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RAILROAD ACCIDENT REPORT

ILLINOIS CENTRAL RAILROAD COMPANY

TRAIN SECOND 76
DERAILMENT AT
GLENDORA, MISSISSIPPI
SEPTEMBER 11, 1969

...AL TRANSPORTATION SAFETY BOARD

NATIONAL TRANSPORTATION SAFETY BOARD
Bureau of Surface Transportation Safety
Washington, D. C. 20591

SS-R-8

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ADOPTED: AUGUST 19, 1970

U.S. NATIONAL TRANSPORTATION SAFETY BOARD
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FOREWORD

This report of facts and circumstances and determination of probable cause of the National Transportation Safety Board is based on facts developed in the field investigation by the Bureau of Railroad Safety of the Federal Railroad Administration. In developing its recommendations, the Safety Board has considered the suggestions the Federal Railroad Administration made in forwarding the investigatory data. The recommendations made herein, however, are recommendations of the Safety Board.

TABLE OF CONTENTS

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Train Second 76
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Glendora, Mississippi
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I. SYNOPSIS

About 2:35 p.m., September 11, 1969, an Illinois Central freight train struck a pedestrian near the Glendora, Mississippi, station. When the engineer applied the brakes in full emergency in an attempt to avoid striking the pedestrian, the 149-car train buckled at the 108th car. The resulting derailment involved 15 cars, including eight tank cars loaded with vinyl chloride. The cars separated in the derailment and the coupler of one of the cars punctured one of the tank cars, spilling its contents on the ground.

Initially, the breeze dispersed the vapor; however, about 8:30 p.m. the vapor accumulated in low places and was ignited by an unknown source. The ignition was followed by several explosions.

Upon advice from a State chemist, an estimated 17,000 to 21,000 persons were evacuated because of an alleged danger from phosgene.

The following morning a fire-impinged tank car of vinyl chloride exploded violently, seriously damaging the surrounding area. Four tenant houses, several auxiliary buildings, automobiles, and equipment were destroyed and damaged by fire.

The pedestrian was seriously injured and a power company employee was burned. Both recovered.

The Safety Board determines that the derailment was caused by the buckling of the underframe of the 108th car when the engineer made a full emergency brake application in an attempt to avoid striking a pedestrian who was walking in the track. The car buckled because of excessive and uncontrollable compression in the train which developed when the full emergency brake application created greater braking force on the head of the train than on the rear.

The fire and explosions resulted from the rupture of a tank car of vinyl chloride by the coupler of one of the derailed cars. The absence of interlocking couplers and other means of preventing separation and jackknifing allowed the cars to jam up together. The pileup resulted in additional mechanical damage to the tanks and allowed the fire from the leaking tank to impinge on the others.

II. FACTS

A. Location and Method of Operation

This accident occurred at Glendora, Mississippi, about 97.5 miles south of Memphis, Tennessee, on the Illinois Central Railroad. Glendora is on that part of the Illinois Central's Tennessee Division extending between Gwin, Mississippi, and Memphis, Tennessee, a distance of 148.9 miles. (See Appendix 1.)

The railroad through Glendora is a single-track line running approximately north and south. From the south, there are successively 1,915 feet of 1^{o} curve to the left, a tangent of 1,353.5 feet to the point of initial derailment, and an additional 1,304 feet to the point of tangency of a 2^{o} curve to the left; 1,120.8 feet of 2^{o} curve to the left; 2,295.9 feet of tangent; 1,347 feet of $2^{o}40'$ curve to the right, to the point where the locomotive struck the man, and continuing 2,023 feet to the end of the curve.

The track is on a 5-foot fill, and the track grade for a considerable distance north and south of the accident site is practically level.

Milepost 98 stands 948.5 feet north of the end of the 1^{o} curve and 405 feet south of the point of derailment. County Highway 49 crosses the track at a point 850 feet north of milepost 98. Several dwellings, farm buildings, and pieces of farm equipment were located on both sides of the track in this area.

FIGURE 1

GENERAL DERAILMENT

Glendora depot, a small frame building, is 4,988 feet north of the point of derailment. A side track lies on the east side and extends northward for 1,816 feet from its switch, which is 501 feet south of Glendora depot. There are road crossings 390 feet south of Glendora depot and 1,020 feet north of the depot. North of Glendora depot there were a small building, a trailer, and bushes on the east side of the track.

At the time of the accident, the weather was clear with a 3 mile-per-hour wind blowing in a southwesterly direction.

Train operation on this line was by timetable and train orders. The track in the accident area was not equipped with block signals. The maximum authorized speed for freight trains in the accident area was 49 miles per hour.

The train struck the pedestrian at a point 827 feet north of milepost 97. The general derailment occurred about 400 feet north of milepost 98. (See Appendix 1.)

B. Description of the Accident

1. Train and Crew

Illinois Central freight train second 76, destined for Memphis, Tennessee, left Gwin, Mississippi, at 12:10 p.m., September 11, 1969, with 149 cars. The locomotive consisted of four SD 40 diesel-electric units, Nos. 6010, 6011, 6012, and 6006.

The locomotive was not equipped with a device to record the speed of the train, but it did have a speedometer. It was equipped with a radio by which the engineer could communicate with the crew on the caboose, with land stations, and with other trains within range on the same frequency. The locomotive had an oscillating headlight in addition to its regular stationary headlight.

The train had a four-man crew, including the engineer, conductor, brakeman, and flagman. At the time of the accident, the engineer was operating the locomotive from the lead unit and the brakeman was in the control compartment with him. The conductor and flagman were in the caboose.

The train had received the required brake tests and inspections. There was no evidence during the trip of malfunctioning of brakes or other mechanical components of the train.

The rest and hours of service of the crewmembers met the requirements of the Hours of Service Law.

2. Track

The track in the accident area consists of 112-pound continuous welded rail in lengths of 1,436 feet, relaid in 1967 on an average of 60 treated crossties per 100 feet. All crossties had two double-shoulder, 13-inch tie plates, spiked with two rail-holding spikes per tie plate. The track had 40 rail anchors per 100 feet in accordance with Illinois Central requirements. The ballast, 90 percent slag and 10 percent limestone, was a minimum of 10 inches deep below the crossties. The track was laid on a fill approximately 5 feet high.

3. Derailment

Approaching Glendora, train second 76 was moving northward at about 42 miles per hour. The stationary and oscillating head lights were burning, the bell was ringing, and the horn was being sounded for the road crossings.

North of milepost 97, in the curve to the right, the engineer saw a man walking northward about 350 feet ahead of the train. The engineer immediately began sounding the usual alarm of a succession of short blasts on the horn. When the locomotive was within about 200 feet of the man, the engineer applied the brakes in full emergency. The speed of the train was not materially reduced before the right front of the locomotive struck the pedestrian a moment after he looked backward.

It is not known exactly how far the locomotive travelled after the engineer applied the brakes in emergency. The engineer and brakeman estimated that the locomotive went 20 to 25 car lengths (50-foot cars) after striking the man. The engineer thought the train stopped quicker than a train of that makeup would be expected to stop.

After stopping, the engineer asked a track foreman at Swan Lake, Mississippi, by radio, to call an ambulance and to notify local authorities that the train had struck a pedestrian at Glendora. The time was noted as 2:35 p.m.

A witness described seeing a box car buckle upward immediately after the emergency brake application and before the train stopped. This car was identified as Milwaukee car 2010, the 108th car in the train. (See Figure 2, page 7) This car was thrown out of the train, landing on one end and reversing itself. Fourteen additional cars, including 10 cars of hazardous materials, derailed. None of the equipment ahead of the 106th car in the train derailed. The 106th car stopped upright and in line with the track structure, with the north trucks derailed. The 107th to 119th cars, inclusive, derailed and stopped in various positions on both sides of the track, as shown in Appendix 2. The 120th car stopped upright and in line with the track, with the north trucks derailed.

In the meantime, the conductor walked northward from the caboose and found that 15 cars had derailed. He informed the engineer, by means of a portable radio, to tell the dispatcher that a wrecker would be needed. The conductor discovered that a tank car had been punctured and was spewing a white vapor from the puncture. He went back to the caboose and found from the waybills that the commodity was vinyl chloride.

After consultation with the dispatcher, the conductor was instructed to warn the people in the immediate vicinity to evacuate because of the flammable and toxic nature of the material.

C. Post-Derailment Activities

1. Activities of Railroad Personnel

Immediately after the locomotive stopped, the brakeman went back along the east side of the train, searching for the pedestrian. The pedestrian, a 74-year-old man, was found lying in the bushes about 12 feet from the track. He suffered a concussion; contusions and abrasions of the legs, arms, spine, and chest, and a deep laceration of the back of the left leg. The pedestrian was hard of hearing, and slightly crippled because of a stroke suffered sometime prior to the day of the accident.

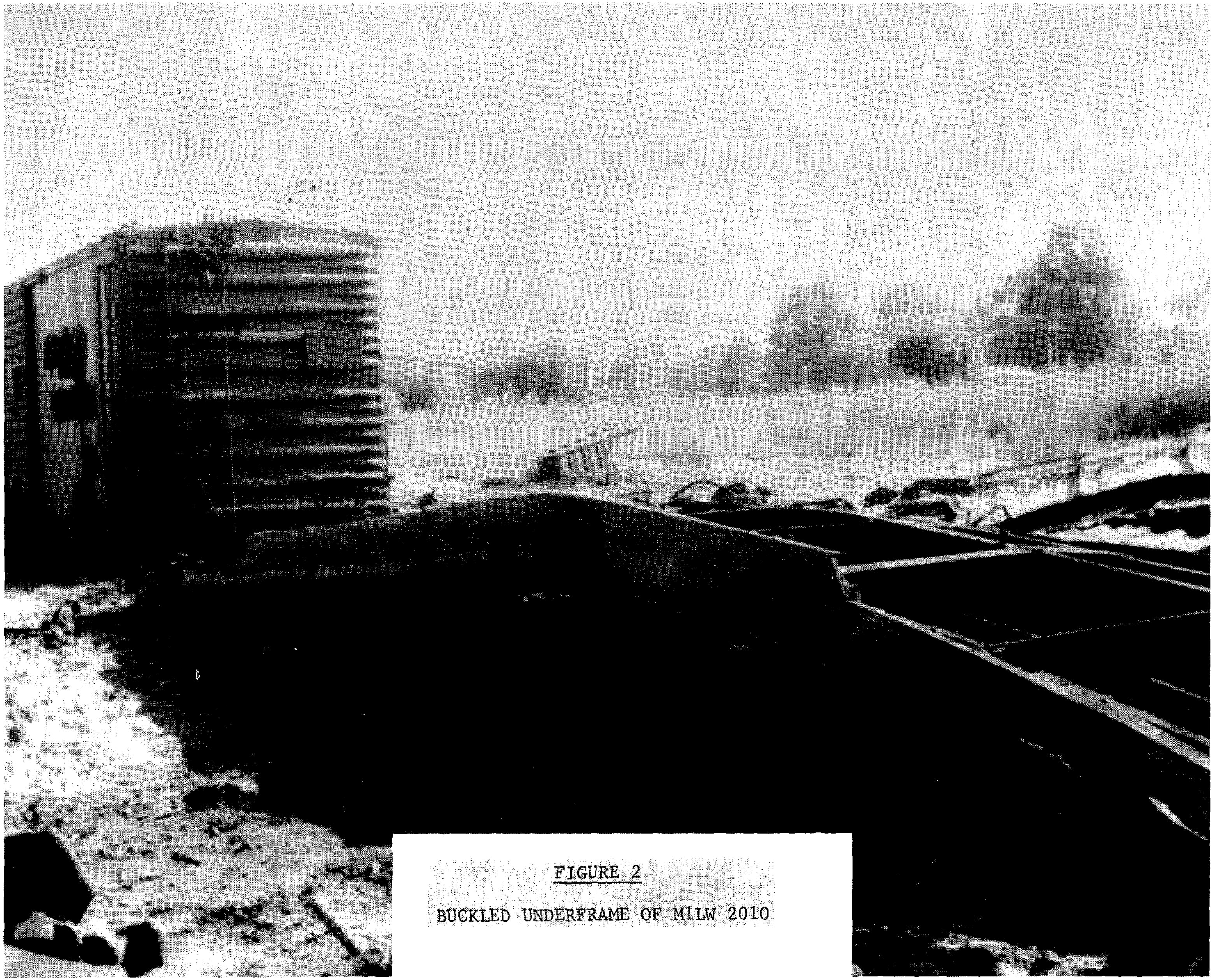

FIGURE 2

BUCKLED UNDERFRAME OF MILW 2010

The conductor and a railroad special agent, with help from some of the local residents, warned those people in the immediate area of the danger from the toxic and flammable vinyl chloride vapors. The track foreman stationed men on the roads leading to the scene to warn motorists of the danger, and he warned residents south of Glendora. Most of the people in the immediate area moved out; however, about a dozen persons on the windward side of the wreck remained.

2. Activities of Power Company Personnel

A serviceman of the Mississippi Power and Light Company arrived at the scene of the derailment about 4 p.m. He noted that the only effect on the power system was a tightening of the wires because of a tank car lying against a guy wire to a pole. The serviceman did not see any railroad personnel on the scene and left to report to his manager. After reporting the situation, the serviceman and his manager returned to the scene with a small crew. After evaluating the situation, the manager released the crew, and the manager and serviceman went to Swan Lake to discuss cleanup operations with railroad personnel.

Since there was no responsible railroad operating official available, the manager and serviceman went to their homes. The manager returned to the scene of the derailment about 7:30 p.m.

About 8 p.m. someone pointed out to the power company manager that a powerline had been pulled taut against a tree limb and was glowing. The manager notified the serviceman to return to the scene with a bucket truck and to prune the limbs which were touching the wires. The serviceman drove his truck to the tree, which was about 300 feet northwest of the wreck. When he got out of the truck, he noted a strong odor and noted that a vapor, which he compared to fog, had accumulated to a height of about 5 feet in low places. As he got into the truck to move it, a flash of light occurred in the area where the wrecked cars were lying and he heard an explosion. He jumped from the truck and ran northward for about 80 to 90 feet before the fire overtook him, the fire inflicting second degree burns on his arms, hands, neck, and head. A resident in the area took him to a doctor who treated him and sent him to a hospital.

3. Activities of Civil and Military Personnel

During the afternoon, the carrier requested assistance from the Tallahatchie County Sheriff's Office and the Mississippi Highway Patrol in maintaining security for the area. The Highway Commissioner advised the Governor's Office of the situation which was developing at Glendora. The Governor's Office established liaison with the Civil Defense Director and the National Guard.

The Chemical Warfare Department at Fort McClellan, Alabama, and the State chemist at Mississippi State University advised the Governor's office that there was a possibility that phosgene gas represented a hazard to the residents in the area. Having been advised of this threat, the Governor ordered the National Guard to begin an immediate evacuation of all persons in the quadrant south and west of Glendora. This evacuation started at 7:30 p.m., was completed by 11 p.m., and involved an estimated 17,000 to 21,000 persons.

D. Fire & Explosions

1. Description of the Material

In the train, cars 113 through 120 were tank cars loaded with vinyl chloride monomer. Appendix 3 contains a description of the tank cars. All of the tank cars met the applicable Federal and industry requirements for transporting vinyl chloride.

Vinyl chloride is a colorless, sweet smelling, flammable gas at ordinary temperatures and forms explosive mixtures with air. The gas is heavier than air and may travel a considerable distance to a source of ignition, and will flash back. Fires involving vinyl chloride result in the production of hydrogen chloride gas, phosgene gas, carbon monoxide, carbon dioxide, and water. Under the conditions such as those at Glendora, the combustion of vinyl chloride produces no detectable amount of phosgene. Vinyl chloride, when heated, can polymerize with explosive force. Vinyl chloride acts as a general anesthetic and may be fatal in high concentrations; threshold limit value is 500 parts per million. 1/ The commodity is normally shipped in tank cars as a liquid under pressure.

2. Description of Fire and Explosions

Descriptions of the leaking tank car indicated that a whitish vapor escaped from the punctured tank car with a roar for about an hour. The breeze dispersed the vapor until about sundown, at which time it was noticed that the vapor was accumulating in low places.

1/ Chemical Data Sheet SD-56, Vinyl Chloride, Manufacturing Chemists' Association, Inc.

According to the power company serviceman and other witnesses, the fire originated in the area where the punctured tank was leaking. The serviceman saw no fire around him until it ran along the ground after the explosion. He estimated that the fire was about 200 feet away when he started to run northward.

Immediately after the initial flash, everyone in the immediate area went to a barricade point about a mile northeast of the scene. A series of flash fires and minor explosions occurred thereafter, billowing clouds of smoke about 500 feet into the air.

About 9:30 p.m., fire trucks from Glendora, Greenwood, and Clarksdale, Mississippi, arrived and were allowed to go to the derailment scene to protect the buildings in the area. About 11 p.m. a Mississippi Highway Patrol Inspector arrived at the barricade point with the admonition that phosgene gas was being given off by the vinyl chloride and ordered the evacuation of all persons in the area to Webb, about 10 miles northwest of Glendora.

About 6:45 a.m. the following day, GATX Car 85069 containing vinyl chloride, exploded violently. The tank separated near one end, close to a circumferential weld. The tank was deformed and flattened. A section of the tank, about 20 feet long, landed about 350 feet southeast of the site, and a tank head landed 50 feet further away. A part of the opposite end, including the underframe, was propelled northwestward. This piece, after attaining a height of 50 to 60 feet, hit the ground 725 feet from the track and ricocheted over a 50-foot tree for another 100 feet. A part of the jacket, measuring 10 by 15 feet, came to rest 475 feet northeast of the track. The other tank head landed 650 feet southeast of the track in a tenant house yard. Another section, measuring 7 by 18 feet, went 850 feet south of the point of explosion.

The heat against the tank resulted from the burning vinyl chloride escaping from SHPX Car 85212. The tank shell of SHPX 85069 had thinned to a quarter of an inch in an area about 3 feet in diameter and was discolored by heat.

The 116th car, SHPX 85144, was punctured as a result of the explosion of SHPX Car 85212. The escaping vinyl chloride ignited and burned for 12 days.

3. Damage

The pedestrian struck by the locomotive was hospitalized with contusions and abrasions of the legs, arms,spine, and chest; a concussion; and a deep laceration of the left leg.

The power company serviceman suffered second- and third-degree burns on both hands and arms and on the left side of his face and neck.

The carrier estimated the cost of damages to the equipment and lading at $125,525.21 and $36,753.00, respectively.

Four tenant houses, four farm buildings, and seven automobiles were destroyed by fire, and the plantation office building was damaged seriously by the explosion and flying debris. One farm tractor was destroyed and another tractor was damaged by a flying piece of tank. Damage was done to trees, crops, and farm animals in the vicinity.

III. ANALYSIS

A. Train Braking

The exact points where the engineer first sighted the pedestrian, applied the train brakes, and stopped the head of the train are not known. However, it is known that the train stopped more quickly than one would normally expect a train of that consist to stop. The resultant pressure on the 108th car, an empty boxcar, vertically buckled the underframe. A witness described seeing the car "jump up and down" before being "thrown" out of the train.

While the boxcar was built in 1944, its record indicates that no structural changes were made that would have contributed to the buckling. Inspections made after the accident by railroad and agents of the Federal Railroad Administration did not develop any defects that may have contributed to the failure of the center sill.

The nature of the failure indicates that the car was subjected to compressive forces that exceeded the strength of the structure. This type of failure of empty cars, involving severe braking, has been documented in many past accidents. Under normal emergency braking, full braking power is developed successively by the locomotive and each car behind it until the rear car attains full braking. This lag may require up to 18 seconds before the rear car receives full braking power.

During this lag, considerable compression in the train is developed because momentarily the braking force on the head end of the train is greater than on the rear. The only action the engineer can take to compensate for this is to release the brakes on the locomotive. The momentum of the locomotive tends to stretch the train and relieve some of the compression; however, this increases the stopping distance. At Glendora, the engineer did not release the brakes on the locomotive because the braking force of the locomotive was needed to stop the train as quickly as possible.

The brakes of a freight car are set for maximum deceleration of the empty car; therefore, its deceleration capability is decreased as the car is loaded. With the exception of two, all of the cars behind the car which buckled were loaded. Ahead of the MILW car 2010 were 22 empty cars, 84 loaded cars, and four locomotive units. Therefore, the deceleration should have been greater on the head end of the train because of a more favorable braking ratio.

In combination with the rapid deceleration of the head end, there is a possibility that the emergency brake application was not transmitted to the rear part of the train. Under this condition, there would have been considerably less braking force on the rear part of the train, resulting in greater compression in that part of the train than if each car in the train were braking at the maximum rate.

It is not known why the head end of this particular train stopped as quickly as it did. One would have expected a minimum stopping distance of approximately twice the distance required in this case. This rapid deceleration certainly was a contributing factor in the buckling of the cars.

B. Derailment

Based on the evidence, there is no question that the derailment resulted when the boxcar buckled. The absence of interlocking couplers allowed the cars to separate and jackknife. A disengaged coupler punctured the tank and allowed the spillage of the vinyl chloride which ignited. Had the cars remained coupled and in line with the track, they would not have jackknifed and piled up in a jumbled mass. Once the vinyl chloride vapor ignited, the fire impinged on the other tanks.

Railroad employees determined immediately after the derailment that vinyl chloride was leaking, and cautioned people in the immediate area that there was danger. After this, however, the carrier exerted little control over the situation. At one time prior to the ignition of the vapors, persons actually climbed upon the derailed cars. No apparent attempt was made to remove possible sources of ignition or to prevent motor vehicles from approaching the immediate vicinity of the wreck. At one time, between the time of derailment and ignition of the vinyl chloride, representatives of the Mississippi Power and Light Company approached the scene but could find no railroad representative there.

There was no way of determining the source of ignition. Many electrical appliances and motors were in the immediate area. The motors of automobiles could have been a source. One witness described hearing the leaking tank shift just prior to the ignition. As the commodity leaked out, the change in load distribution could have caused the tanks to move and generate a friction spark capable of igniting the vinyl chloride vapor. Based on available evidence, the vapor did not accumulate to a height sufficient to reach the arcing electric wire.

C. Fire and Explosion

The absence of devices to prevent uncoupling and jackknifing of the cars allowed them to pile up. The insulating jackets on the vinyl chloride tanks were subjected to impact damage as a result of the pileup. When the cars are jammed together, they are subjected to the effects of fire from any one of them which might ignite.

The series of so-called explosions, which followed the ignition of the vinyl chloride, were probably unconfined rapid combustion of vinyl chloride vapor. The fire impinged on SHPX Car 85069 for about 10 hours before the tank exploded. During this 10-hour interval, cooling the tank with a water spray would have prevented the explosion.

There is a great need for responsible persons to receive better and more widely disseminated information regarding the proper handling of people exposed to the effects of hazardous materials. The 17,000 to 21,000 persons were evacuated to protect them from the danger of phosgene gas. With the information available to the civil authorities at the time, one cannot criticize the decision to evacuate the population. However, the danger from phosgene gas did not justify the action.

In March 1970, the Bureau of Explosive of the Association of American Railroads issued B.E. Pamphlet No. 7A, Dangerous Articles Emergency Guide, in which the following appears under the Vinyl Chloride title:

"Evacuation:

> If it appears that fire can be controlled, get away but don't evaucate - put hoses on stands, etc.
>
> If large quantities involved, evacuate for radius of 1500 feet if fire (or reaction) becomes uncontrollable."

Phosgene is a very minor combustion product from the burning of vinyl chloride. Very small quantities of phosgene can be produced when vinyl chloride is burning under specific conditions which involve pre-mixing of vinyl chloride with oxygen. Under diffusion conditions, such as those which existed at Glendora, the combustion of vinyl chloride produces no detectable amount of phosgene. All of the data sheets and technical literature reviewed state that phosgene gas can be produced from burning vinyl chloride, but none of the literature states that the quantity of phosgene that can be produced in an open fire constitutes a hazard to bystanders. For example, see Chemical Safety Data Sheet SD-56, Vinyl Chloride, published by the Manufacturing Chemists' Association, Inc., Fire Protection Guide on Hazardous Materials, published by the National Fire Protection Association; and Chemical Data Guide for Bulk Shipment by Water, published by the United States Coast Guard.

Although the quantity of phosgene formed during combustion of the vinyl chloride could exceed the maximum allowable concentration, the heat from the fire breaks down most of the phosgene formed. 2/ Thus, the phosgene generated in the fire posed no danger. Carbon monoxide which formed was also safely dispersed by the chimney effect of the heat of the fire in this case.

It appears that the reported danger from phosgene obscured the fact that a real danger from hydrogen chloride may have existed. The burning of a single tank car of vinyl chloride, under the most unfavorable conditions of atmosphere and wind, may produce a ground level concentration of hydrogen chloride above the

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2/ Combustion of Chlorinated Plastics, Colman and Thomas, Junior Applied Chemistry, July, 1954. See also, Handbook of Compressed Gases, Compressed Gas Association, Inc.

maximum allowable concentration (5ppm), up to a distance of about 2 miles. At Glendora, three tank cars of vinyl chloride burned or exploded. There was no quantitative measure of hydrogen chloride in the area or reports of any personal injury that can be related to the presence of hydrogen chloride.

In this instance, no evidence was adduced to indicate that an assessment was made, by persons properly qualified, of the true dangers of burning vinyl chloride. It is clear in this case that either experts on the scene must be able to make proper decisions as to the dangers which exist, or that appropriate information must be immediately available by telephone at a national hazardous materials data center, as previously recommended by the Safety Board. 3/

3/ NTSB Railroad Accident Report, SS-R-2, Derailment and Collision, Train PR-11A, Extra 2210 West and Train SW-6, Extra 2217 East, Dunreith, Indiana, January 1, 1968.

IV. CONCLUSIONS

1. The train was being operated in compliance with prevailing regulations and instructions at the time of the accident.

2. The curvature of the track and vegetation growing adjacent to the track prevented the engineer and brakeman on the locomotive from seeing the pedestrian at a distance greater than about 500 feet.

3. After the engineer applied the brakes in full emergency, the head end of the train stopped more quickly than would have been expected. The exact distance that the train traveled and the reason for the shorter than usual stopping distance were not developed in the investigation.

4. The empty MILW car buckled because of undue pressure resulting from uneven braking of the train under full emergency conditions. The front part of the train decelerated at a rate greater than the rear part.

5. The arcing electric line did not ignite the vinyl chloride vapor because the vapor never accumulated to that depth.

6. Phosgene gas was not a hazard to the population because it was not developed in sufficient quantity to be measurable.

7. After the derailment, the site was not protected in a manner to prevent injury to railroad employees and others. At one time, employees climbed upon the wrecked tank cars to make observations.

8. There was an inadequate assessment by persons on scene of the dangers to the public in this accident.

V. GENERAL CONCLUSIONS

This accident is a good example of what can happen when a normal freight train on a level track is decelerated by a properly initiated emergency brake application. At best, a properly initiated emergency brake application is transmitted rearward successively from the locomotive through each car, resulting momentarily in greater deceleration on the head end than on the rear. The unequal decelerating forces established within a train by the variance of braking power of the individual cars contributes to the problem. The braking system is designed to provide maximum braking of an empty car without sliding the wheels; consequently, when the car is loaded, the braking efficiency is reduced.

It is not uncommon for empty cars to buckle under the pressures created in normal emergency braking. Train speeds have increased, and car capacity has increased. In turn, the loaded car braking ratio is lower; therefore, dependable, consistent deceleration is harder to attain than it was 25 years ago. An emergency application of the brakes can result in damage to the train due to slack action or separations in the train because of broken couplers or knuckles. The action of a given freight train when brakes are applied is not always predictable. The proper service braking of a freight train is not a science but an art. The result depends upon the skill and experience of the engineer. When train brakes are applied in emergency, however, the only control that an engineer can exert is to release the brakes on the locomotive.

These aspects of train braking constitute a problem of long standing. An engineer's knowledge of these conditions sometimes deters his use of the train brakes in preference to other means of controlling the train. For instance, an engineer of a train approaching a grade crossing occupied by a motor vehicle knows that full emergency braking may damage his train and he hopes that the vehicle will vacate the crossing, therefore, the engineer sometimes makes a full emergency brake application only as a last resort. At Waterloo, Nebraska, on October 2, 1967, 4/ a freight train struck a schoolbus, resulting in the death of four children and injuries to the other nine. The bus stopped, and then moved slowly onto the crossing in full view of the

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4/ NTSB Highway-Railroad Accident Report, SS-R/H-3, Waterloo, Nebraska, Public School Bus, Union Pacific Railroad Company Freight Train Accident, October 2, 1967.

engineer; however, the engineer did not apply the train brakes until he was sure that the schoolbus was actually going to occupy the crossing in the path of the train. The engineer at a grade crossing faces the dilemma of whether to make a full emergency application and risk damaging the train, or to make a full-service application and lessen the chances of avoiding the vehicle or pedestrian. Engineers should not be placed in situations such as this where they have to decide which course is better--the one which places the risk on the train or the one which places the risk on the other party. This dilemma would not exist if the freight train braking system were consistently capable of maximum emergency braking without damaging the train.

Stopping distances achieved in the 1887 Burlington Brake Tests are comparable to those achieved in actual practice today. It was concluded after the tests that the best braking system was one operated by air and controlled with electricity. Several other tests conducted since that time also have concluded the electropneumatic brake was most desirable. With the exception of the radio-controlled remote systems, the electropneumatic brake has not been developed for use on freight trains.

It is often not possible to determine the stopping distance of brake application history of a train involved in an accident. Proper data of this type, however, could indicate the frequency with which less than ideal braking is responsible for or contributes to accidents. Statistical justification from such accident data could indicate the need for train braking improvements. Thus, the lack of braking history in accidents or in railroad operations in general is a key problem in determining how much improvement is necessary

The first approach to the overall braking question should be to develop equipment capable of recording the braking effects in accidents. The degree of need for improvements to benefit the general public could then be determined from the accident data. It is now evident, however, that improved braking equipment is already desirable to avoid accidents and damage resulting from the combination of rapid deceleration and slack action. This situation in railroad emergency brake application is one of the few remaining in transportation technology in which an unpredictable accident can be caused by normal use of an operating control.

VI. Probable Cause

The Safety Board determines that the derailment was caused by the buckling of the underframe of the 108th car when the engineer made a full emergency brake application in an attempt to avoid striking a pedestrian who was walking in the track. The car buckled because of excessive and uncontrollable compression in the train which developed when the full emergency brake application created greater braking force on the head of the train than on the rear.

The fire and explosions resulted from the rupture of a tank car of vinyl chloride by the coupler of one of the derailed cars. The absence of interlocking couplers and other means of preventing separation and jackknifing allowed the cars to jam up together. The pileup resulted in additional mechanical damage to the tanks and allowed the fire from the leaking tank to impinge on the others.

VII. RECOMMENDATIONS

The Safety Board recommends that:

1. The Federal Railroad Administration, in cooperation with the railroad industry, initiate research and development which will result in practical locomotive instrumentation capable of recording data relating to the braking behavior of trains. The data obtained should be of sufficient scope and accuracy to allow evaluation of the braking performance of the train and to record the manner in which the brakes were applied. The project should contemplate initially the instrumentation on sufficient numbers of locomotive units to insure a sampling of freight train accidents and should include provision for cooperative evaluation of records by Government and industry.

2. The Federal Railroad Administration initiate research and development to provide prototype models of freight train braking systems

(a) capable of providing shorter stopping distances which nearly approach the theoretical limit under all conditions of loading and length of trains;

(b) capable of stopping a train in the emergency applications now required by regulations without internal collisions, train separations, or damage to the train or its lading;

(c) capable of propagating brake application, both service and emergency, throughout the length of a train more expeditiously and surely;

(d) capable of more rapid application of the full intended stopping force to the rails at each car after the application signal is received at each car.

3. The Illinois Central Railroad Company initiate a program to train employees in the proper procedures to insure adequate protection to employees and bystanders at accidents involving hazardous materials.

The Safety Board reiterates and emphasizes the following recommendations made in the report of the accident which occurred on the Southern Railway at Laurel, Mississippi, on January 25, 1969:

> "5. . . . the Association of American Railroads and 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.
>
> "10. . . . the A.A.R. review the function of the Bureau of Explosives regarding its performance in protecting the public from danger resulting from railroad accidents involving hazardous materials and take the necessary action to develop an effective, cooperative program with the carriers to accomplish the intended purpose of the responsibility delegated to the Bureau of Explosives by Title 49, Code of Federal Regulations, Section 174.506. The Board endorses the FRA's proposed amendment of the regulations which will provide that reports of incidents and accidents involving hazardous materials presently made to the Bureau of Explosives by rail carriers will also be filed with the FRA.
>
> "11. . . . the Federal Railroad Administration include in its current study of an improved coupler design, the problem of keeping cars coupled and in line with the track and with each other after a derailment occurs. In order to attain an integrated organization of track and rolling stock features that could limit the after effects which can now follow a simple derailment, the Federal Railroad Administration should also study related technical approaches to control interference with traffic on adjacent tracks and wayside structures during derailments, such as means of limiting the lateral excursion of wheels, and separation of trucks from car."

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H. REED, Chairman

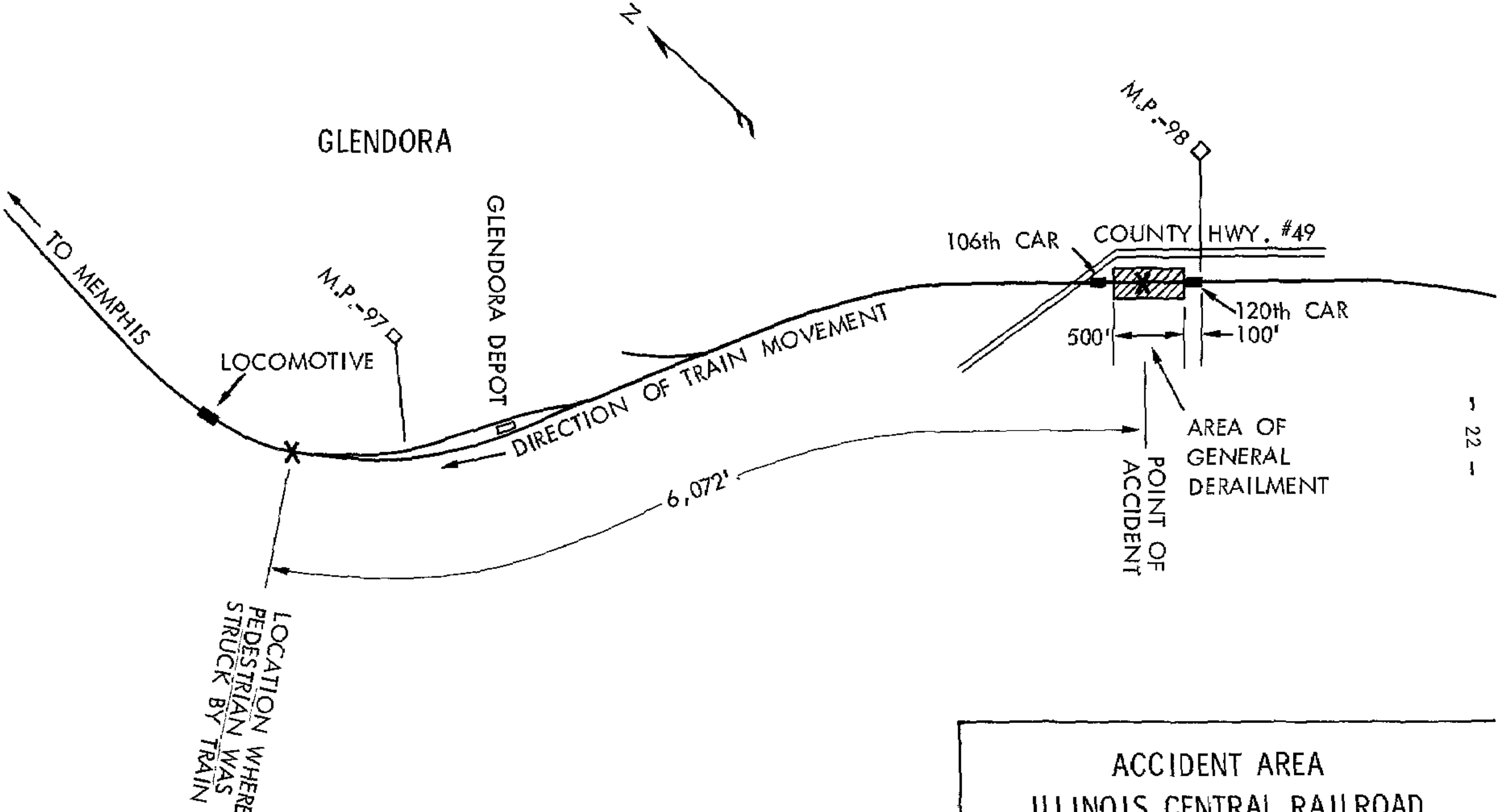
/s/ OSCAR M. LAUREL, Member

/s/ FRANCIS H. McADAMS, Member

/s/ LOUIS M. THAYER, Member

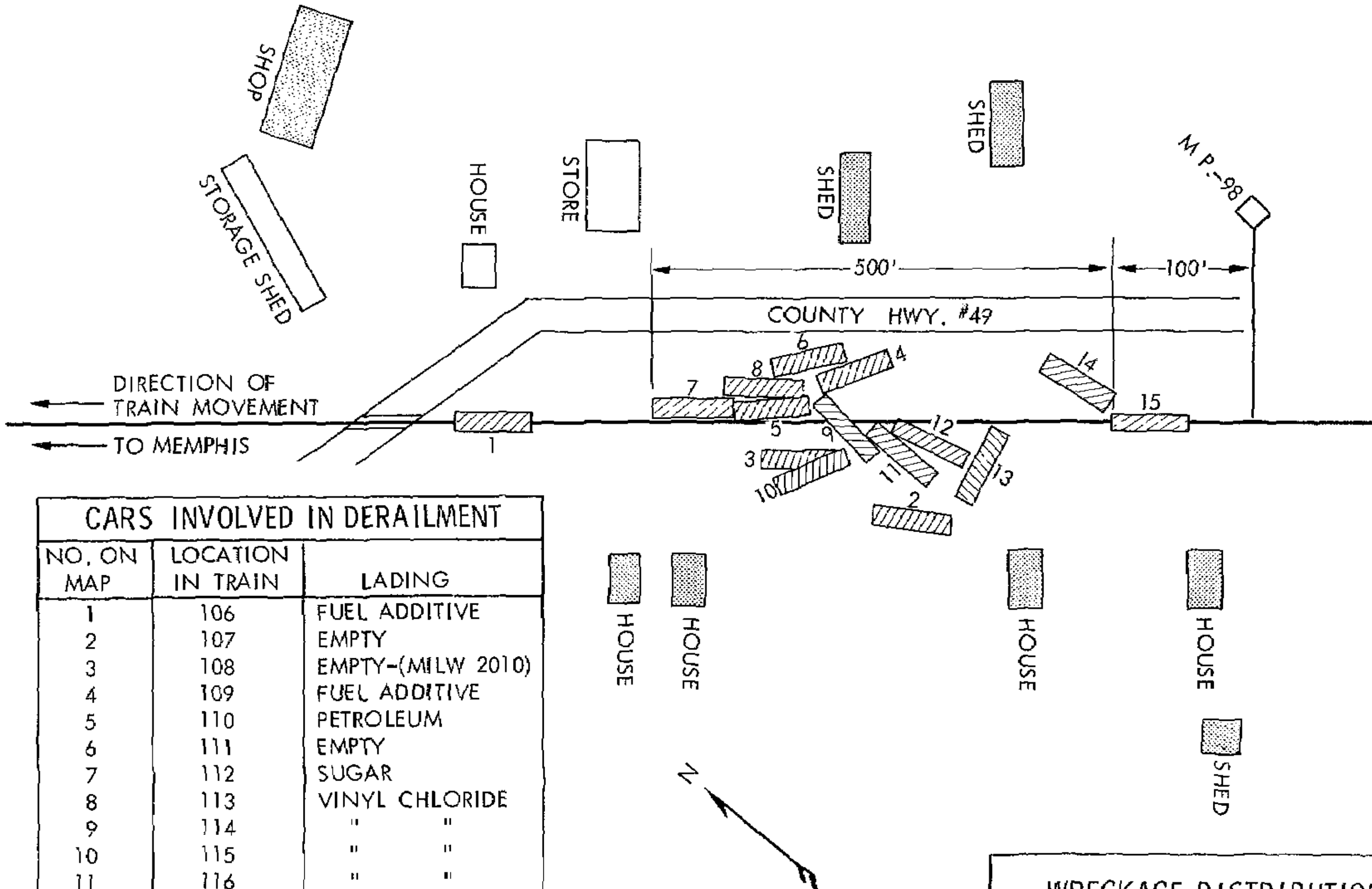
/s/ ISABEL A. BURGESS, Member

August 19, 1970



ACCIDENT AREA
ILLINOIS CENTRAL RAILROAD
GLENDORA, MISS.
SEPTEMBER 11, 1969

APPENDIX 1



CARS INVOLVED IN DERAILMENT		
NO. ON MAP	LOCATION IN TRAIN	LADING
1	106	FUEL ADDITIVE
2	107	EMPTY
3	108	EMPTY-(MILW 2010)
4	109	FUEL ADDITIVE
5	110	PETROLEUM
6	111	EMPTY
7	112	SUGAR
8	113	VINYL CHLORIDE
9	114	" "
10	115	" "
11	116	" "
12	117	" "
13	118	" "
14	119	" "
15	120	" "

BURNED STRUCTURES

WRECKAGE DISTRIBUTION
AT GENERAL DERAILMENT
ILLINOIS CENTRAL R.R.
GLENDORA, MISS.
SEPTEMBER 11, 1969

APPENDIX 2

PERTINENT CHARACTERISTICS OF THE TANKS INVOLVED IN THE DERAILMENT

REPORT's MARKS	CAR NO.	CLASS OF CAR	DATE BUILT	TYPE OF UNDERFRAME	COUPLER	DOT TANK SPECIFICATIONS	TANK TEST DATE	CAPACITY GALLONS	LADING	MONETARY DAMAGE EQUIP
ACFX	85195	TANK	12 - 1967	STUB END SILL	E	105A-200W	11 - 1967	24,869	VINYL CHLORIDE MONOMER	(EST) 5,000.00
ACFX	85197	TANK	12 - 1967	STUB END SILL	E	105A-200W	11 - 1967	24,846	" "	(EST) 6,000.00
ACFX	85537	TANK	3 - 1968	STUB END SILL	E	105A-200W	1968	24,860	" "	(EST) 6,500.00
SHPX	85144	TANK	9 - 1966	STUB END SILL	E	105A-200W	6 - 1966	24,871	" "	20,274.07
SHPX	85212	TANK	12 - 1967	STUB END SILL	E	105A-200W	11 - 1967	24, 865	" "	20,339.79
SHPX	85069	TANK	6 - 1965	CONTINUOUS CTR, SILL	E	105A-300W	5 - 1965	23,841	" "	18,053.42
UTLX	83889	TANK	7 - 1962	STUB END SILL	E	105A-300W	5 - 1968	22,000	" "	(EST) 6,000.00
UTLX	83876	TANK	5 - 1962	STUB END SILL	E	105A-300W	4 - 1962	22,000	" "	(EST) 500.00

APPENDIX 3