National Transportation Safety Board
Office of Railroad, Pipeline and Hazardous Materials Investigations
Human Performance and Survival Factors Division
Washington, D.C. 20594

March 24, 2017

HUMAN PERFORMANCE GROUP CHAIRMAN'S FACTUAL REPORT

A. ACCIDENT

NTSB Accident Number:	DCA-16-MR-011
Date of Accident:	September 29, 2016
Time of Accident:	8:41 a.m. (EST)
Type of Train and No:	Passenger Train No. 1614
Railroad Owner:	New Jersey Transit (NJT)
Train Operator:	New Jersey Transit
Crew Members:	1 Engineer, 1 Conductor, 1 Brakeman
Location of Accident:	Hoboken, New Jersey

B. HUMAN PERFORMANCE GROUP

Stephen M. Jenner, Ph.D. (Group Chairman)
Human Performance Investigator
National Transportation Safety Board

Fred Mattison
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Primary Investigator
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Willie Bates
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SMART

C. SUMMARY OF THE ACCIDENT

The IIC will develop an accident summary that will be included in the NTSB public docket.

D. DETAILS OF THE INVESTIGATION

1. Behavioral Factors

a. *Sleep/Wake/Work History*. The engineer's sleep, wake and work history is included in Table 1.

Table 1. The engineers sleep/wake/work history

Date	Awoke	Duty Times	Activities at Home	Sleep
Monday	5:30 a.m.	7:31 a.m.-8:20 p.m.	Arrived home 9:10 p.m. Ate dinner, spent time with family, relaxed	To bed between 10:30-11:00 p.m., fell asleep "usually very quickly."
Tuesday	6:30 a.m.	Off duty (did not nap)	Drove kids to school; chores around the house	To bed between 10:30 – 11:00 p.m., fell asleep quickly. (Quality of sleep was "fine")
Wednesday	6:30 a.m.	Off duty	Drove kids to school; chores around the house; family time; dinner	To bed between 10:30 – 11:00 p.m.
Thursday	5:00 a.m. "feeling rested" Departed house at 6:05 a.m.	On duty at 6:46 a.m.	N/A	N/A

The engineer told investigators that he needed about 7 hours sleep to feel rested. He stated that he would take a nap "not every day, but sometimes" between assignments in the breakroom.[1] His nap may last between 1-2 hours. He stated that his quality of sleep was "fine" and he wakes up feeling "fine." During his sleep periods, he may wake up to use the bathroom.

2. Operational Factors

a. Training and Experience

[1] Such activities are not prohibited by rule or policy when an engineer is not required to perform service.

The engineer was hired in May, 1987 as a part-time ticket agent at the Mountain Station in South Orange, New Jersey. He performed that job for about five years (while attending college, where he graduated with a business degree). In 1991, he was hired as a full-time claim agent in New Jersey Transit's rail claims department. On October 4, 1998, he went into the locomotive engineer training program, and became a promoted engineer in March, 2000. He has worked as a locomotive engineer since that time.

The engineer was qualified to operate on the Pascack Valley Line (where the accident occurred) and all the other lines on the Hoboken Division. He is also qualified into New York and Sunnyside Yard.

b. Accident Trip

The engineer described the accident trip as a mostly normal day. For the past week, instead of the usual 5-car train, he was operating a 4-car train. He stated that this generally did not affect the manner in which he operated the train, other than braking a little easier because of the number of passengers standing in the cars. Because the same number of passengers occupied fewer train cars, this did cause some delays, and during this period he routinely arrived at the Hoboken Station about 6 minutes late. He told investigators that there were no consequences (i.e., disciplinary actions) for arriving late.

The engineer told investigations what is unusual about the Pascack Valley Line is the number of road crossings (which he indicated was more than 60 crossings over a short stretch of track). This required him to frequently blow the horn while operating through neighborhoods. He stated that this added to his workload and required him to stay focused while looking out for cars, pedestrians and ensuring that the crossing gates were down. The engineer told investigators that he felt he had adequate training and experience on that Hoboken line to operate safely, including making proper station stops and blowing the proper horn sequence as the train approached a grade crossing.

While operating on the Pascack Valley, the conductor would often begin the trip in the operating compartment then, as the train gets full, he would move to the passenger cars. Normally, the conductors would remain in the passenger cars for the duration of the trip. On some occasions, a conductor may enter the operating compartment to discuss operations with the engineer. Typically, this would occur under unusual situations, such as when a crossing gate is down and the train needs to be stopped for the conductor to get off and flag the train through the crossing. A conductor may also enter the operating compartment to deliver a copy of the Form D to the engineer. Neither of these instances occurred during the accident trip.

Train 1614 entering Hoboken Station. Train 1614's last stop prior to Hoboken was Secaucus. The engineer departed Secaucus and operated the train on track 3 at or near track speed towards Hoboken. He told investigators that he received "a normal set of signals." The train approached Hoboken on track 3 all the way through West End, then was routed to track 5, which was a normal operation for that train.

Operating speeds -- As the train enters Hoboken interlocking limits, the signal indication required him to slow from 30 mph to 15 mph before reaching the 600-foot long train shed. Trains are to operate at a maximum speed for 10 mph as it enters the shed and approaches the platform.

The engineer told investigators that he had operated his train in accordance with the signal indications. As he was about to enter the train shed, he recalled the following: looking at his watch and noting that his train was six minutes late; looking at the speedometer and seeing that he was traveling 10 mph; blowing the horn, and ringing the bell. The next thing the engineer remembered was hearing "a loud bang. I was getting hit with dust and dirt. I was thrown from the cab. I hit my head, the back of my head, I presume on the wall behind me. And then I had a period where I was going in and out of consciousness."

c. Event recorder data

Table 3 includes particular engineer-initiated activities and events during the last 12 minutes of the accident trip.

For a period of about 2 minutes (prior to reaching the train shed) the train was decelerating and had slowed to 10.45 mph 80 seconds before the collision (1244 feet from the platform).

The bell was last initiated 62 seconds before the accident as the train was traveling at 8.55 mph. Event recorder data shows no horn initiation around that time.[2] The data also shows that the throttle was moved from Idle to T4, 38 seconds before the accident (766 feet from the platform) and just prior to him reaching the train shed.

Table 3. Select activities documented on the train's event recorder

TIME	ACTIVITY	DURATION (seconds)	SPEED (mph)	DISTANCE FROM PLATFORM (feet)

[2] None of the 6 passengers interviewed by a New Jersey Transit Police officer reported hearing the horn moments before the accident. However, investigators reviewing the video of the outward-facing believed that the horn was sounded at around the time the bell was sounded.

8:31:18	Bell initiated[3]	50 seconds	51 mph	19.188 feet
8:31:21	Horn initiated	< 1	51	18,905
8:41:27	Train begins decelerating from 13.3 mph while in Idle		13.3	1319
8:41:31	Train decelerates to 10.45 mph		10.45	1244
8:41:46	Throttle: T2 to Idle	26 in Idle	8.0	1064
8:41:49	Bell initiated[4]	62 (remained on until collision)	8.55	1026
8:41.50	Horn initiated[5]	< 1		
8:42:12	Throttle: Idle to T4	38 in T4	7.6	766
8:42:50	Engineer Induced Emergency braking (EIE)	< 1	20.9	24
8:42:51	Collision	N/A	20	N/A

Alerter – Event recorder data indicates that the alerter in the operating compartment had sounded on three occasions during the accident trip which, according to NJT, are not unusual occurrences: 8:07.05 (lasting about 2 seconds), 8:30:49.9 (lasting about 2 seconds), and 8:33:47.9 (lasting about 4 seconds).

Accident witness

At the time of the accident, a New Jersey Transit employee (a conductor who was assigned to another train) was standing between tracks 9 and 10 in the Hoboken Terminal. He had first heard train "rumbling" before seeing it enter the station. He believed that the train was not slowing down. As the train approached, he looked through the window (for a "couple of seconds") of the operating compartment (the engineer's side) to try to identify the locomotive engineer. The witness told investigators that he did not see anybody in the compartment. He stated,

> I seen the train coming in. I knew something was up. And that's the first thinking I'm looking for, is – my eyes go right to where – where's the engineer? What is he doing? You know, is – and there was – I was down a little bit lower than the train, and my angle was a little bit. But from what I could see inside – I didn't have a perfect shot of where he might be sitting, but from what I could see, there was nothing there. There was nobody.

[3] The bell and horn were initiated as the train neared Secaucus Station.

[4] On a previous trip on the route (September 26, 2016), the engineer had initiated the bell 1,551 feet from the end of the platform as the train was traveling at 12 mph, and kept it ringing until the train came to a stop.

[5] Possibly due to the short duration of the horn blast, this data point was not captured on the event recorder.

Engineer's actions at crossings during the accident trip.

Investigators examined the video from Train 1614 outward-facing camera (that records audio and video data) for the entire accident trip. The video captures the engineer operating his train over dozens of crossings, and captures his bell and horn sequence as he approached each grade crossing. The data indicated that for several of these crossings, the engineer did not operate in accordance with the Train Horn Rule.[6] Table 2 lists the instances where proper procedure was not followed:

Table 2. The engineer's improper bell or horn sequences at crossings

TIME	EVENT
7:27:19	Train approaches crossing with the bell and 5 whistle blasts
7:32:02	Train approaches crossing with bell and 4 whistle blasts. Incomplete whistle pattern prior to crossing
7:33:55	Train approaches crossing with bell and 4 whistle blasts. Sequence finished early. Two more blasts immediately after passing crossing. Bell left on.
7:39:27	Train stops at Montvale Station at 5 car marker
7:45:50	Train approaches crossing with bell and 4 whistle blasts. Finished whistle sequence early.
7:46:16	Late horn sequence at crossing
7:49:16	Train passes through crossing with no horn. Horn sequence started after crossing.
7:53:01	Train approaches crossing with bell and 3 whistle blasts.
7:54:15	Train passes work zone adjacent to track with no bell or horn leaving station
8:09:35	Train passes through crossing with no horn or bell
8:09:48	Train approaches crossing with bell and 4 whistle blasts. Finished whistle sequence late
8:09:58	Horn/bell sequence with no crossing
8:10:25	Horn/bell sequence with no crossing
8:21:10	Train passes through crossing with no horn. Horn sequence started after crossing
8:22:09	Train passes through crossing with no horn. Horn sequence started after crossing
8:22:44	Horn/bell sequence with no crossing
8:29:39	Train passes through crossing with late horn sounding. No bell.

[6] Under the Train Horn Rule (49 CFR Part 222), locomotive engineers must begin to sound train horns at least 15 seconds, and no more than 20 seconds, in advance of all public grade crossings. Train horns must be sounded in a standardized pattern of 2 long, 1 short and 1 long blasts. The pattern must be repeated or prolonged until the lead locomotive or lead cab car occupies the grade crossing.

d. Equipment

The engineer said he was very familiar with the train equipment he was operating, and had been running it for years. He said there have only been minor modifications to the equipment.

The operating compartment was equipped with an alerter. During extended periods of inactivity, the alerter will make an audio alert that progressively gets louder if it is not acknowledged. The alerter sequence will reset with throttle manipulations, and when the horn or bell is sounded.

e. Cellular Phone Use

The engineer stated that his cellular phone was turned off and stowed with his personal belongings, which he had kept on the floor in the operating compartment. The engineer's cellular phone records show no activity (i.e., incoming or outgoing calls, SMS, or data usage) at any time during the accident trip.

Medical Factors[7]

a. Health

The engineer, 48-years-old, was 6-feet tall, 322 pounds and had a body mass index (BMI) of 43.67 kg/m2.[8] He told investigators that he had not been taking any medications. He stated that he did not have any history of sleep apnea or any other sleep disorders, and did not use a CPAP machine. He did not recall ever having any black-out episodes. He used a night guard, which he received from his dentist, to keep him from grinding his teeth at night. His last required physical examination at New Jersey Transit was in July 2016. His hearing was normal, and he was required to wear corrective lenses while operating trains. He was medically cleared for service.

b. Post-accident toxicological testing

In accordance with Federal Regulations, following the accident the engineer, conductor and assistant conductor were required to be tested for drugs and alcohol. Blood and urine specimens were collected at a local facility. The results of these tests were negative for illicit drugs and alcohol for the three crewmembers.

[7] For a more comprehensive medical history of the engineer, see the NTSB's Medical Officer's Factual Report.
[8] According to his medical history taken by the sleep clinic on October 4, 2016.

c. Sleep Study and Obstructive Sleep Apnea

Following the accident, the engineer underwent a home sleep study on October 4, 2016. The results indicated an Apnea–Hypopnea Index (AHI)[9] of 89. The sleep study concluded that he had severe sleep apnea.

Other Crewmembers on Train No. 1614

1. Brakeman

a. Experience

The brakeman on the accident train has been working as a brakeman/conductor for 20 years.

b. Sleep/Wake/Work history

The brakeman was off duty Tuesday night at 12:47 a.m. He went to bed at 1:30 a.m. and awoke 8:00 a.m. Wednesday morning. He was off duty on Wednesday. Wednesday night he went to bed at 10 p.m. and slept until 5:15 a.m. He said he felt "fine." On Thursday he went on duty at 6:31 a.m.

c. Accident Trip

The brakeman arrived at work a few minutes before the start of his shift, and later walked with the engineer to the train. They had a casual conversation, and the brakeman did not notice anything unusual about the engineer's behavior.

During the trip, the brakeman was responsible for the third and fourth passenger cars. He described the trip as being routine, and that the engineer operated the train properly at each station stop.

As the train approached Hoboken terminal the brakeman was in the fourth car, preparing to make an announcement over the PA system. After the train crossed over the switches and fourth car entered the straightaway, he noticed that the train was not slowing (as is normal operations). He also sensed that the train was beginning to accelerate. He made the decision to try to apply the emergency brakes, which required him to move through a crowd of passengers.

[9] The Apnea–Hypopnea Index or Apnoea–Hypopnoea Index (AHI) is an index used to indicate the severity of sleep apnea. An apnea is a complete cessation of breathing for 10 seconds or longer. An AHI of 5 to15 is classified as mild obstructive sleep apnea; 15 to 30 is moderate OSA; 30 or more is severe OSA.

Just prior to him reaching the emergency brake, he thought he heard the emergency brakes being applied, and then felt an impact.

After the collision, he assisted with the evacuation of passengers from the train. He had also exited the train and re-entered at the first car, then made his way to the operating compartment. He saw the engineer lying on unconscious on the floor under some rubble.

2. Conductor

a. Experience

The conductor was hired July 9, 2003, as an assistant conductor. He worked as a ticket collector. He has worked about 11½ years as a qualified conductor. He had worked every line in the Hoboken Division.

b. Sleep/Wake/Work history

On the morning of the accident he awoke at 4:50 a.m. after receiving between 7-8 hours sleep. He went on duty at 6:30 a.m. He works the extra board, and had worked on the previous 3 days before the accident.

c. Accident Trip

The conductor signed up for work a little before the engineer arrived. He conducted a job briefing, then he observed the engineer and brakeman walking together to the train. The conductor then called the dispatcher to make sure that there were no restrictions. (The dispatcher confirmed that there were none). He then got on the train and communicated with the engineer that there were no speed restrictions, or Form Ds. He talked briefly with the engineer, and believed that his behavior was normal.

During the trip, the conductor was responsible for the first two cars of the train. He noticed the cars were much more crowded, due to the train operating with four cars instead of its usual five.

He believed that the trip was routine until the time of the accident. He had not spoken to the engineer since the train departed Spring Valley, which was not unusual. After the accident, he assisted with the emergency evacuation of the passengers. He did not see or speak to the engineer after the accident.

* End of Report *

Compiled by: /s/_____ Date: March 24, 2017
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