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HAZARDOUS MATERIALS SPECIAL INVESTIGATION REPORT RELEASE OF OLEUM DURING WRECKAGE-CLEARING FOLLOWING DERAILMENT OF SEABOARD SYSTEM RAILROAD TRAIN EXTRA 8294 NORTH, CLAY, KENTUCKY, FEBRUARY 5, 1984

National Transportation Safety Board
Washington, DC

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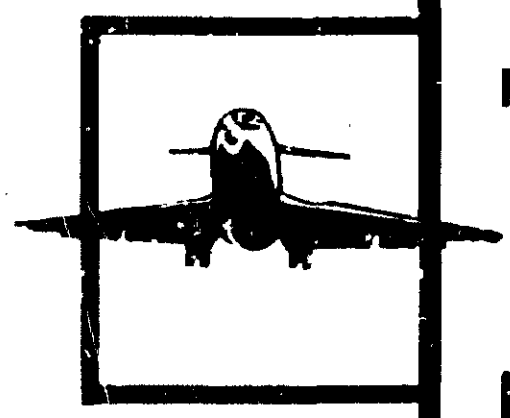

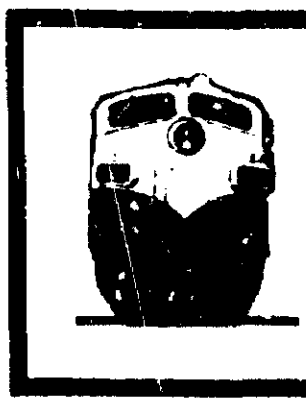

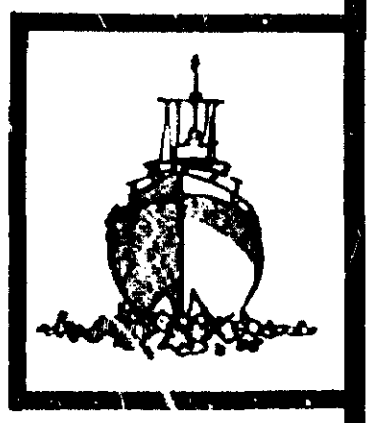

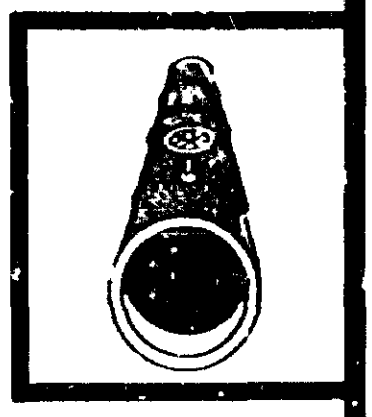

PB85-917004

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

HAZARDOUS MATERIALS SPECIAL INVESTIGATION REPORT

RELEASE OF OLEUM DURING WRECKAGE-CLEARING FOLLOWING DERAILMENT OF SEABOARD SYSTEM RAILROAD TRAIN EXTRA 8294 NORTH CLAY, KENTUCKY FEBRUARY 5, 1984

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12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594		13. Type of Report and Period Covered Hazardous Materials Special Investigation Report February 5, 1984 14. Sponsoring Agency Code
15. Supplementary Notes		

16. Abstract At 8:50 a.m., on February 5, 1984, 38 cars of Seaboard System Railroad freight train Extra 8294 North, consisting of 106 cars and a 4-unit locomotive, were derailed at a facing point switch near Clay, Kentucky. The derailment began when a broken truck bolster on the trailing end of the 56th car (SCL boxcar 635204) struck the closure rail of a left-hand turnout and derailed. One of the derailed cars, tank car GATX 94350, contained oleum (fuming sulfuric acid). During the derailment the trailing end of the tank car incurred a 4-inch by 1/8-inch fracture from which a small amount of acid leaked and produced light vapor clouds. A temporary plug was installed to prevent further leakage.

Two days later, as a wreckage-clearing crew contracted by the railroad was preparing to empty the oleum car, the temporary repair plug in the fracture blew out and an estimated 1,800 gallons of oleum was released and vaporized. During the following 24 hours, a 2- by 3-mile area of Bourbon County, Kentucky, was affected, forcing the evacuation of 25 families; 24 residents were treated for minor respiratory complaints. Investigation of the emergency response activities disclosed that the actions taken during this emergency failed to stabilize and reduce the risks to the public health and safety because available technical resources were not used effectively and actions taken were not directly coordinated among responding organizations. Total property damage was $582,403, including the cost of hazardous materials cleanup.

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CONTENTS

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Adopted: April 30, 1985

RELEASE OF OLEUM DURING WRECKAGE-CLEARING FOLLOWING DERAILMENT OF SEABOARD SYSTEM RAILROAD TRAIN EXTRA 8294 NORTH CLAY, KENTUCKY FEBRUARY 5, 1984

SYNOPSIS

At 8:50 a.m., on February 5, 1984, 38 cars of Seaboard System Railroad freight train Extra 8294 North, consisting of 106 cars and a 4-unit locomotive, were derailed at a facing point switch near Clay, Kentucky. The derailment began when a broken truck bolster on the trailing end of the 56th car (SCL boxcar 635204) struck the closure rail of a left-hand turnout and derailed. One of the derailed cars, tank car GATX 94350, contained oleum (fuming sulfuric acid). During the derailment the trailing end of the tank car incurred a 4-inch by 1/8-inch fracture from which a small amount of acid leaked and produced light vapor clouds. A temporary plug was installed to prevent further leakage.

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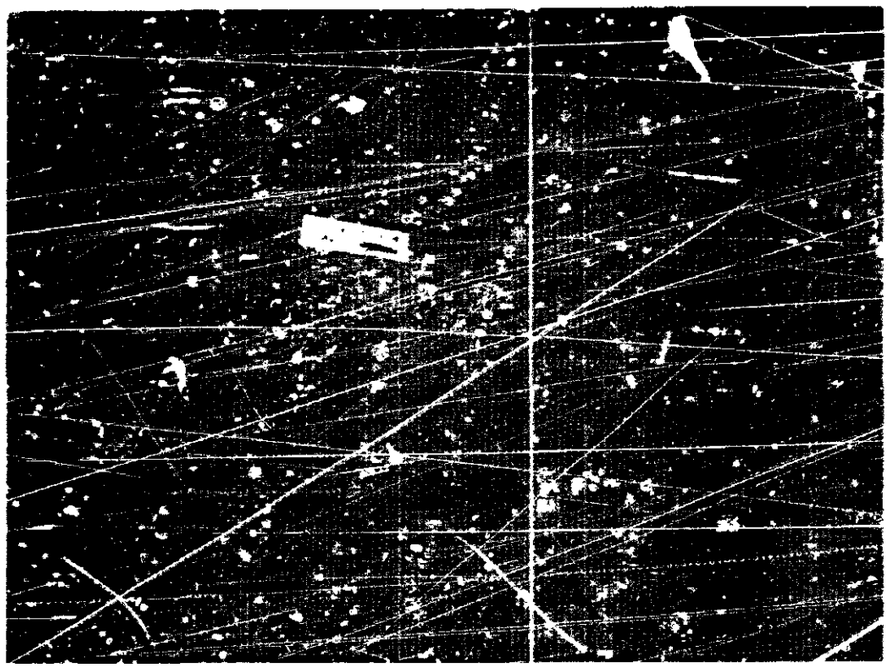
INVESTIGATION

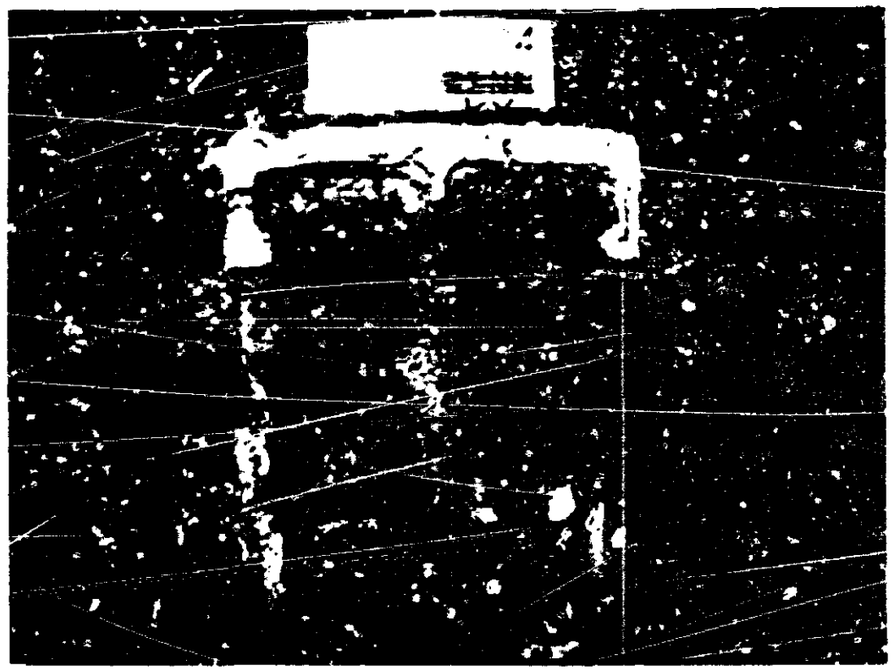
The Accident 1/

February 5.--Seaboard System Railroad (Seaboard) train GATCI-04, operating as Extra 8294 North, derailed at milepost (MP) 84.7 near Clay, Kentucky, at 8:50 a.m. on February 5, 1984. The train derailed when a broken truck bolster on the trailing end of the 56th car (SCL boxcar 635204) struck the closure rail of a lefthand turnout. (See figure 1.)

1/ The National Transportation Safety Board investigated this accident as a major transportation accident because of the safety issues involved in the handling of hazardous materials following a railroad derailment, and this report reflects that investigation. However, because of the Safety Board's mandate to determine the facts, conditions, circumstances, and probable cause of any railroad accident in which there is substantial property damage, it also investigated the railroad aspects of the accident, and has determined the probable cause of the derailment itself. (See appendix C.)



Front View



Left Section

Right Section

Figure 1.--Front and sectional views of SCL 635204 truck bolster.

The forward portion of the train stopped about 4,100 feet from the switch point with the 55th head car derailed and in an upright position. The 56th head car remained upright with all wheels derailed and separated from the trailing car by 36 feet. The 57th through the 60th cars were empty DOT 111A100W2 tank cars which contained residual amounts of sulfuric acid from a previous trip. These cars overturned to the west and came to rest between the rails of the adjacent southbound main track with a trailing separation of 951 feet. These cars were equipped with standard E-type couplers and were not fitted with head shields. 2/ None of these tank car heads was damaged by impact, and none released residual product. The 61st car overturned to the west, coming to rest aligned with the track structure 902 feet north of the 62nd car, which remained upright.

The 63rd car, GATX 94350, a DOT 111A100W2 tank car loaded with oleum and not fitted with headshields or shelf couplers, overturned to the west and came to rest between the rails of the adjacent main track. It was separated from the trailing car by 207 feet. The trailing head of the tank car was struck to the right of center by derailing equipment, creating a 4-inch-long fracture in the metal. A slight amount of oleum was released through the fracture and vaporized into the atmosphere. The 64th through 92nd cars derailed at various angles to the track. The 83rd car, a DOT 112J340W tank car last containing liquefied petroleum gas (LPG), derailed to the west across the adjacent main track at an angle of 80°, coming to rest in an upright position. A 10-foot-long area of its shell was damaged. The car also was equipped with E-type shelf couplers; the leading end coupler shank was broken, and the trailing end remained coupled to the lead coupler of the trailing car. The 10 following cars derailed and came to rest in an upright position at various angles to the track structure.

After the derailment, the conductor of Extra 8294 North discovered that the derailing cars had damaged the Seaboard's telephone line which paralleled the tracks, and he contacted a following train, train No. 142, by radio and requested that the Seaboard dispatcher in Corbin, Kentucky, be notified. Train No. 142 stopped south of Clay and phoned the Corbin dispatcher around 8:50 a.m., and informed him that Extra 8294 North was stopped. Around 9:20 a.m., train No. 142 reported to the Corbin dispatcher that about 34 cars were derailed, including several tank cars--one containing sulfuric acid. It also reported that no one was injured. The telephone lines were noisy, and the dispatcher could barely maintain contact with train No. 142.

Shortly after the derailment, a farmer who resided within 300 feet of the derailment site contacted the Bourbon County Sheriff's Office and reported that "some rail cars had been left behind." The sheriff's dispatcher advised the resident to contact Seaboard's Corbin office. At 9 a.m., the resident contacted the Corbin dispatcher and reported that, "it looks like several of the cars are going to fall from the tracks any minute." The dispatcher reportedly responded that he was not aware of any problems in the area at that time. At 9:20 a.m., the derailment was confirmed from train No. 142, and the dispatcher notified the Seaboard Operations Center in Jacksonville, Florida.

2/ "E" coupler refers to the standard Association of American Railroads automatic coupler. The shelf coupler is a special coupler required on all hazardous materials tank cars after February 28, 1985. The shelf coupler contains top and bottom "shelves" cast integral with the coupler head to prevent vertical disengagement of mating couplers.

Around 9:10 a.m., the rear brakeman went to the nearby farm and informed its residents that their horses might escape because the derailed cars had knocked down some fencing. Reportedly, the rear brakeman informed the farmer that "all of the tank cars were empty and there were no risks." After the rear brakeman returned to the derailment site, the conductor reviewed the train consist and noted that tank car GATX 94350 was listed as a "dangerous" car and informed the rear brakeman to stay away from it. When SBD gives its traincrews the waybills and consists for their train, it also provides computer-generated emergency information on the hazardous materials in the train.

During the next 30 to 40 minutes, as the rear brakeman attempted to inspect individual cars, he observed "vapor coming out of a tank car and I got away from it." After the brakeman ascertained the car numbers of the derailed cars, he returned to meet with the conductor in the caboose. Train No. 142 pulled the rear standing cars southward to a nearby signal box.

At 9:30 a.m., based on the farmer's complaint, a Kentucky State trooper was dispatched to the scene of the accident. When the trooper arrived onscene, around 10 a.m., he found the locomotives of Extra 8294 North about 1/2 mile north of the derailment site, and the rear section of the train had been removed.

The State trooper approached the derailment site from the nearby farm and met the rear brakeman near the tracks. The rear brakeman stated that, "there was one car with sulfuric acid on its side" to their north. The trooper reported later that the crewmember was "not very conclusive" in his assessment of the derailment and seemed to be concerned only about one tank car in the derailment. As a result, the trooper walked along the tracks until reaching a tank car placarded with a North American identification number 1831 and stenciled "OLEUM, GATX 94350." 3/ The trooper reported that this car had a small hole about the size of a silver dollar in its south end ("A" end) from which small wisps of smoke were emanating. The trooper, uncertain as to whether all available train information had been reported to the State, advised the rear brakeman of the requirement to notify the State Emergency Response Center and provide all of the necessary train information.

The trooper next contacted his dispatcher at Dry Ridge, Kentucky, to confirm the farmer's complaint and requested his dispatcher to contact Seaboard's Corbin office for further details. The State Police dispatcher responded that the Seaboard Corbin train dispatcher could confirm only that there had been a derailment in the Clay District. Recognizing that a hazardous material had been released and that residents had not been warned, the State trooper took his copy of the U.S. Department of Transportation (DOT)/Research and Special Programs Administration's (RSPA) Emergency Response Guide (DOT-P-5800.2) and began contacting nearby farm residents, reading to them the guide's advice regarding oleum. (See appendix D.)

Around 10:20 a.m., the conductor contacted the Corbin dispatcher, who in turn notified the Seaboard Operations Center that GATX 94350 was leaking. About 10:30 a.m., the Seaboard Operations Center notified CHEMTREC, 4/ the Tennessee

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3/ The North American identification number 1831 refers to specific corrosives and appears on a black-and-white placard.

4/ CHEMTREC is the Chemical Transportation Emergency Center operated by the Chemical Manufacturers Association which provides immediate advice at the scene of emergencies, then promptly contacts the shipper of the chemicals involved for more detailed assistance and appropriate followup.

Chemical Company, the Environmental Protection Agency (EPA), and Seaboard management, including its hazardous materials control manager.

At 10:58 a.m., the Dry Ridge Post of the Kentucky State Police notified the Kentucky Disaster and Emergency Service (DES) communications center and the State Fire Marshal's office in Frankfort, Kentucky. DES, in turn, notified the Kentucky Department of Natural Resources (DNR). At 11:03 a.m., DES was notified by telephone by the Seaboard Hazardous Materials Control Department, which confirmed that a 34-car derailment had occurred involving a tank car leaking sulfuric acid. About 11:20 a.m., the DES duty officer activated the hazardous materials response team in accordance with Kentucky's disaster plan.

The State response team consisted of representatives of the State Fire Marshal's office, the DES area coordinator, the Kentucky State Police, and the DNR. The Bourbon County DES director also was notified. At 11:30 a.m., the Paris Police Department dispatcher was notified by the DES area coordinator, and the State Fire Marshal alerted the Bourbon County Fire Department.

By noon, the Seaboard division superintendent, along with the assistant superintendent, the master mechanic, and the trainmaster, arrived onscene from Corbin and the superintendent requested that the waybills at the rear of the train be brought to the derailment site. The superintendent initially met with the State Fire Marshal and DNR representatives who advised that the car still was releasing small amounts of oleum vapor and that the hazard potential was minimal. The Seaboard superintendent advised that he would be better able to discuss wreckage-clearing plans after he had inspected the derailment site. As he inspected the tank car, he noted slight wisps of vapor being released through the damaged jacket near the bolster. However, because of the outer jacket, the location or extent of the damage to the inner shell could not be determined. The Seaboard superintendent observed moisture condensation in those areas where the jacket had loosened. 5/ Additionally, during this time, the State Fire Marshal's representative checked the "empty" tank car containing residual amounts of LPG using an explosive vapor meter to verify that no vapors were being released.

At 12:30 p.m. and 1 p.m., the Seaboard Operations Center contacted the shipper in Copperhill, Tennessee, and learned that empty tank cars UTLX 12830, UTLX 12831, UTLA 12828, and UTLX 12838 had been cleaned and rinsed with water; that the strength of the oleum in tank car GATX 94350 was 65 percent; and that the tank car should not be moved because the movement of the leaking car might worsen the leak. The Seaboard Operations Center relayed this information to the Corbin dispatcher.

At 1:25 p.m., State Fire Marshal representatives, the DES coordinator, and the DNR representative conferred with the Seaboard superintendent. A State Fire Marshal representative informed Seaboard officials that the damaged oleum car could not be moved before unloading. This decision was made before any other options were discussed, such as available methods for moving the car safely.

5/ At this time snow was falling and residual heat from the inner tank, at approximately 120° F, was melting the snow and forming "sweat beads" on the exposed portions of the inner tank.

The Seaboard superintendent related to the State representatives that he planned initially to clear the mainline track of debris and upright the damaged oleum tank car on the southbound tracks, and then to transfer the oleum into several tank trucks. The Seaboard hazardous materials coordinator, who arrived onsite around 2 p.m, began to contact trucking firms, CHEMTREC, and the shipper to locate tank trucks or tank cars into which the oleum could be unloaded. The shipper identified leased empty tank cars that were available and specific types of tank trucks and equipment required for the transfer. The shipper expressed concern about the difficulty of transferring the oleum if it solidified and recommended that steam be applied to exterior heating coils of the car in order to reduce the viscosity of the oleum. CHEMTREC provided a list of truck firms with the requisite stainless steel, insulated tank trucks equipped with tractor pumps. Seaboard developed plans to unload GATX 94350 into three stainless steel, insulated tank trucks. Around 2 p.m., Seaboard contracted a hazardous material cleanup and removal contractor to handle the transfer, to be performed on February 6, 1984.

Between 2 p.m. and 4 p.m., the State DES coordinator decided to release the local DES area coordinator and firefighters. Also, the DES area coordinator briefed the news media on the derailment and plans to deal with the hazardous materials. Later, the DES coordinator met with DNR representatives, State Fire Marshal representatives, and Seaboard representatives, and all agreed that DNR and State Fire Marshal representatives would remain at the scene until all the oleum was unloaded and that further DES support was not required.

Later, as plans were being made for the unloading, the Seaboard hazardous materials coordinator reported that "more fumes appeared from the fracture in the car and gurgling could be heard for the first time." The State Fire Marshal's representative directed the Seaboard superintendent that "the oleum car would not be moved . . . and not to touch it until it was transferred." The State Fire Marshal's representative stated that he could not be sure about any structural damage that might have occurred in the derailment, and that he did not think that Seaboard should take the chance on losing any of its contents because at that time there had not been any spillage whatsoever on the ground. Also, since they were unable to inspect the inner shell of the tank, he felt that Seaboard should leave it where it was. The State Fire Marshal's representative recommended that Seaboard use the fittings on GATX 94350 to transfer the oleum.

Without discussing with Seaboard the means which would later be used for transferring the oleum, the State Fire Marshal's representative told the Seaboard superintendent to proceed with the wreckage-clearing operations. The superintendent stated that he would comply with the State Fire Marshal representative's decision in spite of the fact that he and his master mechanic believed that they could move the car safely. As a result, the superintendent decided to build a temporary track around the oleum car to open the mainline. With the arrival of railroad derricks during the night, wreckage-clearing crews started moving wreckage from both the north and south ends of the derailment.

Meanwhile, in the afternoon, a representative from the Bureau of Explosives (B of E) of the Association of American Railroads (AAR) had met with the Seaboard superintendent and State Fire Marshal's representative. The B of E representative had recommended that the Seaboard patch and attempt to upright the tank car in order to transfer the entire contents of the tank. The B of E representative inspected the tank car and concluded that there did not appear to be any other areas on the tank car in which wheels or rail had impinged the inner tank, that the tank did not appear to be resting on

any wheel sets beneath the car, and that the car roll onto the southbound track without skidding or sliding. However, the superintendent reported to the B of E representative that the State Fire Marshal had decided not to move the car until it was unloaded and a temporary track was built. The B of E representative, at the request of the Seaboard superintendent, agreed to remain on the scene until the next day.

February 6.--Around midnight, the Seaboard cleanup and removal contractor arrived at the site and met with the Seaboard hazardous materials coordinator, who directed that the tank car be patched and the oleum transferred. Following an inspection of the tank car, the supervisor for the contractor advised the Seaboard coordinator that the outer jacket would be removed from the A-end and an attempt would be made to locate the breach and patch it. Also, the contractor advised that he would make arrangements for additional equipment 6/ to be sent from his home base in Findley, Ohio, to "cold tap" an opening in the tank car to facilitate transfer. This was necessary since the liquid eduction lines of the tank car were not in a position where they could be used effectively. 7/

For reasons of personnel safety, the contractor elected to plug the car temporarily before performing the "cold tapping" operation, rather than to weld a patch across the breach; neither the plugging nor the cold tap would require the use of open flames around the car. (See figure 2.) After Seaboard agreed with these plans, the contractor cut and removed portions of the outer jacket at the A-end of the tank car. During the afternoon, the contractor placed a temporary plug made of lead wool into the breach in the head of the tank car and reported that no liquid or vapor was being discharged from the breach before the patching operation.

By 3:20 p.m., two empty tank cars had arrived. Upon inspection, Seaboard determined that neither car was suitable for the transfer because one tank car had not been purged of an incompatible residue and the other was not considered to be in acceptable condition. With the assistance of the shipper, a suitable empty tank car was located and routed to Clay and was scheduled to arrive the evening of February 7. During Seaboard's discussions with the shipper, the shipper again expressed its concern that because of the temperature drop during the day, the oleum might solidify and that it also might be necessary to apply steam to the car's heating coils in order to reduce the viscosity of the oleum during the unloading operations. As a result, arrangements were made onsite to prepare a steam generator. During these discussions, Seaboard also requested the shipper to send representatives to the site to provide technical advice during unloading operations.

6/ The equipment was a 2 1/2-inch Mueller Drilling and Tapping Machine modified by the subcontractor for tank car applications by removing the base plate (saddle fitting). As supplied by Mueller, this device is intended for tapping water and gas mains up to 8 inches in diameter and 1-inch thick. It has a maximum working pressure of 90 psi. The Mueller Co. does not recommend this device or any of their products for tank car penetrations. Mueller representatives were not aware that this device had been modified by the subcontractor for tank car penetrations and later expressed concern about the capability of the modified equipment to provide an adequate seal when used to tap tank cars.

7/ With the tank car rolled over on its side, the interior liquid eduction lines were inverted above the liquid level of the oleum within the tank. The eduction line is a loading or unloading pipe that extends from the top of the tank car to the low point or sump at the bottom of the tank car.

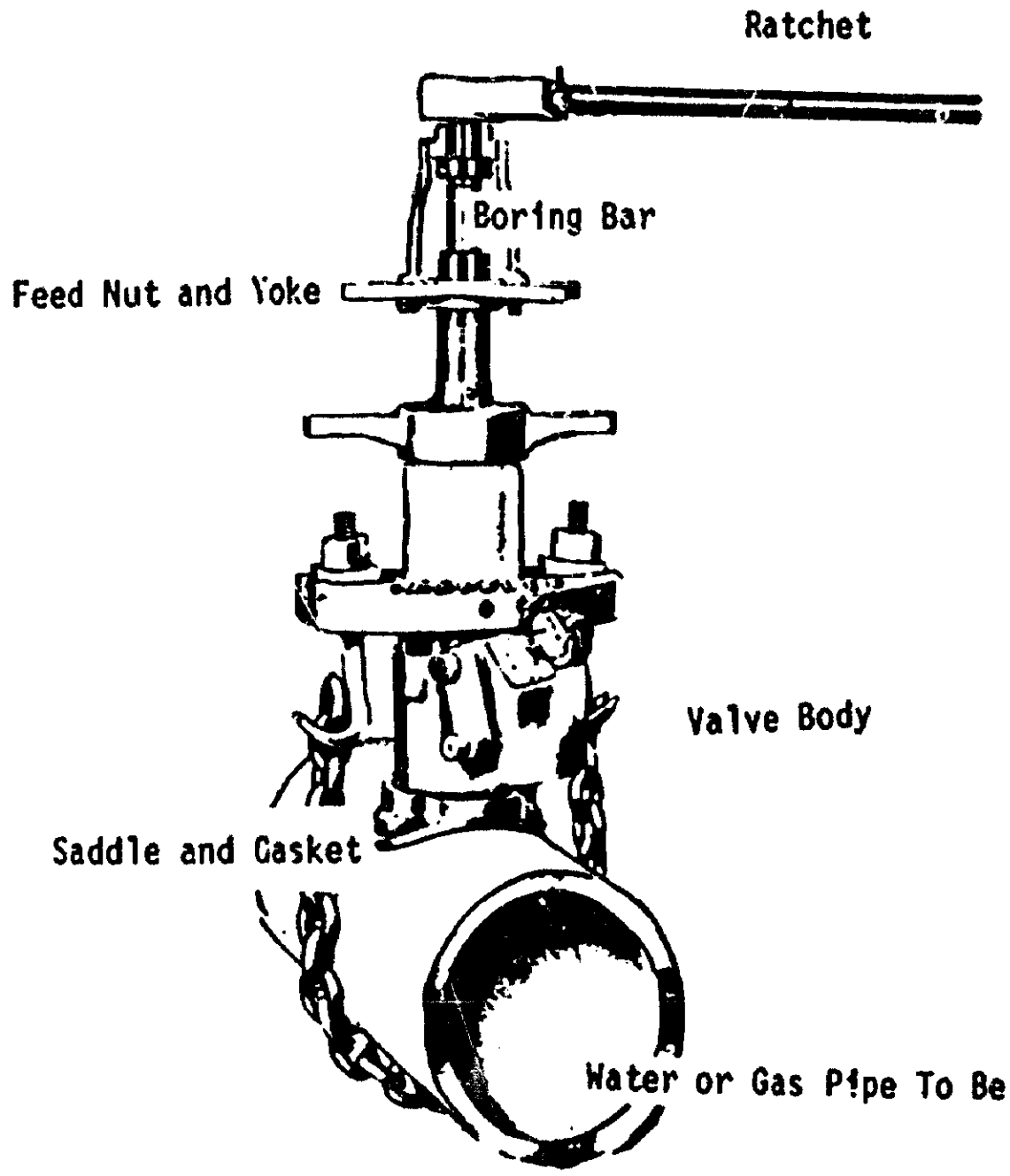


Figure 2.--Mueller Co. "B" drilling and tapping machine in designed application.

February 7.--According to Seaboard plans, the Seaboard cleanup and removal contractor was to prepare the transfer equipment and drill the opening into the tank car when the tapping equipment arrived; additionally, the contractor would transfer the product into an empty tank car with shipper personnel assisting and State Fire Marshal and DNR representatives onscene to monitor these operations. At 10 a.m., the tapping device arrived, and Seaboard contractor personnel centered it on top of the shell of the tank car with a mechanical locking device so that the tap would enter the vapor space instead of the liquid. About 2:10 p.m., as the tapping device penetrated the unvented car, the temporary plug installed earlier blew out from the damaged oleum car. Following the blowout, a 100-foot sulfuric acid vapor plume erupted at the point the tapping equipment had penetrated into the tank, and an acid pool formed at the south end of the car. (See figure 3.) A command post was formed immediately at the Escondida Road access point by the DNR representative who contacted the DES communications center. In turn, this center notified the State Fire Marshal, the Kentucky State Police, and DES representatives. By 3 p.m., representatives from all these agencies had returned to the site.

Immediately after the plug blew out, cleanup and removal personnel attempted to replace it. However, because visibility was reduced by the vapor surrounding the breached tank head, they were unable to insert a second plug. During this operation, personnel wore self-contained breathing apparatus and full protective equipment as they attempted unsuccessfully to clear a path through the vapor using water lines. Additionally, agricultural lime was applied to the pooled oleum, but it was not effective in reducing the intensity of the vapor cloud.

At 2:25 p.m., Kentucky DNR personnel moved horses from an adjacent farm as a large vapor cloud drifted eastward over several thoroughbred breeding farms. At 2:45 p.m., adjacent roads were closed by State police as an 8-foot by 4-foot pool of liquid formed beneath the A-end of the tank car. At 3 p.m., the State Fire Marshal's representative requested additional airpacks from the Bourbon County Fire Department and a team of forward observers was established, including the State Fire Marshal's representative, the Seaboard hazardous materials coordinator, and the cleanup and removal personnel. At 4:30 p.m., a new command post was established 3 miles south of the site by the DES area coordinator. The command post consisted of the DES, the State Fire Marshal, the Kentucky State Police and the Seaboard. By 5:30 p.m., shipper personnel and the State environmental monitoring team arrived onscene. (See appendix E.)

Personnel at the scene observed the vapor cloud rising and initially did not believe evacuation of nearby residents was needed. However, at 5:30 p.m., a temperature inversion forced the vapor cloud close to the ground, and the cloud began to drift toward several farms along Route 627 for a distance of about 1 mile. Based on the DOT Emergency Response Guide Book, the State Fire Marshal's representative called for an immediate evacuation of an area 1 1/2 to 2 1/4 miles to the south and southeast of the site. Kentucky State Police contacted about 25 families and advised them that the Young Men's Christian Association (YMCA) at Paris, Kentucky, had been designated as a shelter for evacuees. Although about 25 families were advised to evacuate, many chose either to remain in their homes or to stay with families and relatives. Notification was completed by 8:30 p.m.

At 6:30 p.m., when the suitable empty tank car arrived to receive the oleum, cleanup and removal personnel, along with shipper advisers, made several unsuccessful attempts to pump the liquid product from the car's 1-inch-diameter air vent located in the dome to lower the liquid level of oleum below the breach. However, with the ambient temperature below 30° F, the oleum solidified in the transfer lines.

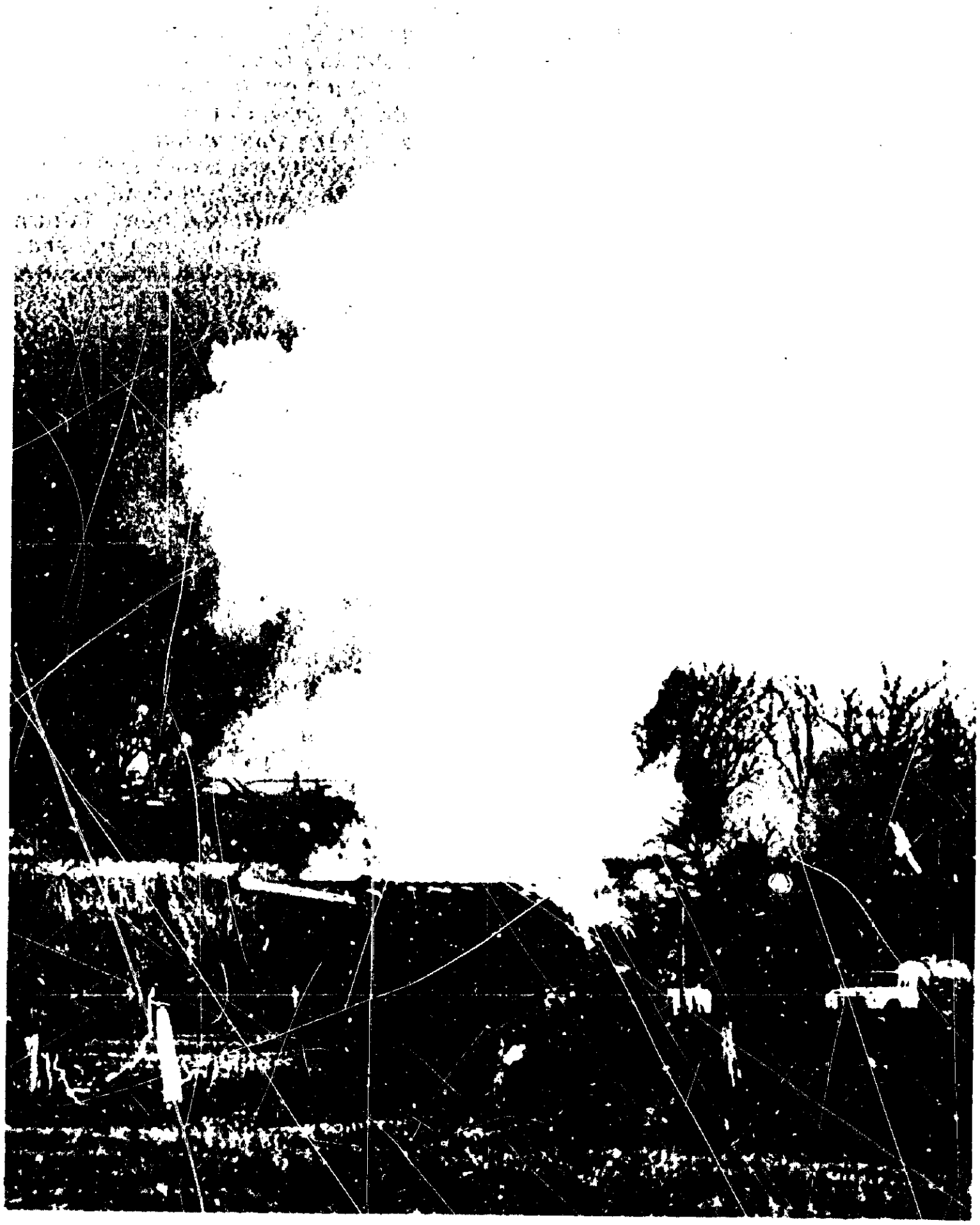


Figure 3.--GATX 94350 venting during plug release, February 7, 1984.

By this time, the vapor cloud had drifted east to Spears Mill Road and north to Spears Mill Church, encompassing a 1.5- by 1-mile area. The area was low-lying with hilly terrain extending northward to the city of Paris. (See appendix E.) As a result of dropping temperatures, patches of fog were intermixed with the sulfuric acid vapor cloud being carried northward from the site. Around 10 p.m., the temperature dropped to 20° F and the wind was calm. Hydrogen sulfide concentrations as high as 20 ppm 8/ were observed about 1/2 mile west of the derailment site. At 11:45 p.m., with the temperature having dropped to 13° F and the wind at 3 knots from the southwest, the vapor cloud drifted farther west to Route 1678 and was reported to have reached the city of Paris, 3 1/2 miles from the derailment site. During this time, as the cloud advanced toward Paris, the Paris Police and Kentucky State Police dispatchers received complaints from residents of a "definite lung and throat irritation and a taste effect." About 24 residents were treated by local physicians during the next 48 hours. These residents lived mostly in low-lying terrain extending north of the derailment site to Paris, about 3 1/2 miles. The county sheriff's office contacted the State DES command post, and an environmental monitoring representative was sent to Paris. Based on readings from a photoionization meter which monitors hydrogen sulfide levels, the representative reported "from 3 to 7 ppm with no strong concentrations observed for very long." During this time, the Sheriff's Office attempted to obtain from DES, CHEMTREC, and the shipper's onscene chemist additional information necessary to predict cloud behavior, short- and long-range health effects, and precautions to be taken should the cloud intensify.

February 8.--At 1:30 a.m., as a result of a meeting among parties onscene, the shipper was requested by Seaboard to weld a patch across the fracture in order to stabilize the leak. Shipper personnel had to return to the Copperhill plant to obtain additional welding equipment.

The State environmental response representative reported that during this time:

> The people had been adequately warned that if they smelled anything unusual they would have time to leave before any harm could be done. In addition, the temperature was around 10° F that night which meant there would not be any open doors or windows where the vapors could get inside. As for the possible harm to livestock I felt that they would tolerate any exposure much better due to their body weight.

Around 5:30 a.m., the State environmental response team met with the Bourbon County Sheriff and recommended that the opening of schools be delayed until daylight so that the sun could burn off the fog. Following a meeting, the school superintendent ordered schools closed for the day.

With the arrival of additional equipment from the shipper, new patch work began at 8 a.m. At 9:20 a.m., the leak had been plugged and the patch installed across the fracture. The remaining vapor cloud was observed to dissipate shortly afterward. However, product which had leaked into the insulation between the jacket and shell of the tank car continued to produce a small vapor cloud.

8/ Parts per million (ppm). The threshold limit for hydrogen sulfide is 10 ppm. (NIOSH "Pocket Guide"). The threshold limit is the time-weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effects.

Initial attempts to unload the car using a displacement pump to transfer product through the 2.75-inch tap hole were not successful. The shipper discovered that the oleum had solidified in the eduction line on the receiving car. The shipper then injected small amounts of water into the eduction line and at approximately 5 p.m., the oleum in the eduction line thawed.

At 11:24 a.m., a truckload of soda ash was brought to the site and was spread over the spill area. The State Fire Marshal considered the situation stabilized at this time. Around 3 p.m., evacuees were notified that the vapor cloud had dissipated and that they could return to their homes.

By 6:30 p.m., wreckage-clearing personnel had begun transferring product in volume. Because there was no means of neutralizing the vapors still being expelled from the vent on the receiving tank car, vapors again were released in large amounts. Therefore, the State Fire Marshal's representative ordered the operation stopped since another temperature inversion was forecast. Because Seaboard's and the shipper's actions had not been successful for transferring the oleum and controlling the hazards posed to public safety, additional technical assistance was requested of a local oleum supplier by the State Fire Marshal. The State Fire Marshal's representative held a meeting at 10 a.m., on February 9, attended by the local oleum supplier, the Seaboard superintendent, the Seaboard hazardous materials coordinator, and shipper personnel. At this meeting, it was agreed that the local oleum supplier would supply additional equipment to minimize further delays and reduce the amount of vapors being expelled during the unloading operation. By 3 p.m., the unloading operation was completed.

Next, a patch was welded over the tap opening; however, shortly thereafter, a vapor leak developed around the original patch on the A-end head fracture as the internal pressure increased. Once again, a large vapor cloud formed and stayed over the area; emergency response personnel feared another evacuation would be necessary, and State authorities continued to monitor air quality. After another patch was welded over the damaged tank end, the vapors were controlled. Finally, a gondola lined with plastic was brought to the site, and the damaged car was loaded about 10:40 p.m., on February 9, and removed from the scene at 1 a.m. on February 10.

Injuries to Persons

	Crewmembers	Response Personnel	Others
Fatal	0	0	0
Nonfatal	0	1	24
Total	0	1	24

Tank Car Information

GATX 94350, a jacketed DOT 111A100W2 tank car with 4-inch-thick, fiberglass insulation, had 6-inch-diameter, half-oval exterior heating coils and E-type couplers. This car was not fitted with headshields. It had an empty shell volume of 12,055 gallons, a maximum gross weight of 263,000 pounds, and a tank head radius of 88 inches. The dome attachments included the fill-hole cover, a 2-inch liquid eduction pipe, and a combination 1-inch air connection and safety vent.

After the derailment, tank car GATX 94350 came to rest on its side with its A-end facing south and cradled between the adjacent southbound tracks. There was no evidence that the car had skidded before coming to rest, and the outer jacket appeared to be loosened near the bottom just behind the bolster on the B-end. The outer jacket was creased slightly near the dome. Also, the head end was fractured in the A-end, where small amounts of vapors were observed to be escaping immediately following the derailment. There was a narrow 4-inch-long gash in the lower right quadrant of the A-end tank head about 22 1/2 inches below the centerline and 30 inches from the outer head radius.

Meteorological Information

From 7 a.m., February 4, 1984, to 7 a.m., February 5, 1984, the maximum temperature was 51° F and minimum temperature was 24° F.

The following meteorological conditions existed:

(1) at the time of derailment, February 5--

Time -- 8:50 a.m.
Sky -- cloudy
Temperature -- 29° F
Visibility -- 2 miles; light snow
Humidity -- 86 percent
Wind -- southwest at 9 mph

(2) at the time of plug release on February 7--

Time -- 2 p.m.
Sky -- clear
Temperature -- 23° F
Visibility -- 10 miles
Humidity -- 57 percent
Wind -- southwest at 9 mph

Method of Operation

Trains operate over this track by indications of signals of a traffic control system. Corbin Division Timetable No. 1, effective October 30, 1983, authorized a maximum train speed of 50 mph. According to the timetable's hazardous materials instructions, which had been in effect for several years, traincrews are required to ascertain that appropriate placards are in place on both sides and ends of tank cars before they are coupled into the train. The timetable states further that in the event of an "emergency involving spillage, loss of hazardous material or fire, the conductor or his designee will notify the nearest emergency response group, such as fire, rescue and police departments, and remain at the scene until a response group arrives or until released by proper authority." Furthermore, the timetable adds, "when emergency response personnel arrive at the scene, the conductor must take the initiative to identify himself. He must furnish them with information from waybills and train consist of any hazardous materials in the train as well as any knowledge he has of conditions as they then exist." (See appendix G.)

In addition to the duties for trainorews set out in the applicable timetable, the Corbin superintendent issued Bulletin Board Order No. 2-22-A on March 1, 1983, emphasizing further the conductor's responsibility "to take the initiative in contacting any local fire department, or request the dispatcher to do this for them and when emergency response people arrive at the scene or at a command post to set up for emergency response, make themselves known to those people and furnish necessary information from the waybills and train consist on the hazardous materials as promptly as possible until or unless relieved by proper authority."

The rear brakeman acknowledged that during his postaccident inspections he did not pay attention to the placarded cars. He stated also that he did not have any formal classroom training to enable him to deal with responses to emergency conditions as a result of a derailment. The superintendent emphasized that the response that is expected is outlined in the special instructions contained in the current timetable and bulletin.

Before they are given an operating rules examination, traincrews are instructed to familiarize themselves with the operating rules on which they will be examined. Following this 4-hour class, traincrews are given an examination on the material covered, and incorrect answers are reviewed. They are given an opportunity to take a second class the same day should they score below 80 percent on the rules examination. Seaboard has made no evaluation to determine if these tests are valid indicators of the crewmember's knowledge of the operating rules and requirements. Efficiency checks and monitoring of traincrews are conducted routinely throughout the year to determine compliance with specific operational procedures; however, checks are not made to determine crewmembers' knowledge and ability to perform required emergency actions following a derailment involving the release of hazardous materials.

Other Information

Oleum.—Oleum is concentrated sulfuric acid (H_2SO_4) to which has been added sulfur trioxide (SO_3) to increase its effective strength to 114 percent H_2SO_4. The addition of SO_3 makes H_2SO_4 anhydrous, and on exposure to the atmosphere it releases SO_3 which in turn reacts with the moisture in the atmosphere, hydrolyzing violently and producing heavy vapors.

GATX 94350, the 63rd car in the train, was leased to the Tennessee Chemical Company, Copperhill, Tennessee, and loaded by the company with 175,900 pounds or 10,600 gallons of 65 percent oleum on January 30, 1984. A 670-gallon or 9 1/4-inch outage was left. 9/

Oleum is loaded at a temperature of approximately 125° Farenheit (F) and will solidify when it cools to approximately 84° F; if the oleum container is punctured, the SO_3 will be released, and the temperature at which it will solidify will be lowered to 37° F. In this accident the tank car was punctured and some SO_3 was released. The oleum started to solidify in the area where the insulation jacket was damaged. The Chemical Manufacturers Association's Safety Data Sheet states that when oleum comes in contact with metal, hydrogen gas may be produced, and the production of hydrogen gas is accelerated when the metal is heated. Welding operations are not recommended because of the flammability of hydrogen gas that may be produced.

9/ Outage is free space between the liquid level and the top of the tank car to allow for expansion of the product.

Emergency Planning.--The Commonwealth of Kentucky has a comprehensive disaster plan which was developed in 1977 under a grant from the Federal Emergency Management Agency, formerly the Office of the Federal Disaster and Assistence Administration. The plan addresses the responsibilities of local governments as well as the State government. Although it primarily is concerned with "emergencies of a magnitude as to constitute a disaster," it can be invoked for emergencies of lesser magnitude. Local governments and State departments/agencies are required to develop supporting plans to implement the Commonwealth of Kentucky disaster plan. Annex Q of the Commonwealth of Kentucky Natural Disaster Plan deals with hazardous materials and governed the response by State agencies during this hazardous materials emergency. The Bourbon County Emergency Operational Plan was developed to complement the State plan and to organize the response of the city and county governments in carrying out their responsibilities in case of a natural or man-made disaster, including the release of hazardous materials.

Management of the Emergency Response.--The management of the emergency response by State units was a responsibility shared by the Office of the State Fire Marshal and the DES. The Kentucky State Police's responsibilities included providing a secure area around the spill area, providing communications, rescue, and/or evacuation support and assistance. The Office of the State Fire Marshal held operational authority for the emergency response objectives of protecting life and property and of limiting the potential for increasing the risk to life and property. The DES area coordinator was assigned responsibility for coordinating the flow of information and activities of the responding governmental and private agencies involved with the emergency. These State agencies were supported by the DNR. The DNR objectives included providing technical assistance, assessing the degree of hazard, overseeing cleanup, and insuring protection of the environment.

The primary local emergency response agencies included the Bourbon County Sheriff's Department and Fire Department, the Bourbon County Director of Emergency Services, and the City of Paris Police and Fire Departments. These local agencies' priorities included protecting life and property of the local residents affected or potentially affected by the spill, ascertaining information concerning the accident and disseminating it to the public in order to prevent panic as well as for evacuation/rescue planning purposes, and taking action to rescue persons in affected areas and to evacuate persons in potentially affected areas.

Seaboard priorities included restoration of rail service, completion of transfer and stabilization of the oleum; repair and removal of the damaged rail equipment; and postaccident cleanup. Two Seaboard hazardous materials coordinators were assigned to assist the superintendent in coordinating information for the establishment of mitigation procedures. Specific tasks included (1) documentation of the amount of chemicals spilled, (2) coordination with local emergency response officials and contractors, and (3) preparation of an environmental cleanup proposal for site restoration. In the past 7 years, 22 oleum transportation accidents/incidents have been reported to the Materials Transportation Bureau/DOT. At least 3 of the 22 releases, each involving a total of more than 4,000 gallons, involved jointly the Seaboard, the same cleanup and removal contractor, and the same shipper response personnel as were involved at Clay, Kentucky.

On February 10, 1984, Safety Board investigators met with Bourbon County and city of Paris emergency response supervisors and personnel to discuss problems encountered by local emergency response agencies during the hazardous materials emergency. At the meeting, some of the observations made by emergency personnel included the following:

- o There was insufficient communication between State and local agencies.
- o The Paris Police Department was not notified by State agencies of the product release on February 7.
- o The Paris Police Department was not notified of the school closing on February 8.
- o Local agency personnel did not receive firm guidance from the command post, and local agency representation at the command post was intermittent.
- o Although a small emergency operations center is available at the Paris Police Department, it was not used during this emergency.
- o Erroneous reports were released resulting in the public's receiving misinformation. Press coordination did not occur through a single contact.
- o Paris and Bourbon County Fire and Police Departments have received no hazardous materials training.

In summary, local agencies took little or no action unless directed to do so by State agencies, because they assumed that all necessary activities were being conducted or directed by the State agencies, i.e., the local response agencies initially acted only in a supportive role to the State agencies. Substantive involvement did not occur until the situation deteriorated after the temporary plug blew on February 7, and it was decided to evacuate local residents. Local response agency personnel were designated to conduct the evacuation.

ANALYSES

The Release

The displacement of the manway, handrail, draft gear carrier, and outer jacket at the trailing end of GATX 94350 indicates that the lower corner of a trailing car overrode and struck the trailing end of GATX 94350 in the lower half of its head. This damage occurred because the E-coupler on the tank car allowed the two cars to disengage and then impact during the derailment. In view of the size and location of the fracture, had either a vertical coupler restraining system (shelf coupler) or a head shield been installed on this tank car at the time of the derailment, the fracture would have been prevented.

The urgent need to establish priorities for the installation of coupler vertical restraint systems previously was demonstrated in an accident involving a DOT 111 tank car which released ethylene oxide, a highly volatile unstable commodity. As a result of its investigation of this accident, the Safety Board issued Safety Recommendation I-81-5 to RSPA on September 30, 1981:

> Amend 49 CFR 173.31(a)(6) to establish priorities for installation of coupler vertical restraint systems on DOT specification tank cars required to be retrofitted by February 28, 1985, based on the relative dangers posed in accidents by the commodity being transported.

On February 11, 1982, RSPA responded:

> ... industry will use its specialized knowledge to assure that the tank cars carrying the most hazardous materials are retrofitted first. The incentive for industry to support such a program is economic. The incremental cost to retrofit tank cars carrying the most hazardous material first is minimal if any, since the cars must be fitted within a limited time period under the rule (HM-174).

The Safety Board noted in its February 11, 1985, evaluation that since the regulatory deadline for these retrofits was imminent, Safety Recommendation I-81-5 was placed in a "Closed--No Longer Applicable" status even though the recommended priority system had not been developed by the DOT.

Despite RSPA's assurances, none of the six DOT 111 tank cars involved in this accident was equipped with shelf couplers nor were they required to be at the time of the accident. Tennessee Chemical Company representatives reported that they had retrofitted only 60 of their 397 cars with shelf couplers in the first 3 years of their program; however, during this same period of time, the companies that lease tank cars to the Tennessee Chemical Company had retrofitted 200 of the 333 cars leased to the company.

Some tank car owners petitioned RSPA to extend the final date for the installation of shelf couplers. An emergency final rule, Docket HM-174, Amdt. 173-183, granting the extension was issued on February 27, 1985. It allowed the more than 4,000 tank cars not retrofitted to be loaded with hazardous materials and transported if the car was loaded before March 1, 1985. The petitions requesting extension of the date by which the improved coupler system must be installed contained no information about the products to be transported in the tank cars not retrofitted with this safety improvement feature. RSPA knows that tank cars used to transport flammable materials such as ethylene oxide, acrolein, or acrylonitrile and acids such as fuming nitric acid or oleum pose hazards to public safety and health even when containing only residuals of these materials and placarded "empty." Yet, it acknowledges that it did not seek to determine which products would be transported in the more than 4,000 tank cars to assist it in evaluating the merits of the petitions. This action by RSPA extends indefinitely the time alloted shippers for entering "empty" tank cars not equipped with a coupler vertical restraint system into rail transportation with consideration only of the economic impact upon shippers. Information essential for weighing the impact upon public safety was not sought. As in its 1981 Safety Recommendation I-81-5, the Safety Board continues to urge RSPA to incorporate into all its decisions consideration of the relative hazards of materials posed to public safety and health in accidents.

The fracture in the end of the tank car was below the level of the liquid and small; thus, oleum was released slowly. However, the damage to the exterior steel jacket and internal insulation partially exposed the tank surface to the atmosphere. The absence of insulation resulted in a lowering of the temperature of the material within the tank which in turn resulted in the formation of a partial vacuum in the vapor space within the tank. The vacuum apparently was sufficient to overcome the hydraulic head (pressure) of the liquid at the fracture because oleum stopped flowing from the fracture.

The atmospheric pressure outside the tank was greater than pressure within the tank. This caused air to be forced into the tank through the fracture, rise through the oleum within the tank as air bubbles, and be released into the vapor space of the tank.

This produced the "gurgling" noises that were heard about 7 hours following the derailment. As this process continued, the vacuum within the tank was reduced sufficiently to allow small outflows of oleum to recur. Finally, as the temperature within the tank car continued to drop, the vacuum again was increased sufficiently to stop the flow of oleum. The fact that the cloud around the tank car was smaller earlier in the day as compared to its size in the afternoon further suggests that the temperature of the oleum was being influenced by the ambient temperature as a result of damage to the tank's insulation.

The continued cooling of the oleum overnight in subfreezing temperatures resulted in the oleum's forming a crust at the fracture. At this time, conditions had become stable. This was confirmed 26 hours after the derailment when the outer jacket adjacent to the fracture was removed to install the temporary lead wool plug as an additional precaution against any future release of oleum.

When the tapping machine penetrated the tank on February 7, oleum again flowed from the fracture and sulfuric trioxide vapors vented through the hole made by the tapping machine. The specific reason(s) for these events is not known; however, the following possibilities may have been involved:

- o If there was positive pressure in the vapor space, the penetration of the tap into the tank caused the internal pressure to drop initially thereby initiating a phase change of the volatile liquid. This resulted in the rapid changing of the liquid into vapor, increasing rapidly the internal pressure in the tank;

- o Hot metal chips produced by the tapping procedure dropped into the tank reacted with the oleum producing gases such as hydrogen, which then increased the pressure within the tank;

- o If there was a vacuum in the vapor space, penetration of the tank by the tap released the vacuum and allowed the weight of the oleum above the fracture to apply pressure at the fracture sufficient to break the crust and eject the temporary plug.

Whichever scenario may have occurred, the penetration of the tank by the tapping machine triggered an internal pressure increase within the vapor space which resulted in the release of the oleum through the fracture and the release of sulfur trioxide through the hole made by the tap. Since these hazards had not been anticipated by the wreckage-clearing personnel, the protective measures they had taken were inadequate. The many uncertainties which existed relative to the properties of oleum in a closed container indicates a need for improving hazard identification procedures during unloading operations.

Traincrew Emergency Response

Train crewmembers are responsible for the safety of the train and for initiating necessary emergency actions. Seaboard requires that they take specific actions to protect themselves and the public, as well as to interact effectively with community emergency response agencies to provide specific information about the materials involved in a derailment. The Safety Board's investigation disclosed that this traincrew did not follow the emergency response requirements prescribed by Seaboard in its timetable and bulletins. Even though members of the traincrew talked with nearby residents, no warning of the potential hazards posed by the derailed tank cars was given after

inspection of the derailment revealed that a tank car carrying hazardous materials was involved. Moreover, all derailed placarded tank cars were not inspected, because in reviewing the train consist, the conductor improperly identified the tank car containing the oleum as the only rail car transporting hazardous materials. Rather than searching the consist for cars transporting hazardous materials, the conductor searched only for cars designated "dangerous" -- a designation limited to cars that require special handling during switching. Compounding the failure of the crew to properly inspect the derailed cars transporting hazardous materials, the rear brakeman failed to look during his inspection for cars bearing hazardous material placards.

Two of the train crewmembers, the brakeman and the conductor, were aware that the tank car containing the oleum was leaking; however, they did not report this fact to Seaboard until ordered to do so by a State policeman, nor did the traincrew comply with the emergency response requirements of Seaboard after the arrival of emergency response agencies. None of the crewmembers sought out emergency personnel to provide information from the train documents about materials being transported, the identity of shippers or the guidance included at the end of the train consist for assisting emergency agencies in handling hazardous material emergenc .

Interviews with train crewmembers concerning t. eir actions indicate that they were not aware of the need to coordinate with emergency response agencies or to perform duties other than to document the extent of the wreckage. Even though they had participated in the annual rules classes and had passed the associated tests, they denied knowledge that they had resporsibilities concerning public safety or coordination with emergency response agencies.

In a derailment at Colonial Heights, Virginia, on May 31, 1982, another Seaboard traincrew also failed to follow Seaboard postderailment requirements. As a result of its investigation of that derailment, 10/ the Safety Board issued Safety Recommendation R-83-48 to Seaboard on May 24, 1983:

> Periodically instruct and test traincrews and supervisory personnel on the procedures for using documents to identify all cars transporting hazardous materials and the information to be provided to assist emergency response personnel.

In its July 24, 1984, response to Safety Recommendation R-33-48, Seaboard stated that it had an ongoing program of training and testing its conductors on the use of pertinent waybill and consist information. Seaboard further stated that it had incorporated into each Division Timetable, which every traincrew is required to have while on duty, special instructions concerning the handling of waybill and other hazardous materials information pertinent to the train consist. Although Safety Recommendation R-83-48 was placed in a "Closed--Acceptable Action" status based on Seaboard's action, the Safety Board noted in its reply on January 11, 1985, that the problem involving the traincrew actions during an emergency was found in the investigation of the Clay, Kentucky, accident and a Marshville, North Carolina, accident on April 10, 1984. 11/

10/ Railroad Accident Report--"Derailment of Seaboard Coast Line Railroad Train No. 120 at Colonial Heights, Virginia, May 31, 1982" (NTSB/RAR-83/04).

11/ Railroad Accident Report--"Seaboard System Railroad Freight Train FERHL Derailment and Fire, Marshville, North Carolina, April 10, 1984" (NTSB/RAR-85/05).

Traincrews are the first railroad employees on the scene and must be prepared to act as the first responders in accidents. As such, they must be trained to initiate actions necessary to protect employee and public safety. Moreover, traincrews will have in their possession information essential to the effective handling of hazardous conditions created by derailments by community emergency response agencies. Only through effective, periodic training, testing, and monitoring of all train crewmembers can Seaboard have confidence that its requirements for an emergency situation will be understood and accomplished by its traincrews.

Management of the Emergency Response

Under the State plan, the State Fire Marshal or his designated representative was vested with operational responsibility for the emergency response activities. Initially, the State Fire Marshal's representative did not view the derailment as one which posed significant risks to public safety. This view may have resulted in his not maintaining a command post throughout the emergency and for not initially calling upon available expertise to assist in determining what actions should be taken to minimize threats to public safety.

The initial order of the State Fire Marshal's representative that the tank car containing the oleum not be moved was correct at the time because the extent of damage to the car had not been determined. However, he gave no further consideration to his decision after inspection of the tank car revealed little likelihood of extensive damage. At that time, the hazards of rerailing the oleum car should have been reevaluated against the hazards of other alternative actions.

Upon learning that the oleum in the tank cars could not be transferred to another tank car through the tank's fittings because of the position of the tank car, the State Fire Marshal's representative declared that the transfer of the oleum from the damaged tank was a problem for Seaboard to resolve. Moreover, he did not seek any early advice from the shipper of the tank car. The shipper should be a resource of technical expertise easily identified from the shipping documents on the train and easily accessible through use of the CHEMTREC communications system. Such sources at least could have provided onscene officials a greater appreciation of the problems involved with attempts to transfer the oleum from the damaged tank car.

Also, because the State Fire Marshal did not perceive the accident as a threat to public safety and because he believed that Seaboard could safely handle the transfer of oleum, he allowed the railroad to take actions it considered necessary without his having technical knowledge of the actions to be taken. By failing to exercise complete oversight after relinquishing the responsibility of transferring the oleum to Seaboard, State agencies effectively isolated themselves from technical resources and from available onscene expertise. Additionally, because the hazards of the tapping and transfer operations were not anticipated, precautions were not taken, the transfer operations were not adequately monitored, and communications with local emergency response agencies were not maintained.

Upon deciding to transfer the oleum from the damaged tank car before uprighting it, Seaboard and its contractor developed a plan to accomplish the transfer. Neither Seaboard personnel nor its contractor developed contingency plans; nor did either caution the State Fire Marshal's representative about the potential risks or need for contingency plans in the event of a large release of oleum. Furthermore, neither requested that the shipper of the oleum be present during the tapping operation. Reducing further their ability to handle unforeseen problems concerning the transfer, the tapping procedure was

begun before all necessary equipment was in place, and the tapping operation was conducted while many key representatives of Seaboard and State agencies were away from the site. It was only after the release of a large amount of oleum during the tapping operation that the acute threat to public safety was recognized and the State Fire Marshal effectively assumed control over all activities and sought outside technical assistance. A problem which had threatened public safety for about 5 days was resolved successfully within a few hours.

This accident vividly demonstrates that all derailments involving hazardous materials must be treated as life- and health-threatening emergencies until all hazardous materials have been identified, their containers have been assessed for integrity, and if necessary, the products have been removed from damaged containers or otherwise made safe. The Safety Board believes that the person in charge of emergency response activities at derailments involving the release of hazardous materials must understand that each incident is unique and poses unique problems. By using the advice of available expertise, the person in charge will be prepared better to determine that a course of action is being pursued which presents the least chance of endangering the public. Persons charged with the management of emergency responses cannot, nor should they be expected to, know how to handle every situation. Instead, they must rely upon onscene expertise and other available technical resources to identify available courses of action and to determine the potential hazards posed to the public safety by each action. Only then can a course of action be approved. Furthermore, each action taken must be closely monitored by technical specialists to ensure that the results obtained are those anticipated and that timely warning is provided of unanticipated results so that other alternative action can be considered. Moreover, close monitoring of all onscene actions by the person in charge is required so that officials of nearby communities can be kept informed about events and prepared to assist in taking lifesaving action should evacuations be required.

Uncertainties of Wreckage-Clearing Operations

The extent to which tank cars are damaged during derailments often cannot be assessed readily; therefore, the consequences of moving a tank car or otherwise attempting to remove its product cannot be predicted with certainty even after close inspection. For example, in this accident, a temporary plugging procedure which had previously proved successful was not successful because of the changing condition of the materials within the tank car. As a result, a far greater amount of oleum was released than that released during the actual derailment. Moreover, the tapping operation was conducted on the unvented car even though Seaboard's contractor was uncertain of the internal pressure and temperature within the tank car, of the ability of the temporary plug to stabilize the leaking car, and of the availability of equipment to perform the transfer. Additionally, the shipper's employees initially contacted by telephone for assistance were given only limited information about the procedures planned to be used and were not onscene before the tapping operation was begun.

These untested actions for accomplishing the transfer were developed and implemented by Seaboard and its contractor without seeking necessary expert advice, warning emergency response personnel about the uncertainties which existed, or informing the State Fire Marshal of the potential risks involved in the transfer. Previous Safety Board reports on investigations of derailments have identified the need for improvements in wreckage-clearing, product transfer, and rerailing operations. Based on its investigations of derailments at Pensacola, Florida, in November 1977; Waverly, Tennessee, in February 1978; and Youngstown, Florida, in February 1978, the Safety Board issued the following Safety Recommendations to the Association of American Railroads (AAR) on August 30, 1978:

I-78-14

Complete development and documentation of safety procedures for identifying and assessing hazardous materials dangers, and for coordinating wreckage-clearing operations with local public safety officials.

I-78-15

Disseminate these safety precautions, as soon as they are documented, to railroad, wreckage-clearing contractor personnel, and public safety officials in the communities through which railroads operate.

I-78-16

Establish a procedure for regular reviews of selected railroad wreckage-clearing operations so that these safety procedures can be upgraded promptly as new safety concerns are identified.

After investigating a derailment at Crestview, Florida, on April 18, 1979, 12/ the Safety Board issued Safety Recommendation I-79-13 to the Federal Railroad Administration (FRA) on September 13, 1979:

> Analyze risks to wreck-clearing personnel during wreck-clearing operations involving hazardous materials releases to determine needed health safeguards, operating precautions, and medical treatment capabilities for hazardous material exposures, and establish appropriate safety requirements based on its findings.

Following the issuance of Safety Recommendation I-79-13 to the FRA and a followup with the AAR on progress being made with respect to Safety Recommendations I-78-14 through -16, both the FRA and the AAR responded that a joint effort was being made to develop wreckage-clearing procedures. Subsequently, the FRA contracted with the U.S. Air Force's Rocket Propulsion Laboratory at Edwards Air Force Base, California, for a study of wreckage-clearing procedures. The results of the ensuing studies are described hereafter.

During its investigation of a derailment near Inwood, Indiana, on November 8, 1979, Safety Board investigators again observed the risk assessment problems faced by wreckage-clearing personnel as damaged hazardous materials tank cars were being handled. As a result of a special investigation, 13/ the Safety Board issued Safety Recommendation I-80-2 to the FRA on October 21, 1980:

> Develop guidelines for handling cars containing pressurized liquefied gases at accident sites based on research and tests of a representative sample of damaged tank cars.

12/ Railroad Accident Report--"Louisville and Nashville Railroad Company Freight Train Derailment and Puncture of Hazardous Materials Tank Cars, Crestview, Florida, April 8, 1979" (NTSB-RAR-79-11).

13/ Special Investigation Report--"Tank Car Structural Integrity After Derailment, October 16, 1980" (NTSB-SIR-80-1).

In response to the Safety Board's recommendation, the FRA undertook coordinated efforts with the AAR and developed a program "to determine or characterize the range of damage types which tank car heads and shells could sustain through reviews of past accidents, visits to railroad repair shops and direct observations at accident sites." All five of the foregoing recommendations are now in an open status pending further joint action by the FRA and the AAR. In January 1983, the guideline manual, "Post Accident Procedures for Chemicals and Propellants" (Report No. AFRPL TR-82-007), was published by the FRA and the U.S. Air Force. This document provides general guidance compiled from Federal and private sources concerning hazard assessment, mitigation actions, and wreckage removal. The guide stresses the importance of forming a technical advisory group soon after an incident and before initiating wreckage-clearing operations. Moreover, the guide specifically stresses that,

> In deciding which hazards mitigation options to use, personnel must be aware of the available alternatives, personnel and equipment requirements, and appropriate specific applications for each method. Procedures need to identify available options to on-scene decisionmakers so that the optimum solution considering both safety and cost-effectiveness is reached. The options also should be developed in an integrated form so that the total scene will be considered at every step in the wreck-handling processes.

In June 1984, the report, "Accident Management Orientation Guide" (Report No. AFRPL-TR-82-075), was released jointly by the FRA and the U.S. Air Force. The guide includes "information necessary for consideration in making optimal decisions to be made for all on scene emergency hazardous materials response operations from the initial notification of emergency response personnel through departure from the accident scene of the clean-up disposal teams, to resumption of normal operations." The guide advocates that, "an overall plan should be developed for every aspect of constructing the transfer system and its operation. The standard operating procedure (SOP) should include an appropriate check off list to assure that all steps are followed, leaving nothing to chance."

While these two reports, as reference material, provide considerable information about wreckage-clearing operations, various assessment techniques, and coordination requirements during emergency response activities that involve wreckage- clearing operations, the information is not organized in a cohesive form so as to serve as useful safety procedures to be followed by emergency response personnel onsite. The Safety Board urges the AAR and the FRA to incorporate the emergency wreckage-clearing safety procedures in a format which will be more useful to onscene personnel.

The deficiencies in wreckage-clearing operations documented as a result of the Safety Board's investigation of the derailment at Clay, Kentucky, provide further evidence of the urgent need for such safety procedures, and the Safety Board, therefore, reiterates Safety Recommendations I-78-14 through -16 to the AAR.

CONCLUSIONS

1. The trailing coupler of tank car GATX 94350 disengaged during the derailment allowing a following rail car to override the coupler and strike the lower right quadrant of the tank car.

2. The trailing head of tank car GATX 94350 was fractured when struck by a trailing rail car allowing a slow release of oleum.

3. A vertical coupler restraining system installed on GATX 94350 would have prevented the fracture of its head during this derailment.

4. Local emergency agencies were not notified promptly of this derailment by Seaboard.

5. Train crewmember actions after the derailment did not comply with Seaboard emergency action requirements contained in train bulletins and the timetable.

6. Seaboard's training, testing, and monitoring of traincrews about emergency actions are not effective for assuring that traincrews understand the actions they are expected to take.

7. Deficiencies have been identified previously in Seaboard's training of its traincrews about expected emergency actions.

8. The initial decision to not allow the reralling of GATX 94350 was proper because an assessment of damages had not been made.

9. The initial public safety actions of the State Fire Marshal were proper; however, he was not aware of the potential hazards posed to public safety by the wreckage-clearing operations.

10. The State Fire Marshal initially did not seek necessary technical information to aid him in assessing the hazards to public safety and health posed by the damaged, leaking tank car of oleum.

11. Neither Seaboard nor its contractor advised the State Fire Marshal of the potential hazards to public safety and health posed by the oleum transfer and wreckage-clearing operations.

12. Emergency response agencies were not involved in the making of critical decisions affecting public safety because the State Fire Marshal did not exercise complete oversight after he turned over to the Seaboard responsibility for transferring the oleum from the damaged tank.

13. The leak in the tank car containing oleum had stopped before wreckage-clearing operations were begun by Seaboard.

14. Seaboard and its contractor developed a plan of action for transferring the oleum without seeking necessary technical advice from the manufacturer of the oleum or from other resources.

15. Seaboard and its contractor used a tapping device which had not been designed or approved by its manufacturer for use on tank cars and which had not been proven by tests by Seaboard or its contractor for the tapping of tank cars.

16. The tapping of the tank car was performed at a time when representatives of Seaboard who participated in making the decision were not present and before all equipment needed to perform the transfer were onsite and in place.

17. The large release of oleum during the tapping operations was not anticipated by Seaboard or its contractor because necessary technical advice had not been sought to resolve the many uncertainties which existed relative to the status of the oleum in the damaged tank car.

18. The large release of oleum occurred as a result of the venting of the vapor space in the overturned tank car.

19. The plan by Seaboard and its contractor for transfer of the oleum contained no procedures for ensuring public safety during its implementation even though both should have recognized that the actions being taken were experimental and unproven.

20. A weather inversion contributed greatly to the widespread dispersion of the released oleum.

21. Information exchange among emergency response agencies was not well coordinated during the early stages of the emergency.

22. Local emergency response agencies recognized that they were not kept informed sufficiently about the status of the actions being taken; yet they did not take the initiative to communicate their concerns to State agencies.

23. The extended duration of the emergency and the increased hazards posed to public safety and health resulted from the lack of early, effective, and coordinated management of all emergency activities.

24. Resolution of the emergency was achieved only after the State Fire Marshal recognized fully the hazards posed to public safety and health, took full control of all activities, sought necessary technical advice for handling the oleum, and effectively coordinated and monitored the actions of all agencies and organizations taking part in the emergency response.

25. Public safety was endangered needlessly during the wreckage-clearing operations.

26. Neither the Association of American Railroads nor the Federal Railroad Association has issued recommended procedures for promoting safety during wreckage-clearing operations.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board reiterated the following Safety Recommendations issued to the Association of American Railroads on August 30, 1978:

> Complete development and documentation of safety procedures for identifying and assessing hazardous materials dangers, and for coordinating wreckage-clearing operations with local public safety officials. (I-78-14)
>
> Disseminate these safety precautions, as soon as they are documented, to railroad, wreckage-clearing contractor personnel, and public safety officials in the communities through which railroads operate. (I-78-15)
>
> Establish a procedure for regular reviews of selected railroad wreckage-clearing operations so that these safety procedures can be upgraded promptly as new safety concerns are identified. (I-78-16)

Also, as a result of this investigation, the National Transportation Safety Board recommended:

--to the Seaboard System Railroad:

Require its railroad dispatchers to notify local emergency response agencies immediately of a derailment of a train transporting hazardous materials. (Class II, Priority Action) (R-85-79)

Modify its program of periodic training of train service employees to include instructions on the meaning and applications of operating rules applicable to an emergency involving hazardous materials. (Class II, Priority Action) (R-85-80)

--to the Kentucky Disaster and Emergency Services:

Require State and local onscene commanders at the site of transportation accidents that involve hazardous materials to contact CHEMTREC promptly for information on emergency actions to be taken, and to obtain technical assistance from shippers or manufacturers of the hazardous materials in or released from damaged tank cars. (Class II, Priority Action) (I-85-16)

Require State and local onscene commanders at the site of transportation accidents that involve hazardous materials to monitor closely the activity of public and private responders and technical advisers, so that the various response options and contingencies are understood and examined, the potential impact of proposed actions on public safety is considered, and necessary precautionary measures are taken in coordination with all involved agencies. (Class II, Priority Action) (I-85-17)

Require that all county emergency operational plans within the State be reviewed periodically to update contingency procedures for mass casualty and hazardous materials emergencies; require that the plans be exercised periodically in drills in which all local emergency response agencies participate. (Class II, Priority Action) (I-85-18)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ G.H. PATRICK BURSLEY
Member

April 30, 1985

APPENDIXES

APPENDIX A

INVESTIGATION

The National Transportation Safety Board was notified of the accident about 12:42 p.m., on February 5, 1984. The Safety Board immediately dispatched an investigator from its Atlanta Field Office to the scene. Additional members of the investigative team were dispatched to the scene from Washington, D.C., following the hazardous materials release during the transfer operations on February 7, 1984.

Groups formed to investigate the hazardous material, mechanical, operating, and track aspects of the accident were comprised of personnel from the Safety Board, Seaboard System Railroad, Federal Railroad Administration, Association of American Railroads, Paris Police Department, Bourbon County Sheriff Office and Department of Emergency Services, Kentucky Fire Marshal, Kentucky Departments of Emergency Services and Natural Resources, O.H. Materials Company, and Tennessee Chemical Company.

APPENDIX B

TRAINCREW PERSONNEL INFORMATION

The crewmembers of Train Extra 8294 North were qualified for their respective positions in accordance with Seaboard's requirements.

Engineer

The engineer, 46, began his railroad service in 1963 as a trainman. He was promoted to locomotive engineer in November 1966 following completion of the carrier's engineer training program. He last was examined on operating rules in 1982, and last attended a safety class in 1983.

Reserve Engineer

The reserve engineer, 44, began his employment with the Louisville and Nashville Railroad (L&N) in July 1962. Upon completion of the engineers training program in November 1966, he was promoted to locomotive engineer. He last was examined on operating rules in 1982, and last attended a safety class in 1984.

Trainman (Front Brakeman)

The trainman, 44, has 26 years of train service with the L&N and its successor, Seaboard. He last was examined on operating rules in 1982, and last attended a safety class in 1983.

Conductor

The conductor, 42, began service as a brakeman with the L&N in September 1966; he was promoted to conductor during 1970. He last was examined on operating rules in 1982, and last attended a safety class in 1984.

Trainman (Rear Brakeman)

The trainman, 36, began service as a brakeman for the L&N in 1971. He last was examined on operating rules in 1982, and last attended a safety class in 1983.

APPENDIX C

SUMMARY OF RAILROAD ASPECTS

Seaboard System Railroad (Seaboard) train GATCI-04, operating as Extra 8294 North, originated at the Seaboard's yard in Atlanta, Georgia, on February 4, 1984. En route to Cincinnati, Ohio, the train stopped at Etowah, Tennessee, and later, at Patio, Kentucky. After the required train airbrake test was made at Patio, the train continued northward with a 4-unit diesel-electric locomotive, 88 loaded freight cars, 17 empty freight cars, and a caboose, for a total of 9,043 trailing tons; the train was 5,574 feet long.

The locomotive was not equipped with a speed recording device; however, at MP 89.2, a wayside defect detector capable of recording speed and signaling the presence of dragging equipment indicated the train's speed to be 47 mph as it passed. The train then traversed a succession of curves beginning at MP 87; as it was passing the south end of a 12.9-mile section of double track at a left-hand No. 20 turnout at MP 84.7 near Clay, Kentucky, at 8:50 a.m., on February 5, 1984, the airbrakes applied automatically in emergency.

The train derailed on the CC Subdivision of the Corbin Division of the Seaboard about 101 miles north of Corbin, Kentucky, on the rail line that extends between Corbin and Cincinnati, Ohio, a distance of 180 miles. The track in the vicinity of the derailment was tangent and built on a 25-foot-high fill. The derailment initiated at the closure rail for a left-hand turnout with a facing point switch, at the southernmost point of double tracks which extend northward for 12.9 miles. The track structure was examined for 1 mile in advance of the derailment, and no signs of dragging equipment or track conditions were noted which could have caused or contributed to the derailment.

Thirty-eight cars derailed; 30 were loaded and 8 were empty including 1 tank car containing a residual amount of liquefied petroleum gas. (See figure 4.) Five of the loaded cars--a boxcar and four hoppers--were destroyed. SCL 635204, a boxcar loaded with rolled paper product, was the 56th car behind the locomotive. Sometime before the head-end of the 56th car passed over the left-hand No. 20 turnout of the switch, the trailing truck bolster failed on the right side of the center casting, allowing the right side to fall to the track structure and strike the closure rail of the left-hand turnout. 14/ The right side of the "B" end truck was dislodged from the car and was found to the east of the northbound main track about 1,726 feet from the derailment point. The remaining portion of the truck was found under the car. The right side of the broken truck bolster, from the trailing or B-end truck of SCL 635204, was found on the right-of-way to the east of the northbound main track about 1,726 feet from the switch point. The car was being hauled A-end forward at the time of the derailment.

SCL 635204 was built by the Pullman Standard Company in September 1962. The boxcar was 57 feet 8 1/4 inches long and had a 39-foot 8-inch distance between the truck centers. The car's lightweight was 78,200 pounds; its capacity and load limit were 140,000 and 142,800 pounds, respectively. National Castings manufactured the 70-ton capacity trucks, type National C-1, in June 1962. The trucks were certified to the Association of American Railroads specifications as meeting Materials and Design Load Requirements

14/ The truck bolster is the transverse load-carrying member of the truck which receives the weight of the car through the center plate, and transmits it through the suspension to the truck frame.

for Trucks, M-201 and M-203. Each bolster, a grade B steel casting, was equipped with seven D-3 single-double track coil spring nests and 6-inch by 11-inch side roller bearings. Information stenciled on the side of the SCL boxcar indicated that the last time it was on a repair track for a periodic airbrake maintenance was during August 1981 on the Seaboard Coastline in Waycross, Georgia. On February 17, 1984, this car was found to have a gross weight of 216,000 pounds, equally distributed on both trucks.

Following the accident, the broken truck bolster was transported to the carrier's laboratory in Waycross, and a test sample was sent to the Safety Board's metallurgical laboratory. Metallurgical examination disclosed that an initiating crack grew progressively until the truck bolster failed suddenly. Examination indicated that a preexisting fatigue crack caused the failure. A scanning electron microscope examination revealed fracture features typical of fatigue cracking with heavy postcracking oxidation. Fatigue cracking appeared to have originated on the lower bolster surface. Postfracture damage and the rounding of the fracture edge at the lower surface obliterated the immediate origin area. The fatigue/oxide zone penetrated the bolster section, about 1 3/4-inches long by 1/2-inch deep. The fracture surface chevrons or herringbone patterns originated at the bottom member of the bolster with the fracture surface encircling the width of the crossmember.

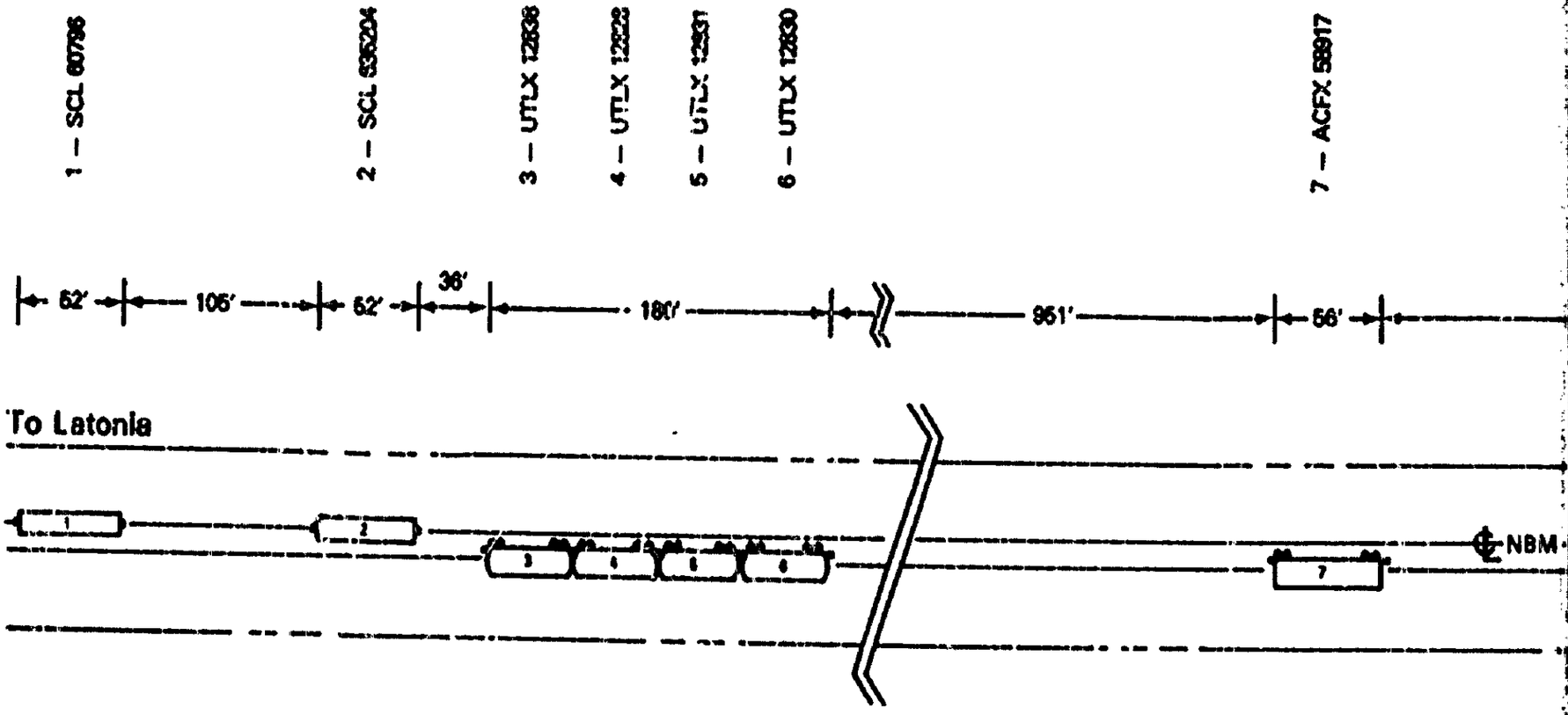
During the derailment, the trailing A-end head of GATX 94350 was fractured in its lower right quadrant, and then came to rest on its side with its A-end facing south and cradled between the adjacent southbound tracks. There was no evidence that the car had skidded before coming to rest, and the outer jacket appeared to be loosened near the bottom just behind the bolster on the B-end. The outer jacket was creased slightly near the dome. Also, the A-end head-end was fractured and small amounts of vapors were observed to be escaping immediately following the derailment. There was a narrow 4-inch gash in the lower right quadrant of the A-end tank head about 22 1/2 inches below the centerline and 30 inches from the outer head radius.

GATX 94350, a jacketed DOT 111A100W2 tank car having 4-inch, fiberglass insulation, had 6-inch half-oval exterior heating coils and E-type couplers. This car was not fitted with headshields. It had an empty shell volume of 12,055 gallons, a maximum gross weight of 263,000 pounds, and a tankhead radius of 83 inches. The dome attachments included the fill-hole cover, a 2-inch liquid eduction pipe, and a combination 1-inch air connection and safety vent.

As a result of the derailment, 800 feet of track and adjacent telephone lines were damaged. The property damages, including the cost of clearing the wreckage and cleaning up the hazardous materials spill, was $582,403.

Because boxcar SCL 635204 was loaded within gross weight limits, that the load was positioned properly within the car, and the truck bolster contained a preexisting crack, the Safety Board concludes that track/train dynamics generated sufficient loading on the damaged bolster to cause its final and sudden failure. Except for the broken bolster on boxcar SCL 635204, no other deficiencies were noted in either the track or train which could have contributed to the derailment.

The displacement of the manway, handrail, draft gear carrier, and outer jacket at the trailing end of GATX 94350 indicates that the lower corner of a trailing car overrode and struck the trailing end of GATX 94350 in the lower half of its head. This damage occurred because the E-coupler on the tank car allowed the two cars to disengage and then impact during the derailment. In view of the size and location of the fracture, had either a vertical coupler restraining system (shelf coupler) or a head shield been installed on this tank car at the time of the derailment, the fracture would have been prevented.



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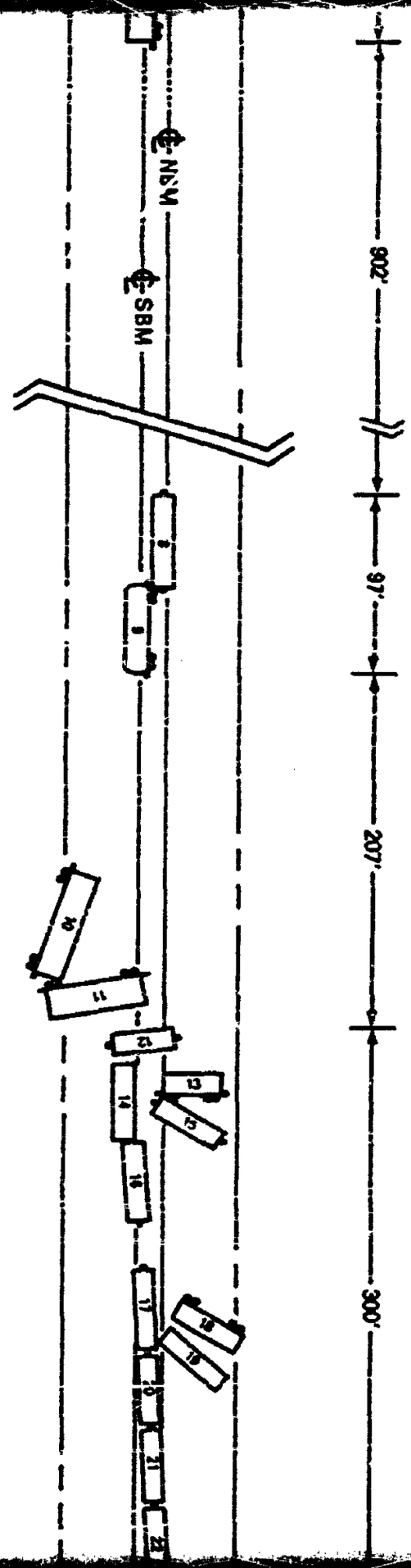
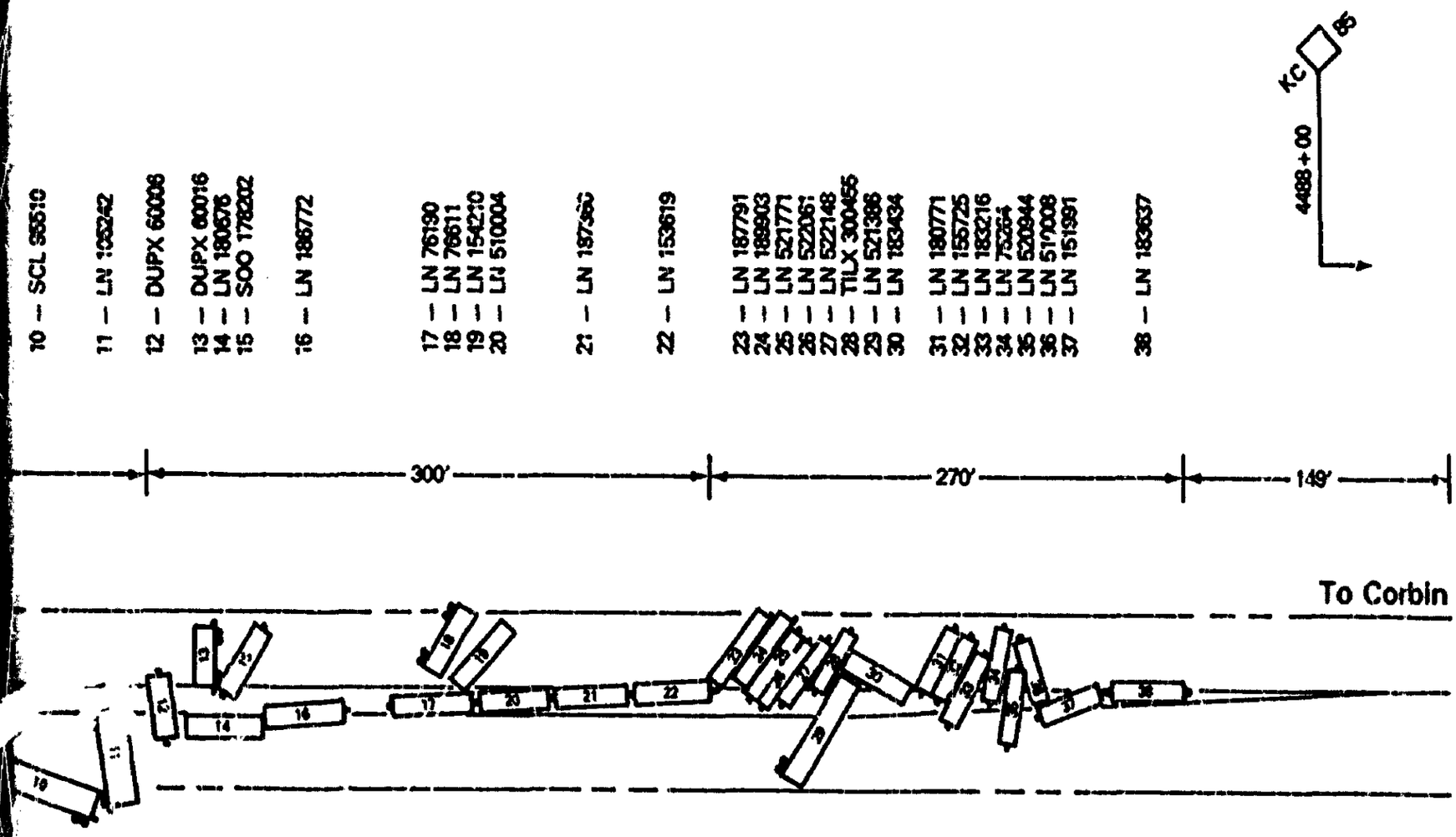
32. ~


NBM
SBM
202'
97'
207'
300'
8 — SCL 25661
9 — GATX 94350
10 — SCL 95510
11 — LN 105242
12 — DUPX 60006
13 — DUPX 90016
14 — LN 130676
15 — SOO 178202
16 — LN 186772
17 — LN 76190
18 — LN 76611
19 — LN 154210
20 — LN 510004
21 — LN 187380
22 — LN 153619

APPENDIX C



VS 4488+44
PS 7101

32-b

FIGURE 4

Derailment at Clay, Ky.

KC-85

Scale: 1" = 100' **February 8, 1984**

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C. 20594

Reported by: Seaboard System — Brief of Railroad No.: DCA-84-HZ-002

Location:	Time:	Date:	Weather:	Visibility:
Clay, Kentucky (MP 84.7)	8:50 a.m.	02/05/84	Cloudy (Snow)	2 miles

Train:	Railroad:	Class:	Direction:	Operating Phase:	Track No.:
1	Seaboard System	Freight	North	Enroute	1
2					
3					

Accident Description: Train Extra 8294 derailed 38 cars at a facing switch. The derailment began when a broken truck bolster on the trailing end of the 56th car (SCL boxcar 635204) struck the closure rail of a lefthand turnout and derailed. Tank car GATX 94350 carrying Oleum sustained a crack allowing vapors to escape. A major release occurred when transferring the chemical 2 days later.

Probable Cause:
1. Engagement of trailing truck bolster of SCL 635204 with closure rail.
2. Pre-existing fatigue crack in truck bolster.
3.

Other Factors:
1.
2.
3.

Fatalities:	Number:	Description:	Injuries:	Number:	Description:
	0			24	Minor chest & throat
					irritation; nearby residents
					only.

Probable Cause of Casualty:
1. Inhalation of Oleum fumes.
2.
3.

Property Losses:
Railroad: $532,403
Non-Railroad: $ 50,000

APPENDIX D

EXCERPT FROM
U.S. DEPARTMENT OF TRANSPORTATION/
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION
EMERGENCY RESPONSE GUIDEBOOK
GUIDE NO. 39

POTENTIAL HAZARDS **Guide 39**

HEALTH HAZARDS

Poison.
Poisonous if inhaled or swallowed.
Vapor extremely irritating.
Contact may cause burns to skin and eyes.
Runoff from fire control or dilution water may cause pollution.

FIRE OR EXPLOSION

Some of these materials may burn but do not ignite readily.
May ignite combustibles (wood, paper, oil, etc.).
Violent reaction with water.
Explosive concentrations of gas may accumulate in tanks.
Runoff to sewer may create fire or explosion hazard.

EMERGENCY ACTION

Keep unnecessary people away.
Stay upwind; keep out of low areas.
Isolate hazard area and deny entry.
Wear positive pressure breathing apparatus and special protective clothing.
FOR EMERGENCY ASSISTANCE CALL CHEMTREC (800) 424-9300.
Also, in case of water pollution, call local authorities.

FIRE

Do not get water inside container.
Small Fires: Dry chemical or CO2.
Large Fires: Flood with water.
Move container from fire area if you can do it without risk.
Cool containers that are exposed to flames with water from the side until well after fire is out.

SPILL OR LEAK

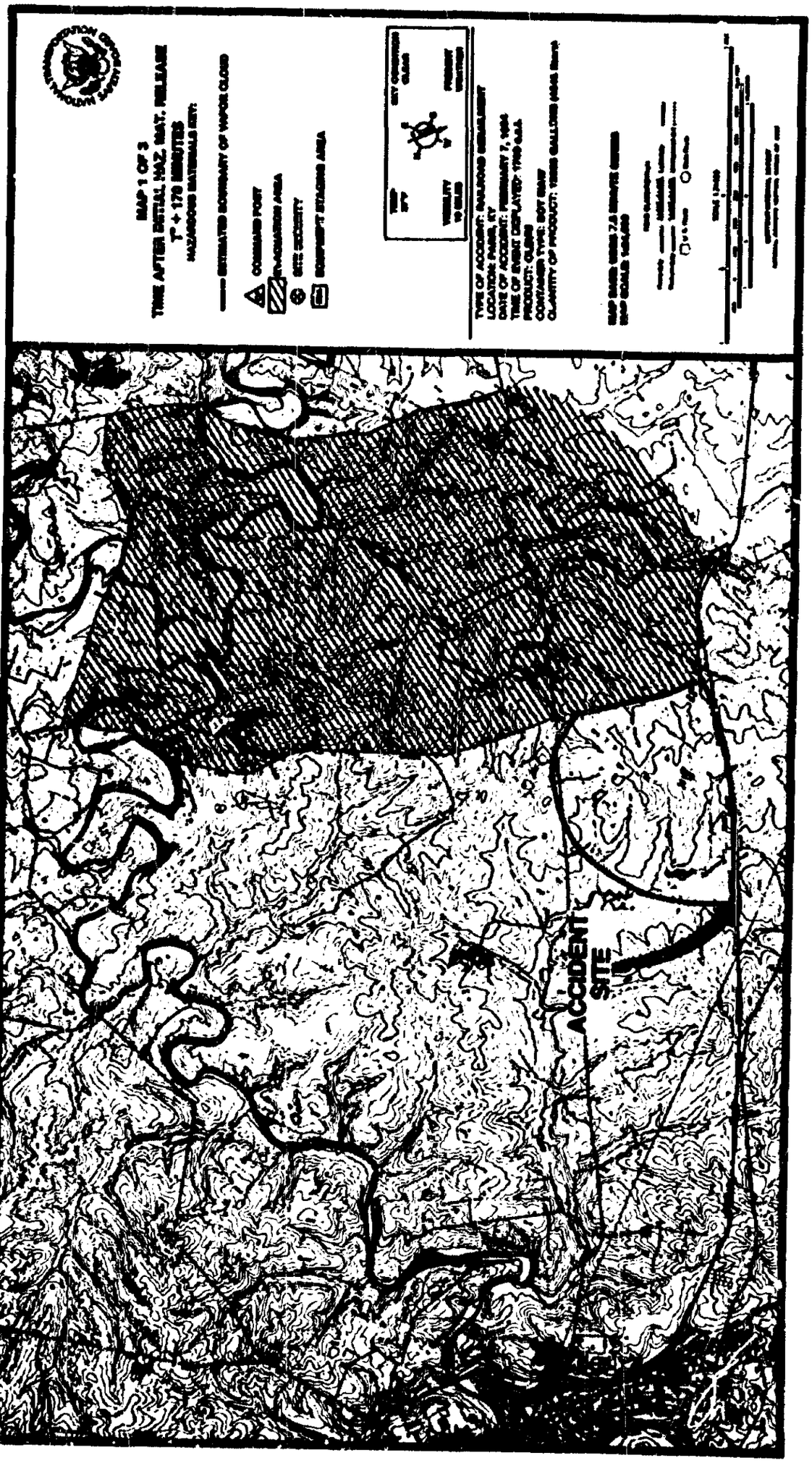
Do not get water inside container.
Do not touch spilled material.
Stop leak if you can do it without risk.
Use water spray to reduce vapors but do not put water on leak area.
Keep combustibles (wood, paper, oil, etc.) away from spilled material.
Small Spills: Flush area with water. (USE CAUTION)
Large Spills: Dike for later disposal and dilute with large amounts of water.

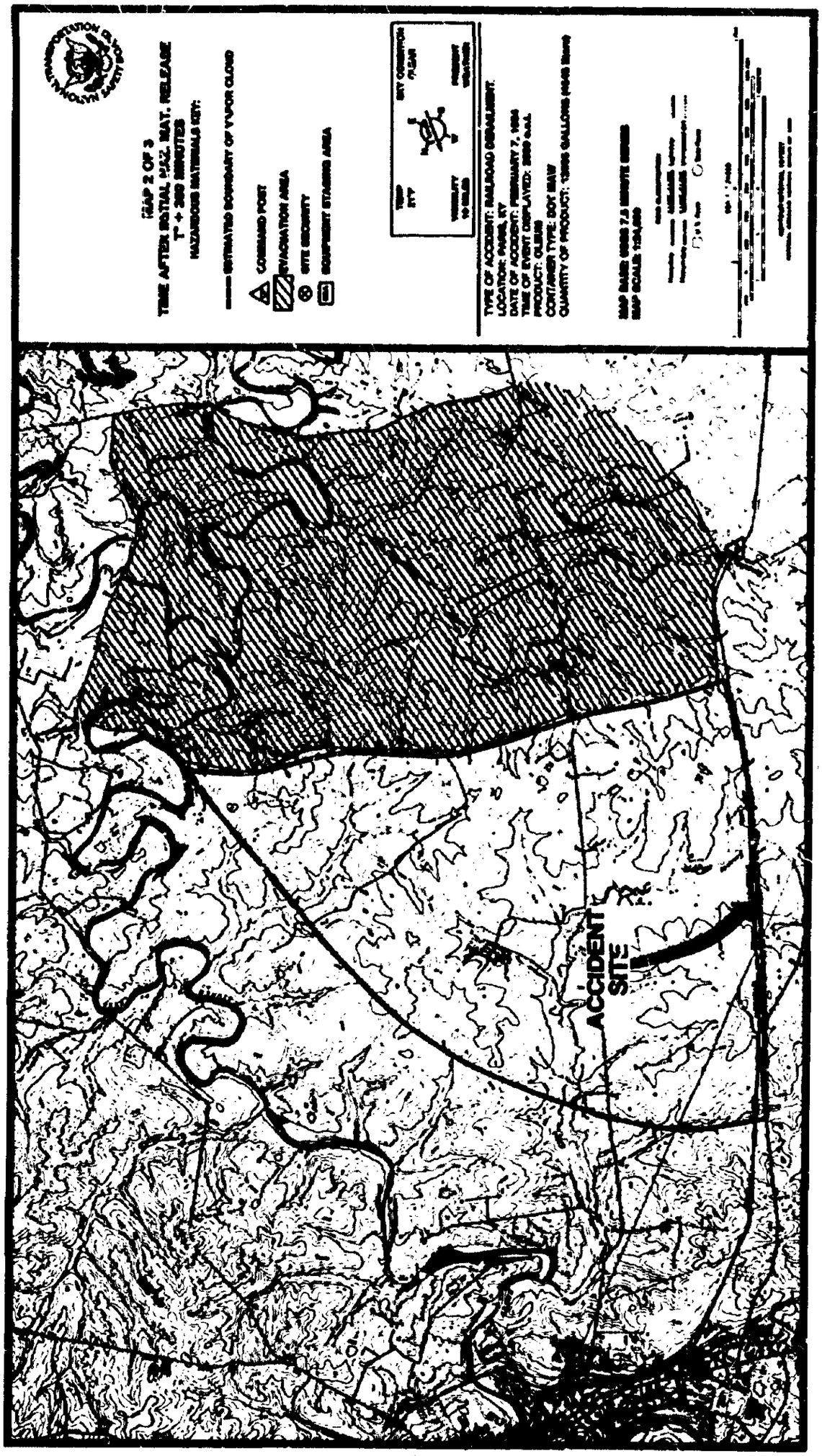
FIRST AID

Move victim to fresh air; call emergency medical care.
If not breathing, give artificial respiration.
If breathing is difficult, give oxygen.
Remove and isolate contaminated clothing and shoes.
Speed in removing material from skin is of extreme importance.
Wipe material from skin immediately; then flush skin or eyes with running water for at least 15 minutes.
Keep victim quiet and maintain normal body temperature.

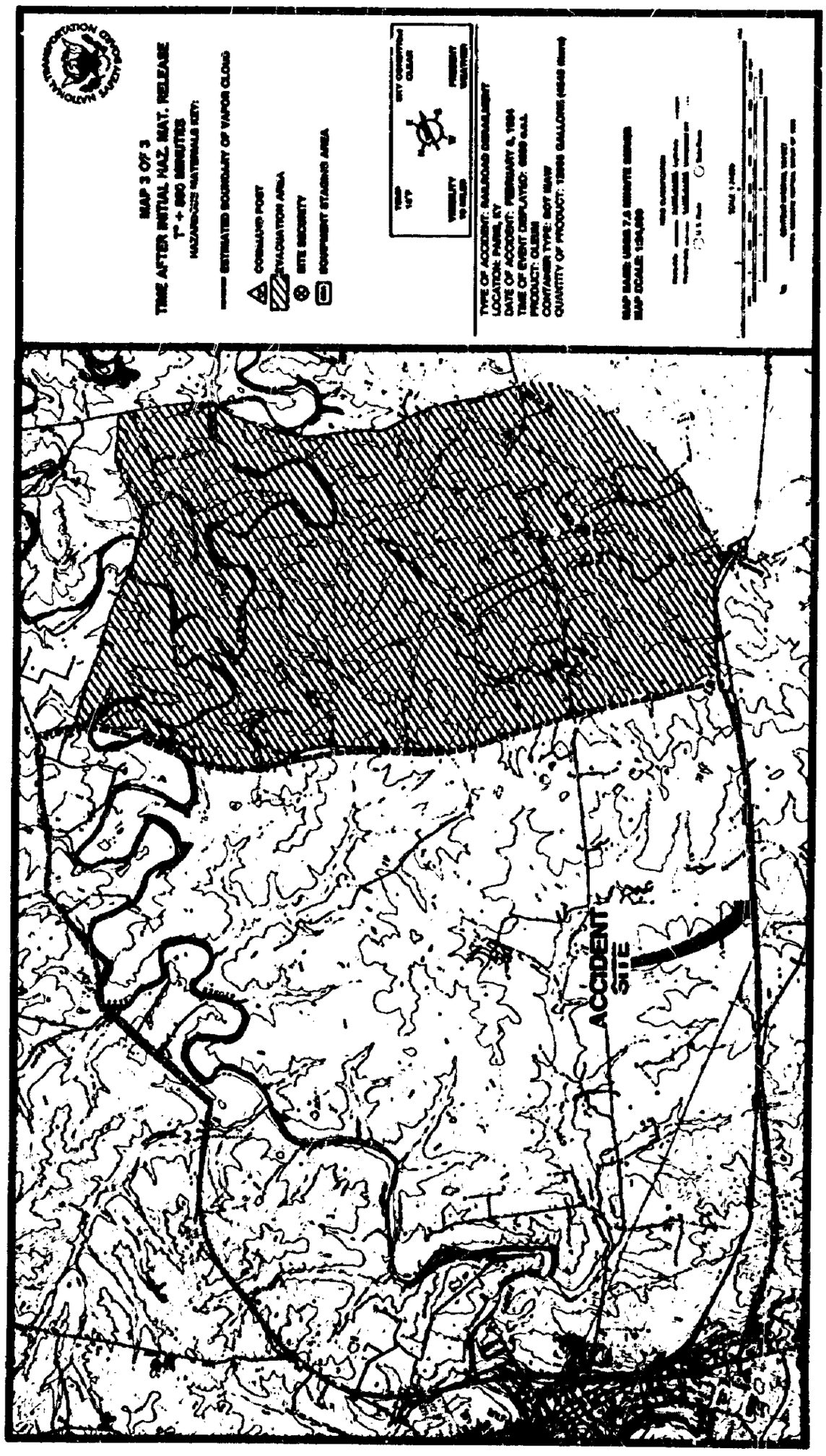
APPENDIX E

HAZARDOUS MATERIALS SPILL MAPS (3)




MAP 2 OF 3
TIME AFTER INITIAL PAZ MAT. RELEASE
T + 360 MINUTES
HAZARDOUS MATERIALS KEY:
ESTIMATED BOUNDARY OF VAPOR CLOUD
COMMAND POST
EVACUATION AREA
SITE SECURITY
EQUIPMENT STAGING AREA
KEY CROSSWIND FLOW
TRIP
EVT
VISIBILITY
10 MILES
PREVAILING WINDS
TYPE OF ACCIDENT: RAILROAD DERAILMENT
LOCATION: PAOLI, KY
DATE OF ACCIDENT: FEBRUARY 7, 1994
TIME OF EVENT DISPLAYED: 3600 hrs.
PRODUCT: OLEUM
CONTAINER TYPE: BOX BANK
QUANTITY OF PRODUCT: 12000 GALLONS (45425 liters)
MAP BASED USING 7.5 MINUTE SERIES
MAP SCALE: 1:24,000
ACCIDENT SITE

APPENDIX E


MAP 3 OF 3
TIME AFTER INITIAL HAZ. MAT. RELEASE
T + 600 MINUTES
HAZARDOUS MATERIALS KEY:
ESTIMATED BOUNDARY OF VAPOR CLOUD
COMMAND POST
EVACUATION AREA
SITE SECURITY
EQUIPMENT STAGING AREA
SKY CONDITION
CLEAR
TEMP.
15°F
VISIBILITY
10 MILES
PRESENT
WEATHER
TYPE OF ACCIDENT: RAILROAD DERAILMENT
LOCATION: PARIS, KY
DATE OF ACCIDENT: FEBRUARY 6, 1994
TIME OF EVENT DISPLAYED: 0600 HRS
PRODUCT: CLSSH
CONTAINER TYPE: BOT WAW
QUANTITY OF PRODUCT: 13800 GALLONS (4600 liters)
MAP BASE: USGS 7.5 MINUTE SERIES
MAP SCALE: 1:24,000
ACCIDENT SITE

APPENDIX F

PRODUCT DATA SHEET CHRIS MANUAL

OLM	OLEUM

[illegible] Fuming sulfuric acid	Oily liquid Colorless to cloudy Sharp, choking odor Mixes and reacts with water producing heat. Sulfuric acid is produced
AVOID CONTACT WITH LIQUID AND MIST. [illegible] [illegible]	
Fire	Not flammable May cause fire on contact with combustibles Flammable gas may be produced on contact with metals [illegible] protective [illegible] breathing apparatus DO NOT USE WATER ON ADJACENT FIRES
Exposure	CALL FOR MEDICAL AID MIST Irritating to eyes, nose and throat If inhaled, will cause coughing or difficult breathing [illegible] LIQUID Will burn skin and eyes Harmful if swallowed Remove contaminated clothing and shoes Flush affected areas with plenty of water IF IN EYES, hold eyelids open and flush with plenty of water IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk DO NOT INDUCE VOMITING
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS [illegible] May be dangerous if it enters water intakes Notify local health and wildlife officials Notify operators of nearby water intakes

1. RESPONSE TO DISCHARGE

[illegible]
Issue warning - corrosive
Restrict access
Chemical and physical treatment
Disperse and flush

2. LABEL

3. CHEMICAL DESIGNATIONS

3.1 Synonyms: Fuming sulfuric acid
3.2 Coast Guard Compatibility Classification: Inorganic acid
3.3 Chemical Formula: $SO_3 \cdot H_2SO_4$
3.4 IMCO/United Nations Numerical Designation: 8/1831

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless to cloudy
4.3 Odor: Sharp penetrating choking

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: [illegible]
5.2 Symptoms Following Exposure: [illegible]
5.3 Treatment for Exposure: INGESTION: [illegible]
5.4 Toxicity by Inhalation (Threshold Limit Value): 1 mg/m³
5.5 Short-Term Inhalation Limits: [illegible]
5.6 Toxicity by Ingestion: Severe burns of mouth and stomach
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: [illegible]
5.9 Liquid or Solid Irritant Characteristics: [illegible]
5.10 Odor Threshold: 1 mg/m³

6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Avoid use of water on adjacent fires
6.5 Special Hazards of Combustion Products: Toxic and irritating vapors are generated
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable

7. CHEMICAL REACTIVITY

7.1 Reactivity with Water: [illegible]
7.2 Reactivity with Common Materials: [illegible]
7.3 Stability During Transport: Not stable
7.4 Neutralizing Agents for Acids and Caustics: [illegible]
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent

8. WATER POLLUTION

8.1 Aquatic Toxicity: [illegible]
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

9. SELECTED MANUFACTURERS

1. Allied Chemical Corp. Industrial Chemicals Division Morristown, N.J. [illegible]
2. Monsanto Co. [illegible] St. Louis, Mo. [illegible]
3. [illegible] Chemical Co. Industrial Chemicals Division [illegible] Park Ave. New York, N.Y. [illegible]

10. SHIPPING INFORMATION

10.1 Grades or Purity: [illegible]
10.2 Storage Temperature: [illegible]
10.3 Inert Atmosphere: No requirement
10.4 Venting: Open

11. HAZARD ASSESSMENT CODE

[illegible]
A-O-P

12. HAZARD CLASSIFICATIONS

12.1 Code of Federal Regulations: Corrosive material
12.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	0
Health	
Vapor Irritant	4
Liquid or Solid Irritant	4
Poisons	3
Water Pollution	
Human Toxicity	3
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	4
Water	3
Self-Reaction	0

12.3 NFPA Hazard Classifications:

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	0
Reactivity (Yellow)	2
	W

13. PHYSICAL AND CHEMICAL PROPERTIES

13.1 Physical State at 15°C and 1 atm: Liquid
13.2 Molecular Weight: Not pertinent
13.3 Boiling Point at 1 atm: Decomposes
13.4 Freezing Point: Not pertinent
13.5 Critical Temperature: Not pertinent
13.6 Critical Pressure: Not pertinent
13.7 Specific Gravity: [illegible]
13.8 Liquid Surface Tension: Not pertinent
13.9 Liquid-Water Interfacial Tension: Not pertinent
13.10 Vapor (Gas) Specific Gravity: Not pertinent
13.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
13.12 Latent Heat of Vaporization: Not pertinent
13.13 Heat of Combustion: Not pertinent
13.14 Heat of Decomposition: Not pertinent
13.15 Heat of Solution: Not pertinent
13.16 Heat of Polymerization: Not pertinent

Continued on page [illegible]

NOTES

REVISED 1978

APPENDIX G

HAZARDOUS MATERIAL INSPECTIONS
SBD TIMETABLE NO. 1
OCTOBER 30, 1983

HAZARDOUS MATERIALS

SWITCHING PLACARDED CARS

BEFORE SWITCHING with cars containing hazardous materials, certain precautions must be taken by train and engine service employees, in addition to those outlined by Bureau of Explosives Posters No. 3 and No. 4.

BEFORE COUPLING TO: (a) Cars containing hazardous materials; (b) Empty tank cars last containing hazardous materials; (c) A placarded car offered for shipment, including cars that are known to require placards; or before accepting a placarded car offered in interchange, the following must be ascertained:

(1) Derails, dockboards, tank couplings and similar connections must be removed and in the clear.

(2) Persons in or about cars must be warned and must be requested to vacate cars while such cars are being switched, if practicable.

(3) There are no signs of leaking.

(4) Running gear appears to be in good condition.

(5) If a tank car, all manhole covers, outlet valve reducers, outlet valve caps, outlet valve cap plugs, end plugs and plugs or caps on openings are securely in their proper places.

(6) Appropriate placards are in place on both sides and both ends.

(7) Stenciling located on sides of car indicates that tank and safety valves are not overdue for retest.

(8) If a covered hopper, discharge gates (bottom doors) are closed.

EMERGENCY INVOLVING HAZARDOUS MATERIALS

The conductor, or other Company personnel, at the scene must initiate such action as to insure public safety, protect property and look after the Company's interest. The following actions are to be taken as soon as possible — IF IT IS SAFE TO DO SO:

(1) Rescue injured, remove them to a safe area, administer first aid and call for assistance.

(2) Survey the scene and adjacent area, determine conditions including identifying cars/trailers containing hazardous materials (all placarded cars) involved in the emergency or in the immediate area, and notify proper authority by quickest means available.

(3) Protect life and property. This may require evacuation of people from the area, fire fighting, removal of cars or containers and contents.

(4) In the event emergency involves spillage, loss of hazardous material or fire, the conductor or his designee will notify or request the chief dispatcher to notify the nearest EMERGENCY RESPONSE GROUP, such as Fire and Police departments, Medical Rescue, etc., and remain at the scene until arrival of the Response Group or until released by proper authority.

THE INFORMATION FURNISHED BY THE CONDUCTORS FIRST REPORT TO THE CHIEF DISPATCHER OR APPROPRIATE AUTHORITY, SUCH AS: (a) IF THERE IS FIRE; (b) EXPLOSION; (c) FUMING; or (d) LEAKING FROM ANY PLACARDED EQUIPMENT, TOGETHER WITH THE CONTENTS AND OTHER WAYBILL INFORMATION, IS VITAL WHEN DETERMINING WHAT COURSE OF ACTION IS NECESSARY. THE CONDUCTOR MUST KEEP THE WAYBILLS IN HIS POSSESSION FOR READY REFERENCE FOR PERSONNEL AT THE SCENE.

* U.S. GOVERNMENT PRINTING OFFICE: 1985-461-135:20020

HAZARDOUS MATERIALS — Continued —

FIRE INVOLVING HAZARDOUS MATERIALS

In the event of fire involving any equipment with the following commodities, evacuation distance will be guided by the hazardous materials printout furnished train crew; however, in the absence of the hazardous materials printout, the following will govern:

(1) **EXPLOSIVE A** — All persons should be evacuated for a distance of one mile from scene.

(2) **EXPLOSIVE B, FLAMMABLE GAS, NON-FLAMMABLE GAS, OXYGEN AND FLAMMABLE OR ORGANIC PEROXIDE** — All persons should be evacuated for a distance of one half mile from scene.

(3) **POISON GAS OR CHLORINE** (that is leaking, fuming or venting) — All persons should be kept out of the immediate area and upwind as far as necessary to avoid contact with the material fumes or smoke.

(4) **ANY HAZARDOUS MATERIALS** (that are burning or if their container is involved in a fire) — All persons should be kept out of the immediate area and upwind as far as necessary to avoid contact with the material, fumes or smoke.

WHEN EMERGENCY RESPONSE PERSONNEL ARRIVE

When Emergency Response Personnel arrive at the scene, the conductor must take the initiative to identify himself. He must furnish them with information from waybills and train consist of any hazardous materials in the train as well as any knowledge he has of conditions as they then exist.

DERAILMENT INVOLVING HAZARDOUS MATERIALS

In addition to the previous requirements, the conductor at the scene after making preliminary report to the train dispatcher, must determine and transmit to the chief dispatcher, by the quickest means available, the following information:

(1) Proper geographical location, including nearest city or town and nearest mile post.

(2) Time emergency occurred, train number, origin and destination.

(3) Prevailing weather conditions.

(4) Cause of accident, if readily apparent.

(5) Number and position of engines and/or cars derailed.

(6) Total loads, empties and tonnage in train and location of derailed cars.

(7) Contents of derailed cars, including STCC and UN identification number of any hazardous materials, and whether or not there is any evidence of leaking or loss of material.

(8) Name, address (if known), and extent and disposition of injured or killed.

(9) Geographical and topographical information (road or parallel roads blocked, on fill or cut, curve or tangent track, on bridge, trestle, overpass or underpass).

(10) When supervisor arrives, explain situation, what has been done, who has been notified and any advice received from chief dispatcher. Be governed by supervisor's instructions.

END
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