National Transportation Safety Board

Railroad Accident Brief

Long Island Rail Road Passenger Train Strikes Platform in Atlantic Terminal

Brooklyn, New York

The Accident

On, January 4, 2017, about 8:18 a.m. eastern standard time, Long Island Rail Road (LIRR) passenger train 2817, consisting of six cars, collided with the platform at the end of track 6 in the Atlantic Terminal in Brooklyn (a borough of New York City, New York).[1] The lead end of the lead car came to rest on top of the concrete platform at the end of the track. (See figure 1.) As result of this accident, 108 people were injured. Damage was estimated at $5.3 million. The accident occurred inside the terminal and was not affected by the weather.

[1] (a) All times referenced are eastern standard time. (b) Atlantic Terminal, which the LIRR shares with New York City Transit, is beneath a commercial building that has restaurants and retail stores. (c) LIRR is part of New York's Metropolitan Transportation Authority.

NTSB/RAB-18/02

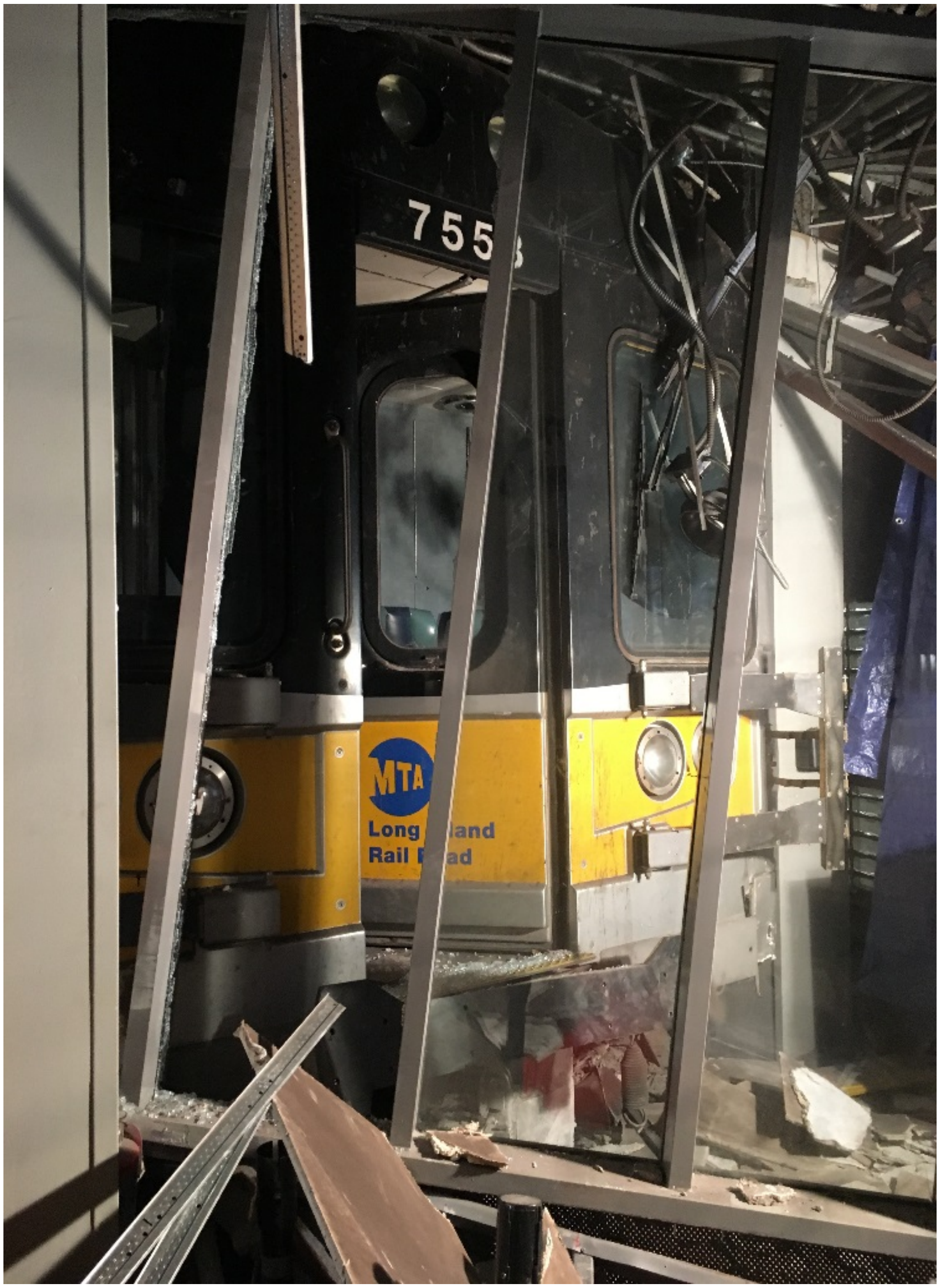

Figure 1. The accident train's lead car.

The Investigation

On the day of the accident, the LIRR engineer, conductor, and assistant conductor were scheduled to go on duty at the West Side Storage Yard in New York City at 12:16 a.m. The engineer commuted by train to work each day from Hicksville, New York, to Penn Station in New York City. On the night of the accident, the commuter train was running late, so the engineer's supervisor told him to disembark at Jamaica Station and wait there for his assigned train. Meanwhile, the supervisor arranged for a temporary replacement to fill in for the delayed engineer on the first scheduled revenue trip (on train 802) to Long Beach Station. On the return trip (on train 805), the regular engineer relieved his replacement at 4:28 a.m. and the regular crew continued running the route. The crew continued to Atlantic Terminal. They arrived at 4:51 a.m. and secured the train on track 1.

The train left Atlantic Terminal at 5:16 a.m. and arrived at Far Rockaway Station in the New York City borough of Queens at 6:10 a.m.; the train made 11 station stops. The crew moved to the cab on the opposite end of the train and changed the train's designation to 2817. They started the return trip to Atlantic Terminal at 7:20 a.m. The engineer and crew performed the required brake tests; the brakes operated as designed.

The engineer said he encountered a restricting signal at the Brook 2 Interlocking on main track 1, which required him to slow to restricted speed (not to exceed 15 mph).[2] (See figure 2.) The train then crossed from main track 1 to main track 2 where it encountered another restricting signal at the Brook 1 Interlocking that also required the train to travel at restricted speed. However, the maximum authorized track speed in the terminal was restricted to 5 mph. In this circumstance, the engineer must still be prepared to stop in one-half his range of vision while not exceeding 5 mph. The train was lined into track 6.

When the train reached the end of track 6, it struck the bumping post and continued until the first car crashed through a wall of an employee-only area. The train stopped on the concrete at the end of the track, which was level with the platform that runs parallel to the track.

The engineer said he remembered approaching the track 6 platform and then being thrown from his seat. The engineer said track 6 had a slight descending grade. To control the train speed, it was necessary to continually manipulate the master controller between power and braking. Using this technique, the engineer said the train's speed would normally fluctuate between 4 and 6 mph.

The locomotive was not equipped with either inward- or outward-facing cameras. Investigators reviewed event recorder data, which included the speed and master controller positions (and other inputs by the engineer), as the train entered the Atlantic Terminal. On the day of the accident, the train slowed to less than 5 mph near the restricting signal at Brook 1 Interlocking. The train's speed slowed to 2.4 mph, but it then started to accelerate until it reached 10 mph about 1,131 feet from the end of the track. Again, the train's speed slowed to 8.5 mph about 1,000 feet from the end of the track; however, it gradually accelerated to almost 13 mph (with the master controller in the minimum power position) when it struck the bumping post.

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[2] According to the *Long Island Rail Road Operations Manual, restricted speed* is a mode of operation, at which a train can be stopped within one-half the range of vision, short of the next signal, another train, obstruction, derail, or switch improperly lined, looking out for broken rail or crossing protection not functioning, while not exceeding 15 mph.

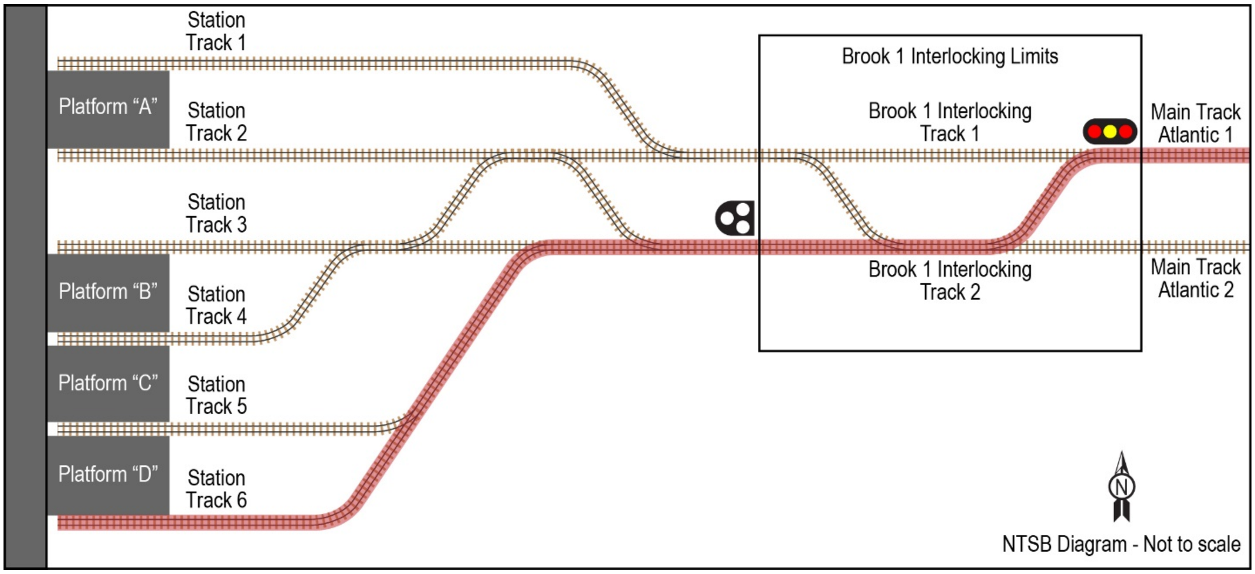

Figure 2. Diagram of tracks at Atlantic Terminal. (Brook 2 is to the right of Brook 1 and is not shown in the figure.)

Equipment

All six LIRR cars were coupled pairs with an operating cab at each end. A 750-volt direct-current third-rail supplied power to the cars, which were equipped with friction and electric brakes.

After the collision, three cars (7067, 7073, and 7074) remained upright and did not derail. The lead car (7553), which was the most damaged, derailed upright with its front end resting on the raised concrete at the end of the track.[3] Its front truck disconnected from the car body and moved about 6 feet backward.

Due to the damage to the lead and second cars, the electric and pneumatic brake systems could not be tested. A National Transportation Safety Board (NTSB) investigator examined the brake systems and running gear, draft components, glazing, signage, electrical components, and car body general condition. No defective conditions were found. When an NTSB investigator tested the brakes of four cars (7067, 7068, 7073, and 7074), he found that the brakes functioned as designed.

Track and Structure

Six LIRR station tracks (tracks 1 through 6) are in the Atlantic Terminal; track 6 was the southernmost track. Each track ended at a bumping post.[4] Walls and a roof enclosed the tracks at Atlantic Terminal. The accident train approached and entered the track in a 14-degree curve to the

[3] The concrete area in front of the train was level with the platform and was a continuation of the platform. However, the term *platform* applies only to the area adjacent to the train where passengers get on and off the train.

[4] A *bumping post* is a braced post, block, or obstruction placed at the end of a stub or spur track that halts car movement and prevents cars from going off the ends of the rails.

right and a 1-percent descending grade. Near the end of track 6, the grade was a 1-percent ascending grade.

LIRR had designated the maximum authorized speed as 5 mph from Brook 1 to the end of the platform tracks.[5] LIRR inspected the station tracks weekly. The last inspection before the accident occurred on January 3, 2017. The postaccident inspections of the track found no deviation from track standards, other than those caused by the accident.

Bumping Post

Train 2817 was traveling about 13 mph when it struck the bumping post at the west end of track 6. The lead car destroyed the bumping post. The car traveled 13 feet 6 inches after making contact with the bumping post. A segment of the rail attached to the bumping post pierced the floor of the lead car and entered the electrical closet directly behind the engineer's control cab.

In 2015, the LIRR engineering management asset group inventoried all bumping posts in passenger yard tracks, including those in the Atlantic Terminal. The bumping post that was struck was a Western Cullen Hays, Inc., model WDC. The manufacturer calculated that the bumping post had a maximum impact capacity of 415,000 pounds force. This capacity equals about six partially loaded M-7 multiple-unit locomotive passenger cars that are moving about 1 mph with no power applied. The accident train consisted of six M-7 cars; according to the event recorder, the train struck the bumping post at about 13 mph with the power shutting off at, or just before, impact.[6]

Signal and Train Control

The LIRR train movements on the Far Rockaway branch were governed by operating rules, general orders, timetable instructions, and the signal indications of a traffic control system supplemented with an automatic train control (ATC) system. Position light and color-light signals displayed the train movement authorities. Train movements into the Atlantic Terminal were coordinated by the Brook 1 tower operator at the terminal. All signals and switches were inspected and tested following the accident. No abnormalities were found, and the system functioned as designed.

The ATC system limited train speeds when encountering specific signals. If the locomotive ATC did not receive a cab signal track code, the train was restricted to 15 mph, and the system would stop the train if it exceeded 15 mph. Cab signal track codes were not transmitted to trains entering Atlantic Terminal. Train 2817 was restricted by the ATC to 15 mph after passing the first restricting signal at Brook 2 and changing from track 1 to track 2. According to the event recorder, train 2817 did not exceed 15 mph.

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[5] LIRR Timetable Special Instruction 1038-B, which was included in General Order 203, was effective November 14, 2016.

[6] M-7 multiple unit locomotives were manufactured by Bombardier, Inc., between 2002 and 2007. M-7 multiple unit locomotives are both locomotives and passenger cars that are powered electrically by use of a third rail.

Positive Train Control

On August 10, 2010, LIRR submitted its Positive Train Control (PTC) Implementation Plan to the Federal Railroad Administration (FRA). Following a plan revision, the FRA granted provisional approval to LIRR on July 7, 2011. In 2016, LIRR submitted a planned timeline to the FRA for full implementation of PTC technology by December 2018.

Under the main track exceptions section of the federal regulations, LIRR requested and the FRA approved a Passenger Terminal Exception for the array of tracks between Brook 1 Interlocking limits and the Atlantic Terminal. In its request, LIRR stated that the 5-mph maximum authorized speed for train movements through this area would remain. Furthermore, a 15-mph maximum speed would still be enforced by the restricting aspect of the ATC. In its request, LIRR stated that no freight trains would operate in this area.

Method of Operations

The LIRR train movements into Atlantic Terminal were primarily governed by signal indications with the ATC enforcing the train speeds appropriate to the wayside signal indication. Written instructions limited the maximum authorized speed for trains within Atlantic Terminal—including track 6—to 5 mph. However, the ATC only enforced the 15-mph limit because of the restricting signal indication entering the terminal.

Personnel Information

Engineer

The 50-year-old engineer was hired as an engineer by the LIRR on April 26, 1999. His engineer certification was current; it was due for renewal on November 17, 2019. The records showed that railroad supervisors observed the engineer's compliance with operating rules 56 times in the 12 months before the accident. The engineer failed to have his timetable and other instructions current and in proper order on November 15, 2016, at Hillside Station.

At the time of the accident, the engineer had no documented acute or chronic medical conditions and was medically certified to perform his duties. Following the accident, several specialists evaluated the engineer for possible impairing medical conditions. The neurology and the cardiology evaluations did not identify any issues; however, a sleep medicine evaluation identified undiagnosed obstructive sleep apnea (OSA).

The sleep specialist documented the engineer's height as 5 feet 10 inches, weight as 275 pounds, BMI as 39.5 kg/m^2, and neck circumference as 18.5 inches, which are the risk factors indicating possible sleep apnea.[7] Further, the engineer scored 12 of the possible 24 points on the

[7] According to the National Institute of Health, a body mass index of over 35 kg/m^2 indicates severe obesity and increases the risk of Type II diabetes, high blood pressure, cardiovascular disease, and obstructive sleep apnea (OSA).

subjective Epworth Sleepiness Scale.[8] Finally, a noninvasive polysomnographic evaluation (sleep study) conducted in a sleep center documented he had an apnea-hypopnea index (AHI) of 101.3 episodes per hour.[9] The sleep medicine specialist diagnosed severe obstructive sleep apnea (OSA) and prescribed continuous positive airway pressure (CPAP) as treatment.[10]

Following a 2013 fatal rail accident in Bronx, New York, in which undiagnosed OSA was implicated, Metro-North Railroad, a subsidiary of Metropolitan Transportation Authority (MTA), began an OSA screening program in January 2015 for its locomotive engineers. Since then, Metro-North Railroad has expanded the program to include its conductors. At the time of this accident, MTA had plans to include LIRR in the OSA screening program, but had not yet implemented the change. After the accident, on April 17, 2017, LIRR started screening locomotive engineers during their FRA recertification testing using the MTA OSA screening program.

The engineer was on the second day of his work week (Tuesday through Saturday); Sunday and Monday were his days off. The engineer shifted his sleep schedule by about 11 hours during his days off to coincide with his family's normal circadian sleep cycle.[11] This twice weekly reversal of his sleep and awake periods causes circadian rhythm desynchronization. According to New York City Transit's *Fatigue Awareness Training Manual*, changing work/sleep schedules back and forth more quickly than body rhythms can adjust will cause desynchronization, which leads to chronic fatigue.

After working the night shift, the engineer said that he usually slept 5 hours after arriving home about 11:00 a.m.[12] He also said he would nap when he had a long layover between assignments.

On Monday evening, the engineer took a 2-hour nap before leaving for work about 11:00 p.m. During his shift, he followed his normal routine and took a few naps when he had the opportunity. After arriving home, he slept for 5 hours. On Tuesday evening, he had a 3-hour nap before leaving for work around 11:00 p.m. Because there was a delay during the engineer's commute, he arrived at work late and was unable to nap during the accident shift.

Although the engineer may have been getting nearly 8 hours of sleep in a 24-hour period, the 8 hours were not uninterrupted. His training failed to adequately convey that uninterrupted hours of sleep in a 24-hour period are needed for people to obtain the full, restorative benefits of

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[8] The *Epworth Sleepiness Scale* is a subjective measure of the potential to fall asleep. The scale is administered by questionnaire. Generally, a score of 10 or higher is considered an excessive amount of sleepiness, depending on the situation.

[9] An *apneic episode* is the complete absence of airflow though the mouth and nose for at least 10 seconds. A *hypopnea episode* is when airflow decreases by 50 percent for at least 10 seconds or decreases by 30 percent if there is an associated decrease in the oxygen saturation or an arousal from sleep. The AHI sums the frequency of both types of episodes. An AHI of less than 5 is considered normal. An AHI of 5-15 is mild sleep apnea; 15-30 is moderate sleep apnea and more than 30 events per hour is considered severe sleep apnea.

[10] *CPAP* is a treatment for OSA that uses a machine to generate positive air pressure that is delivered though a mask that covers the nose or nose and mouth to keep the airways open during sleep.

[11] The engineer typically went to sleep about midnight on his days off and about 11:00 a.m. on the days he worked.

[12] Typically, he slept from 11:00 a.m. to 4:00 p.m.

sleep, including feeling rested and having the ability to focus and a sense of emotional well-being.[13]

In summary, the engineer desynchronized his circadian rhythms on his days off, and he did not get 8 hours of uninterrupted sleep on the days he worked. After the accident, he was diagnosed with severe OSA. These factors led to poor sleep quality and resulted in the engineer being chronically fatigued.

Conductor

The 46-year-old conductor was hired by the railroad on September 28, 1998. Her conductor certification was current and was due for renewal on September 16, 2019. The records showed that railroad supervisors observed the conductor's compliance with operating rules 51 times in the 12 months before the accident. No noncompliance entries were found. A review of her occupational records found that she was medically certified for her safety-sensitive position.

Assistant Conductor

The 51-year-old assistant conductor was hired by the railroad July 11, 2007. His conductor certification was current; it was due for renewal on April 29, 2018. The records showed that railroad supervisors observed the assistant conductor's compliance with operating rules 53 times in the 12 months before the accident. No noncompliance entries were found. A review of his occupational records confirmed that he was medically certified for his safety-sensitive position.

Toxicology

Quest Laboratory conducted FRA-mandated postaccident toxicology for the LIRR engineer, conductor, and assistant conductor in accordance with federal regulations. Testing was negative for tested-for drugs and alcohol.

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[13] Based on contemporary sleep research findings, such as M. Kahn, G. Sheppes, and A. Sedeh, "Sleep and Emotions: Bidirectional Links and Underlying Mechanisms," *International Journal of Psychophysiology* 89, no. 2 (2013): 218-228; M. Kahn, S. Fridenson, R. Lerer, Y. Bar-Haim, and A. Sadeh, "Effects of One Night of Induced Night-Wakings Versus Sleep Restrictions on Sustained Attention and Mood: A Pilot Study," *Sleep Medicine* 15, no. 7 (2014): 825-832; and P.H. Finan, P.J. Quartana, and M.T. Smith, "The Effects of Sleep Continuity Disruption on Positive Mood and Sleep Architecture in Healthy Adults," *Sleep* 38, no. 11 (2015): 1735-1742.

Probable Cause

The National Transportation Safety Board determined the probable cause of the Brooklyn, New York, accident was that the engineer of Long Island Rail Road train 2817 fell asleep due to his chronic fatigue. Contributing to his chronic fatigue was the engineer's severe undiagnosed obstructive sleep apnea, and Long Island Rail Road's failure to initiate obstructive sleep apnea screening for safety-sensitive personnel and refer at-risk safety-sensitive personnel for definitive obstructive sleep apnea testing and treatment before the accident. Further contributing to the accident was the Federal Railroad Administration's failure to require railroads to medically screen employees in safety-sensitive positions for obstructive sleep apnea and other sleep disorders. Also contributing to the accident was the lack of either a device or a safety system that could have intervened to stop the train before the collision.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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Adopted: February 6, 2018

For more details about this accident, visit www.ntsb.gov/investigations/dms.html and search for NTSB accident number DCA17FR002.

The NTSB has authority to investigate and establish the facts, circumstances, and cause or probable cause of a railroad accident in which there is a fatality or substantial property damage, or that involves a passenger train. (Title 49 *United States Code* (*USC*) Section 1131 - *General authority*)

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, "accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties . . . and are not conducted for the purpose of determining the rights or liabilities of any person." Title 49 *Code of Federal Regulations*, Section 831.4. Assignment of fault or legal liability is not relevant to the NTSB's statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report. 49 *USC* 1154(b).