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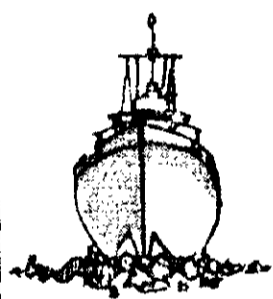
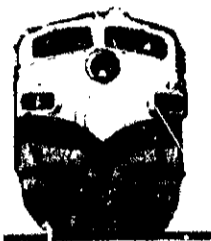
RAILROAD ACCIDENT REPORT

LOUISVILLE & NASHVILLE RAILROAD COMPANY
FREIGHT TRAIN DERAILMENT AND PUNCTURE
OF HAZARDOUS MATERIALS TANK CARS
CRESTVIEW, FLORIDA
APRIL 8, 1979

NTSB-RAR-79-11

UNITED STATES GOVERNMENT

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16. Abstract <p>About 8 a.m., on April 8, 1979, 29 cars, including 26 placarded tank cars containing hazardous materials, of Louisville & Nashville Railroad Company freight train No. 403 derailed while moving around a 4°02' curve between Milligan and Crestview, Florida. Two tank cars of anhydrous ammonia ruptured and rocketed. Twelve other cars containing acetone, methyl alcohol, chlorine, carbolic acid, and anhydrous ammonia ruptured, and their contents either burned or were consumed by fire. Fourteen persons were injured as a result of the release of anhydrous ammonia and other materials or during the evacuation of 4,500 persons. Property damage was estimated to be \$1,258,500.</p> <p>The National Transportation Safety Board determines that the probable cause of this accident was the large compressive force generated between the 36th and 37th cars by a combination of excessive train tonnage and improper train handling which caused the 36th car to overturn the outside rail of the 4°02' curve and derail. Contributing to the severe consequences of the accident was the release of anhydrous ammonia and other hazardous materials, through ruptures and punctures in the sides of the tank cars, which caused all of the injuries and led to the evacuation of 4,500 persons from the area.</p>			
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Adopted: September 13, 1979

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FREIGHT TRAIN DERAILMENT
AND PUNCTURE OF HAZARDOUS MATERIALS
TANK CARS
CRESTVIEW, FLORIDA
APRIL 8, 1979

SYNOPSIS

About 8 a.m., on April 8, 1979, 29 cars, including 26 placarded tank cars containing hazardous materials, of Louisville & Nashville Railroad Company (L&N) freight train No. 403 derailed while moving around a 4°02' curve between Milligan and Crestview, Florida. Two tank cars of anhydrous ammonia ruptured and rocketed. Twelve other cars containing acetone, methyl alcohol, chlorine, carbolic acid, and anhydrous ammonia ruptured, and their contents either burned or were consumed by fire. Released chlorine and anhydrous ammonia dispersed, forming a cloud that grew until it threatened a 300-square-mile area downwind of the derailment. More than 4,500 persons in the path of the cloud were evacuated. The released hazardous materials posed a threat to the health and safety of the surrounding population and wreck-clearing personnel for 9 days. Fourteen persons were injured by exposure to the hazardous materials; property damage was estimated at \$1,258,500; and the Yellow River was threatened with pollution.

The National Transportation Safety Board determines that the probable cause of this accident was the large compressive force generated between the 36th and 37th cars by a combination of excessive train tonnage and improper train handling which caused the 36th car to overturn the outside rail of the 4°02' curve and derail. Contributing to the severe consequences of the accident was the release of anhydrous ammonia and other hazardous materials, through ruptures and punctures in the sides of the tank cars, which caused all of the injuries and led to the evacuation of 4,500 persons from the area.

INVESTIGATION

The Accident

L&N freight train No. 403 departed Goulding Yard, Pensacola, Florida, about 5:25 a.m. on April 8, 1979, southbound for Chattahoochee, Florida. The train consisted of 5 locomotive units and 114 cars, including 67 tank cars carrying hazardous materials. A predeparture inspection and initial terminal-type airbrake test made at Goulding Yard disclosed no defects. The train had originated in New Orleans, Louisiana, on April 7, 1979.

The crewmembers made frequent observations of the train en route and observed no unusual conditions. The fifth locomotive unit, however, shut down several times en route because a device that protected the engine from a low-water level actuated. The front brakeman was able to reset the device and restart the engine while the train was in motion. A hot-box detector ^{1/} which the train passed about 28 miles south of Goulding Yard indicated no defects. The engineer had applied the train's airbrakes several times before the train passed the hot-box detector to control the speed of the train and noted no problems with their operation.

After traveling about 43 miles from Goulding Yard, the train entered a 5-mile-long descending grade--with a three-quarter mile-long hump about 3 miles down--toward the Yellow River Bridge near Crestview in Okaloosa County. The engineer stated that at the top of the grade the train was traveling about 38 to 40 mph and the throttle was in the No. 8, full-throttle position. At this time he made a minimum service application of the brakes to maintain the speed of the train down the grade. In about one-half mile he felt the train was not slowing adequately, and he made an additional application and reduced the throttle in 10-second intervals to the No. 6 position. The train's speed was then 40 mph, according to the engineer. About eight-tenths of a mile farther, he increased the brake application to full service and reduced the throttle to the No. 4 position to maintain the train speed at 40 mph. One and seven-tenths mile farther, while still moving at 40 mph, the engineer released the brakes as the train entered the hump. (See figure 1.)

The engineer stated that after the locomotive crested the hump, the speed of the train was not reduced on the continued descending grade toward the Yellow River Bridge as he had anticipated. Consequently, he reduced the throttle to the No. 3 position in order to maintain the 40-mph speed. He recalled that the train had traveled another six-tenths of a mile since the release of the brakes. He also stated that in anticipation of the approaching 35-mph speed restriction across the Yellow River Bridge he reduced the throttle to the No. 2 position. The train had traveled 1 mile since the brake release. One-tenth of a mile farther he initiated a 10-pound brake application. Four-tenths of a mile farther he increased the application to 28 pounds while reducing throttle to the No. 1 position. When train speed reduced to 35 mph in another three-tenths of a mile, he released the brakes just before the locomotive moved from a 3° curve to the right and entered the tangent track over the Yellow River Bridge.

After crossing the bridge the locomotive immediately entered a 4°02' curve to the left. The engineer stated that train speed had reduced to 30 mph. He said that about 700 feet into the curve he began increasing the throttle at the rate of one position about every two-tenths of a mile to prevent the train from stalling on the 1-percent, 5-mile-long ascending grade into Crestview. The engineer stated that the throttle was in the No. 4 position as the locomotive moved from the 4°02' curve. The train was still moving about 30 mph when the train's brakes applied suddenly in emergency about 8 a.m. Looking rearward, he saw fire near the cars near the bridge.

^{1/} An automatic detection device located adjacent to the track to sense overheated wheel and axle conditions.

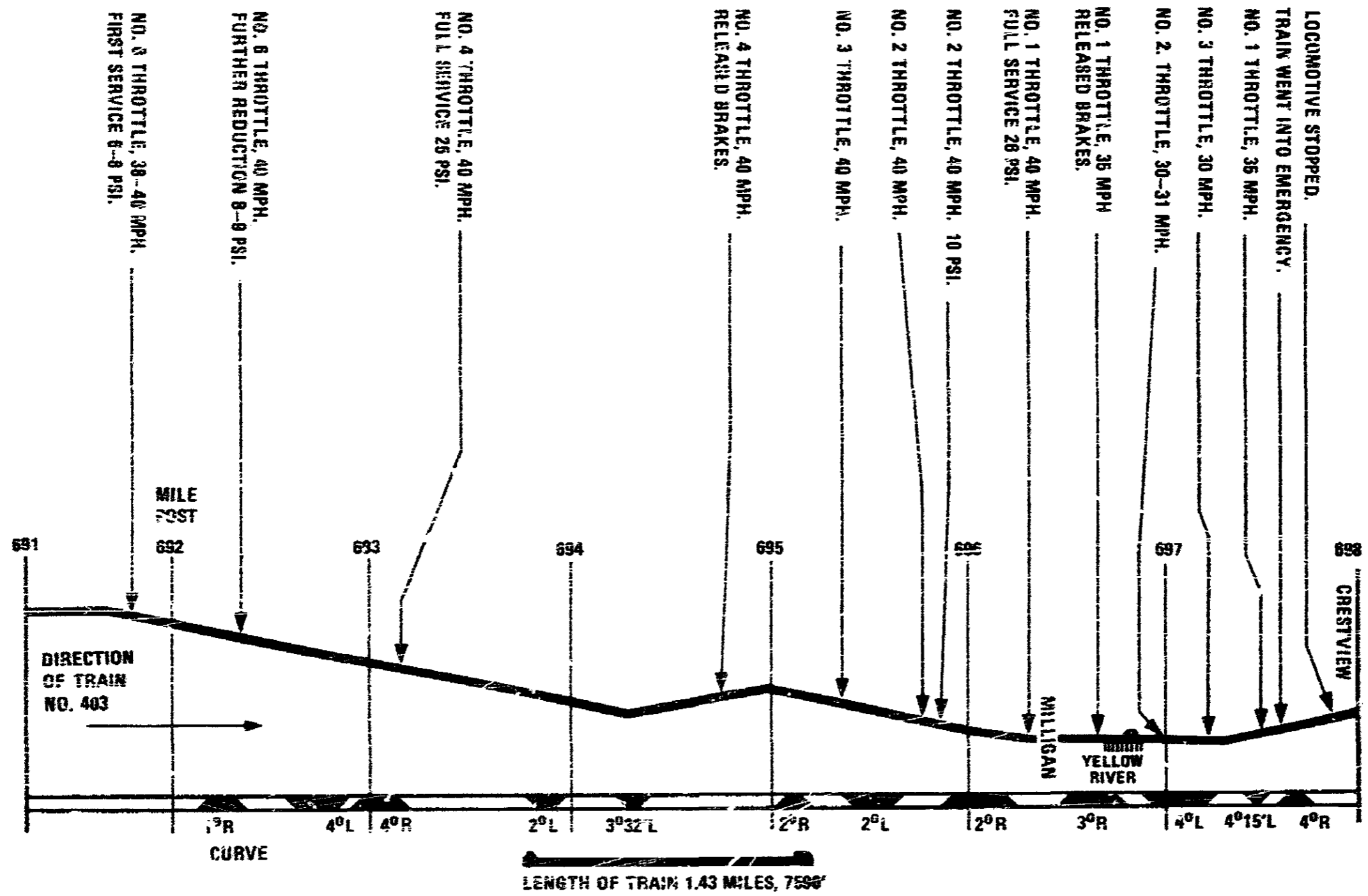


Figure 1. Profile of track between mileposts 691 and 698 showing locations of throttle reductions and brake applications.

After the lead portion of the train stopped, the head brakeman went back along the track and found that the train had separated about 1,500 feet between the 36th and 37th cars and several cars had derailed. He saw tank cars lying on their sides, in line, along the outside of the curve and tank cars jackknifed across the track just south of the bridge. (See figure 2.) A fire had started in the jackknifed cars. About 8:03 a.m., the 59th car exploded, releasing a gas cloud and propelling a portion of the tank eastward. The head brakeman radioed the engineer about the derailed cars, the fire, and the gas cloud. The engineer informed the L&N Crestview operator of the derailment and fire, and local emergency personnel were notified. About 8:15 a.m. the head brakeman met responding firefighters at the Antioch Road crossing about 1,540 feet south of the bridge. After talking with the firefighters he uncoupled the 35th car from the derailed 36th car and returned to the locomotive.

Meanwhile, the conductor inspected the rear of the train north of the bridge while the flagman went farther north along the track to provide the required flagging protection. When the conductor arrived at the bridge, he heard the hissing of escaping gas and also witnessed the 59th car explode. He saw a green vapor cloud rising from the derailed cars and started toward the caboose. While walking from the scene he met two arriving deputy sheriffs and told them that the cloud might contain chlorine gas. The conductor later gave the waybills and train consist information, which included a printed list of the hazardous materials being hauled in the train, to a trainmaster who arrived at the scene about 8:30 a.m. About 8:45 a.m. the trainmaster gave the information to the firefighters who had arrived at the Antioch Road crossing.

The 59th tank car, which exploded first and which contained anhydrous ammonia, had been wedged between two adjacent tank cars after they derailed. This had caused indentations on opposite sides of the tank cylinder between the second and third weld lines. A radial crack had propagated around the tank wall, separating the tank in two sections. When the tank car exploded, one portion of the tank rocketed east and one portion west of the track, 650 feet and 250 feet respectively.

The 56th tank car, containing anhydrous ammonia, had derailed, rolled over, and dislodged its dome housing cover. Its relief valves were damaged, and the tank stopped upside down on top of its relief vent. The tank was also lying on the side of the track embankment with one end pointed upward and the lower end engulfed in a ground spill fire of acetone and methyl alcohol released from other ruptured tank cars. About 8:23 a.m. the 56th car exploded, releasing a white mushroom-type cloud several hundred feet into the air and about 100 feet in diameter. The tank had split along a longitudinal line near the middle of the shell.

After the 56th car exploded, derailed cars numbered 48 through 55 were engulfed in a bright yellow-orange fire with intermittent smoke. The fire continued to burn for about 60 hours, consuming the acetone, methyl alcohol, and carbon tetrachloride leaking from the ruptured and punctured cars. All of the breached cars contained residues which slowly vented in the wreck area for 5 days. An Eglin Air Force Base Bioenvironmental Engineering Assistance Team monitored air quality near the site for 5 days. Trace amounts of various chemicals were

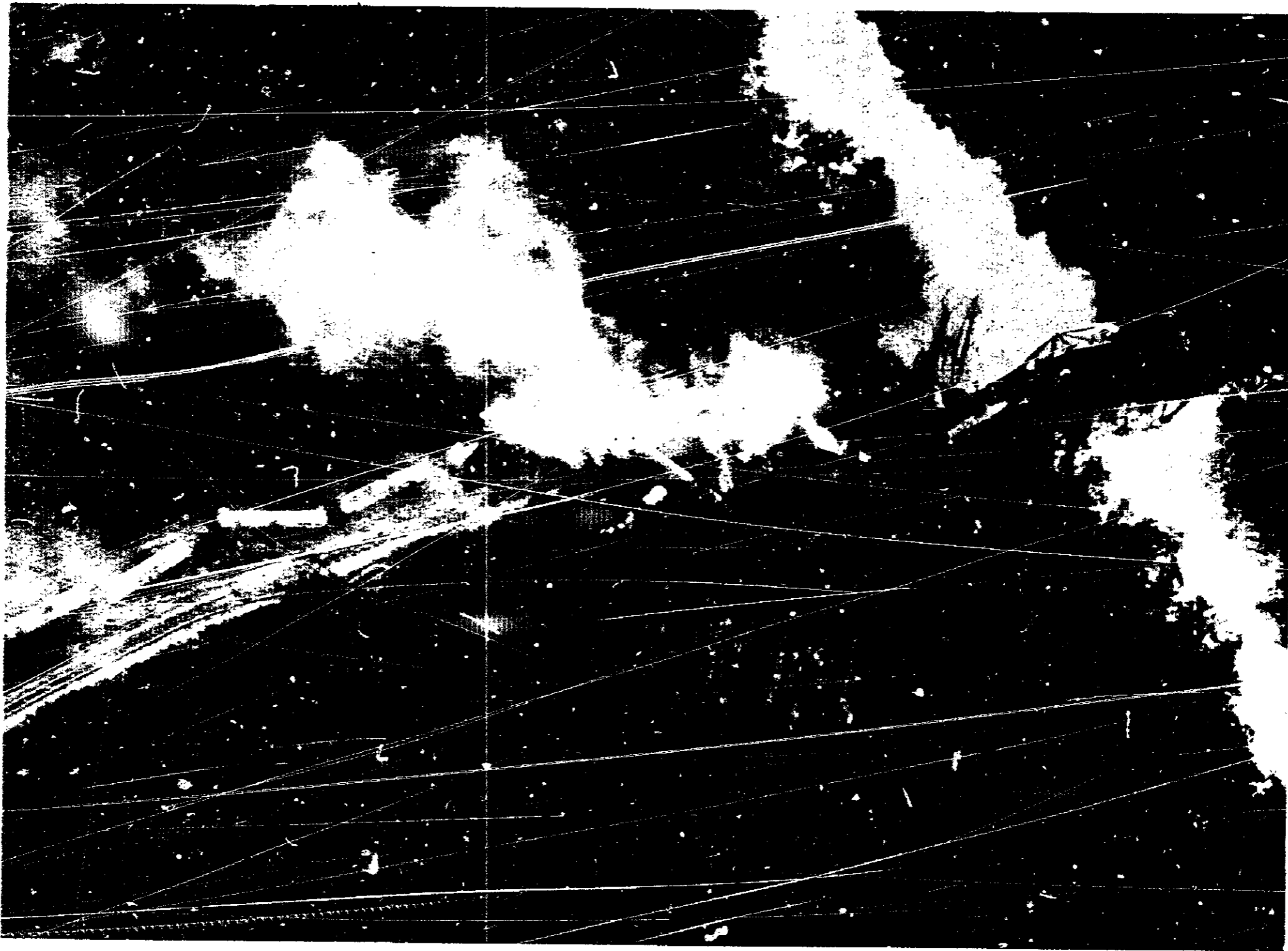


Figure 2. View of derailment site.

measured. Sulfur, phenol, and phosgene were detected during the first day and chlorine and ammonia were detected for 5 days. ^{2/} Phosgene gas, which can be deadly when inhaled in even small doses, resulted from the heating of the carbon tetrachloride.

Injuries to Persons

<u>Injuries</u>	<u>Crewmembers</u>	<u>Passengers</u>	<u>Other</u>
Fatal	0	0	0
Nonfatal	0	0	14 ^{3/}
None	4	0	0

Damage

Twenty-nine cars derailed; 28 were tank cars and 1 was a covered hopper car. (See figure 3.) Seventeen of the tank cars were destroyed, nine cars were heavily damaged, and two cars received moderate damage. Fifteen of the tank cars lost their lading because of sustaining the following damages:

<u>Train Location</u>	<u>Type Car</u>	<u>Commodity</u>	<u>Damage to tank</u>
42	105A	anhydrous ammonia	dome leak
43	105A	anhydrous ammonia	3-inch cut in side of inner tank
44	105A	anhydrous ammonia	3-inch cut in bottom of inner tank
48	111A	sulfur	4-inch cut in head
49	111A	carbon tetrachloride	9-inch and 10-inch cuts in side
50	111A	acetone	3-inch cut in side; tank crushed

^{2/} Eglin Air Force Base Bioenvironmental Engineering Assistance Report of Support Provided at Crestview from April 8 through 13, 1979.

^{3/} Ten persons who had been clearing the wreckage were treated for gas inhalation.

51	111A	acetone	8-inch cut in side; tank crushed; dome torn away.
52	111A	acetone	31-inch "Y" cut in side; tank crushed
53	111A	methyl alcohol	car broken in two
54	111A	methyl alcohol	1-foot cut in side
55	105A	chlorine	18-inch punctured hole in side
56	112S	anhydrous ammonia	rocketed; three pieces
58	105A	anhydrous ammonia	4-inch cut in side of inner tank
59	105A	anhydrous ammonia	rocketed; two pieces
62	111A	carbolic acid	jacket cut

Approximately 750 feet of track structure was destroyed just south of the bridge at the beginning of the curve. The high (outer) rail in the curve was displaced outward while a portion of the track structure was displaced to the inside. About 1,500 feet of track structure west of the destroyed track was damaged. The 72-foot, south-approach, ballast-deck pile trestle of the bridge over the Yellow River was destroyed by the derailment. The southeast corner post and collision strut of the steel through-truss bridge was damaged; the south-end floor beams, chords, and stringers were damaged, and the lateral bracing and timber bridge deck sustained heavy fire damage.

All trees and ground cover in an area extending for 650 feet northwest of the derailment site were defoliated by the ammonia from the vapor cloud. There was also extensive fire damage within a 130-foot radius of the derailed and burning cars.

Property damages were estimated to be:

Equipment	\$ 813,500
Track and structures	258,000
Lading	187,000
Total	\$ 1,258,500

Crew Information

The crew of No. 403 was comprised of a locomotive engineer and head brakeman on the lead unit of the locomotive, and a conductor and rear brakeman in the caboose at the rear of the train. (See appendix B.)

Train Information

Train No. 403 consisted of 107 loaded cars, 6 empty cars, and a caboose. Sixty-seven of the 107 loaded cars were heavily loaded tank cars without baffles. The L&N originally estimated the train's trailing weight as 10,628 tons, and this weight was shown on the train consist information. A recalculation of train tonnage after the accident indicated that the trailing weight was actually about 11,360 tons. The locomotive consisted of five diesel-electric, four-axle units manufactured by the Electro-Motive Division of General Motors:

<u>Locomotive initial and number</u>	<u>Model</u>	<u>Tonnage rating 4/</u>
L&N 1045	GP-30	2,172
L&N 1013	GP-30	2,172
SCL 515	GP-38-2	2,172
L&N 510	GP-9	1,975
L&N 4129	GP-38-2	2,172
		10,663

The locomotive units were equipped with No. 26-L and 24-RL airbrake systems, wheel slip-slide detectors, speed indicators, and radio with which locomotive crewmembers could communicate with crewmembers on the caboose, on other trains, and with the train dispatcher or other stations. The locomotive units were not equipped with speed-recording or event-recording equipment. The lead unit was not equipped for dynamic braking.

Locomotive unit L&N 4129 was added to the locomotive at Goulding Yard. The engineer stated that when he boarded the locomotive at Goulding Yard, an alarm bell was ringing and the engine on unit 4129 had shut down due to the activation of the engine low-water protection device. He reset the device and

4/ Tonnage rating of a locomotive unit is the trailing tonnage which the unit can pull at a specified minimum speed over a given territory.

started the engine. The engine detection device again actuated and shut the engine down about 11 miles and again at about 36 miles from Goulding Yard. After the derailment, the engineer found that the device had once more shut down the engine. The engine water was checked each time the device actuated and the level was found to be satisfactory before the engine was restarted. After the accident, unit 4129 was used several times before being sent to a repair facility. Engineers using this unit did not report any problems with the low-water detection device. L&N mechanical personnel did not make any repairs to the low-water detection device on unit 4129 after the accident. The cause of the engine shutdown was not determined.

Twenty-six of the 28 derailed tank cars contained hazardous materials which required a placard. Seventeen contained anhydrous ammonia, three contained acetone, four contained methyl alcohol, and one each contained chlorine and carbolic acid. One of the cars contained carbon tetrachloride and another sulfur; neither of these hazardous materials is regulated in rail freight transportation.

The 17 derailed tank cars loaded with anhydrous ammonia each had a capacity of about 33,500 gallons. Of the 17 cars, 11 were DOT specification 105A-type cars, which had welded, insulated steel shells and which were designed for transporting compressed gases and flammable and nonflammable gases and liquids. Four were 112S-type cars which had welded, uninsulated steel shells and which were designed for transporting liquefied compressed gases or flammable liquids. Two were 112A-type cars which were the same as the 112S-type cars except that they had not been equipped with headshields. The 105A-type cars were equipped with F-type couplers, and the 112-type cars had top-and-bottom, shelf-type E couplers.

Ten of the 11 other tank cars involved in the derailment were 111A-type cars, which had shells of steel or aluminum alloy and which were designed for transporting flammables, combustibles, and other liquids not under pressure. Five of the 111A-type cars were equipped with E-type couplers, four were equipped with F-type couplers, and the type of coupler on one is unknown. The chlorine car was a 105A-type car. None of the tank cars contained baffles to control liquid surge.

Track Structure

In the direction of train No. 403's travel, the single main track was a series of curves on a descending grade for about 5 miles leading to the Yellow River. Approaching the Yellow River, the grade moderated from about 1 percent to generally level over a ballast-deck pile trestle, approximately 1,370 feet long. The track entered onto the trestle in a right-hand 3° curve, continued for about 932 feet to a 112-foot spiral, and then continued about 335 feet on a tangent before crossing the five-span, 125-foot, through-truss bridge over the river. The track ascended at about a 0.15-percent gradient for about 1,000 feet before crossing the bridge. (See figure 4.) Continuing southward the track crossed another ballast-deck pile trestle, about 72 feet long, and then entered a spiral about 231 feet long into a left-hand, 4°02' curve about 1,592 feet long. Beyond the bridge and trestle, the track descended for about 2,000 feet at a grade of about 0.12 percent. The track then ascended at about a 1-percent gradient toward Crestview.

The track structure on either side of the bridge was laid on a sandy subsoil which underlies a crushed-rock ballast section. The shoulder ballast section was full and extended outward 12 inches or more from the cross-tie ends. The tie cribs were

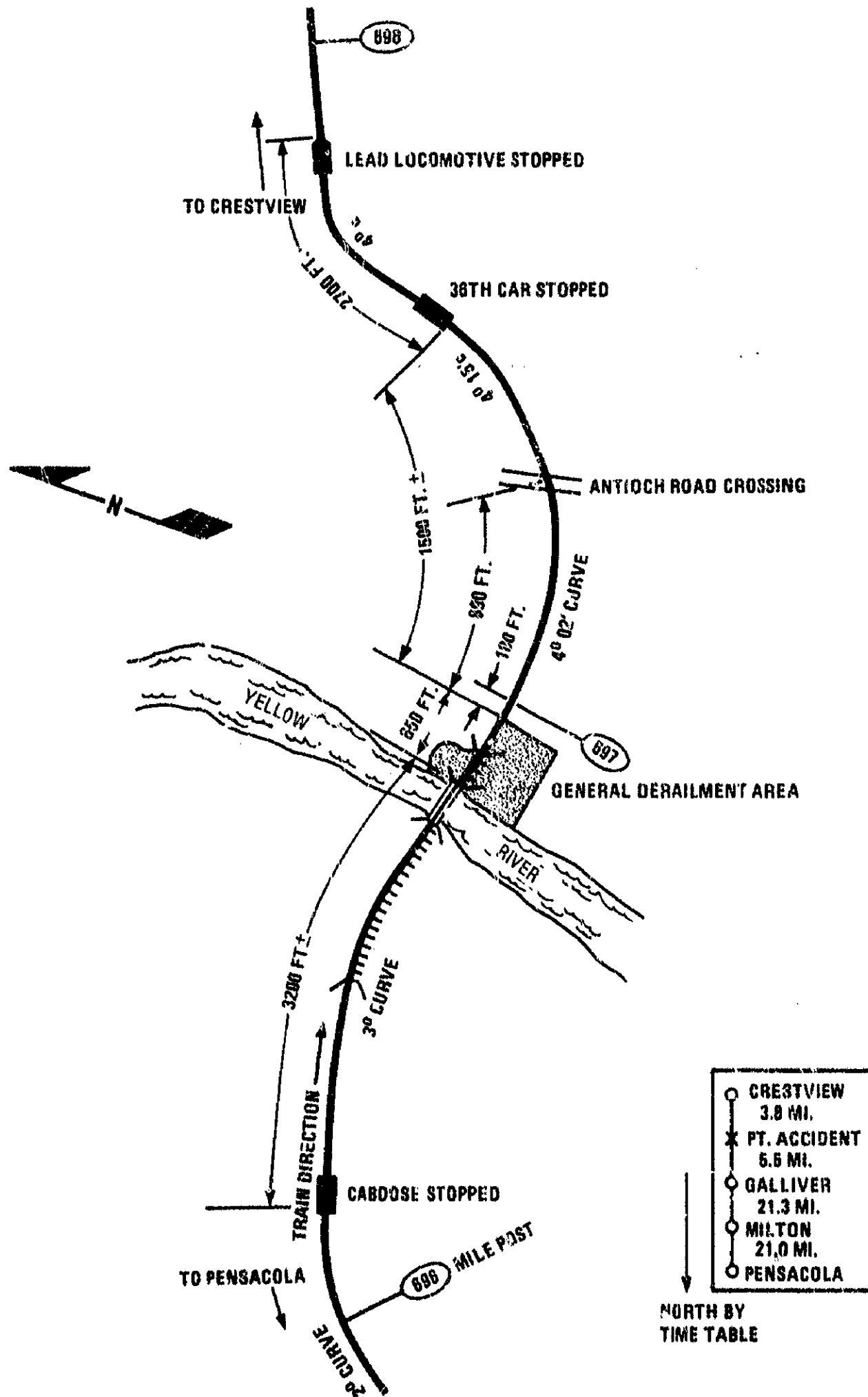


Figure 4. Track alignment at accident site.

full and compacted. The ballast section on the north trestle was full and compacted. The cross-ties were treated, mixed hardwood, measuring 9 inches by 7 inches by 8 feet 6 inches, and were spaced on nominal 21-inch centers. Tie plates were 7 3/4 inches by 14 inches, double-shouldered, with a spiking pattern of one railholding spike on the gage side and one railholding spike on the field side of the rail. North of the derailment site, rails were restrained from longitudinal movement by base-applied rail anchors on each side of the cross-ties up to the bridge expansion joints at the north end of the north trestle. Longitudinal rail restraint was not applied on the north ballast-deck pile trestle, the through-truss bridge span, or the south ballast-deck pile trestle. Base-applied rail anchors on each side of the cross-ties provided rail restraint south of the derailment site. The through-truss bridge had track inner guardrails across its span.

The rail was 132-pound RE, control-cooled, relay, continuous-welded rail, manufactured in 1951, 1952, 1953, and 1957, and was laid at this site in December 1976 and January 1977. The track was last timbered and surfaced out of face before the rail was relaid in November 1976. The left-hand, 4°02' curve south of the Yellow River Bridge had a design elevation of 3 1/2 inches for an equilibrium speed of about 35 mph. The track was maintained to meet or exceed Federal Track Safety Standards for Class 3 track.

The Federal Railroad Administration (FRA) in its emergency order No. 11 issued on February 7, 1979, required the L&N to upgrade its operations and maintenance of track over which hazardous materials were moved. Included in this order was a 30-mph speed restriction, which FRA inspectors would frequently monitor, on trains hauling hazardous materials cars. On March 1, 1979, the L&N requested relief from all of the terms of the order on two segments which it stated were in compliance with FRA regulations. One of these segments included the accident area. When all pertinent track conditions were corrected, the FRA lifted the emergency order on this segment on April 6, 1979, 2 days before the accident.

The L&N had inspected the track in the area 22 times during the preceding 30 days. On March 6, 1979, the L&N track geometry vehicle was used to inspect the track, and it indicated a deviation in crosslevel of 1 3/8 inches in 31 feet in the spiral of the curve adjacent to the south end of the Yellow River Bridge. Federal regulations state that the variation in crosslevel on spirals in any 31 feet may vary from zero to 1 1/4 inches for Class 3 track. On March 9, 1979, an inspection made in conjunction with FRA emergency order No. 11 was also conducted using a FRA track geometry vehicle. This inspection also disclosed the deviation in crosslevel in the spiral of the curve. The L&N placed a slow order limiting train speed to 25 mph through the area. On April 1, 1979, the crosslevel defect was corrected. On April 3 the slow order was removed and the speed limit was raised to the normal 35 mph. The track had been inspected ultrasonically for rail defects on March 29, 1979, and April 2, 1979, and no defects were noted in the derailment area.

The Yellow River Bridge was last inspected on March 20, 1979, by the L&N's bridge inspectors. No exceptions were found which would affect the maximum speed of 35 mph over the bridge.

Method of Operation

In the vicinity of the accident, train movements are governed by timetable and train orders. The maximum authorized speed was 49 mph. Approaching the point of the derailment, train speed was limited to 40 mph, and to 35 mph on the approaches to, and on, the Yellow River Bridge. Normal daily traffic is four freight trains in each direction. Traffic density over the track increased from 4.4 million gross tons per year in 1970 to 11.4 million gross tons in 1978. The number of cars containing hazardous materials also increased during this period. Anhydrous ammonia shipments to Jacksonville, Florida, constituted a majority of the shipments of hazardous materials.

Tonnage ratings for the locomotive units assigned to train No. 403 indicated that the locomotive should handle a maximum of 10,663 tons. However, according to the Association of American Railroads' (AAR) track train dynamics (TTD) program, a maximum of 8,000 trailing tons is recommended for trains negotiating 1-percent grades at 30 mph to prevent drawbar forces exceeding a critical 250,000 pounds. (See appendix C.) During the previous year, eight trains with about 11,000 trailing tons stalled, and five trains experienced broken couplers or knuckles, while on the Crestview grade. (See appendix D.)

L&N special rules governing train makeup and handling do not limit the length or tonnage of trains operating between Pensacola and Chattahoochee. The rules inform engineers that when negotiating sag ^{5/} territory the speed of the train must be reduced before the train moves into a sag. The rules say this should be done sufficiently in advance by throttle reduction. (See appendix E.) These instructions are also recommended by the AAR's TTD program. The TTD program also recommends that brakes should not be released when leaving a curve of more than 2° to prevent heavy slack run-in and strong lateral coupler forces. (See appendix F.)

In November 1977 after a derailment involving the leakage of anhydrous ammonia at Pensacola, the L&N began a policy of furnishing crewmembers with train consist data containing hazardous materials emergency information.

Meteorological Information

At the time of the accident, it was daylight, visibility was about 7 miles, and the temperature was about 57° F. The sky was 80-percent overcast with clouds at 20,000 feet, misting rain, and moderate winds from the south at 5 mph, gusting to 20 mph.

Medical and Pathological Information

Throughout the 9 days of the emergency, toxic gases were being liberated from seven of the eight individual chemicals involved. The liberated gases reacted with the moisture in the mucous membranes of the victims' lungs, eyes, and noses producing various acids, consequently trapping vapor in the affected organs.

^{5/} A rapid decrease in grade followed by an increase in grade sufficient to result in abnormal slack adjustment.

All of the 14 injured persons were treated for inhalation of chlorine and toxic fumes; 3 of the injured persons were hospitalized. When inhaled, ammonia vapor injures the linings of the respiratory tract. Depending on the concentration of gas in the atmosphere and the length of exposure, injury will range from irritation of the eyes, nose, and throat to blindness or death due to laryngeal or bronchial spasm and/or severe pulmonary edema.

Despite the use of self-contained breathing apparatus and short work shifts to limit exposure, 10 wreck-clearing workers were overcome by fumes. Some of these workers were hospitalized. Other workers complained of nausea, dizziness, and eye and pulmonary irritation at the site during the operation. In addition to ammonia and chlorine, fumes from the carbon tetrachloride, acetone, methyl alcohol, and carbolic acid cars, and possible residues or reaction of byproducts from the mixing or burning of the escaping chemicals, existed at the scene. Physicians were uncertain about the medical treatment for exposed employees. Doctors were aware only of injuries from "chlorine or some toxic fumes" when admitting patients during the 9-day period of the emergency. They were uncertain about the additive effects of these gases in combination or reinforcing each other and possibly aggravating chemical exposures. For example, certain gases (carbon monoxide, alcohol, etc.) produce increased respiratory activity resulting in increased ingestion and ultimately greater toxicity.

Survival Aspects

One witness in a parked truck near the railroad bridge saw the train begin to derail and drove immediately about 450 feet west to escape the area. After stopping, he heard an explosive sound, saw a white ground fog advancing toward him, and immediately closed the truck windows. Soon, the fog began seeping into the vehicle cab, where he remained for about 15 minutes until the fumes became excessive. At this time he fled on foot toward the Antioch Road where he met arriving firefighters from Crestview who administered oxygen to him. He was then taken to a Crestview hospital where he remained for several days while being treated for ammonia inhalation.

The Crestview Fire Department went to the scene of the accident after receiving notification of the train derailment from local residents and the railroad operator about 8:05 a.m. At the Antioch Road crossing the firefighters met the head brakeman who radioed the engineer for the train's consist information. However, the information that the engineer held identified each hazardous material with a code number and classified them only as "dangerous." The conductor, who had been at the caboose about 1 mile from the road crossing, was the only crewmember who had a complete list of the hazardous materials being hauled. The head brakeman told the firefighters that the train was carrying a large quantity of anhydrous ammonia and that everyone should be kept away. At 8:23 a.m., while still at the road crossing, the head brakeman and the firefighters saw the second tank car explode.

After the second explosion, the trainmaster and the sheriff's deputies sought out the firefighters at the road crossing. While the fire chief and trainmaster used the list to determine the contents of the derailed cars, the sheriff and civil defense personnel evacuated several hundred people in the town of Milligan and a 1-square-mile area to the west of the derailment. However, when the vapor cloud rose to

over 200 feet and began moving westward, the evacuation area was extended 4 1/2 miles to the town of Baker, Florida, and involved over 1,500 residents. Information about the cloud movement was provided by observations from an Air Force AC 130 aircraft that had been requested by firefighters to respond to the scene. ^{6/} To assure that the AC 130 had uncontested access to the site in the airspace above the area, Crestview officials requested the Federal Aviation Administration's Flight Service Station (FSS) at Crestview Airport to prohibit unauthorized use of entry into that airspace. The FSS complied and issued a Notice to Airmen (NOTAM) prohibiting unauthorized aircraft from the area.

By 11:30 a.m. the evacuation area was enlarged to include the entire northwest quarter of Okaloosa County, Florida. This area included over 300 square miles and affected more than 4,500 residents. The decision to evacuate the area was based on continued wind dispersion of the cloud and from data received from the military aircraft which reported that the vapor cloud had reached a 5,000-foot altitude and had traveled 5 miles downwind. By noon the cloud extended 28 miles northward to the Florida/Alabama State line. During the afternoon the cloud rose from the tank cars at a 45° angle, its height had diminished, and it had traveled about 1,000 feet horizontally through the surrounding vegetation.

By 5 p.m. firefighters had positively identified the locations of five hazardous materials involved in the derailment--methyl alcohol, sulfur, anhydrous ammonia, acetone, and carbolic acid. The car of chlorine was located later. Because of the remote location of the derailment, firefighters lacked the capability of extinguishing the fire in the derailed cars. Between 5:16 p.m. and 6:18 p.m. firefighters were able to extinguish a fire on the bridge which had begun as a result of the fire in the derailed cars. By evening three more persons had been treated for exposure to toxic fumes.

During the next day, the fire began to subside and the vapor cloud had reduced to a height of 1,000 feet in the derailment area. Based upon reduced release rates of under 300 pounds per minute for the chlorine and ammonia, and a predicted downwind hazard range of less than 4 miles, the evacuation area was reduced from 13 miles to 4 miles downwind. Residents in the outer evacuation area were allowed to return home by 7 a.m. on April 10.

By 4:15 a.m. on April 11, the tank car fires had burned out and wreck-clearing crews began to right the carbon tetrachloride, anhydrous ammonia, and chlorine tank cars and transfer the remaining commodity to other tank cars and tank trucks. The chlorine tank car was dragged to an open-air mixing pit, 20 feet by 20 feet by 4 feet deep, where the chlorine was neutralized with caustic soda. By April 12, six wreck-clearing employees had been treated for toxic fume inhalation, and two of these employees had been hospitalized.

Between April 12 and 16 the transfer of the remaining hazardous materials to trucks and other rail tank cars at the site was completed. Four more workers were treated for ammonia inhalation on April 16 when the 58th tank car, containing anhydrous ammonia, began leaking during transfer operations. On April 13 all residents were allowed to return to their homes.

^{6/} "National Transportation Safety Board Spill Map, Crestview, Florida, April 8, 1979."

Tests and Research

Inspection of the 35 head cars of train No. 403 which did not derail disclosed no defects that would have caused the accident. The 49 rear cars and the caboose which did not derail were returned to Pensacola from the accident site. They were immediately inspected by L&N personnel and again by investigators on April 9, when an airbrake test was performed; no defects were noted which would have caused the accident. Components of the 29 derailed cars were inspected at the wreck site. No prederailment defects were found on the cars that could have caused the accident.

The east side of the derailed 36th car's rear striking casting showed unusually heavy contact marks from the coupler shank. The derailed 37th car's broken leading coupler's knuckle indicated a new torsional break. The 37th through the 40th cars had rail scraping marks on the inside of their east truck side frames and respective wheels. The 39th car had a piece of the outside rail driven through its trailing truck bolster, and the coupler knuckle on its trailing end was broken. The speed indicator of L&N 1045, the leading locomotive unit, was calibrated on April 12 and reported to be accurate at 20 mph and at 30 mph, 1 mph fast at 40 mph, and 1 mph fast at 50 mph.

Testing and examination of several loose wheels found at the derailment site revealed that they were loosened by impact forces that occurred during the derailment. A punctured air hose removed from the trailing end of the 38th car was forwarded to Smithers Scientific Services, Inc., of Akron, Ohio, for testing. No indications of defective materials or construction were found during the tests. The tests revealed that the hose did not burst from internal air pressures, but was cut by externally applied cutting forces during the derailment.

Track measurements taken following the derailment (see appendix G) did not disclose any deviations from applicable FRA track safety standards. The investigation of retrieved individual components, such as rails, crossties, and fastenings, through the destroyed area disclosed no defects which could have contributed to the cause of the derailment. All but approximately 25 feet of the outside rail of the 750 feet of destroyed track was recovered after the derailment. All of the fractures were examined and none were found which contained preexisting defects. Portions of recovered outside rail exhibited wheel flange markings on the gage side on its web. An examination of the track for 1 mile on either side of the derailment site revealed no deviations from FRA track standards, and no marks which indicated dragging equipment were found on the structure approaching the site. No soil shears were noted in the fill section under the track through the derailment area.

Computer simulations were conducted by the FRA, the L&N, and the AAR to duplicate the train-handling sequences as described by the engineer. The simulations indicated that the train would stop before reaching the point of derailment. Several additional tests were made on the computer using various speeds and train-handling methods. These included the bursting of an air hose on the 38th car, which caused an emergency train brake application. Large compressive or lateral forces, which could have caused the derailment, were not produced during these tests.

The Westinghouse Air Brake Company (WABCO) conducted tests to simulate the train's airbrake system reaction to the brake applications as described by the engineer. Additional tests were also made using various brake applications to simulate a burst air hose and excessive trainline leakage. These tests indicated that brake applications as recalled by the engineer would have stopped the train before it reached the point of derailment. Only when the brakes were released after each application was there an indication that the train would have continued through the derailment area. With brake application, release, and application again before the air pressure in the trainline was adequately replaced, the braking ability of the train would have been reduced. (See appendix H.) The WABCO tests also showed that the lead cars had more braking than the rear cars. This condition would have allowed the rear of the train to continue moving momentarily faster than the lead portion at the point where the engineer released the brakes as the train left the 3° curve.

Other Information

Of the eight different products involved in the derailment, five were shipped under DOT hazardous placards: anhydrous ammonia, a nonflammable gas; acetone, a flammable liquid; methyl alcohol, a flammable liquid; chlorine, a nonflammable gas; and carbolic acid, a class B poison. Also involved were one car each of urea, sulfur, and carbon tetrachloride.

Anhydrous ammonia.--Anhydrous ammonia is shipped liquefied under a DOT green placard, "nonflammable gas." The threshold limit value (TLV) or the average concentration to which persons may be exposed for ammonia is 50 parts per million. ^{7/}

Anhydrous ammonia is a liquid which at atmospheric pressure boils at -28° F. The ammonia will remain in a liquid state when the temperature is above the boiling point if it is contained under pressure. If the pressure is removed when the temperature is above the boiling point, the liquid will be converted rapidly into a gas. This conversion results in rapid cooling of the commodity. When vaporized, 1 part by volume of the liquid becomes 855 parts by volume of gas. To conserve space, the commodity is loaded in tank cars as a liquid under pressure. If, after the ammonia is loaded, the temperature rises, some of the liquid will be converted to a gas which will increase the pressure within the tank and maintain the remainder of the commodity in the liquid state. When the ambient temperature reaches 70° F, as it did on the day of the accident, the pressure necessary to retain the anhydrous ammonia as a liquid in the tank is about 90 psi. The release of the ammonia gas resulted in heavy fog saturated with aqueous ammonia, and in the presence of chlorine produced ammonium chloride, which contributed to the heavy fog density.

Carbolic acid.--Carbolic acid is shipped under the DOT placard, "class B poison." The threshold limit for carbolic acid is 5 parts per million. As defined in 49 CFR 173.343 class B poisons are

... substances, liquid or solid (including pastes and semisolids) other than Class A poisons or Irritating materials, which are known to be so toxic to man as to afford a hazard to health during transportation; or which, in the absence of adequate data on

^{7/} American Conference of Government Industrial Hygienists.

human toxicity, are presumed to be toxic to man [because when tested on laboratory animals in small amounts they] produce death within 48 hours.

Carbolic acid is an aqueous solution of phenol, which is one of the most poisonous of the common industrial chemicals. Phenol melts at 108° F and has a relatively high ignition temperature of 1,319° F. Symptoms of phenol poisoning include nausea, vomiting, dim vision, ringing in the ears, paralysis, and coma. Once absorbed into the body phenol can have severe systemic effects. Fires involving phenol are best fought with large amounts of water spray and wearing clothing impervious to vapors. Additionally, runoff waters must be confined to prevent contamination. This chemical has a distinct odor of a disinfectant.

Chlorine.--Chlorine is shipped liquefied under the black-and-white DOT placard, "chlorine." The TVL for chlorine is 1 part per million. It is liquefied under moderate pressure, or when cooled to -30° F. When vaporized, 1 part by volume of the liquid becomes 457 parts by volume of gas. Upon release, chlorine gas produces a greenish-yellow gas that is 2 1/2 times heavier than air. Gaseous chlorine is highly toxic and irritating and on exposure combines with moisture in mucous membranes to form hydrochloric acid.

Carbon tetrachloride, sulfur, and urea.--This group represents products with the ability to rapidly disperse combustion gases in fires with various levels of toxicity. As such these chemicals pose far greater toxic risks than as a fuel for fire. For example, carbon tetrachloride in a fire will decompose to phosgene, a class A poison (TLV = 1 part per million), sulfur into sulfur dioxide (TLV = 10 parts per million), and urea into nitrous oxides (TLV = 5 parts per million). These liberated products during a fire quite readily react with oxygen and moisture within the respiratory system and decompose into an acid. Small quantities of sulfur and carbon tetrachloride are regulated for passenger transport and as such are shipped under DOT placard, "Otherwise Regulated Material (ORM)," because the properties of these compounds are such that each compound can cause extreme annoyance or discomfort to passengers or crews in the event of leakage during transportation. When not transported in conjunction with passenger transport, these products are not recognized by DOT in the "quantity and form" in which transported to present an unreasonable risk; consequently, these chemicals are shipped exempted from 49 CFR requirements.

Acetone and methyl alcohol.--Both of these chemicals are examples of products which present a far greater threat in a derailment as a fuel in a fire than as a toxic substance. Both of these products are shipped under a red DOT placard, "flammable liquid." Acetone vapors have a TVL of 1,000 parts per million and methyl alcohol has a limit of 200 parts per million. In fires these products liberate combustion gases and smoke. Acetone burns with a characteristic orange flame and methyl alcohol with a less colorful light-blue flame.

Emergency response.--During the hours following the accident various Federal, State, and private response teams arrived at the scene. These teams represented the U. S. Environmental Protection Agency (EPA), the U.S. Coast Guard, the Florida Civil Defense, the Florida Department of Transportation, the

FRA, the Safety Board, the AAR's Bureau of Explosives, the Dow Chemical Company, Georgia-Pacific Corporation, Air Products and Chemicals, Inc., of Penascola, the L&N, and the L&N's wreck removal contractor. Many of these teams responded on their own or were dispatched to the scene by someone who was not in command of the operation. During the arrival of these teams, local Crestview officials who had taken initial steps regarding evacuation and firefighting sought a person who might have overall charge of the response teams and who could advise them about what to do about evacuations, control of the fire, and removal of the wreckage. Most of the groups involved, however, had only accident investigative authority or were product-handling specialists. As a result of an earlier derailment in the area, the Crestview and Okaloosa County officials had formulated their own contingency plan, so they used it during this emergency. In the confusion of the early hours of the emergency, the first chlorine specialist team was turned back by local officials when they learned the team was en route.

When an incident occurs that might cause pollution of waterways and coastal areas, the EPA and the Coast Guard have some coordination responsibilities. According to the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 1510) (see appendix I), the EPA or the Coast Guard is responsible for sending an onscene coordinator (OSC) to an accident involving inland waters to see if the party responsible for the discharge is taking proper action. The EPA or the Coast Guard also must provide a chairman to head an advisory regional response team (RRT). The RRT, comprised of Federal and State agencies, serves as the body for coordination and advice during a pollution discharge. According to 40 CFR 1510.34, the agencies are supposed to have predesignated members serve on each RRT. During a pollution emergency, the members of the RRT ensure that the resources of their agencies are made available to the OSC. The RRT is activated as an emergency response team when a discharge involves a significant number of persons or regionally significant amounts of property.

The RRT, with the EPA's OSC as chairman, was convened in Crestview at 9:45 p.m. on April 9, 1979, with volunteers from the responding agencies and companies. The volunteers were not predesignated as required by 40 CFR 1510.34. The RRT immediately began reviewing L&N plans for the hazardous materials removal and wreck clearing. It was not until this time that local officials knew what to expect regarding outside assistance. The RRT approved the L&N plans on April 10. The RRT was disbanded and the OSC left the accident site on April 14. The National Response Team (NRT) (40 CFR 1510.32), as part of its "continuing evaluation of response actions," issued a report on the RRT/OCS activities at Crestview. 8/

ANALYSIS

The Derailment

When train No. 403 was switched at Goulding Yard into a 7,550-foot-long train of 114 cars with an estimated weight of 10,628 trailing tons, it was similar in length and weight to other trains that the L&N occasionally operated

8/ National Response Team Review of RRT-OCS Activities, Crestview, Florida, Train Derailment, Document Number 16450/4.

between Pensacola and Chattahoochee. Consequently, when the five locomotive units were coupled to the train, the L&N employees probably were not overly concerned about the train's tonnage and the adequacy of the locomotive power since the total listed tonnage rating of the units was 10,663 tons. Also, the L&N operating rules or special rules covering train makeup and handling did not limit the length or tonnage of trains between Pensacola and Chattahoochee.

A major problem with unlimited train length and tonnage is the difficulty of taking into account the numerous combinations of grades and curvature of track over which a long, heavy train will operate. When grades are 1 percent or greater and curves are as sharp as 4°, resistive forces that the locomotive must overcome sharply increase. The forces affect long, heavy trains more than shorter, lighter trains because long trains at any one time can have many sections moving over different grades and curves. When the combinations of grades and curves become numerous and they are encountered repetitively, as train No. 403 encountered between Pensacola and the Yellow River Bridge, the forces acting on and within the train become extremely variable and are dynamically incalculable. This may be the reason the computer simulations that attempted to duplicate the forces generated by train No. 403 did not develop compressive or lateral forces large enough to have caused a derailment.

The ability of long, heavy trains to negotiate varying curves and grades has been examined within the industry's TTD program. Since maximum forces acting upon car couplers are affected by train tonnage, speed, and grades, the TTD program developed recommendations concerning these variables. For trains traveling 30 mph over 1 percent grades, the TTD program recommends a maximum of 8,000 trailing tons. This recommended tonnage is less than the 10,628 trailing tons estimated to have been on train No. 403 when it departed Pensacola and the 11,360 trailing tons actually on train No. 403 at the time of its derailment. The unusual impact markings on the striker casting and the broken coupler knuckle between the 36th and 37th cars were influenced by the 3,360 trailing tons on train No. 403 that were over the TTD-recommended maximum.

On July 31, 1978, the Safety Board recommended that the FRA:

Promulgate regulations to require railroads to limit the length and tonnage of trains carrying hazardous materials to train makeup principles developed under the track train dynamics program. (Class II, Priority Action) (R-78-46)

The recommendation was made following the Safety Board's investigation of an accident at Pensacola on November 9, 1977. ^{9/} The FRA has not yet taken any action on this recommendation.

Since L&N trains with large tonnage similar to train No. 403 have successfully negotiated the track through the derailment area, additional factors of train handling and train makeup may have contributed to train No. 403's

^{9/} "Railroad Accident Report--Louisville & Nashville Railroad Company Freight Train Derailment and Puncture of Anhydrous Ammonia Tank Cars, Pensacola, Florida, November 9, 1977" (NTSB-RAR-78-4).

derailment. Critical factors affecting the train-handling aspects of train No. 403 were train speed, type of brake applications, and the speed needed to make the ascending Crestview grade. Additional train makeup factors were the 67 heavily loaded tank cars without baffles, the inadequate locomotive power, and the intermittent shutdown of the locomotive's fifth unit.

The engineer's belief that the train was moving at 40 mph as it entered the descending grade to the Yellow River is probably accurate. The maximum allowable speed was 40 mph in the area, one locomotive unit had been shutting down intermittently, and the heavy tonnage of the train caused a lack of adequate locomotive power. With the recent FRA emergency order and increased surveillance on this line, the engineer probably would have been concerned about train overspeed even though the 30-mph FRA speed restriction had been removed. Also, because of the tonnage of the train and inadequate locomotive power, it is doubtful that the train could have attained a speed much greater than 40 mph on the grades between Pensacola and Crestview.

The engineer stated that he did not release the brakes after each application. However, the tests conducted by WABCO concluded that the train's speed down the grade and through the derailment area could have been kept at 35 to 40 mph only by releasing the brakes after each application. The L&N special rules governing train handling and the TTD program recommend a reduction in train speed before entering a descending grade. The engineer of train No. 403 said that he made a minimum service brake application after the train was already at the top of the grade. It is apparent that the engineer did not follow the recommended procedures when train No. 403 entered the grade at about the restricted speed of 40 mph. His failure to adequately slow the train before the grade necessitated the second minimum brake application and a full service brake application farther down the grade.

When the engineer previously applied and released the brakes, he did not allow sufficient time between each application to restore necessary air pressure. This lack of air pressure led to the decrease in braking ability that was evident as the engineer made brake applications on the grade. This reduction in braking ability was confirmed in the brake tests conducted by WABCO. The WABCO tests also showed more braking on the lead cars of the train than on the rear cars. This condition allowed the rear of the train to continue moving momentarily faster than the lead portion when the engineer released the brakes as the locomotive left the 3° curve. The TTD program recommends against releasing the brakes when leaving curves of more than 2° in order to prevent heavy slack run-in and large lateral coupler forces.

The continued slowing of the train from 35 to 30 mph after the brake release and movement through the 4°02' curve and up the grade to Crestview, even though the throttle was continually advanced, indicated an inability of the lead portion of the train to pull away from the rear portion which was still coming down the grade. Since eight L&N trains with similar tonnage had stalled and five others had experienced broken couplers or knuckles on the Crestview grade during the previous year, it is apparent that sufficient locomotive power to ascend the grade is critical. Train No. 403, with less than the recommended locomotive power, probably would not have been able to ascend the grade. Also, any lessening of wheel/rail adhesion because of wet rail due to the misting rain, and with the fifth

locomotive unit experiencing a possible shutdown, additional slowing definitely would have occurred. These conditions would have allowed the heavy slack run-in from the rear to produce excessive lateral forces which would have caused the markings on the striker casting and the broken knuckle between the 36th and 37th cars. The lateral forces from this run-in would have caused the outside rail tipping and derailment in the 4°02' curve.

The 67 tank cars assembled in train No. 403 is considered by industry to be a large concentration of cars containing hazardous materials in one train. For example, the Missouri Pacific Railroad Company, who handles a large number of hazardous shipments, limits its trains to 75 cars when the train contains more than 40 cars with hazardous materials. A large number of tank cars can add liquid surge forces which substantially increase longitudinal buff and draft forces on the couplers. These surge forces will influence train slack action particularly in a sag where the cars leave a descending grade and enter an ascending grade, causing an opposite surge, while other tank cars are still on the descending grade. The tank cars on train No. 403 were in this situation in the derailment area. The added surge forces and the effects of slowing as the train entered the ascending grade could have created the increased compressive forces and damage to the couplers between the 36th and 37th cars. These added forces also could have caused the rear wheels of the 36th car to tip the outside, high rail in the curve and derail.

The probability that the 36th car tipped the high rail is also evidenced by the low rail markings on the side frame of the car's rear truck. These markings indicate the low rail wheels dropped inside of track gage as the high rail tipped outward. Similar low rail markings on the 37th and 38th car side frames also indicate high rail tipping while train movement continued before the emergency brake application.

The Safety Board concludes that improper train handling generated the large compressive force between the 36th and 37th cars and caused the 36th car to overturn the outside rail of the 4°02' curve and derail. As the wheels of the 39th car's leading truck derailed, the outside rail broke and was forced upward. When the north end of the broken rail speared the trailing truck's bolster, continued car movement would have pushed the rail toward the outside. Tank car turnover followed, most likely beginning at the 39th car and progressing forward through the 38th and 37th cars. When the 39th and 40th cars separated during this sequence, due to the breaking of the 39th car's coupler knuckle, the severe track damage allowed the 40th and 41st cars to leave the fill and overturn adjacent to the outside of the curve. As the 39th and 40th cars separated, the air hoses connecting the two cars would have pulled apart and caused the emergency brake application. The general pile-up of cars, beginning with the 42nd car, resulted from the abrupt stop due to the derailing 36th through 41st cars.

Event Recorders

The engineer had to depend on his memory when he told investigators what actions he took before the derailment. To provide more precise information in case of an accident, and to enable railroads to determine better train-handling procedures, the Safety Board recommended on July 31, 1978, that the FRA: "Promulgate regulations to require locomotives used in trains on main tracks

outside of yard limits to be equipped with operating event recorders (Class II, Priority Action) (R-78-44)." The recommendation was made following the Safety Board's investigation of the Pensacola accident. The FRA has not yet taken action on this recommendation.

Hazardous Materials

Cargo Release.--The 59th car, a 105A-type tank car containing anhydrous ammonia, was indented on opposite sides of the tank cylinder between the second and third weld lines. As the indentations increased to more than 1 foot during the derailment, the radial crack propagated around the tank wall. The squeezing of the tank increased internal pressure, and when the crack reached the critical length, the tank separated into two sections causing the portions to rocket east and west of the track.

The pressure relief valve on the 56th car could not operate after the car came to rest upside down. With one end of the tank pointed upward while the lower end was engulfed in the ground spill fire the tank car developed an internal pressure buildup that caused it to rupture 20 minutes after the derailment.

The eight 111A-type tank cars, which are not designed to carry commodities under pressure, sustained damage during the derailment that allowed their flammable contents to leak and burn. The fire caused an increase in pressure in the leaking 112- and 105A-type tank cars, even though the cars were designed with a pressure relief system to help prevent excessive internal pressure buildup. The fire also consumed the carbon tetrachloride which produced the phosgene gas detected at the site.

The Safety Board previously recommended that the Department of Transportation "initiate a research program to identify new approaches to reduce the injuries and damages caused by the dangerous behavior of pressurized, liquefied flammable gases released from breached tanks on bulk transport vehicles. (I-76-5)" The Research and Special Programs Administration's Materials Transportation Bureau has contracted for research (Contract DOT-RC-82039, September 26, 1978) into "new approaches for controlling pressurized flammable liquefied gas releases" from breached tanks on bulk transport vehicles. The behavior of the anhydrous ammonia and chlorine -- nonflammable pressurized liquefied gases -- released from breached and ruptured tanks at Crestview and other accidents suggests that these problems may be similar to problems with the transportation of pressurized liquefied flammable gases and that current research may be relevant to the problems of both. New approaches to control future losses might have application to pressurized liquefied nonflammable gases, such as potentially lethal anhydrous ammonia and chlorine, as well as the flammable gases.

Cargo Identification.--Only the conductor had a document that showed the names of commodities in each tank car. The L&N had not followed its own procedures that require crewmembers to be knowledgeable of the train consist and to have the train consist information immediately available for firefighters. Firefighters experienced a 45-minute delay in obtaining the waybills and consist information with pertinent hazardous materials emergency information. This delay could have had serious consequences, particularly if they had attempted to fight

the fire before the second explosion. Firefighters should have known immediately where to find the train's hazardous materials information. Also, if the crewmembers had been injured, a longer delay in obtaining the information would have occurred. If the crewmembers had been killed or injured, there was no identified location where the consist information must be kept.

The quick action on the part of rescue personnel in evacuating nearby Milligan after obtaining the train consist information prevented the lethal cloud from injuring more residents downwind from the derailment. The availability of train consist information with pertinent emergency information is imperative for providing emergency forces with prompt information. In its report on the Pensacola accident the Safety Board recommended that the FRA: "Promulgate regulations to require railroads to provide pertinent hazardous materials information on waybills and to make this information available to public emergency personnel. (Class II, Priority Action) (R-78-47)." The FRA has not yet taken any action on this recommendation.

Injuries.—The injuries to wreck-clearing personnel and the risks such an operation pose for others indicate the need for safety guidelines. The Safety Board, as a result of its investigation of the derailment and rupture of a liquefied petroleum gas tank car at Waverly, Tennessee, on February 22, 1978, ^{10/} where 16 persons were killed during the wreck clearing, recommended that the AAR: "Provide guidelines to railroad employees to aid them in an assessment of tank car damage and procedures for proper handling of tank cars. (Class II, Priority Action) (R-79-5)." The AAR has not yet responded to the Safety Board, and the recommended guidelines have not been issued.

Despite the use of self-contained breathing apparatus and short work shifts to limit exposure, 10 wreck-clearing workers were overcome by fumes. Other workers complained of nausea, dizziness, and eye and pulmonary irritation during the operation. The injuries during wreck-clearing operations demonstrate the continuing vulnerability of wreck-clearing employees to hazardous materials releases, and the need to develop adequate protective measures for such employees. The Safety Board has previously discussed the wreck-clearing safety problem and on August 30, 1978, requested the AAR to: "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. (Class I, Urgent Action) (I-78-14)" As yet, these safety measures have not been developed.

Problems were encountered in the medical treatment of the exposed employees. Exposures must be known before physicians can prescribe treatment. No systematic records of exposures were maintained for these employees. Some exposure records may be necessary for these employees to determine potential health risks from both one-time and repeated exposures to hazardous materials release. In addition, The field practices of wreck-clearing crews should be examined to determine needed health safeguards and operating precautions.

^{10/} "Railroad Accident Report — Derailment of Louisville & Nashville Railroad Company's Train No. 584 and Subsequent Rupture of Tank Car Containing Liquefied Petroleum Gas, Waverly, Tennessee, February 22, 1978" (NTSB-RAR-79-1).

The NRT report of this incident described the need for onscene advice of industrial hygienists or toxicologists during emergencies. The Safety Board shares the NRT's concerns. Industry or other Federal agencies such as the Occupational Safety and Health Administration could assist in providing technical data about exposure limits for workers. Analysis of this data could be of value in determining the operational and manpower safeguards needed to adequately protect employee safety in future hazardous materials wreck-clearing operations.

Emergency Response Network.—The Safety Board's analysis of the emergency response at Crestview reinforces its concern that an effective hazardous materials emergency response network be established under the leadership of the DOT to ensure prompt and adequate support for onscene officials handling such emergencies. As a result of its public hearing into derailments and hazardous materials, the Safety Board recommended on June 29, 1978, that the DOT:

Supply the leadership required to establish an adequate nationwide hazardous materials emergency response network able to meet all facets of hazardous materials emergency response needs, using existing State and private resources whenever possible. (Class II, Priority Action) (I-78-10) 11/

In response to that recommendation, the Secretary of Transportation directed the U.S. Coast Guard to develop and implement a national hazardous materials emergency response center. The proposed center was to be built on the framework of the National Oil and Hazardous Substances Pollution Contingency Plan and utilize the National Response Center (NRC), OSC, NRT, RRT, and also industry assistance.

Because the release at Crestview threatened to pollute the Yellow River, the national contingency plan was implemented. The Safety Board's observations of how the contingency plan functioned indicate problems that must be resolved before the plan is enlarged into the basic plan for the network. Some of these deficiencies were also noted in the NRT report of the OSC/RRT activities in this emergency.

Implementation of an effective network, in combination with adequate onscene communications, should provide onscene officials with the advice needed to determine the dangers involved within minutes after initial notification. The network should be able to provide updated advice as needed until the emergency is over. At no time during the first 8 hours of the Crestview emergency did the OSC or RRT provide the community officials with the benefit of their expert advice. Furthermore, the RRT was disbanded and the OSC left the accident site 3 days before the emergency was over.

Without an OSC or RRT to help them, officials at Crestview used their own contingency plan and initiated and relied on their own efforts to identify the hazardous materials involved, the threats posed by these substances, and sources

11/ "Safety Effectiveness Evaluation--Analysis of Proceedings of the National Transportation Safety Board into Derailments and Hazardous Materials, April 4-6, 1978" (NTSB-SEE-78-2).

for expert advice. Despite the lack of OSC and RRT assistance, the local officials performed effectively with the limited resources available, and they are to be commended for their actions. Their success was abetted substantially by the specific circumstances of this accident, including its location in a sparsely populated area, and the early outbreak of fire which resulted in an airborne plume of dangerous gases downwind, rather than a ground-level plume, which would have been more hazardous to onscene personnel. The Safety Board believes unavailability of the OSC or RRT to deliver advice to local officials during the early stages of an emergency is a serious flaw in the current system which must be corrected. The DOT Task Force on Hazardous Materials Transportation reported that "no matter what mechanism is established, the need for a strong working relationship with State and local officials is of utmost importance to smooth handling of an emergency." ^{12/} The Safety Board concurs fully with this statement.

During the first day of the emergency, communications to and from the command post at the site were extremely heavy. This was due in part to the lack of a single emergency telephone number for the local officials to call to seek advice or help from a national emergency response center. It was also due in part to the uncoordinated dispatching of experts to the scene. Except for the experts called in under the local emergency plan, Federal and industry personnel sent to the scene were dispatched at the request or direction of persons who were not in command of the emergency response operations. The result was that each organization sending personnel felt obligated to acquire additional information about the incident to justify its action, or to identify special items that their personnel would need at the site, such as protective equipment and special tools. In the confusion of the early hours of the emergency, the first chlorine specialist team was turned back by local officials when they learned the team was en route. Such problems could be substantially alleviated by coordinated dispatching of specialists sent to the scene through a national emergency response center.

The use of the Air Force AC 130 aircraft with communications links to the ground observers provided aerial observations of the plume that were essential to the local officials arriving at a decision to evacuate the population in the projected path of the plume. The Safety Board believes that early availability of aerial observer aircraft with communications links to onscene officials provides information about the hazardous materials threats involved that cannot be acquired readily by any other practical means. This capability should be incorporated appropriately into the planned network.

The Safety Board recognizes that the present NRT/RRT/OSC operations under the national contingency plan are designed to prevent or mitigate pollution of waterways, rather than to provide advice and support in all hazardous materials transportation emergencies. The NRT's internal evaluation after the Crestview operations focused on the RRT/OSC performance relative to pollution control. If this system is to be expanded into the DOT's network, the pollution control objective must also be expanded to address safety concerns, beginning with the earliest minutes of the emergency. The DOT task force recognized that this would have to be achieved by assisting local authorities. To assure that local authorities

^{12/} Report of DOT Task Force on Hazardous Materials Transportation, September 1978.

are adequately served by the Federal system, the Safety Board believes that the local authorities involved should have an effective voice in postemergency evaluations of the Federal emergency response support delivered. This will require modification of evaluation procedures now used under the national contingency plan.

Because of the inability of representatives from the various Federal agencies to arrive immediately at the accident site, the RRT was not able to be organized until more than 24 hours after the initial explosions. Consequently, during the first 24 hours local emergency personnel had to depend upon their own training, experience, and the information furnished by the L&N when determining what immediate actions to take. When the RRT was organized the members who volunteered from the responding agencies were not predesignated as outlined in 14 CFR 1510. Consequently, the representatives as well as local officials were not sufficiently familiar with the functions of the EPA and the national contingency plan. It is evident that better liaison concerning the national contingency plan is needed among the EPA and Federal, State, and local officials.

An additional problem confronting coordination in hazardous materials accidents is that the EPA responds only if water pollution problems are involved. The EPA was involved at Crestview because of the potential pollution of the Yellow River. The EPA was not involved in the hazardous materials derailment at Waverly, Tennessee, which did not involve water pollution. This situation also shows the need for the training of local emergency personnel and for providing them support in emergency situations involving hazardous materials.

CONCLUSIONS

Findings

1. The total tonnage of train No. 403 was greater than that recommended by AAR track train dynamics guidelines for the grades and curves in the derailment area.
2. The actual weight of train No. 403 was 732 tons greater than the weight indicated on its train consist information.
3. The track approaching the derailment site was a combination of curves and grades that required special train makeup and train-handling considerations.
4. The train was not slowed adequately before entering the sag as recommended by L&N rules and AAR track train dynamics guidelines.
5. The intermittently operating locomotive unit could have shut down approaching the derailment site, causing a lack of power on the ascending grade.
6. A lack of baffles in the tank cars could have increased longitudinal forces within the train.

7. New markings on the striker casting and coupler shank on the derailed end of the 36th car indicates unusual buff forces were applied to the car.
8. The trailing truck of the 36th car was apparently the first car to derail.
9. Postaccident inspection of train No. 403's cars did not disclose any mechanical defects that contributed to the cause of the derailment.
10. Postaccident inspection of the track leading to and in the derailment area did not disclose any conditions that contributed to the cause of the derailment.
11. The lack of speed-recording and event-recording equipment on the locomotive precluded the determination of the precise train-handling technique used by the engineer.
12. The rupture and burning of 111A-type tank cars containing flammable liquids affected the rupture and release rates of products contained in the adjacent derailed 112- and 105A-type tank cars.
13. The safeguards designed for the 112-type tank car did not prevent the unexpected and violent rupture because of the car's damaged pressure relief system and involvement in the ensuing fire.
14. Immediate identification of the hazardous materials involved in the derailment was hindered when locomotive crewmembers did not have a complete train consist record.
15. The train consist with pertinent hazardous materials emergency information assisted the firefighters in determining the necessary actions to be taken.
16. Aerial observations aided the local emergency personnel in making decisions, and should be considered in future emergency planning, communication, and rescue procedures.
17. Injuries sustained by wreck-clearing personnel indicate a need for wreck-clearing guidelines.
18. There are no procedures for local or Federal public safety officials to control wreck-clearing operations involving hazardous materials.
19. An effective hazardous materials emergency response network is needed.
20. A means for controlling releases of pressurized liquefied nonflammable gases is needed.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the large compressive force generated between the 36th and 37th cars by a combination of excessive train tonnage and improper train handling which caused the 36th car to overturn the outside rail of the 4°02' curve and derail.

Contributing to the severe consequences of the accident was the release of anhydrous ammonia and other hazardous materials, through ruptures and punctures in the sides of the tank cars, which caused all of the injuries and led to the evacuation of 4,500 persons from the area.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board recommended that:

--the Louisville & Nashville Railroad Company:

"Establish train makeup and operation guidelines according to track train dynamics principles for trains carrying hazardous materials and operate the trains accordingly. (Class II, Priority Action) (R-79-64)"

--the Federal Railroad Administration:

"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 materials exposures, and establish appropriate safety requirements based on its findings. (Class II, Priority Action) (I-79-13)"

In addition, the National Transportation Safety Board reiterates the following recommendations which were made to the Federal Railroad Administration on July 31, 1978, as a result of the Pensacola accident 13/:

"Promulgate regulations to require locomotives used in trains on main tracks outside of yard limits to be equipped with operating event recorders. (Class II, Priority Action) (R-78-44)"

"Promulgate regulations to require railroads to limit the length and tonnage of trains carrying hazardous materials to train makeup principles developed under the track train dynamics program. (Class II, Priority Action) (R-78-46)"

"Promulgate regulations to require railroads to provide pertinent hazardous materials information on waybills and to make this information available to public emergency personnel. (Class II, Priority Action) (R-78-47)"

-- the Department of Transportation:

"Establish procedures to enable the national hazardous materials emergency response network, being developed under Recommendation 2 of the September 1978 DOT Hazardous Materials Transportation Task Force Report, to provide immediate instructions to local public authorities in time to help them mitigate the effects of the incident

13/ NTSB-RAR-78-4, op. cit.

during the earliest stages of an accident. (Class I, Urgent Action) (I-79-7)

"Develop and arrange for distribution of a brief training program that will inform local public authorities regarding when and how to contact the planned national hazardous materials emergency response network, what specialized advice and supporting resources they can expect from the network when its is contacted, how the network will help them evaluate the effects of the actions they are taking, and how they can interact most effectively with the network. (Class II, Priority Action) (I-79-8)

"Establish procedures that will coordinate the dispatching of Federal agency and industry representatives to the scene of a serious hazardous materials emergency, and integrate continuing communications with such representatives, through the planned national hazardous materials emergency response network. (Class II, Priority Action) (I-79-9)

"Establish procedures to enable the national hazardous materials emergency response network to make military or civilian observer aircraft, with communications links to onscene emergency response officials, available to local authorities in serious hazardous materials transportation accidents, and to have unauthorized aircraft prohibited from the area. (Class I, Urgent Action) (I-79-10)

"Develop procedures for local officials to participate in the evaluation of the services provided by the planned hazardous materials emergency response network and for managers of the network to report to these officials on actions taken in response to the evaluations. (Class II, Priority Action) (I-79-11)"

—the Research and Special Programs Administration:

"Expand current research into 'new approaches for controlling pressurized liquefied flammable gas releases' from breached tanks on bulk transport vehicles to include control of pressurized liquefied nonflammable ammonia and chlorine gas releases. (Class II, Priority Action) (I-79-12)"

As a result of its "Special Investigation Report--Onscene Coordination Among Agencies at Hazardous Materials Accidents" (NTSB-HZM-79-3), the Safety Board made the following recommendations, concurrently with those above, to the Department of Transportation:

"Pursue action on Recommendation I-77-2 and expand it to develop and disseminate guidelines for planning emergency response to transportation accidents involving all hazardous materials. These guidelines should clearly delineate the onscene command structure, establishment of a command post and communications, and structure of the coordination of efforts, and require control of access to the

accident site. Furthermore, the relationships and responsibilities of the responding Federal, State, local, and private agencies should be clearly identified. (Class II, Priority Action) (I-79-5)

"Develop a universal, highly visible means for identifying the onscene commander and command post at the site of hazardous materials emergencies, and promote its use among Federal, State, and local government agencies and private organizations. (Class II, Priority Action) (I-79-6)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PATRICIA A. GOLDMAN
Members

/s/ G.H. PATRICK BURSLEY
Member

September 13, 1979

APPENDIX A
INVESTIGATION

The National Transportation Safety Board was notified of the accident about 9 a.m. on April 8, 1979. The Safety Board immediately dispatched an investigator from its Atlanta field office and an investigative team from Washington, D.C. to the scene. Investigative groups were established for operations, equipment, track and structures, and hazardous materials.

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APPENDIX B

LOUISVILLE & NASHVILLE CREWMEMBER INFORMATION
TRAIN NO. 403, APRIL 8, 1979

Engineer Ernest E. York, 52, was employed as a shop laborer on July 3, 1943. He left service on August 8, 1944. He was re-employed in engine service as a fireman on June 14, 1952, and was promoted to an engineer on February 5, 1958. He passed his last medical examination on April 17, 1978, and his last operating rules examination in September 1977.

Head Brakeman John L. Durgins, 51, was employed as a freight house laborer on December 16, 1943. He left service on June 6, 1945, and was re-employed as a section laborer on May 26, 1947. He transferred to train service as a trainman on August 3, 1974. He is presently qualified as a trainman only.

Conductor Wayne Johnson, 49, was employed as a brakeman on March 14, 1951. He left service to serve in the armed forces, on December 21, 1951, and returned to work on January 25, 1956. He was promoted to conductor on May 20, 1966.

Rear Brakeman Michael McKinley, 31, was employed as a trainman on January 16, 1970. He was promoted to conductor on November 11, 1972.

APPENDIX C

EXCERPTS FROM
ASSOCIATION OF AMERICAN RAILROADS'
TRACK TRAIN DYNAMICS
TRAIN MAKEUP GUIDELINES

3.3 TRAIN CHARACTERISTICS

3.3.1 DRAWBAR STRENGTHS

As the total strength of a chain is limited by the strength of its weakest link, so is the ability of a freight train to resist high drawbar forces limited by the weakest draftgear component.

The principal draftgear components are the couplers, knuckles and yokes. Of these, the weakest element is generally the knuckle. It is also noteworthy that the knuckle has been designed intentionally in this manner, since it is the most easily replaced item.

Knuckles and couplers are manufactured in three categories: Grade B, C, and E, having ultimate tensile strengths of 350,000, 550,000 and 650,000 lbs., respectively. As Grade B knuckles are commonly applied to interchange cars, this type of knuckle is taken as the limiting factor in determining the maximum power requirements. The exceptions involve such cases as unit trains in operations where the railroad may elect to install stronger draftgear components to permit a more massive concentration of locomotive power.

When starting a train a typical single 6-axle locomotive unit can develop approximately 100,000 lbs. drawbar pull. However, a 70,000 lb. limit is generally accepted by the industry and is used in rating this class of power in train operations. This level of drawbar pull (i.e., tractive effort minus locomotive resistance) is developed for a full throttle setting and a speed of 12 mph. Four such units would develop about 280,000 lbs. of drawbar pull. In grade territories where more than three 6-axle units are used in multiple, cars immediately behind the locomotive consist should be equipped with higher-strength knuckles.

Thus the knuckles and couplers on the first car must withstand the steady state drawbar forces of the locomotive, plus the additional dynamic slack action generated by jerk forces, wheelslips, etc. From the above data it can be readily seen that knuckles and couplers can be subjected to draft forces in excess of 250,000 lbs., without even considering the dynamic effects of slack action.

The following graph (figure 15) was prepared to illustrate the allowable trailing tonnage for various compensated grades at designated speeds so that the resulting drawbar forces will not exceed 250,000 lbs. The train resistance was calculated using the Davis formula for freight cars:

$$R = 1.3 + 29/w + 0.045V + 0.0005AV^2/wn$$

where R = resistance (in lbs/ton) on level tangent track

w = unit weight per axle (in tons)

n = number of axles per car

A = effective cross sectional area of car (in square ft)

V = speed (in miles per hour)

The grade resistance (in lbs/ton) is 20 times the percentage of grade.

A pragmatic factor of 0.80 on the raph is applied to the trailing tonnage to allow for adverse operating conditions such as: weather, weak knuckles, yokes and couplers, grade discrepancies, train surges, rail inequalities and slippage due to curve oilers.

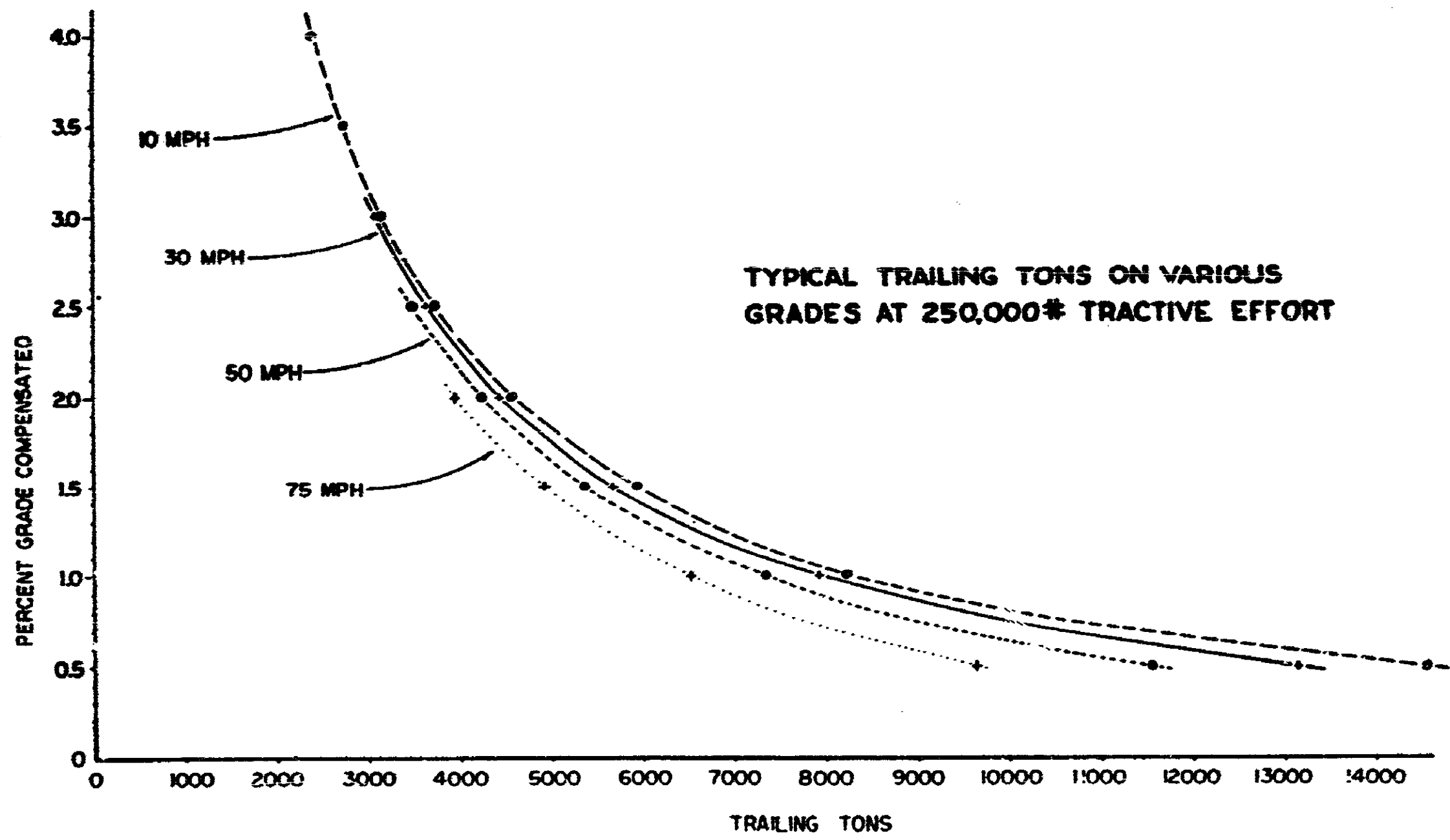


Figure 15.

APPENDIX D

LISTING OF TRAINS
THAT STOPPED ON THE CRESTVIEW GRADE
BETWEEN JANUARY 1, 1978 AND APRIL 7, 1979

Date	Train Number	No. Loco. Units	Cars		Tonnage	Remarks
			Loads	Empties		
02-10-78	461	4	83	81	11,576	Stalled
02-17-78	407	4	101	28	11,003	Broken coupler
03-12-78	403	4	122	0	11,677	Stalled
03-13-78	407	4	115	17	11,199	Stalled
03-15-78	403	5	109	14	11,006	Stalled
05-04-78	407	5	109	3	10,735	Stalled
05-13-78	407	5	111	0	11,375	Broken knuckle
07-29-78	403	6	104	30	10,036	Broken train line
09-14-78	403	3	111	28	11,432	Stalled
12-29-78	407	6	107	12	10,022	Stalled
01-12-79	403	5	112	22	11,100	Stopped for inspection
01-19-79	403	4	116	8	10,725	Stalled
02-9-79	407	6	132	18	11,997	Broken coupler

APPENDIX E
EXCERPTS FROM
LOUISVILLE AND NASHVILLE RAILROAD COMPANY
SPECIAL RULES

**Louisville and Nashville
Railroad Company
SPECIAL RULES**

**Governing Train Handling,
Air Brakes
And Dynamic Brakes**

LOUISVILLE AND NASHVILLE
RAILROAD COMPANY

RULES AND REGULATIONS

Governing Train Handling, Air Brake and
Dynamic Brake.

Effective April 1, 1975

Approved
C. N. Wiggins, Vice-President, Operations

The rules and instructions set forth in this manual govern employees of the Louisville and Nashville Railroad Co. whose duties require they be familiar with train handling, air brakes, dynamic brake, and their related operation.

This manual must not be defaced in any manner and must be kept up to date as replacement instructions are issued. This manual must be readily accessible while on duty.

W. A. Rice,
System General Road Foreman of Engines

VII. NEGOTIATING SAG OR DIP TERRITORY

1. (2-166) IN ORDER TO CONTROL SLACK WHEN MOVING THROUGH SAGS, THE TRAIN SPEED MUST BE ALLOWED TO REDUCE BEFORE THE TRAIN MOVES INTO THE SAG AND "THROTTLE MODULATION" USED TO NEGOTIATE THE TERRITORY. THIS IS ACCOMPLISHED BY REDUCING THE THROTTLE BEFORE APPROACHING SUCH AREAS. THE AMOUNT OF SPEED REDUCTION DEPENDS PRIMARILY ON THE LENGTH AND GRADIENTS OF THE SAG. IN CASES OF LONG SAGS AND HEAVY GRADES, THIS SPEED REDUCTION MAY BE AS GREAT AS 15 TO 20 MPH.

2. WHEN NEGOTIATING HUMP, KNOLL OR "HOGBACK" TERRITORY, SLACK ACTION CAN OFTEN BE REDUCED BY THE FOLLOWING THROTTLE MODULATION:

(a) REDUCE THE TRAIN SPEED WHEN APPROACHING THE SAG BY REDUCING THE THROTTLE. PAST EXPERIENCE SHOULD INDICATE THE AMOUNT THAT SPEED SHOULD BE ALLOWED TO REDUCE TO OPERATE THROUGH A GIVEN SAG WITHOUT EXCEEDING THE MAXIMUM AUTHORIZED SPEED.

(b) CONTINUE TO REDUCE THE THROTTLE TO PREVENT SPEED INCREASE AS THE HEAD PORTION OF THE TRAIN BEGINS DESCENDING ONTO THE SAG.

(c) JUST BEFORE THE HEAD PORTION OF THE TRAIN REACHES THE ASCENDING GRADE, BEGIN TO ADVANCE THE THROTTLE GRADUALLY.

(d) CONTINUE TO ADVANCE THE THROTTLE ONE NOTCH AT A TIME UNTIL THE REAR PORTION APPROACHES THE BASE OF THE SAG. THIS SHOULD RESULT IN THE TRAIN ACCELERATING AND THEREBY PREVENT A HEAVY SLACK RUN-IN FROM THE REAR OF THE TRAIN.

(e) REDUCE POWER AS THE REAR PORTION STARTS ON THE ASCENDING GRADE OUT OF THE SAG THEREBY PERMITTING SLACK TO ADJUST GRADUALLY.

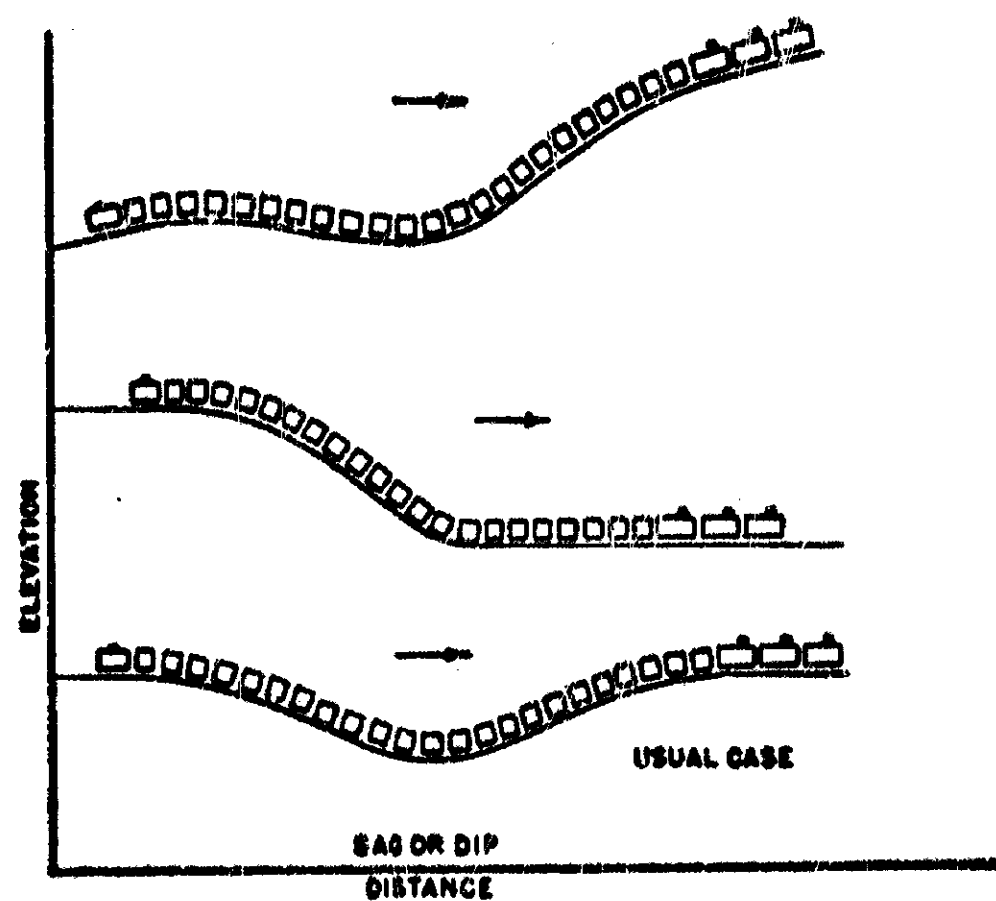
APPENDIX F

EXCERPTS FROM
ASSOCIATION OF AMERICAN RAILROADS'
TRACK TRAIN DYNAMICS
TRAIN HANDLING GUIDELINES

2.2.6. NEGOTIATING SAG OR DIP TERRITORY

SAG OR DIP.

A RAPID DECREASE IN GRADE FOLLOWED BY AN INCREASE
IN GRADE SUFFICIENT TO RESULT IN ABNORMAL SLACK ADJUSTMENT.



TRACK WITH CURVATURE GREATER THAN 2° SHOULD BE TREATED WITH
SPECIAL CONSIDERATION.

Figure 35.

The starting or stopping of a freight train in sag or dip territory may be achieved generally in accordance with the procedures for "Starting" or "Stopping" as outlined in Section 2.1.3.2.A., page 2-81, and Section 2.1.2.2.A., page 2-21, for level terrain. Special consideration must be given to the state of slack.

NEGOTIATING

IN ORDER TO CONTROL SLACK WHEN MOVING THROUGH SAGS, THE TRAIN SPEED MUST BE ALLOWED TO REDUCE BEFORE THE TRAIN MOVES INTO THE SAG AND "THROTTLE MODULATION" USED TO NEGOTIATE THE TERRITORY. THIS IS ACCOMPLISHED BY REDUCING THE THROTTLE BEFORE APPROACHING SUCH AREAS. THE AMOUNT OF SPEED REDUCTION DEPENDS PRIMARILY ON THE LENGTH AND GRADIENTS OF THE SAG. IN CASES OF LONG SAGS AND HEAVY GRADES, THIS SPEED REDUCTION MAY BE AS GREAT AS 15 TO 20 MPH.

2-166

NORMALLY, SAG OR DIP TERRITORY DOES NOT PERMIT UTILIZATION OF THE DYNAMIC BRAKE since the grades are generally not long and there is not adequate time to set up, apply and release the dynamic brake. Such an operation could result in excessive slack adjustments in the train.

The purpose of the above noted speed reduction is to enable the train to be pulled and accelerated through the sag, and thereby prevent both a severe slack run-in as the rear portion of the train moves on to the descending grade, and a severe run-out and possible break-in-two as slack runs out when the rear portion of the train moves onto the ascending grade.

"THROTTLE MODULATION" METHOD: (USUAL CASE)

1. REDUCE THE TRAIN SPEED WHEN APPROACHING THE SAG BY REDUCING THE THROTTLE. PAST EXPERIENCE SHOULD INDICATE THE AMOUNT THAT SPEED SHOULD BE ALLOWED TO REDUCE TO OPERATE THROUGH A GIVEN SAG WITHOUT EXCEEDING THE MAXIMUM AUTHORIZED SPEED.
2. CONTINUE TO REDUCE THE THROTTLE TO PREVENT SPEED INCREASE AS THE HEAD PORTION OF THE TRAIN BEGINS DESCENDING ONTO THE SAG.
3. JUST BEFORE THE HEAD PORTION OF THE TRAIN REACHES THE ASCENDING GRADE, BEGIN TO ADVANCE THE THROTTLE GRADUALLY.
4. CONTINUE TO ADVANCE THE THROTTLE ONE NOTCH AT A TIME UNTIL THE REAR PORTION APPROACHES THE BASE OF THE SAG. THIS SHOULD RESULT IN THE TRAIN ACCELERATING AND THEREBY PREVENT A HEAVY SLACK RUN-IN FROM THE REAR OF THE TRAIN.

5. REDUCE POWER AS THE REAR PORTION STARTS ON THE ASCENDING GRADE OUT OF THE SAG THEREBY PERMITTING SLACK TO ADJUST GRADUALLY.

The above listed procedure of throttle modulation should prevent heavy and severe slack adjustment and prevent possible break-in-twos.

2.2.7. CURVATURE CONSIDERATIONS

There is definite proof that excessive lateral forces are generated in curve negotiations which can cause rail turnover type derailments on curves in excess of 2 degrees, and particularly on curves of 4 degrees or greater. The lateral forces which can cause this situation come from the dynamic stresses produced by run-ins of slack, by having long cars coupled to short cars, by having long, light cars preceding blocks of heavily loaded cars, by having slack run in against the locomotive, by coupler or truck characteristics, or by high continuous buff or draft forces.

IF CONDITIONS PERMIT, SPEED CHANGES AS A RESULT OF THROTTLE MANIPULATION OR DYNAMIC OR AIR BRAKE APPLICATION SHOULD NOT BE MADE WITHIN, NEAR THE BEGINNING OR END OF ANY CURVE IN EXCESS OF 2 DEGREES. THE SPEED MUST BE REDUCED TO THE AUTHORIZED SPEED OR LOWER BEFORE THE LOCOMOTIVE ENTERS THE RESTRICTED SPEED ZONE.

2-167

WHERE PRACTICAL, TRAIN SPEED AND BRAKE OPERATION SHOULD BE PLANNED SO THAT MAXIMUM OR HEAVY DYNAMIC BRAKING IS NOT USED WHEN NEGOTIATING CURVES GREATER THAN 2 DEGREES.

2-168

When a heavily powered locomotive consist is hauling a heavy train slowly around a sharp curve, it is very possible that the high tractive effort developed will pull any light cars located in the train over the inner rail, straightening them out like a "stringline". The cars may be pulled over the inner rail by the flange climbing the inner rail, by the inner rail turning over, or the car may be rolled inwards.

TO REDUCE THE PROBABILITY OF "STRINGLINING" OF CARS WHEN OPERATING LONG TRAINS WITH 18 POWERED AXLES OR MORE OVER CURVATURE GREATER THAN 4 DEGREES AT SPEEDS OF LESS THAN 25 MPH, NO MORE THROTTLE SHOULD BE USED THAN IS ABSOLUTELY NECESSARY TO ADVANCE THE TRAIN AROUND THE CURVE.

2-169

Speed restrictions as determined under the considerations of Sections 2.1.5.5. and 4.1.1. should be strictly obeyed.

APPENDIX G
TRACK GEOMETRY MEASUREMENTS
FROM FIELD NOTES

In Direction of Train No. 407's Travel (Toward Site)

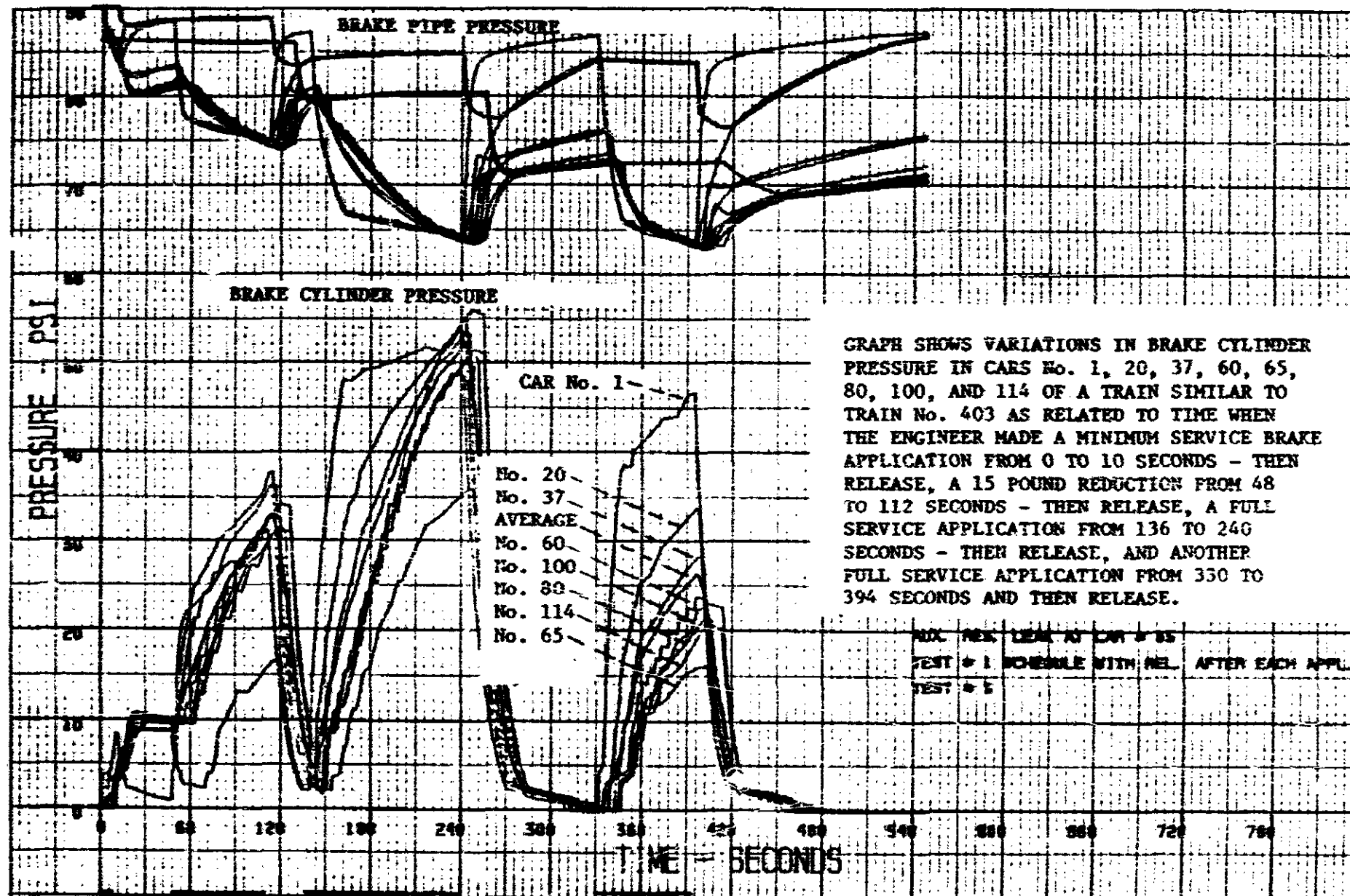
Station	Mid-Ordinate** (Inches)	Elevation*** (Inches)	Gage (Inches)
25	1/4	1 1/2	56 1/4
24	1/2	1	56 3/8
23	3/8	3/4	56 1/2
22	1/4	3/4	56 1/4
21	1/4	3/4	56 1/4
20	1/4	1/2	56 1/4
19	1/8	1/8	56 1/4
18	0	1/8	56 3/8
17	0	1/4	56 1/4
16	0	1/4	56 3/8
15	0	1/4	56 1/2
14	0	0	56 1/2
13	0	0	56 3/8
12	0	1/2	56 1/4
11	0	0	56 1/4
10	0	1/4	56 1/2
9	0	1/4	56 1/4
8	0	1/2	56 1/4
7	0	1/2	56 1/4
6	0	1/4	56 1/2

5	0	1/2	56 1/4
4	0	0	56 3/8
3	0	0	56 3/8
2	0	0	56 3/8
1	0	0	56 3/8

*Stations are at 15.5-foot intervals with 0 at the north end of the thru-truss bridge.

**Midpoint of a 62-foot string line.

***East rail elevated.



APPENDIX H

WABCO AIRBRAKE SIMULATION TEST, TRAIN NO. 403

APPENDIX I

EXCERPTS FROM
40 CFR 1510

**PART 1510—NATIONAL OIL AND
HAZARDOUS SUBSTANCES POLLU-
TION CONTINGENCY PLAN**

Subpart A—Introduction

- Sec.
- 1510.1 Authority.
- 1510.2 Purpose of objectives.
- 1510.3 Scope.
- 1510.4 Abbreviations.
- 1510.5 Definitions (within the meaning of this Plan).

Subpart B—Policy and Responsibility

- 1510.21 Federal policy.
- 1510.22 Federal responsibility.
- 1510.23 Non-Federal responsibility.

Subpart C—Planning and Response Organization

- 1510.31 Emergency response activities and coordination.
- 1510.32 National response team.
- 1510.33 National Response Center.
- 1510.34 Regional response team.
- 1510.35 Regional Response Center.
- 1510.36 On-scene coordination.

Subpart D—Operational—Response Phases

- 1510.40 Phase groupings.
- 1510.41 Phase I—Discovery and notification.
- 1510.42 Phase II—Evaluation and initiation of action.
- 1510.43 Phase III—Containment and countermeasures.
- 1510.44 Phase IV—Cleanup, mitigation and disposal.
- 1510.45 Phase V—Documentation and cost recovery.
- 1510.46 Special considerations.

Subpart E—Coordinating Instructions

- 1510.51 Delegation of Authority.
- 1510.52 Multi-regional actions.
- 1510.53 General pattern of response actions.
- 1510.54 Strike forces.

LIST OF ANNEXES

	<i>Annex No.</i>
1100 Distribution.....	I
1200 National Response Team.....	II
1300 National Response Center.....	III

Title 40—Protection of Environment

LIST OF ANNEXES—Continued

	<i>Annex No.</i>
1400 Primary Agency Office Locations and Boundaries.....	IV
1500 Communications and Reports.....	V
1600 Public Information.....	VI
1700 Legal Authorities.....	VII
1800 Documentation and Cost Recovery.....	VIII
1900 Funding.....	IX
2000 Schedule of Chemicals and other additives to remove oil and hazardous substances discharges.....	X
2100 Non-Federal Interests.....	XI
2500 Technical Information.....	XV

AUTHORITY: Sec. 311(c)(2), Pub. L. 92-500, 86 Stat. 865, 33 U.S.C. 1251, et seq.

SOURCE: 40 FR 6282, Feb. 10, 1975, unless otherwise noted.

Subpart A—Introduction

§ 1510.1 Authority.

This National Oil and Hazardous Substances Pollution Contingency Plan¹ has been developed in compliance with the Federal Water Pollution Control Act, as amended, (33 U.S.C. 1251, et seq.). The President delegated authority and responsibility to the Council on Environmental Quality to carry out subsection (c)(2) of section 311 of the Act, providing for the preparation, publication, revision and amendment of a National Contingency Plan for the removal of oil and hazardous substances.

§ 1510.2 Purpose of objectives.

(a) This Plan, including the Annexes, provides for a pattern of coordinated and integrated response by Departments and Agencies of the Federal Government to protect the environment from the damaging effects of pollution discharges. It promotes the coordination and direction of Federal and State response systems and encourages the development of local government and private capabilities to handle such discharges.

(b) The objectives of this Plan are to provide for efficient, coordinated and effective action to minimize damage from oil and hazardous substance discharges, including containment, dispersal and removal. The Plan, including the Annexes and regional plans, provides for: (1) Assignment of duties

¹This Plan supersedes the August 1973 edition.

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and responsibility among Federal departments and agencies in coordination with State and local agencies; (2) identification, procurement, maintenance, and storage of equipment and supplies; (3) establishment or designation of a strike force to provide necessary services to carry out the Plan and establishment, at major ports, of trained and equipped emergency task forces; (4) a system of surveillance and reporting designed to insure the earliest possible notice of discharges of oil and hazardous substances to appropriate Federal agency; (5) establishment of a national center to provide coordination and direction for operations in carrying out the Plan; (6) procedures and techniques to be employed in identifying, containing, dispersing, and removing oil and hazardous substances; (7) a schedule, prepared in cooperation with the States, identifying dispersants and other chemicals, if any, that may be used in carrying out the Plan; and (8) a system whereby the State or States effected by a discharge may be reimbursed for reasonable costs incurred in the removal of such discharge.

§ 1510.3 Scope.

(a) This Plan is effective for the navigable waters of the United States (section 502(7) of the Act) and adjoining shorelines and for the contiguous zone and the high seas where a threat to the United States waters, shoreface, or shelfbottom exists.

(b) The provisions of this Plan are applicable to all Federal Agencies. Implementation of this Plan is compatible with and complementary to the Joint U.S./Canadian Contingency Plan including the annexes pertaining to the Great Lakes, Eastern and Western coastal areas; International assistance plans and agreements, security regulations, and responsibilities based upon Federal statutes and Executive Orders.

§ 1510.4 Abbreviations.

(a) *Department and Agency title abbreviations.*

AEC--Atomic Energy Commission
CEQ--Council on Environmental Quality
Commerce--Department of Commerce

Corps--U.S. Army Corps of Engineers
DHEW--Department of Health, Education and Welfare
DOD--Department of Defense
DOI--Department of Interior
DOT--Department of Transportation
EPA--Environmental Protection Agency
FDAA--Federal Disaster Assistance Administration
HUD--Department of Housing and Urban Development
Justice--Department of Justice
MarAd--Maritime Administration
NOAA--National Oceanic and Atmospheric Administration
State--Department of State
USCG--U.S. Coast Guard
USGS--U.S. Geological Survey
USN--U.S. Navy

(b) *Operational title abbreviations.*

NRC--National Response Center
NRT--National Response Team
OSC--On-Scene Coordinator
RRC--Regional Response Center
RRT--Regional Response Team

§ 1510.5 Definitions (within the meaning of this Plan).

(a) *Act*--means the Federal Water Pollution Control Act, Pub. L. 92-500 (86 Stat. 816).

(b) *Discharge*--includes but is not limited to any spilling, leaking, pumping, pouring, emitting, emptying or dumping. (For the purposes of this Plan, discharges permitted pursuant to sections 301, 302, 306, 318, 402 or 404 of the Act or section 102 of Pub. L. 92-532 are not included.)

(c) *On-Scene Coordinator (O.S.C.)*--means the Federal official pre-designated by the EPA or the USCG to coordinate and direct Federal discharge removal efforts under Regional Contingency Plans at the scene of an oil or hazardous substance discharge.

(d) *United States*--means the States, the District of Columbia, the Commonwealth of Puerto Rico, the Canal Zone, Guam, American Samoa, the Virgin Islands, and the Trust Territory of the Pacific Islands.

(e) *Coastal waters*--generally are those U.S. waters navigable by deep draft vessels, the contiguous zone, the high seas and other waters subject to tidal influence.

(f) *Inland waters*--generally are those waters upstream from coastal waters (paragraph (e) of this section).

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(g) Contiguous Zone—means the entire zone established by the United States under Article 24 of the Convention on the Territorial Sea and the Contiguous Zone. This is the zone contiguous to the territorial sea which extends 12 miles seaward from the baseline from which the territorial sea is measured.

(h) Public health of welfare--includes consideration of all factors affecting the health and welfare of man, including but not limited to human health, the natural environment, fish, shellfish, wildlife, and public and private property, shorelines and beaches.

(i) Major Disaster—means any hurricane, tornado, storm, flood, high water, wind-driven water, tidal wave, earthquake, drought, fire, or other catastrophe in any part of the United States which, in the determination of the President, is or threatens to become of sufficient severity and magnitude to warrant disaster assistance by the Federal Government to supplement the efforts and available resources of States and local governments and relief organizations in alleviating the damage, loss, hardship or suffering caused thereby.

(j) Oil—means oil of any kind or in any form, including but not limited to, petroleum, fuel oil, sludge, oil refuse and oil mixed with wastes other than dredged spoil.

(k) Hazardous substance—means any substance designated pursuant to subsection (b)(2) of section 311 of the Act.

(l) Size Classes of Discharges—The following classifications are provided for the guidance of the OSC and serve as the criteria for actions as delineated in § 1510.53. They are not meant to imply or connote associated degrees of hazard to the public health or welfare, or a measure of environmental damage. A discharge that poses a substantial threat to the public health or welfare, or results in critical public concern shall be classed as a major discharge notwithstanding the following quantitative measures.

(1) Minor discharge is a discharge to the inland waters of less than 1000 gallons of oil; or, to the coastal waters,

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a discharge of less than 10,000 gallons of oil.

(2) Medium discharge is a discharge of 1,000 to 10,000 of oil to the inland waters, or 10,000 to 100,000 gallons of oil to the coastal waters, or a discharge of a hazardous substance in a harmful quantity as defined by regulations.

(3) Major discharge is a discharge of more than 10,000 gallons of oil to the inland waters or more than 100,000 gallons of oil to the coastal waters, or a discharge of a hazardous substance that poses a substantial threat to the public health or welfare.

(m) Potential discharge—is any accident or other circumstance which threatens to result in the discharge of oil or hazardous substance. A potential discharge shall be classified by its severity based on the guidelines above.

(n) Primary Agencies—are those Departments or Agencies comprising the NRT and designated to have primary responsibility and resources to promote effective operation of this Plan. These agencies are: Commerce, DOD, DOI, DOT, and EPA.

(o) Advisory Agencies—are those Departments or Agencies which can make major contributions during response activities for certain types of discharges. These Agencies are: AEC, DHEW, Justice, OEP and State.

(p) Remove or Removal—is the removal of oil or hazardous substance from the water and shorelines or the taking of such other actions as may be necessary to minimize or mitigate damage to the public health or welfare. For purposes of this Plan, removal refers to Phase III and IV response operations.

(q) Activation—Telephone notification of the appropriate Region or District office of each Primary Agency and those Advisory Agencies identified to receive immediate notification in Regional Contingency Plans or, as required, the assembly of all or selected members of the RRT at the RRC or other location as specified by the Chairman of the RRT.

(40 FR 6282, Feb. 10, 1975, as amended at 41 FR 12658, Mar. 25, 1976)

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Subpart B—Policy and Responsibility

§ 1510.21 Federal policy.

(a) The Congress has declared that it is the policy of the United States that there should be no discharge of oil or hazardous substance into or upon the navigable waters of the United States, adjoining shorelines, or into or upon the waters of the contiguous zone (section 311(b)(1) of the Act).

(b) The primary thrust of this Plan is to provide a coordinated Federal response capability at the scene of an unplanned or sudden, and usually accidental, discharge of oil or hazardous substance that poses a threat to the public health or welfare. Initial actions taken by the Federal OSC, designated pursuant to § 1510.36 of this Plan and the appropriate regional contingency plan, shall be to determine in accordance with section 311(c)(1) of the Act, if the actions taken by the person responsible for the discharge of oil or hazardous substance are proper to remove the discharge. The OSC should, if practicable, insure that the person responsible for the discharge is aware of his responsibility and is encouraged to undertake necessary countermeasures. In the event that the person responsible for the discharge does not act promptly, does not take or propose to take proper and appropriate actions to remove the discharged pollutants, or if the person responsible for the discharge is unknown, further Federal response actions shall be instituted as required in accordance with this Plan. When the person responsible for the discharge is taking proper action, the OSC shall observe and monitor progress, and provide advice, counsel, and logistical support as may be necessary.

(c) Removal actions taken pursuant to section 311(c)(1) of the act are limited to the navigable waters of the United States, adjoining shorelines and the waters of the contiguous zone. Removal actions within the Contiguous zone are limited and do not include those covered by the Outer Continental Shelf Lands Act. When a discharge or potential discharge that poses a threat to the waters of the U.S. occurs outside the jurisdiction under section 311(c) of the Act, the

procedures of this plan apply to the extent practicable and removal action will be accomplished pursuant to other Agency authorities. Removal actions for non-vessel discharges on the outer continental shelf, shall be in accordance with the August 1971 DOI/ DOT Memorandum of Understanding.

(d) In accordance with section 311(d), whenever a marine disaster in or upon the navigable waters of the United States has created a substantial threat of pollution hazard to the public health or welfare, because of a discharge, or an imminent discharge, of large quantities of oil, or of a hazardous substance from a vessel, the United States may: (1) Coordinate and direct all public and private efforts directed at the removal or elimination of such threat; and (2) summarily remove and, if necessary, destroy such vessel by whatever means are available without regard to any provisions of law governing the employment of personnel or the expenditure of appropriated funds. This authority has been delegated to the Administrator of EPA and the Secretary of the Department in which the Coast Guard is operating, respectively, in and for the waters for which each has responsibility to furnish or provide the OSC under this Plan.

(e) In addition to any other actions taken by a State or local government, when the Administrator of EPA or the Secretary of the Department in which the Coast Guard is operating determines there is an imminent and substantial threat to the public health and welfare because of an actual or threatened discharge of oil or hazardous substance into or upon the waters of the United States from any onshore or offshore facility, he may require, through the Attorney General, that the U.S. Attorney of the district in which the threat occurs secure such relief as may be necessary to abate such threat. This authority could be exercised on request of the NRT.

(f) The Federal agencies possessing facilities or other resources which may be useful in a Federal response situation will make such facilities or resources available for use in accordance with this Plan, as supplemented by the regional plans, and as consistent

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with operational requirements, within the limits of existing statutory authority, and within the spirit of the President's intention to minimize discharges and their effects when they do occur.

(g) Environmental pollution control techniques shall be employed in accordance with applicable regulations and guidelines, and regional contingency plans. In any circumstances not covered by regulations or regional contingency plans, the use of chemicals shall be in accordance with Annex X and must have the concurrence of the EPA representative or alternate representative on the RRT; or in his absence the concurrence of the appropriate EPA Regional Administrator.

(h) Response operations carried out to remove discharges originating from Outer Continental Shelf Lands Act operations shall be in accordance with the August 1971 Memorandum of Understanding between DOI and DOT concerning respective responsibilities under this Plan.

§ 1510.22 Federal responsibility.

(a) Each of the Primary and Advisory Federal Agencies has responsibilities established by statute, Executive Order or Presidential Directive which may bear on the Federal response to a pollution discharge. This plan intends to promote the expeditious and harmonious discharge of these responsibilities through the recognition of authority for action by those Agencies having the most appropriate capability to act in each specific situation. Responsibilities and authorities of these several agencies relevant to the control of pollution discharges are detailed in Annex VII to this part. Regional contingency plans shall include provisions to insure:

(1) The recognition of the statutory responsibilities of all involved agencies;

(2) That agency representatives are notified promptly; and

(3) That representatives discharging their agency's responsibilities shall coordinate their efforts with the OSC supervising or monitoring discharge removal operations. (See § 1510.36(a)(3)).

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(b) The Council on Environmental Quality is responsible for the preparation, publication, revision and amendment of this National Contingency Plan. The Council will receive the advice of the NRT on necessary changes to the Plan and shall insure that any disagreements arising among members of the NRT are expeditiously settled.

(c) The Department of Commerce, through NOAA, provides support to the NRT, RRT and OSC with respect to: Marine environmental data; living marine resources; current and predicted meteorological, hydrologic and oceanographic conditions for the high seas, coastal and inland waters; and maps and charts, including tides and currents for coastal and territorial waters and the Great Lakes. When requested by NRT, MARAD will provide advice on the design, construction and operation of merchant ships.

(d) The Department of Defense, consistent with its operational requirements, may provide assistance in critical pollution discharges and in the maintenance of navigation channels, salvage, and removal of navigation obstructions.

(e) The Department of Health, Education, and Welfare is responsible for providing expert advice and assistance relative to those discharges or potential discharges that constitute or may constitute a threat to public health and safety.

(f) The Department of Housing and Urban Development, through FDAA, maintains an awareness of pollution emergencies and evaluates any request for a major disaster declaration received from a Governor of a State pursuant to Pub. L. 93-288. If the President declares that a pollution emergency constitutes a major disaster or that a major disaster is imminent as defined by Pub. L. 93-288, the Administrator, FDAA, will coordinate and direct the Federal response.

(g) The Department of Interior, through the USGS, supplies expertise in the fields of oil drilling, producing, handling, and pipeline transportation. Also, the USGS has access to and supervision over continuously manned facilities which can be used for com-

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mand, control and surveillance of discharges occurring from operations conducted under the Outer Continental Shelf Lands Act. Additionally, the Department of Interior will provide, through its Regional Coordinators, technical expertise to the OSC and RRT with respect to land, fish and wildlife, and other resources for which it is responsible. DOI is also responsible for American Samoa and the Trust Territory.

(h) The Department of Justice can supply expert legal advice to deal with complicated judicial questions arising from discharges and Federal agency responses.

(i) The Department of Transportation provides expertise regarding all modes of transporting oil and hazardous substances. Through the USCG, DOT supplies support and expertise in the domestic/international fields of port safety and security, marine law enforcement, navigation, and construction; manning, operation, and safety of vessels and marine facilities. Additionally, the Coast Guard maintains continuously manned facilities that are capable of command, control, and surveillance for oil discharges occurring on the waters of the United States or the high seas. The USCG is responsible for chairing the RRT and for implementing, developing and revising, as necessary, the regional plans for those areas where it is assigned the responsibility to furnish or provide for OSC's (§ 1510.36(b)).

(j) The Department of State will provide leadership in developing joint international contingency plans. It will also provide assistance in coordination when a pollution discharge transects international boundaries or involves foreign flag vessels.

(k) The Atomic Energy Commission is the designated Agency for administration, implementation and coordination of the Interagency Radiological Assistance Plan (IRAP). AEC will provide advice and assistance to the NRT with respect to the identification of the source and extent of radioactive contamination, and removal and disposal of radioactive discharges.

(l) The Environmental Protection Agency, through the Office of Water and Hazardous Materials, provides ex-

pertise regarding environmental effects of pollution discharges and environmental pollution control techniques, including assessment of damages. EPA shall also advise the RRT and OSC of the degree of hazard a particular discharge poses to the public health and safety. EPA is responsible for chairing the RRT and for development, revision and implementation, as necessary, of regional plans for those areas in which it has responsibility to furnish or provide for the OSC (§ 1310.36(b)). EPA will provide guidance to and coordinate with DOT regarding pollution control and protection of the environment in the preparation of regional plans.

(m) All Federal agencies are responsible for minimizing the occurrence of discharges and for developing the capability to respond promptly in cases of discharges from facilities they operate or supervise, and for making resources available for Federal pollution response operations.

(n) In addition to paragraph (m) of this section, Primary Agencies are responsible for:

(1) Leading all Federal agencies in programs to minimize the number of and environmental damage associated with discharges from facilities they operate or supervise;

(2) Providing representation to the NRT and the RRT's;

(3) Developing, within their operating elements, the capability for a rapid, coordinated response to any pollution discharge;

(4) Making information available to the NRT, RRT or OSC as necessary; and

(5) Keeping NRT and the RRT's informed, consistent with national security considerations, of changes in the availability of resources that would affect the operation of this Plan.

(40 FR 6282, Feb. 10, 1975, as amended at 41 FR 12658, Mar. 26, 1976)

§ 1510.23 Non-Federal responsibility.

(a) The States are invited to provide liaison to RRT's and shall designate the appropriate element of the State

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government that would undertake direction of State supervised discharge removal operations. The designated agency shall be the single State governmental element that will seek reimbursement for removal operation expenditures in accordance with section 311(c)(2)(H) of the Act. Details on reimbursement to States for removal actions taken pursuant to this Plan are contained in 33 CFR Part 153 and Annex IX--Funding.

(b) Industry groups, the academic community, and others are encouraged to commit resources for removal operations. Their specific commitments are outlined by the regional plans. Of particular relevance is the organization of a standby scientific response capability.

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Subpart C--Planning and Response Organization

§ 1510.31 Emergency response activities and coordination.

(a) For pollution emergency response activities, Federal on-scene coordination is accomplished through the OSC. He reports to and receives advice from an RRT composed of appropriate representatives from the Regional and District offices of the Primary and Advisory Agencies.

(b) National level coordination is accomplished through the NRT which receives reports from and renders advice to the RRT. Activities are coordinated through the National and various regional response centers.

(c) The organizational concepts of this Plan are shown on Figure 1.

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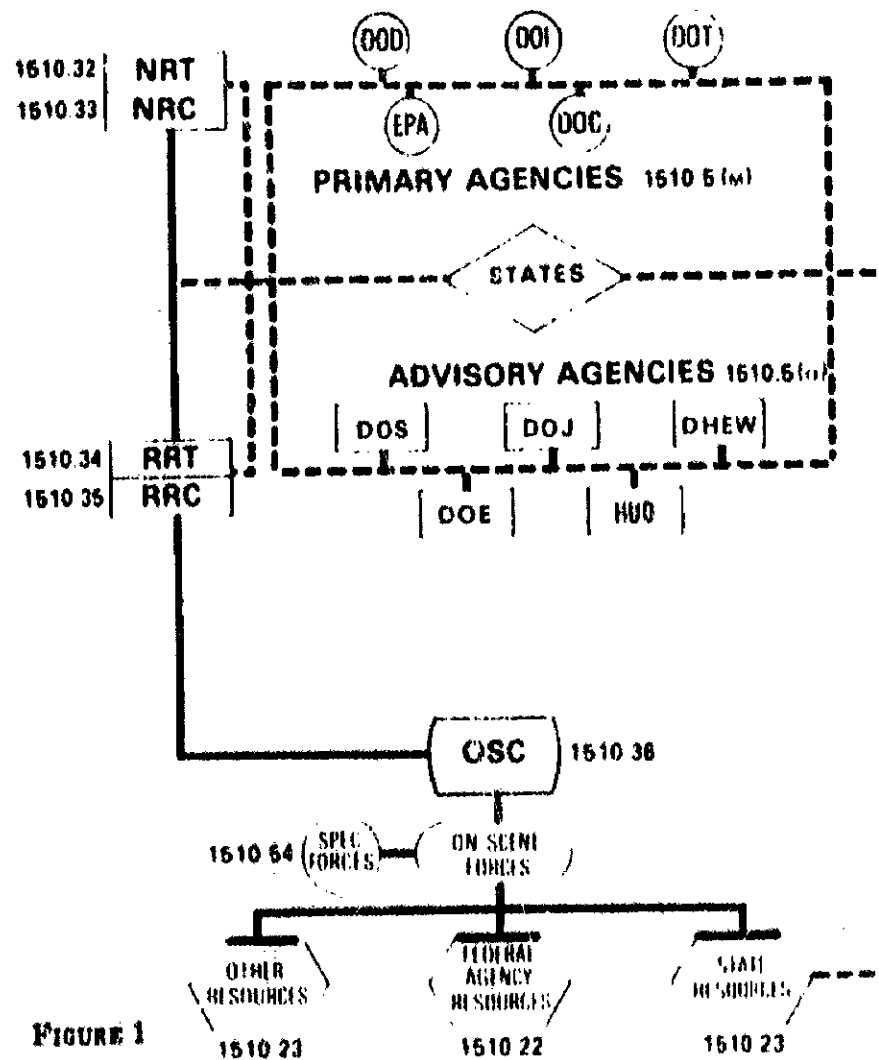


FIGURE 1

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§ 1510.32 National response team.

(a) The NRT consists of representatives from the Primary and Advisory Agencies. It serves as the National body for planning and preparedness actions prior to a pollution discharge and for coordination and advice during a pollution emergency. It shall be organized and shall function as outlined in Annex II to this part.

(b) The NRT shall establish and maintain a Committee on Revision of the National Plan. This Committee shall provide suggested revisions to the NRT for consideration, approval and publication by CEQ. The Primary Agencies shall provide membership on this standing committee. Advisory Agencies shall participate whenever revision or proposed amendments would affect those Agencies. Ad hoc committees may also be established from time to time to consider various matters. Membership on these committees shall consist of the representative from the Primary Agencies and such Advisory Agencies that may have direct involvement.

(c) Based on a continuing evaluation of response actions, the NRT shall consider and make recommendations to appropriate agencies relating to training and equipping response team personnel; necessary research, development, demonstration and evaluation activities to improve response capabilities; and equipment, material stockpiling and other operational matters as the need arises. CEQ shall be advised of any agency's failure to adequately respond to these recommendations.

(d) During pollution emergencies, NRT shall act as an emergency response team comprised of representatives from the Primary and selected Advisory Agencies to be activated in accordance with section 1201.2, Annex II to this part.

§ 1510.33 National Response Center.

(a) The NRC, located at Headquarters, USCG, is the Washington, D.C. headquarters site for activities relative to pollution emergencies. NRC quarters are described in Annex III to this part, and provide communications, in-

cluding a continuously manned communication center, information storage; and necessary personnel and facilities to promote the smooth and adequate functioning of this activity as described in Annex III to this part.

§ 1510.34 Regional response team.

(a) The RRT consists of regional representatives of the Primary and selected Advisory Agencies, as appropriate. RRT shall act within its region as an emergency response team performing response functions similar to those described for NRT. RRT will also perform review and advisory functions relative to the regional plan similar to those prescribed for NRT at the National level. Additionally, the RRT shall determine the duration and extent of the Federal response, and when a shift of on-scene coordination from the predesignated OSC to another OSC is indicated by the circumstances or progress of a pollution discharge.

(b) Each Primary Agency shall designate one member and a minimum of one alternative member to the RRT. Each Advisory Agency may designate a member. Agencies may also provide additional representatives as observers to meetings of the RRT. Individuals representing the participating agencies may vary depending on the subregional area in which the discharge occurred or removal actions are underway. Details of such representation are specified in each regional contingency plan.

(c) Each of the States lying within a region is invited to furnish liaison to the RRT for planning and preparedness activities. When the Team is activated for a pollution emergency, the affected State or States are invited to participate in RRT deliberations.

(d) The RRT shall be activated automatically in the event of a major or potential major discharge. The RRT shall be activated during any other pollution emergency by an oral request from any primary agency representative to the Chairman of the Team. Such requests for team activation shall be confirmed in writing. The time of Team activation, method of ac-

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tivation (e.g., telephone notification or assembly), place of assembly (if appropriate), and means of contact shall be included in POLREPS submitted in accordance with Annex V of this part. Detailed criteria governing how activation will be effected in relation to the circumstances of the incident are specified in each Regional Contingency Plan.

(e) The Chairman shall ensure that the provisions of the Regional Contingency Plan are adequate to provide the OSC with appropriate technical and professional assistance from the primary and advisory agencies commensurate with the agencies' resources, capabilities and responsibilities within the Region. During a pollution emergency the members of the RRT shall ensure that the resources of their respective agencies are made available to the OSC as agreed to and specified in the Regional Contingency Plan for staff augmentation and response activities.

(f) Deactivation of RRT shall be by agreement between the EPA and USCG team members. The time of deactivation shall be included in POLREPS submitted in accordance with Annex V to this part.

(g) Boundaries of the Standard Federal Regions as shown in Annex IV to this part shall be followed for the development of Regional Contingency Plans.

[40 FR 6282, Feb. 10, 1975, as amended at 41 FR 12656, Mar. 26, 1976]

§ 1510.35 Regional Response Center.

(a) The RRC is the regional site for pollution emergency response activities. It will be accommodated in quarters described in each regional plan and will provide communications, information storage and other necessary personnel and facilities to promote the proper functioning and administration of regional pollution emergency response operations.

§ 1510.36 On-scene coordination.

(a) Coordination and direction of Federal pollution control efforts at the scene of a discharge or potential discharge shall be accomplished through the OSC, predesignated by re-

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gional plan to coordinate and direct such pollution control activities in each area of the region.

(1) In the event of a discharge of oil or hazardous substance, the first official on the site from an agency having responsibility under this Plan shall assume coordination of activities under the Plan until the arrival of the predesignated OSC.

(2) The OSC shall determine pertinent facts about a particular discharge, such as its potential impact on human health and welfare; the nature, amount, and location of material discharged; the probable direction and time of travel of the material; the resources and installations which may be affected and the priorities for protecting them.

(3) The OSC shall initiate and direct as required Phase II, Phase III and Phase IV operations, and consistent with other responsibilities, shall coordinate with agency representatives on-scene who are carrying out their agency responsibilities (See § 1515.22(a)). Advice provided by the EPA on the use of chemicals in Phase III and Phase IV operations shall be binding on the OSC expected as provided for in Annex X of this part.

(4) The OSC shall call upon and direct the deployment of needed resources in accordance with the regional plan to evaluate the magnitude of the discharge and to initiate and continue removal operations.

(5) The OSC shall provide necessary support activities and documentation for Phase V activities.

(6) In carrying out this Plan, the OSC will fully inform and coordinate closely with RRT to ensure the maximum effectiveness of the Federal effort in protecting the natural resources and the environment from pollution damage.

(b) EPA and the USCG shall insure that OSC's are predesignated for all areas within the region in accordance with the following criteria:

(1) The EPA shall furnish or provide for OSC's on inland waters.

(2) The USCG shall furnish or provide for OSC's for the coastal waters, and for Great Lakes waters, ports and harbors.

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(3) The major consideration in selection of the OSC shall be based upon that Agency's capability and resources for pollution control response activities and the individual OSC's knowledge of the National Contingency Plan and the appropriate Regional Contingency Plan.

(c) All Federal agencies are required by executive order to develop emergency plans and procedures for dealing with accidental pollution. All Federal agencies, therefore, are responsible for designating the offices to coordinate response actions for facilities or vessels under their jurisdiction and for the provision of means to remove or mitigate the effects of discharges from their facilities. If the responsible Agency does not act promptly or take appropriate action, the EPA or USCG shall, depending on the area in which the discharge occurs, assume the OSC functions. Pollution control actions taken must be in accordance with Federal regulations and guidelines, EPA policies and this Plan.

140 FR 6282, Feb. 10, 1975, as amended at 41 FR 12658, Mar. 26, 1976)

Subpart D—Operational—Response Phases

§ 1510.40 Phase groupings.

The actions taken to respond to a pollution discharge can be separated into five relatively distinct classes or phases. For descriptive purposes, these are: Phase I—Discovery and Notification; Phase II—Evaluation and Initiation of Action; Phase III—Containment and Countermeasures; Phase IV—Removal, Mitigation and Disposal; and Phase V—Documentation and Cost Recovery. It must be recognized that elements of any one phase may take place concurrently with one or more other phases.

§ 1510.41 Phase I—Discovery and notification.

(a) A discharge may be discovered through: (1) A report submitted by a discharger in accordance with statutory requirements; (2) through deliberate search by vessel patrols and aircraft; and (3) through random or inci-

dental observations by government agencies or the general public.

(b) In the event of a deliberate discovery, the discharge will be reported directly to the RRC. Reports of random discovery may be provided by fishing or pleasure boats, police department, telephone operators, port authorities, news media, or others. Reports generated by random discovery should be submitted to the nearest USCG or EPA office. Regional plans shall provide for such reports to be channeled to the RRC as promptly as possible to facilitate effective response action. Reports of major and medium discharges received by either EPA or USCG shall be expeditiously relayed by telephone to the other agency. Reports of minor discharges shall be exchanged between EPA and USCG as agreed to by the two agencies.

(c) The Agency furnishing the OSC for a particular area is assigned responsibility for implementing Phase I activities in that area.

§ 1510.42 Phase II—Evaluation and initiation of action.

(a) The OSC shall insure that a report of a discharge is immediately investigated. Based on all available information, the OSC shall: (1) Evaluate the magnitude and severity of the discharge; (2) determine the feasibility of removal; and (3) assess the effectiveness of removal actions.

(b) The OSC shall, when appropriate and as soon as possible after receipt of a report, advise the RRC of the need to initiate further governmental response actions. This may be limited to activation of the RRT or a request for additional resources to conduct further surveillance or initiation of Phase III or Phase IV removal operations.

(c) The OSC shall insure that adequate surveillance is maintained to determine that removal actions are being properly carried out. If removal is not being done properly, the OSC shall so advise the responsible party. If, after the responsible party has been advised and does not initiate proper removal action, the OSC shall, pursuant to section 311(c)(1) of the act, take necessary action to remove the pollutant.

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(d) If the discharger is unknown or otherwise unavailable, the OSC shall proceed with removal actions pursuant to section 311(a)(1) of the act.

§ 1510.43 Phase III—Containment and countermeasures.

(a) These are defensive actions to be initiated as soon as possible after discovery and notification of a discharge. These actions may include public health and welfare protection activities, source control procedures, salvage operations, placement of physical barriers to halt or slow the spread of a pollutant, emplacement or activation of booms or barriers to protect specific installations or areas, control of the water discharge from upstream impoundments and the employment of chemicals and other materials to restrain the pollutant and its effects on water related resources.

§ 1510.44 Phase IV—Cleanup, mitigation and disposal.

(a) This includes actions taken to recover the pollutant from the water and affected public and private shoreline areas, and monitoring activities to determine the scope and effectiveness of removal actions. Actions that could be taken include the use of sorbers, skimmers and other collection devices for floating pollutants, the use of vacuum dredges or other devices for sunken pollutants; the use of reaeration or other methods to minimize or mitigate damage resulting from dissolved, suspended or emulsified pollutants; or special treatment techniques to protect public water supplies or wildlife resources from continuing damage.

(b) Pollutants and contaminated materials that are recovered in cleanup operations shall be disposed of in accordance with procedures agreed to at the State or local level.

§ 1510.45 Phase V—Documentation and cost recovery.

(a) This includes a variety of activities, depending on the location of and circumstances surrounding a particular discharge. Recovery of Federal removal costs and recovery for damage done to Federal, State or local govern-

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ment property is included; however, third party damages are not dealt with in this Plan. The collection of scientific and technical information of value to the scientific community as a basis for research and development activities and for the enhancement of understanding of the environment may also be considered in this phase. It must be recognized that the collection of samples and necessary data must be performed at the proper times during the case to fix liability and for other purposes.

§ 1510.46 Special considerations.

(a) *Safety of personnel.* Actual or potential polluting discharges that could have an imminent and substantial effect on both air and water media can pose serious hazards to personnel health and safety. The OSC should be aware of this potential and should exercise caution in allowing civilian or government personnel into the affected area without first verifying the nature of the substance discharged. Regional plans shall identify the sources of information on the hazards, precautions, and personnel protective requirements that will be expected in carrying out response operations. The means for OSC to secure such information also shall be included.

(b) *Waterfowl conservation.* Oil discharges, particularly in estuarine and near shore areas, often cause severe stress to resident and migratory bird species. The DOI representatives and the State liaison to the RRT shall arrange for and coordinate actions of professional and volunteer groups that wish to establish bird collection, cleaning and recovery centers. Regional contingency plans shall, to the extent practicable, identify organizations or institutions that can and are willing to establish and operate such facilities. These activities will normally be considered Phase IV response actions (§ 1510.44 of this subpart).

Subpart E—Coordinating Instructions

§ 1510.51 Delegation of Authority.

(a) When required, delegation of authority or concurrence in proposed or continuing pollution control activities

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initially may be oral; however, written confirmation by the EPA representative on RRT should be completed as soon as possible.

§ 1510.52 Multi-regional actions.

(a) In the event that a discharge or a potential pollution emergency moves from the area covered by one contingency plan into another area, the authority to initiate pollution control actions shall shift as appropriate. In the event that a polluting discharge or potential pollution emergency affects areas covered by two or more regional plans, the response mechanism called for by both plans shall be activated; however, pollution control actions shall be fully coordinated as detailed in the regional plans.

(b) There shall be only one On-Scene Coordinator at any time during the course of a response operation. Should a discharge affect two or more areas, the RRT will designate the OSC, giving prime consideration to the area vulnerable to the greatest damage. RRT shall designate the OSC. If members of one RRT or of two adjacent RRT's, if appropriate, are unable to agree on the designation.

§ 1510.53 General pattern of response actions.

(a) When the predesignated Federal On-Scene Coordinator receives a report of a discharge, or potential discharge, the report should be evaluated. In most situations, the sequence of actions shown below should be followed:

(1) Investigate the report to determine pertinent information such as the threat posed to public health or welfare, the type and quantity of material discharged, and the source of the discharge.

(2) Effect notification in accordance with Annex V to this part and the applicable regional plan.

(3) Determine, in accordance with section 311(c)(1) of the act, whether removal actions are being carried out properly. Removal is considered as being done properly when the following criteria are met:

(i) Private cleanup efforts are effective in terms of the statutory defini-

tion of removal, that is, they are fully sufficient to minimize or mitigate damage to the public health or welfare. Private removal efforts shall be deemed "improper" to the extent that Federal efforts are necessary to prevent continued or further damage.

(ii) Private removal efforts must be in accordance with applicable regulations and guidelines, and Annex X to this part and other provisions or restrictions of this Plan.

(4) Designate the severity of the situation and determine the future course of action to be followed.

(5) Determine whether State action to effect removal is necessary.

(b) The result of the report probably can be categorized by one of five classes. Appropriate action to be taken in each specific type case is outlined below:

(1) If the investigation shows that the initial information overstated the magnitude or danger of the discharge and there is no environmental pollution involved, it shall be considered a false alarm and the case should be closed.

(2) If the investigation shows a minor discharge with the discharger taking appropriate removal action, contact should be established with the discharger. The removal action should be monitored to insure continued proper action by the owner or operator of the vessel, onshore facility or offshore facility from which the discharge occurred.

(3) If the investigation shows a minor discharge with improper removal action being taken, the following measures shall be taken:

(i) An immediate effort should be made to prevent further discharges from the source.

(ii) The discharger shall be advised of the proper action to be taken.

(iii) If the discharger does not follow this advice, warning of the discharger's liability for the cost of removal, pursuant to section 311(f), shall be given. (See paragraph (a)(3) of this section.)

(iv) The OSC should notify appropriate State and local officials. He shall keep the RRC advised and initi-

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ate Phase III and IV operations as conditions warrant.

(v) Information shall be collected for possible recovery of removal costs when removal is effected in accordance with section 311(c)(1) of the Act.

(4) When a report of investigation indicates that a medium discharge has occurred, or the potential for a medium discharge exists, the OSC shall follow the same general procedures as for a minor discharge. Additionally, the OSC shall make a recommendation concerning team activation to the Chairman of the RRT.

(5) When a report indicates that a major discharge has occurred, a potential major pollution emergency exists, or that a discharge or potential discharge which could arouse wide public concern has occurred, the OSC shall follow the same procedures as for minor and medium discharges. RRC and NRT shall, however, be notified immediately of the situation even if the initial report has not been confirmed.

§ 1510.54 Strike forces.

(a) The National Strike Force (NSF) shall be established consisting of personnel trained, prepared, and available to provide necessary services to carry out this Plan. This NSF shall be formed around the Strike Teams established by the U.S. Coast Guard on the East, West, and Gulf coasts, and including the Environmental Response Team (ERT) established by the EPA, when required. The NSF shall provide assistance to the OSC during Phase III, IV, and V operations as the circumstances of the situation dictate. When possible, the NSF will provide training to the Emergency Task Forces and participate with the Regional Response Team in Regional Contingency Plan development.

(1) The Strike Teams established by the U.S. Coast Guard are able to provide communications support, advice and assistance for oil and hazardous substances removal. These teams include expertise in ship salvage, diving, and removal techniques and methodology.

(2) The Environmental Response Team established by EPA to carry out

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the Agency's disaster and emergency responsibilities can provide the OSC and NSF with advice on the environmental effects of oil and hazardous substances discharges, and removal and mitigation of the effects of such discharges. This team includes expertise in biology, chemistry, engineering and, when necessary, meteorology and oceanography.

(3) The Emergency Task Forces established pursuant to section 311(c)(2)(C) shall consist of trained personnel with adequate supplies of oil and hazardous pollution control equipment and materials and detailed discharge removal plans for their areas of responsibility. The Emergency Task Forces shall be established by the Agency responsible for providing the OSC not later than one year from the effective date of this Plan.

(4) The NSF and ERT will generally respond to requests for assistance from the OSC. Requests for the NSF may be made directly to the Commanding Officer of the appropriate Strike Team, the Coast Guard member on the RRT, the appropriate Area Commander, USCG, or to the Commandant, USCG, through the NRC. Requests for the EPA-ERT may be made to the EPA Emergency Coordinator or the appropriate Regional Emergency Coordinator (REC), or the EPA representative on the RRT.