operated in electropneumatic brake operation as prescribed by paragraph (d) (2) of this section.

(j) Before adjusting piston travel or working on brake rigging, cutout cock in brake pipe branch must be closed and air reservoirs must be drained. When cutout cocks are provided in brake cylinder pipes, these cutout cocks only may be closed and air reservoirs need not be drained.

(49 CFR 149(c)) [37 F.R. 12236, June 21, 1972]

* * *

§ 232.19 Airbrake tests on run-through and unit run-through trains.

(a) For the purposes of this section—

(1) "Run-through train" means a train which passes from one carrier to another carrier with no change in consist (including locomotive) other than the addition or removal of a block of one or more cars; and

(2) "Unit run-through train" means a run-through train operated by more than one carrier on a continuous round-trip cycle and consisting of assigned equipment.

(b) The carriers involved shall jointly notify the Federal Railroad Administrator in writing of run-through trains and unit run-through trains operating over their tracks. The notice must identify points of interchange and all other points where equipment and air brake inspections are made.

(c) Each run-through train shall be inspected and tested as prescribed by § 232.12(c)-(j)—

(1) Where the train is originally made up (initial terminal);

(2) Where train consist is changed other than by adding or removing a solid block of cars and train brake system remains charged; and

(3) At intermediate inspection points not more than 500 miles apart, subject to the requirements of paragraph (f) of this section.

(d) Each unit run-through train shall be inspected and tested as prescribed by § 232.12(c)-(j)—

(1) Where the train is originally made up and where it is reassembled after being broken up;

(2) Once during each round-trip cycle of less than 500 miles at an inspection point designated in writing by the carriers involved; and

(3) At intermediate inspection points not more than 500 miles apart, subject to the requirements of paragraph (f) of this section

(e) Each carrier that adds a block of one or more cars to a run-through train or unit run-through train after the train is originally made up, shall inspect and test the block as follows:

(1) In accordance with § 232.12(c)-(j) at the point where the block is added; or

(2) In accordance with § 232.13(d) (1) at the point where the block is added, and § 232.12(c)-(j) at the next point on its line where the inspections and tests can be performed, but not beyond a designated 500-mile inspection point.

(f) For the purpose of the intermediate inspections and tests required by paragraphs (c) (3) and (d) (3) of this section—

(1) Piston travel of a body-mounted 10-inch brake must not exceed 10 inches; and

(2) Piston travel on all other brakes—
(i) Must not exceed the nominal travel specified by more than 2 inches; and

(ii) Must not exceed the maximum travel specified by the badge plate or stencil on the car.

(g) The inspections and tests made under § 232 12(c)-(j) as required by this section shall be performed by qualified carrier personnel at locations where adequate repair facilities are available to maintain power brake systems in effective operating condition in conformity with this part. Defective cars shall be repaired or removed from service at the point of inspection and testing.

(h) Each carrier shall record the inspections and tests made under § 232 12 (c)-(j) as required by this section at the time they are performed by completing Form FRA F-6180-48¹ in duplicate. This form shall be signed by the supervisor or other carrier employee responsible for the inspections and tests. One copy of the form shall be kept in the cab of the locomotive until the train arrives at its final terminal, and one copy shall be retained for 3 months at the terminal where the inspections and tests are made.

(i) At locations where the crew of one carrier takes over control and operation of a run-through train or unit run-through train from the crew of another carrier, the receiving carrier shall inspect and test the train to determine that—

(1) The cab of the locomotive contains a Form FRA F-6180-48 completed as required by paragraph (h) of this section,

(2) Brake pipe leakage does not exceed 5 pounds per minute; and

(3) Brakes apply and release on the rear car from a 20-pound service brake pipe pressure reduction.

If the cab of the locomotive does not contain a completed Form FRA F-6180-48, the train must be inspected and tested as prescribed by § 232 12(c)-(j) before it proceeds.

[37 F.R. 12237, June 21, 1972]

APPENDIX B

Excerpts from Code of Federal Regulations
Hours of Service of Railroad Employees

§ 228.1 Scope.

This part prescribes reporting and record keeping requirements with respect to the hours of service of railroad employees

§ 228.3 Application.

(a) This part applies to each common carrier engaged in the transportation of passengers or property by railroad—

(1) In the District of Columbia or any territory of the United States,

(2) From a State or territory of the United States or the District of Columbia to another State or territory of the United States or the District of Columbia;

(3) From any place in the United States to an adjacent foreign country; or

(4) From any place in the United States through a foreign country to another place in the United States

§ 228.5 Definitions.

In this part—

"Administrator" means the Administrator of the Federal Railroad Administration or any person to whom he has delegated authority in the matter concerned

"Employee" means an individual (1) actually engaged in or connected with the movement of any train, or (2) who dispatches, reports, transmits, receives, or delivers orders pertaining to train movements by the use of telegraph, telephone, radio, or any other electrical or mechanical device.

"Railroad" includes all bridges, ferries, and roads, whether owned or operated under a contract, agreement, or lease, used in connection with that railroad.

§ 228.7 Hours of duty.

(a) For purposes of this part, time on duty of an employee actually engaged in or connected with the movement of any train, begins when he reports for duty and ends when he is finally released from duty, and includes—

(1) Time engaged in or connected with the movement of any train;

(2) Any interim period available for rest at a location that is not a designated terminal;

(3) Any interim period of less than 4 hours available for rest at a designated terminal;

(4) Time spent in deadhead transportation en route to a duty assignment and

(5) Time engaged in any other service for the carrier.

Time spent in deadhead transportation by an employee returning from duty to his point of final release may not be counted in computing time off duty or time on duty.

(b) For purposes of this part, time on duty of an employee who dispatches, reports, transmits, receives, or delivers orders pertaining to train movements by use of telegraph, telephone, radio, or any other electrical or mechanical device includes all time on duty in other service performed for the common carrier during the 24-hour period involved.

§ 228.9 Railroad records; general.

(a) Records maintained under this part shall be—

(1) Signed by the employee whose time on duty is being recorded or, in the case of train and engine crews, signed by the ranking crew member;

(2) Retained for 2 years; and

(3) Available for inspection and copying by the Administrator during regular business hours.

§ 228.11 Hours of duty records.

(a) Each carrier shall keep a record of the following information concerning the hours of duty of each employee:

(1) Identification of employee

(2) Place, date, and beginning and ending times for hours of duty in each occupation.

(3) Total time on duty in all occupations.

(4) Number of consecutive hours off duty prior to going on duty.

§ 228.13 Train delay records.

Each carrier shall keep a record of time delays of 10 or more minutes experienced at a single location by train and engine service crews. The location, date, beginning and ending times, and cause of the delay shall be set forth in the record.

§ 228.15 Record of train movements kept at reporting station.

Each carrier shall keep a record of train movements at each station, tower, office, or other place where information about the movement of trains is reported or relayed by employees through the use of telegraph, telephone, radio, or any other electrical or mechanical device. The direction of travel and time of pass-

ing, or times of arrival and departure, shall be set forth in the record

§ 228.17 Dispatcher's record of train movements.

(a) Each carrier shall keep, for each dispatching district, a record of train movements made under the direction and control of a dispatcher who uses telegraph, telephone, radio, or any other electrical or mechanical device to dispatch, report, transmit, receive, or deliver orders pertaining to train movements. The following information shall be included in the record:

- (1) Identification of timetable in effect.
- (2) Location and date
- (3) Identification of dispatchers and their times on duty
- (4) Weather conditions at 6-hour intervals
- (5) Identification of enginemen and conductors and their times on duty
- (6) Identification of trains and engines
- (7) Station names and office designations
- (8) Distances between stations.
- (9) Direction of movement and the time each train passes all reporting stations
- (10) Arrival and departure times of trains at all reporting stations
- (11) Unusual events affecting movement of trains and identification of trains affected

§ 228.19 Monthly reports of excess service.

(a) Each carrier shall report to the Administrator each of the following instances within 30 days after the calendar month in which the instance occurs:

(1) Members of a train or engine crew or other employees engaged in or connected with the movement of trains are on duty for more than 14 consecutive hours (12 hours after December 25, 1972)

(2) Members of a train or engine crew or other employees engaged in or connected with the movement of trains return to duty after 14 hours of continuous service (12 hours after December 25, 1972) without at least 10 consecutive hours off duty.

(3) Members of a train or engine crew or other employees engaged in or connected with the movement of trains continue on duty without at least 8 consecutive hours off duty during the preceding 24 hours¹

(4) Members of a train or engine crew or other employees engaged in or connected with the movement of trains return to duty without at least 8 consecutive hours off duty during the preceding 24 hours.¹

(5) Employees who transmit, receive, or deliver orders affecting train movements are on duty for more than 9 hours in any 24-hour period at an office where two or more shifts are employed.

(6) Employees who transmit, receive, or deliver orders affecting train movements are on duty for more than 12 hours in any 24-hour period at an office where one shift is employed

(b) Reports required by paragraph (a) of this section shall be filed in writing on FRA Form F-6180-3² with the Office of Safety, Federal Railroad Administration, Washington, D C 20590. A separate form shall be used for each instance reported.

§ 228.21 Civil penalty.

A carrier that fails or refuses to keep records or file reports as required by this part, or to make records available to the Administrator for inspection or copying, is liable to a civil penalty of \$500 for each offense as prescribed by section 20 of the Interstate Commerce Act, 49 USC 20. Each day a failure or refusal continues is a separate offense.

§ 228.23 Criminal penalty.

(a) Whoever knowingly and willfully—

(1) Makes, causes to be made, or participates in the making of a false entry in reports required to be filed or records required to be kept by this part;

(2) Destroys, mutilates, alters, or otherwise falsifies such records;

(3) Neglects or fails to make full, true, and correct entries in such records, or

(4) Keeps a record contrary to the requirements of this part;

Is subject to a \$5,000 fine and 2 years' imprisonment as prescribed by section 20 of the Interstate Commerce Act, 49 USC 20.

¹Instances involving tours of duty that are broken by four or more consecutive hours off duty time at a designated terminal and do not contain more than a total of 14 hours time on duty (12 hours after Dec 25, 1972), are not required to be reported, provided such tours of duty are immediately preceded by 8 or more consecutive hours off duty time. Instances involving tours of duty that are broken by less than 8 consecutive hours off duty and contain more than a total of 14 hours time on duty (12 hours after Dec 25, 1972), must be reported.

²Form may be obtained from the Office of Safety, Federal Railroad Administration, Washington, D C 20590. Reproduction is authorized.