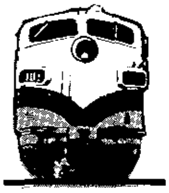
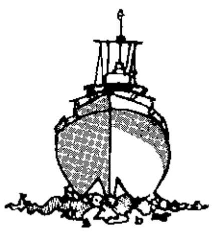


# NATIONAL TRANSPORTATION SAFETY BOARD



WASHINGTON, D.C. 20594

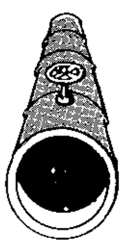


## RAILROAD ACCIDENT REPORT

CHICAGO AND NORTH WESTERN TRANSPORTATION COMPANY

FREIGHT TRAIN DERAILMENTS AND COLLISION

GLEN ELLYN, ILLINOIS



MAY 16, 1976

REPORT NUMBER: NTSB-RAR-77-2

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16 Abstract

About 4:25 a.m. on May 16, 1976, the locomotive and 27 cars of Chicago and North Western freight train No. 242 derailed as they moved eastward on a 1°54' to 2°15' compound curve just west of Glen Ellyn, Illinois. Another CNW freight train, No. 380, was moving eastward on an adjacent track at the time and struck the derailed cars of No. 242; the locomotive and nine cars of train No. 380 derailed. The tank-head of train No. 380's fifth car was punctured during the derailment by the coupler of an adjacent car; this released anhydrous ammonia into the atmosphere. Fourteen persons were injured as a result of the derailment and release of the ammonia. Damage from the accident was estimated to be $1,914,600.

The National Transportation Safety Board determines that the probable cause of this accident was the overturning of the outside rail of a 1°54' to 2°15' compound curve because the rail was unable to withstand the lateral forces of the locomotive induced by the speed of the train on track which did not comply with Federal Track Safety Standards.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

Adopted: March 31, 1977

# CHICAGO AND NORTH WESTERN TRANSPORTATION COMPANY FREIGHT TRAIN DERAILMENTS AND COLLISION GLEN ELLYN, ILLINOIS MAY 16, 1976

## SYNOPSIS

About 4:25 a.m., on May 16, 1976, the locomotive and 27 cars of Chicago and North Western Transportation Company (CNW) freight train No. 242 derailed as they moved eastward on a 1°54' to 2°15' compound curve just west of Glen Ellyn, Illinois. Another CNW freight train, No. 380, was moving eastward on an adjacent track at the time and struck the derailed cars of No. 242; the locomotive and nine cars of train No. 380 derailed. The tankhead of train No. 380's fifth car was punctured during the derailment by the coupler of an adjacent car; this released anhydrous ammonia into the atmosphere. Fourteen persons were injured as a result of the derailment and release of the ammonia. Damage from the accident amounted to $1,914,600.

The National Transportation Safety Board determines that the probable cause of this accident was the overturning of the outside rail of a 1°54' to 2°15' compound curve because the rail was unable to withstand the lateral forces of the locomotive induced by the speed of the train on track which did not comply with Federal Track Safety Standards.

## INVESTIGATION

### The Accident

On May 16, 1976, Extra 6923 East (No. 242), an eastbound Chicago and North Western Transportation Company (CNW) freight train, which consisted of 4 diesel-electric units, 43 cars, and a caboose, departed Clinton, Iowa, for Chicago, Illinois. The train had been inspected and tested before it had departed Fremont, Nebraska, and additional inspections and test were performed en route to Chicago. No discrepancies or malfunctions were found during any of the inspections. The crew was changed at West Chicago, 7.9 miles west of Glen Ellyn, Illinois, but the relieved locomotive crewmembers remained onboard in the second unit of the train. Train orders were issued which authorized No. 242 to operate at a speed of 60 mph between Geneva, 5 miles west of West Chicago, and Kedzie, near Chicago. No. 242 was the first eastbound freight train authorized to operate at that speed over this area under recently issued changes in CNW operating instructions.

About 4:25 a.m., No. 242 was moving about 60 mph on track 2, one of three main line tracks in Glen Ellyn, and began passing another eastbound freight train, Extra 873 East (No. 380), near College Avenue. The locomotive units and about 33 cars of No. 242 had passed the front end of No. 380 as No. 242 began to move around a curve to the right. The locomotive crew-members of No. 242 felt the locomotive lunge toward the north side and then toward the south side. The engineer looked rearward and saw fire coming from under either the rear locomotive unit or the first car. He reached for the brake valve but an emergency application of the brakes already had occurred.

The locomotive and first car separated from the train and continued eastward for about 2,400 feet where the car separated from the locomotive and stopped. The locomotive continued eastward another 2,200 feet. The next 26 cars of No. 242 derailed and obstructed track 3. The engineer of No. 242 immediately called the crew of No. 380 by radio to warn them of the accident.

Train No. 380, which consisted of 2 locomotive units and 63 cars, was moving eastward on track 3 at a speed of about 40 mph as No. 242 passed. When No. 380's engineer heard the warning of the derailment over the radio, he could not see the derailed cars because track 3 was the outside track on the curve. The engineer immediately made an emergency application of the brakes but the train's speed did not reduce substantially before the train collided with the derailed cars.

Glen Ellyn is located 22.4 miles west of Chicago. The 1°54' to 2°15' compound curve on which the accident occurred begins 5,297 feet west of Glen Ellyn and extends eastward for 2,813 feet. The grade for eastbound trains is 0.39 percent, descending, approaching the accident point.

Pennsylvania Avenue parallels the tracks on the north and several apartment houses are located on the north side of the avenue. Apartment houses and single-family dwellings are located along the south side of the tracks. (See figure 1.)

Track 2 consisted of 115-pound, continuously welded, 1,320-foot-long rail which was laid in 1967 on approximately 3,114 ties per mile. The rails were joined together by 36-inch, 6-hole, head-free joint bars and rested on 7 3/4-by 13-inch, 8-hole, double-shouldered tie plates. The rail was secured with two track spikes per plate around the compound curve and was box-anchored on alternate ties using 46 rail anchors per 39 feet of track. The track was ballasted with crushed quartzite to a depth of 14 inches below the bottom of each crosstie.

Although track 2 was constructed of continuously welded rail, there were numerous rail joints between College Avenue and the point of derailment. Several insulated joints were required for grade crossing protection. When the welded rail was installed, the CNW placed a buffer rail on one or both sides of each insulated joint; this resulted in additional rail joints.

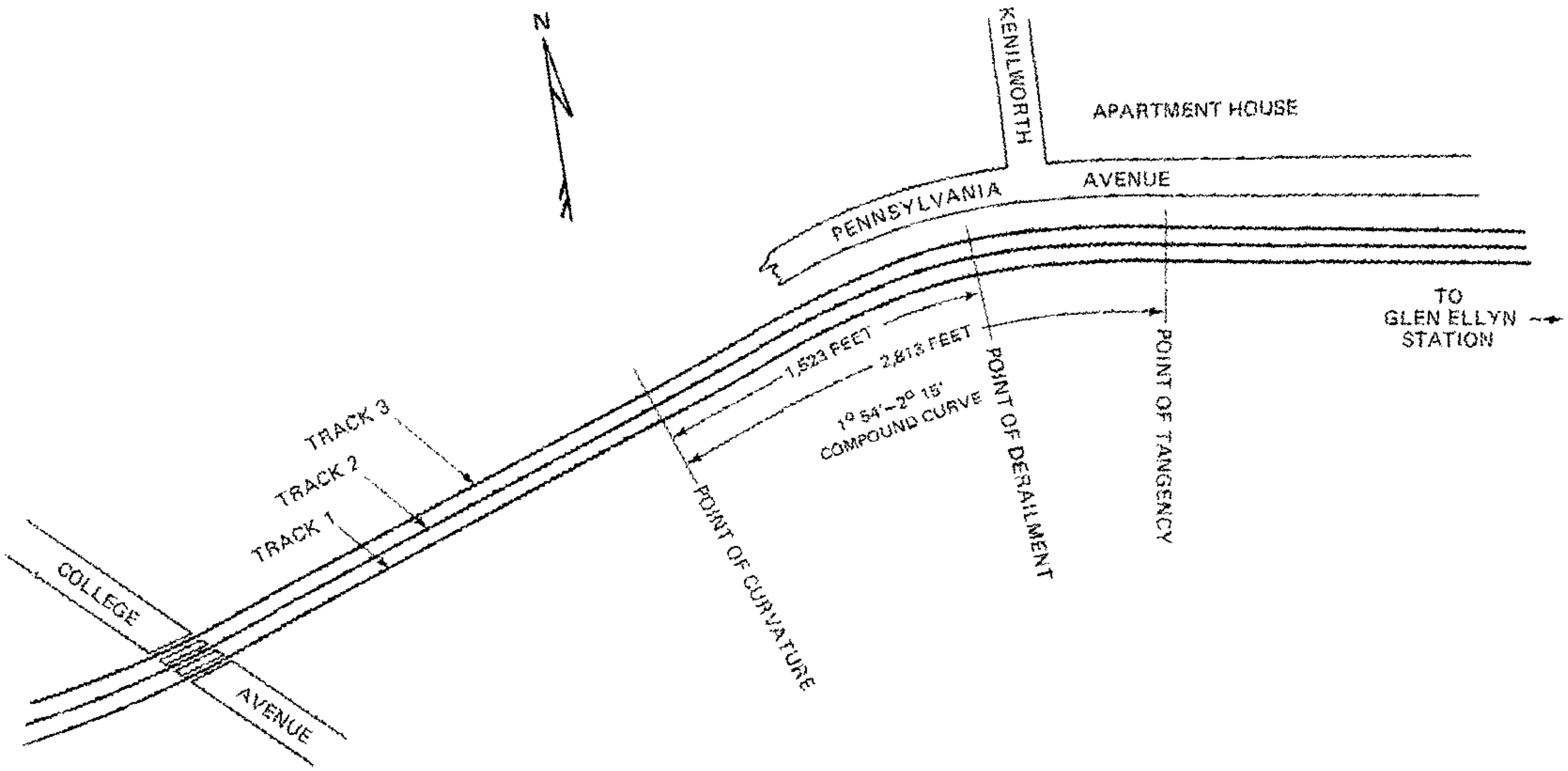


Figure 1. Plan of accident site.

The compound curve had a superelevation of about 4.9 inches. The gage of track 2 through the curve varied from 4 feet 8 1/2 inches to 4 feet 9 5/16 inches. Track 2 is classified as Class 4 under the Federal Track Safety Standards of the Federal Railroad Administration (FRA).

## Injuries to Persons

| Injuries | Crew | Passenger | Other |
|---|---|---|---|
| Fatal | 0 | 0 | 0 |
| Nonfatal | 1 | 0 | 14 |
| None | 9 | 0 | |

No. 380's front brakeman, after hearing No. 242's warning on the radio, was injured when he climbed out of the side window of the locomotive and dropped to the ground. The engineer, who stayed in the cab, was not injured. Fourteen persons were treated for ammonia inhalation.

## Damage to Trains

An examination of the locomotive of No 242 disclosed that three of the four units were damaged. On the second unit, the trailing wheel on the south side of the front truck had a mark on the outer rim which indicated that it derailed. Marks were found on the wheels of the rear truck of the third unit which indicated that it derailed and ran between the rails. Extensive damage was found on the underframe and on both trucks of the fourth unit.

Twenty-one flat cars loaded with trailers and 6 mechanical refrigerator cars of No. 242 derailed. The first car stopped upright on the track structure, 2,397 feet east of the derailment point. The other derailed cars stopped in various positions, on the track structure and on Pennsylvania Avenue. The 13th car crossed the avenue and struck the brick entrance to the parking lot of an apartment complex. The 15th car stopped on its side and a fire started near its refrigeration unit. The fire spread to a trailer before firemen extinguished it.

The locomotive units and first nine cars of No. 380 derailed and stopped in various positions on or adjacent to the tracks. They were heavily damaged.

The tankhead of the fifth car, PSPX 32028, a tank car loaded with 30,318 gallons of anhydrous ammonia, was punctured by the coupler of an adjacent car during the derailment. The anhydrous ammonia escaped from the 1/8-inch by 3-inch puncture and formed a vapor cloud. This car had not been provided with head shields or top and bottom shelf couplers. The car stopped at an angle of 25° with the damaged head slightly elevated.

Other Damage

The first marks of the derailment appeared on the gage side of the ball on the south rail of track 2, 1,523 feet east of the beginning of the curve; the marks extended for 4 feet 2 inches.

From this point neither rail showed any marks for 19 feet. Marks then appeared on the gage side of the ball of the north rail, followed by marks on the web on the gage side of the north rail. The north rail was broken 38 feet 6 inches east of the first mark on the web.

The north rail of track 2 was displaced to the north and stopped against the south end of the crossties on track 3 for a distance of 2,100 feet from the derailment point to the Prospect Avenue grade crossing. The south rail of track 2 was dislodged from its ties and tipped thoughout the same distance. The crossing flangeway rails in Prospect Avenue were shattered on the west end of the crossing.

The north side of the rails of track 2 showed wheel marks from the Prospect Avenue grade crossing east to the next crossing at Park Avenue. In this area the rail anchors and track spikes were damaged on both the south and north rails.

In addition to the damage to track 2, 546 feet of track 3 were destroyed. One rail of track 1 was tipped and the track's alignment was disrupted.

The surface of Pennsylvania Avenue and landscaping on nearby residential properties were damaged considerably.

Damaged-related cost was estimated as follows:

| | |
|---|---|
| Equipment | $ 804,600 |
| Lading | 850,000 |
| Track | 92,000 |
| Removal of Wreck | 81,000 |
| Surrounding Properties | 62,000 |
| Personal Claims | 25,000 |
| Total | $1,914,600 |

Train Information

The locomotive of No. 242 consisted of four SD-40-2 diesel-electric units which were rated at 3,000 horsepower, weighed 368,000 pounds each, and were provided with six-wheel trucks. The locomotive was equipped with cab signals, automatic train control, dynamic brakes, 26L-type air-brakes, automatic sanders, slip-slide detector, an operable radio, and a speed indicator but no speed recorder.

No defective conditions that would have caused or contributed to the cause of the accident were found on the locomotive units.

Method of Operation

In the accident area trains are operated by cab signal indications from an automatic block signal system. There are no wayside signals. The signal system is further supplemented by a two-position train control system. Track 3 is signalled for eastbound train movements and track 2 is signalled for movements in both directions.

The maximum authorized speed in this area is 60 mph for passenger trains and 40 mph for freight trains. The train control system has a high- and low-speed setting which corresponds to the allowable speed. Freight trains that meet certain standards are permitted by train order to operate at passenger train speeds.

Meteorological Information

The weather at the time of the accident was cloudy with scattered ground fog and a light southwest breeze. No precipitation fell during the day of the accident.

Tests and Research

Following the accident, an inspection of track 2 west of the accident site disclosed some defective conditions at the joint areas. One joint area, located on the superelevated north rail about 700 feet west of the derailment point had 170 inches between nondefective crossties. (See figure 2.) This track condition would not qualify for a FRA Class 1 designation, which permits a maximum freight train speed of only 10 mph. There were six additional crosstie defects at joints within 1,700 feet west of the derailment point that would meet only FRA Class 3 specifications, which permit a maximum freight train speed of 40 mph. The six defects were deteriorated crossties or crossties that were not spiked to the rail in the joint area. (See appendix A for track measurements.)

The track measurements taken following the accident showed several locations within two rail lengths where the elevation varied from 1 1/2 inches to 1 3/4 inches from established elevation and in one location it varied 1 1/4 inches in one rail length. Several other locations had wood shims applied between the tie plates and the crossties at the joints to correct excessive changes in cross level. Some of the shims were not secured. (See figure 3.)

An equilibrium speed is produced when the result of the reaction of the unit's weight with centrifugal force is directed toward the center of the track. The superelevation required on a curve of 1°54' and of 2°15' at an equilibrium speed of 60 mph is 4.8 and 5.6 inches.

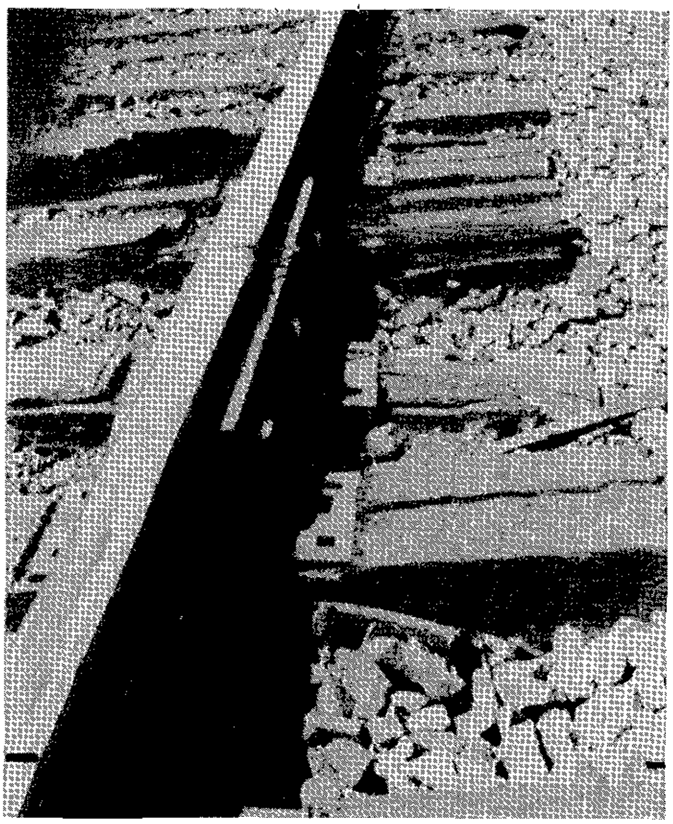

Figure 2. Defective crossties about 700 feet west of derailment point.

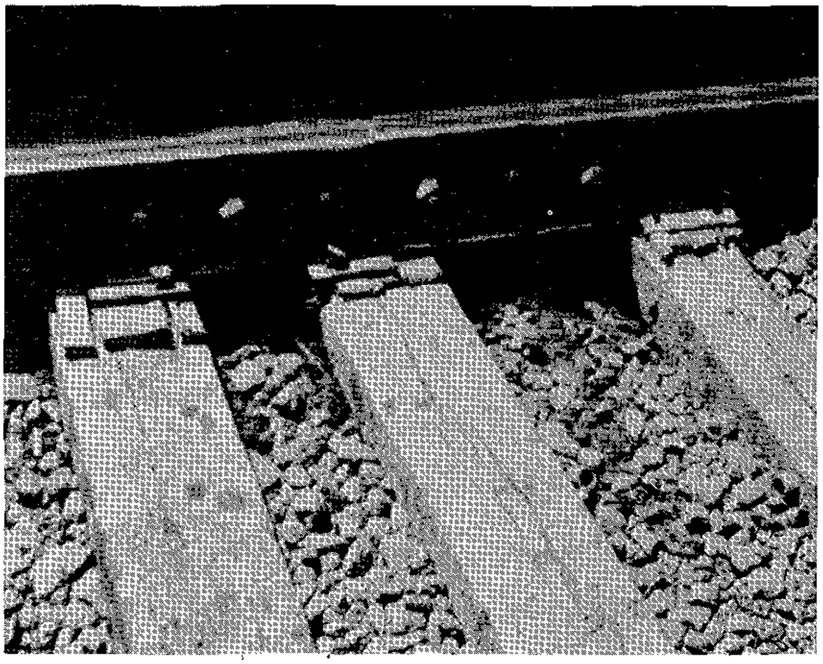

Figure 3. One of several joint locations with shims under tie plates.

The head of the 115-pound rail on track 2 on the north side of the curve was found to be worn about 8 percent.

The Association of American Railroads (AAR) analyzed the broken rail section of the elevated north rail of track 2. The AAR determined that the rail failed as a result of an impact on the gage side of the web; this probably occurred during the derailment.

Hazardous Material Information

Anhydrous ammonia, the chemical that was transported in PSPX 32028, is classified as nonflammable compressed gas under U.S. Department of Transportation safety regulations. About 20,000 gallons escaped through the punctured tankhead between the time of the derailment and 8:30 p.m. on May 16. The remaining 10,000 gallons were transferred into tank trailers brought to the accident site. The ammonia vaporized as it escaped. These ammonia fumes were dispersed by a southwesterly wind and engulfed the damaged tank car and the residential area along the tracks.

The derailment was observed by a Glen Ellyn police sergeant who notified the Dupage County Communications Center (DU-COMM) of the accident at 4:27 a.m. The fire department was dispatched immediately. The firechief reported that he arrived at the scene at 4:31 a.m.

After arriving, the firechief walked along Pennsylvania Avenue in the darkness, searching for injured train crewmen or bystanders. He detected the odor of ammonia as he reached the area near the parking lot of the apartment house. He was unable to see the source of the ammonia because of the fog, darkness, and wreckage. The firechief immediately ordered the evacuation of area residents. The evacuation decision, was made within 10 minutes after the derailment. The firechief was also concerned about a possible explosion of the gas and contamination of the Village Sewage Treatment Plant by chemical run-off.

At 4:30 a.m., a railroad dispatcher alerted DU-COMM to the wreck. The train crewmembers were not asked for, nor did they offer, any advice or instruction about the emergency handling of the tank car. They had not been trained to do so.

An area resident provided the earliest technical assistance to the firechief about 30 minutes following the derailment. The resident was a chemist and described the properties, danger, and probable behavior of the anhydrous ammonia to the firechief.

At 4:55 a.m., the first CNW representative reached the site. Sixteen minutes later, another official of the CNW arrived and discussed the emergency with the firechief. The official advised the use of water on the leaking ammonia.

Shortly after he detected the ammonia odor, the firechief requested that the Manufacturing Chemists Association's Transportation Emergency Center (CHEMTREC) be contacted. He expected CHEMTREC to send someone to the scene to help him with the emergency. However, because he transmitted his request via a portable radio with insufficient range, his request was not received by DU-COMM. CHEMTREC was not notified until 6:26 a.m. when an Illinois Environmental Protection Agency (EPA) representative called CHEMTREC for advice. The EPA representative relayed the CHEMTREC advice to the Glen Ellyn police department at 6:45 a.m. CHEMTREC's advice to the EPA representative was taken from the MCA CHEM-CARD, CC-44. (See appendix B.)

A representative of Phillips Petroleum Company (Phillips), the shipper of the ammonia, also went to the accident site. Phillips' policy is to provide emergency assistance to the railroad if requested.

About 9 a.m., the firechief began using water to reduce the quantity of ammonia vapors that were being dispersed in the area. Shortly thereafter, the tank car was approached to determine the size of the puncture. Because of the way the vapor cloud was formed as ammonia escaped through the crack, observers thought the puncture was a large one; they had concluded that the tank would be empty in 1 to 1 1/2 hours. Examination showed the puncture was only 1/8 inch by 3 inches.

During the afternoon, arrangements were made to transfer the remaining contents of the leaking tank car into two ammonia tank vehicles. The transfer was delayed until the assistant firechief and a consultant of the CNW sealed the puncture; they then pumped off the remaining ammonia from the leaking tank car. The evacuees were permitted to return to their homes about 9:00 p.m.

About 6:30 a.m., on May 17, Lake Ellyn and a storm water reservoir were reported to be contaminated by oil and ammonia from the water runoff from the accident site. The contamination also killed fish in Lake Ellyn.

## ANALYSIS

Because the main line tracks in the vicinity of the accident were supposedly maintained to the Federal Track Safety Standards for Class 4 track, the allowable maximum speeds were 60 mph for freight trains and 80 mph for passenger trains. The CNW, however, had set maximum speeds of 40 mph for most freight trains and 60 mph for passenger trains. The CNW had recently issued new instructions that allowed freight trains that met certain specifications to be operated in the area at 60 mph. Even though carriers may set speed limits lower than those allowed by the FRA, the track must still be maintained to the FRA requirements for each track class.

Train No. 242 was the first eastbound train to qualify for the higher speed since instructions had been issued; a speed of 60 mph was authorized by train order. Crewmembers estimated the speed of No. 242 to be about 60 mph as it entered the curve. The crewmembers on the locomotive stated that immediately before the derailment, the locomotive lunged toward the north side and then toward the south side. Before this movement the locomotive was reported to have been riding well with no unusual lateral movements. The train had traveled a considerable distance without difficulty and had rounded curves of equal or even sharper degree without lunging. Unless there was a mechanical failure of the locomotive as the train approached the point of the accident, it must be assumed that the locomotive was producing generally the same forces in relation to track conditions as it was before the accident. Inspections of the locomotive after the accident disclosed no defective conditions which would have caused the lateral movements. Therefore, it is assumed that track conditions produced the excessive lateral movements felt by the crewmembers.

The increased speed of No. 242 from 40 to 60 mph was a factor in producing sufficient lateral force to cause the north rail of track 2 to overturn. All eastbound freight trains before No. 242 had operated over this track at speeds of 40 mph or less. Six-wheel-truck locomotives produce considerable lateral forces as they move around curves. Increasing the speed to 60 mph over undesirable track conditions produced more lateral force than the track could support

The engineer of No. 380 did not have enough time between the derailment of No. 242 and the collision of his train with the derailed equipment to stop his train short of the collision. The fact that he was notified at all indicates that the engineer of No. 242 was alert.

The elevated north rail of track 2 appeared to have overturned under the fourth locomotive unit, approximately 1,500 feet east of the beginning of the 1°54' portion of the compound curve. Although the FRA permits 3 inches less superelevation than that required for equilibrium speeds, this difference should not create lateral forces great enough to overturn the elevated rail of the curve if the rail is adequately secured to nondefective ties. From the inspection of the track west of the derailment, it was evident that the crosstie conditions under various joints were inadequate to meet Federal Track Safety Standards for Class 4 track. The existing superelevation of 4.9 inches compared favorably with the required 4.8 inches.

Uniformity in the track curvature and superelevation is assumed in preparing criteria for the maximum allowable operating speed. Although track measurements for alignment, gage, and cross level taken at the accident site were within the limits allowed by the Federal Track Safety Standards, the curvature and superelevation varied considerably. From these imperfect track conditions, additional lateral and vertical forces are created as the wheels strike the uneven points in the alignment of the curve and as the wheels ride the surface irregularities of the track. All of the induced lateral and vertical forces must be absorbed by the track structure which supports the train. Any structural deficiency in the track will become evident as it is exposed to the abnormal stress.

Trains moving at speeds of 40 mph or less around curves that have deficiencies such as those described in this case may not generate sufficient forces to cause the outside rail to overturn; but when the speed is increased to 60 mph, these forces are greatly increased.

The condition of track 2 east from the point of the derailment could not be determined because the track was destroyed by the derailment. However, it may be assumed that conditions similar to those found west of the derailment point existed in the destroyed area. The reported riding conditions of the locomotive further supports the assumption that defective conditions existed.

The postaccident examination of track 2 revealed additional conditions --crosstie defects--that would have permitted freight trains to be operated at speeds no higher than 40 mph according to FRA regulations.

This accident shows how hazardous materials can complicate the safe handling of a train emergency. Awareness of the presence of hazardous materials in a train wreck during the earliest stage of the emergency response is essential for policemen and diremen. When hazardous materials are present, firemen may have to abandon their traditional "attack and extinguish" approaches and adopt alternative emergency handling methods.

Federal regulations require that hazardous materials cars be placarded and that commodity names be stenciled on cars carrying certain commodities. The traincrew must carry documents that indicate the position in the train of each car containing hazardous materials. A member of the traincrew also must possess a copy of the shipping papers for the hazardous materials which shows the information required by 49 CFR 172.202 and 172.203. Although emergency personnel are expected to remember to look for the placards, stencils, or crewman with the hazardous materials information, in this case it was not necessary because the firechief immediately recognized the odor of ammonia. The odor of the ammonia was the first indication of hazardous materials given to emergency personnel. These circumstances suggest that current methods should not be relied on to alert emergency personnel to the presence of hazardous materials in train accidents. Public safety officials need a reliable procedure to notify them of the presence of hazardous materials in train accidents so that they can adjust their emergency response to accommodate the special handling that may be required during the critical first few minutes of the emergency. A procedure for linking hazardous materials emergency diagnosis and response experts to onscene public safety officials at railroad hazardous materials emergencies would be more responsive to the immediate decisionmaking needs of these officials than existing procedures, which are based on manuals, training, or computer readouts.

Communications between the DU-COMM communicator and the railroad dispatcher within 3 minutes after the Glen Ellyn derailment suggest a way to meet the need for prompt notification. The railroad dispatcher should know the current status of trains that are carrying hazardous materials and which might be involved in an accident. The dispatcher could be required to communicate this information to the public safety communicator as soon as he becomes aware of a wreck involving such a train. If the dispatcher were provided with the names and locations of the hazardous materials in the train, he could provide this information to the public safety communicator also. The communicator could relay this information to the emergency personnel. At Glen Ellyn, if the dispatcher had known of the anhydrous ammonia shipment at the time of his call to DU-COMM, the firechief could have been alerted before he arrived at the scene.

After emergency personnel have been alerted to the presence of hazardous materials, they must have technical advice on how to eliminate the hazard. The firechief's discussion with the local chemist during the early stage of the emergency showed his need for technical assistance. Based on his training, the firechief did not attack the fire in No. 242's 15th car until he and the local chemist had considered the threat of the ammonia leaking from No. 380's fifth car, and the safety or environmental consequences that could occur from the fire department's actions. Uncertainties about these consequences delayed a response; this prolonged the evacuation. These circumstances question the validity and reliability of current methods of providing emergency assistance to local public safety officials.

There is presently no group of experts, such as the "hazardous materials squad" planned by the Glen Ellyn firechief, available to emergency personnel. CHEMTREC is designed to verbally convey information from written data sources to onscene officials. It can contact experts in member companies who are asked to communicate with the onscene emergency officials. However, the CHEMTREC communications system is not designed in a way that facilitates direct contact between the onscene officials and the expert.

The Safety Board recognizes that the establishment of a "hazardous materials squad" to provide nationwide service in railroad hazardous materials accidents requires study. The availability of competent experts, the establishment of lines of communication between public safety communicators and these experts, the source of funds, liability of advice provided, and methods for evaluating the continuing need for the service are some of the areas that need to be examined. The effects of present regulations and the development of improved emergency response methods, the relationship of such a group to other emergency disaster programs, and reduced training demands also require study before such a program can be recommended.

CHEMTREC's operational experience seems to provide the most comprehensive basis for evaluating a "hazardous materials squad" procedure for train accidents. CHEMTREC is supported by shippers who introduce many hazardous materials into rail transportation and it has worked closely with other organizations that offer emergency assistance. Therefore, it would be uniquely qualified to provide such an evaluation.

## CONCLUSIONS

### Findings

1. Train No. 242 was operating in accordance with the rules of the carrier as it approached the derailment point.

2. The increased speed of No. 242 from 40 to 60 mph produced greater forces against the outer rail of the curve than the forces produced by other trains that operated on the curve at 40 mph or less.

3. The engineer of No. 242 promptly warned the crew of No. 380 of the derailment.

4. The engineer of No. 380 did not have enough time between the derailment of No. 242 and the collision of his train with the derailed equipment to reduce substantially the speed of his train.

5. The examination of track 2 revealed several defective conditions which made the track ineligible for its designation by the FRA as a Class 4 track.

6. The reported lunging of No. 242's locomotive as the derailment occurred was caused by track conditions.

7. The defective crosstie conditions at joints contributed to the track defects which generated the high lateral forces produced by the locomotive as it moved around the compound curve.

8. If the tank car that contained the anhydrous ammonia had been provided with head shields, the tankhead would not have been punctured during the derailment.

9. Current methods of alerting public safety officials to the presence of hazardous materials at the scene of train accidents cannot be relied on to provide information in time to influence early response decisions.

10. Public safety officials need a reliable procedure to notify them of the presence of hazardous materials in train accidents so that they can adjust their emergency response to accommodate the special handling that may be required during the critical first few minutes of the emergency.

11. A procedure for linking hazardous materials emergency diagnosis and response experts to onscene public safety officials at railroad hazardous materials emergencies would be more responsive to the immediate decisionmaking needs of these officials than existing procedures, which are based on manuals, training, or computer readouts.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the overturning of the outside rail of a 1°54' to 2°15' compound curve because the rail was unable to withstand the lateral forces of the locomotive induced by the speed of the train on track which did not comply with Federal Track Safety Standards.

RECOMMENDATIONS

As a result of this investigation, the National Transportation Safety Board made the following recommendations:

.....to the U.S. Department of Transportation:

"Require by regulation that persons performing train dispatching functions maintain a record of trains and cars that are carrying hazardous materials and of current methods of, and procedures for, containment of these materials in the event of a mishap and communicate this information to public safety officials immediately after they learn of a train accident. (Class II, Priority Followup) (R-77-9)

"Require the Chicago and North Western Transportation Company to maintain its tracks to the specifications of the Federal Track Standards for each class and not increase train speeds until it is determined that the track is adequate for such speeds." (Class II, Priority Followup) (R-77-10)

.....to the Chicago and North Western Transportation Company:

"Maintain tracks to the specifications of the Federal Track Safety Standards for each class and do not increase train speeds until it is determined that the track is adquate for such speeds." (Class II, Priority Followup) (R-77-11)

.....to the Manufacturing Chemist Association:

"Analyze the operating experience of the CHEMTREC system and furnish the Materials Transportation Bureau of the U.S. Department of Transportation with recommendations for a system to link appropriate hazardous materials experts with onscene public safety officials during the critical first few minutes of a train accident involving hazardous materials." (Class II, Priority Followup) (R-77-12)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ WEBSTER B. TODD, JR.
Chairman

/s/ KAY BAILEY
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

WILLIAM R. HALEY, Member, did not participate in the adoption of this report.

March 31, 1977

# APPENDIX A

## TRACK MEASUREMENTS

May 20, 1976

### Track Centers

Track #2

Track centers measurements were taken between track #2 and track #3 starting with mid-ordinates station #2 and going west.

| Station | Track Centers |
|---|---|
| 2. | 14'-3" |
| 3. | 14'-4 1/4" |
| 4. | 14'-4 3/4" |
| 5. | 14'-4" |
| 6. | 14'-4" |
| 7. | 14'-4" |
| 8. | 14'-3 1/2" |
| 9. | 14'-3" |
| 10. | 14'-2 3/4" |
| 11. | 14'-3 1/2" |
| 12. | 14'-3 1/2" |
| 13. | 14'-3 1/2" |
| 14. | 14'-3/8" |
| 15. | 14'-4" |
| 16. | 14'-3 1/4" |

May 19, 1976

## MID-ORDINATES
Track #2

1. 1-15/16
2. 2
3. 1-5/8
4. 1-7/8
5. 1-7/8
6. 1-3/4
7. 1-1/2
8. 2-1/16
9. 1-7/8
10. 2
11. 1-3/4
12. 1-7/8
13. 1-7/8
14. 2-1/8
15. 1-1/2
16. 15/16
17. 2-3/4
18. 1-3/16
19. 2-1/4
20. 1-15/16
21. 2-1/4
    2-5/8 bad joint 6' west of station #21
22. 1-15/16
23. 2-1/4
24. 1-7/8
25. 2-1/2
26. 1-3/4
27. 2-1/2
28. 1-11/16
29. 2-1/8
30. 2-3/16
31. 1-7/8
32. 2-1/8
33. 1-5/16
34. 1-13/16
35. 1-7/8
36. 2-1/2
37. 1-1/2
38. 1-5/8
39. 2-1/16
40. 1-5/8
41. 1-15/16
42. 1-3/4
43. 1-7/8
44. 1-7/16
45. 1-1/2
46. 1-3/8
47. 1-1/16
48. 1
49. 5/8
50. 5/8
51. 7/16
52. 3/16
53. 0-0/0
54. 0-0/0

The above measurements were taken at 31-foot spacings using a 62-foot chord, starting at the west end of panels or 92'-6" west of the point of derailment.

(1)
May 17, 1976 (18 rails)
May 18, 1976 (22 rails)

CROSS LEVEL & GAGE CHECK
TRACK #2

The below cross level and gage measurements were taken at 19-1/2 foot spacings starting 112 feet west of the point of derailment on the north rail. This curve is a 2 degree, 11 minute with 4 1/2" full elevation.

| 39-ft rails | Elevation | Gage | |
|---|---|---|---|
| 1/2. | 4-7/8 | 56-15/16 | |
| 1. | 5-1/16 | 56-7/8 | |
| 1 1/2. | 5-1/4 | 57-1/8 | |
| 2. | 5 | 57 | |
| 2 1/2. | 5-1/2 | 56-7/8 | |
| 3. | 5 | 57-1/16 | |
| 3 1/2. | 4-7/8 | 57 | |
| 4. | 5 | 57-1/4 | |
| 4 1/2. | 4-3/4 | 57-1/4 | |
| 5. | 4-7/8 | 56-15/16 | |
| 5 1/2. | 4-7/8 | 57-1/8 | |
| 6. | 5-1/8 | 57-5/16 | |
| 6 1/2. | 5 | 57-3/16 | |
| 7. | 5 | 57-3/16 | |
| 7 1/2. | 4-7/8 | 57-1/8 | |
| 8. | 5 | 57-1/16 | |
| 8 1/2. | 4-3/4 | 57 | |
| 9. | 5 | 57-1/8 | |
| 9 1/2. | 4-3/4 | 57 | |
| 10. | 5-1/16 | 57-1/8 | |
| 10 1/2. | 5 | 57-1/16 | |
| 11. | 5-3/8 | 57-1/4 | |
| 11 1/4. | 5-3/4 | | |
| 11 1/2. | 5-1/8 | 57-1/4 | |
| 12. | 4-7/8 | 57-1/8 | |
| 12 1/2. | 4-1/4 | 57-3/8 | shims 3/4" joint low rail |
| 1/4. | 4 | 56-15/16 | |
| 13. | 3-7/8 | 57-1/8 | |
| 13 1/2. | 4-1/2 | 57-3/16 | shims joint tie not spiked & one bad |
| 14. | 4-7/8 | 57-1/4 | tie. |
| 14 1/2. | 5-3/8 | 57-3/8 | |
| 15. | 5 | 57-1/4 | |
| 15 1/2. | 4-7/8 | 57-1/16 | |
| 16. | 4-3/4 | 57-5/16 | (170" between non-defective ties). |
| 16 1/2. | 4-5/8 | 57 | |
| 17. | 4-3/4 | 57 | |
| 17 1/2 | 4-7/8 | 56-3/4 | |
| 18. | 5 | 57-1/16 | |
| 18 1/4. | 5-1/2 | 57-1/16 | (Joint on South rail two bad ties) |

(2)

## CROSS LEVEL & GAGE CHECK

| 39-ft. rail | Elevation | Gage | |
|---|---|---|---|
| 18 1/2. | 4-3/4 | 57-1/8 | |
| 19. | 4-3/4 | 57 | |
| 19 1/2. | 4-3/4 | 57-1/8 | |
| 20. | 4-7/8 | 57 | |
| 20 1/2. | 4-3/4 | 57-1/8 | |
| 21. | 4-3/4 | 56-7/8 | |
| 21 1/2. | 4-3/4 | 56-15/16 | |
| 22. | 4-1/2 | 57 | |
| 22 1/2. | 4-1/2 | 57-1/8 | |
| 23. | 4-3/4 | 57 | |
| 23 1/2. | 4-3/4 | 56-13/16 | |
| 24. | 4-7/8 | 56-15/16 | |
| 24 1/2. | 5-1/8 | 57 | |
| 25. | 4-7/8 | 57 | |
| 25 1/2. | 4-7/8 | 57 | |
| 26. | 4-7/8 | 56-3/4 | |
| 26 1/2 | 5-1/8 | 56-15/16 | |
| 27. | 5-1/8 | 57-1/16 | |
| 27 1/2 | 5 | 57-1/16 | |
| 28. | 4-7/8 | 57-1/4 | |
| 28 1/2 | 4-5/8 | 56-15/16 | (joint) |
| 29. | 5-3/8 | 56-11/16 | (joint) |
| 29 1/2 | 5-7/8 | 56-15/16 | |
| 30. | 5 | 57 | |
| 30 1/2 | 5 | 56-3/4 | |
| 31. | 5-1/8 | 56-15/16 | |
| 31 1/2. | 4-7/8 | 56-15/16 | |
| 32. | 4-7/8 | 56-7/8 | |
| 32 1/2 | 4-5/8 | 56-3/4 | |
| 33. | 5 | 56-13/16 | (Tag on tie full elevation) |
| 33 1/2. | 4-7/8 | 56-7/8 | |
| 34. | 4-1/4 | 56-5/8 | |
| 34 1/2. | 4 | 56-7/16 | |
| 35. | 3-5/8 | 56-3/4 | |
| 35 1/2. | 3 | 56-5/8 | |
| 36. | 2-7/8 | 56-5/8 | |
| 36 1/2. | 2-1/2 | 56-3/4 | |
| 37. | 2-1/8 | 56-11/16 | |
| 37 1/2. | 1-7/8 | 56-7/8 | |
| 38. | 1-1/2 | 56-15/16 | |
| 38 1/2. | 1 | 56-7/8 | |
| 39. | 3/4 | 56-15/16 | |
| 39 1/2. | 3/8 | 56-7/8 | |
| 40. | 3/8 | 56-3/4 | |
| 40 1/2. | 1/8 | 56-3/4 | |

May 20, 1976

## CROSS LEVEL & GAGE UNDER LOAD
Track #2

The below cross level and gage measurements were taken under load at joints and intermediate points, using 19-1/2 ft. spacing starting 112 ft. west of the point of derailment.

| 39-ft. rail | Elevation | Gage |
|---|---|---|
| 9 1/2. | 4-3/4 | 57-1/16 |
| 12 1/2. | 4 | 57-3/8 (shims 3/4" joint low rail) |
| 1/4. | 4 | 57-1/16 |
| 13 1/2. | 4-3/4 | 57-3/16 (shims joint tie not spiked & one bad tie) |
| 14 1/2. | 5-3/8 | 57-11/16 |
| 16. | 5 | 57-5/8 (joint had been repaired) |
| 17. | 4-3/4 | 57-1/8 |
| 18. | 5-3/8 | 57-1/4 |
| 28 1/4. | 4-3/4 | 57 |
| 28 1/2 | 4-5/8 | 56-11/16 |
| 29. | 5-1/8 | 56-5/8 |
| 41. | 0-0/0 | 56-13/16 |

# APPENDIX B

## Excerpts from MCA CHEM-CARD CC-44

ANHYDROUS AMMONIA

1.3 PHYSICAL FORM & APPEARANCE: Colorless liquefied compressed gas.

1.4 ODOR: Extremely pungent odor, typical ammonia odor

1.5 EFFECT WITH WATER: Liquid mixes with.

1.6 SHIPPING OR B/L DESCRIPTION: Anhydrous Ammonia - Nonflammable Compressed Gas

SHIPPER OR MANUFACTURER: SEE REVERSE

NATURE OF PRODUCT: Nonflammable compressed gas that has liquefied gas in the container. The gas is irritating and the liquid causes severe burns of skin or eyes.

FIRE: Can catch fire, but requires high ignition temperature

EXPOSURE: Exposure to liquid or high concentrations of vapor can cause severe burns. Excessive inhalation may cause severe damage to the lungs or even suffocation.

### IN CASE OF ACCIDENT

SPILL OR LEAK: Keep upwind from small leaks. Evacuate area downwind from large leaks or tank rupture and keep spectators at a safe distance. Approach spills and leaks from upwind. Shut off leak if without risk. Use gas mask with full-face mask and ammonia (Green) cannister (have refill cannisters available) around small leaks. Wear self-contained breathing apparatus around large leaks or spills. If necessary to enter spill area, wear protective clothing made of rubber or other materials impervious to ammonia, including boots and gloves. If possible prevent spilled or leaking liquid from entering waterways by diking or other means of containment. Water spray or fog is extremely effective in absorbing ammonia gas and should be used around leaks of gas only. Do not put water on liquid ammonia. Do not apply water to tank unless it is being heated by nearby fire.

FIRE: Move containers promptly out of fire zone. If removal is impossible, cool containers with water spray.

Agricultural Grade Ammonia *
Refrigeration Grade Ammonia *
Commercial Grade Ammonia *
Metallurgical Grade Ammonia *
$NH_3$ *

EXPOSURE: Remove to fresh air and call a physician at once. If not breathing apply artificial respiration, oxygen. Do not use Pulmotors. If breathing is difficult, administer oxygen. In case of contact with liquid, immediately flush skin or eyes with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes at once. If clothing is frozen to skin thaw with water and remove. Keep patient at rest. Do not apply salves or ointments to skin or mucous membrane burns for at least 24 hours.

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Contact below individual for additional information if the shipper cannot be found:

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The Fertilizer Institute, Wash. D.C.
Office Phone: 466-2700
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Mr. D. Baumann
Olin Corp.
Office - (713) -472-6141

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Allied Chemical Corp.

American Cyanamid Co.
AMSCO
ARCO Chemical Co.

Borden Chemical Co.

Chevron Chemical Co.

Cities Service Co.
Collier Carbon & Chemical Corp.
Commercial Solvents Corp.
Dow Chemical Co./Dixie Chem.
Du Pont
El Paso Products Co. (NM)
W.R. Grace & Co.
FMC Corp.
Gulf Oil Chemicals Co.

Hercules Inc.
Hooker Chemical Corp.
Int*l Mineral & Chemicals Corp.
ICI America Inc.
Mobil Chemical Co.

Monsanto Co.

Olin Corp.

Pennwalt Corp.
PPG Industries, Inc.
Red Barn Chemicals, Inc.
Reichhold Chemicals, Oregon
Shell Chemical Co.

Smith-Douglas, Div. of Borden Chem.
Superior Chemical Products Co.
Sun Oil Co.
TENNECO CHEMICALS (Hydrocarbon Div.
U.S. Industrial Chemicals Co.
Vistron Corp.
Vulcan Material Co., Chemicals Div.