National Transportation Safety Board

Railroad Accident Brief

BNSF Railway Head-On Collision

Panhandle, Texas

June 28, 2016

The Accident

On June 28, 2016, at 8:21 a.m. central daylight time, eastbound BNSF Railway (BNSF) train S LACLPC1-26K (striking train) collided with BNSF train Q CHISBD6 27L (westbound train) at milepost (MP) 525.4 on the BNSF Panhandle Subdivision near Panhandle, Texas.[1] The collision occurred about 0.5 mile east of the east switch of the Panhandle siding. A significant fire resulted from the collision. The locomotive engineer and conductor on the striking train and the conductor on the westbound train died in the accident. The three head-end locomotives and 10 intermodal cars of the striking train derailed. All five head-end locomotives and three intermodal cars of the westbound train derailed. (See figure 1.)

Figure 1. Accident scene. Photo courtesy of BNSF.

[1] All times in this accident brief are eastern daylight time.

Striking Train (S-LACLPC1-26k)

The striking train departed Amarillo, Texas, on main track 2 on June 28, 2016, at 7:45 a.m. This train traveled about 12 miles to Roberts, MP 538.5, where it crossed from main track 2 to main track 1 and continued eastward to the point of the collision. The striking train was powered by three forward-facing locomotives on the head end and two distributive power units (DPU) on the rear end. The train had 56 loaded intermodal cars, no empty cars, weighed 9,120 tons, and was 10,209 feet in length. The striking train received and passed an initial terminal air brake inspection and Class 1A air brake test on June 25, 2016, at 6:05 p.m. in Los Angeles, California.[2] BNSF Mechanical Inspectors completed all inspections and tests in accordance with Title 49 *Code of Federal Regulations* (*CFR*) Parts 215 and 232.[3]

The striking train crew included an engineer and a conductor who went on duty at Amarillo at 6:15 a.m., about 2 hours before the accident. The engineer was off duty for 30 hours, 16 minutes before going on duty, and the conductor was off duty for 61 hours, 45 minutes before going on duty.[4]

Westbound Train (Q-CHISBD6-27L)

The westbound train departed Wellington, Kansas, on June 28, at 2:31 a.m., and had four forward-facing locomotives and one rearward-facing locomotive on the head end, 54 loaded intermodal cars, and no empty cars. The train weighed 7,451 tons and was 8,497 feet long. The train received and passed an initial terminal air brake inspection and Class 1A air brake test performed by BNSF mechanical personnel on June 27, 2016, in Chicago, Illinois.

The crew consisted of an engineer and a conductor who went on duty at 1:45 a.m. in Wellington, Kansas. The engineer told investigators that he and the conductor held a job safety briefing upon arrival at the BNSF Wellington depot before boarding the westbound train. Both the engineer and the conductor were off duty for 21 hours, 25 minutes before returning to duty on the train.

Accident Narrative

The BNSF Herford Subdivision dispatcher, DS101 (dispatcher) was responsible for train movements through the accident site. The dispatcher stated during a postaccident interview that he intended to route the westbound train to enter the east end of the Panhandle siding from main track 1 and for the striking train to proceed eastward on main track 1 on signal indication at MP 526.1, after the westbound train had cleared the Panhandle siding . The dispatcher said that he planned the movements of the striking train and westbound train so that he could move a higher

[2] For more information on the Class 1 air brake inspection and air brake tests, see Title 49 *Code of Federal Regulations* (*CFR*) 232.205 through 232.213.

[3] For more information, see 49 *CFR* Part 215, Appendix D, "Pre-departure Inspection Procedure." Mechanical inspection criteria are found at 49 *CFR* Part 232, "Brake System Safety Standards for Freight and other Non-Passenger Trains and Equipment; End-of-Train Devices."

[4] Title 49 *CFR* Part 228, "Hours of Service of Railroad Employees, Recordkeeping and Reporting; and Sleeping Quarters," requires that employees working a full 12 consecutive hours must be given at least 10 consecutive hours off duty before being permitted to return to work.

priority train (Z-SBDWSB-626), eastward on main track 2 around the striking train. Figure 2 illustrates the planned routing of the striking train and the westbound train at the Panhandle siding.

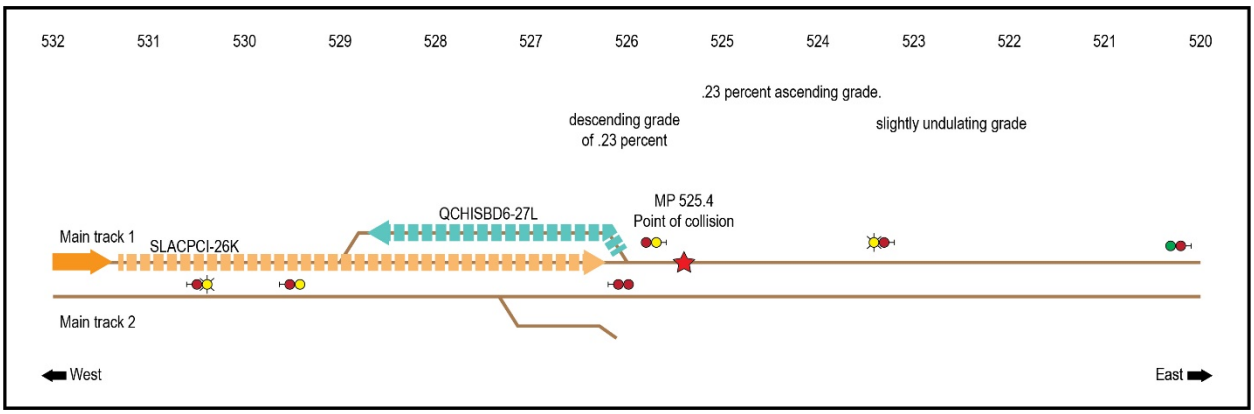

Figure 2. Train dispatcher-planned routing for striking train S-LACLPC1-26K and westbound Q-CHISBD6-27L.

According to the dispatcher, he tried to reach the striking train crewmembers on the radio about 8:06 a.m., to give them a courtesy "heads up" about the encounter at Panhandle. However, he said that he did not get a response from the crew. He requested a "radio check" and someone in the field responded that his radio was "good" (transmitting). He did not try to reach the striking train on the radio again before the accident. He said that at 8:12 a.m., he contacted the crewmembers of the westbound train on the radio and told them of the upcoming encounter at Panhandle with train S-LACLPC1-26K. The westbound train crew acknowledged the radio communication.

About 8:14 a.m., the westbound train received a clear indication (green over red aspect) to proceed at MP 520.5. The striking train encountered control point (CP) 5314 about 8:15 a.m., displaying an approach medium indication (flashing yellow over red aspect) at MP 531.4. The approach medium signal required that the train proceed and be prepared to pass the next signal at a speed no greater than 40 mph and be prepared for a diverging route. The locomotive event recorder data showed that the striking train did not reduce speed and passed the signal traveling about 60 mph at 8:15 a.m.[5]

At 8:17:34 a.m., the westbound train encountered an approach medium signal at MP 523.2. At 8:17:39 a.m., the striking train encountered CP 5289 displaying an approach signal (yellow over red aspect) at MP 528.9. The approach signal at MP 528.9 mandated that the striking train reduce speed to 40 mph and be prepared to stop at the next signal. Event recorder data showed that the striking train did not decrease speed and continued past the west switch of Panhandle, at MP 528.9, traveling about 63 mph at 8:17:39 a.m. At 8:20 a.m., the striking train did not stop, as required, at the stop signal (red over red aspect) at MP 526.1, and continued past the signal, traveling about 65 mph at 8:20 a.m.

[5] All times and speed for striking train S-LACLPC1-26K are based on event recorder data recovered from the DPU on the rear of the train.

Five seconds after the striking train passed the red signal at MP 526.1 on main track 1, it traveled through the dual controlled power switch that was in the reverse position for the intended movement of the westbound train into the Panhandle siding. The striking train continued eastward, past the stop signal on main track 1, and collided with the westbound train at MP 525.4. At the time of the collision, the speed of the striking train was about 57 mph and the speed of the westbound train was about 37 mph.

Medical and Toxicology Information

Striking Train (S-LACLPC1-26K) Engineer

According to the BNSF employment records for the 52-year-old male striking train engineer, a pre-employment physical examination and health questionnaire dated June 28, 1994, identified no significant medical conditions. The BNSF records did not include disclosures from the engineer about fatigue, sleep disorders, obstructive sleep apnea (OSA), treatment of OSA with a continuous positive airway pressure (CPAP) device, or the use of medication to counter fatigue.

National Transportation Safety Board (NTSB) investigators reviewed the medical records of the striking train engineer from his primary care physician dated August 2013 to May 2016. The engineer had a history of insomnia, gastroesophageal reflux disease, hypothyroidism, hypertension, hypercholesterolemia, and allergic rhinitis. His records indicated recurring prescriptions for simvastatin, levothyroxine, and loratadine.[6] Beginning in October 2014, his physician prescribed eszopiclone [3 milligrams (mg)], a short-acting sleep aid, marketed as Lunesta. Lunesta is a central nervous system depressant and carries a warning that in some cases it can impair daytime function the following day. Medical literature also indicates that pharmacodynamic tolerance or adaptation to some adverse depressant effects of eszopiclone may develop and that patients using 3 mg of this medication should be cautioned against driving or engaging in other activities requiring complete mental alertness the day after use.[7] A record of a visit with his primary care provider about 1 year before the accident, on July 21, 2015, indicated that the engineer complained of fatigue. The records for his fatigue evaluation contained no documentation of an evaluation for sleep disorders, including OSA, or questions about any history or treatment of OSA.[8]

In a written statement about the striking train engineer's health, his wife reported that he used a bilevel positive airway pressure (BiPAP) machine and mask at night for snoring until he

[6] According to the United States National Library of Medicine (USNLM), simvastatin is a cholesterol-lowering medication; levothyroxine is a replacement thyroid hormone, and loratadine is an oral nonsedating allergy medication. (Accessed on June 29, 2017, at: https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=fdbfe194-b845-42c5-bb87-a48118bc72e7; https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=1e11ad30-1041-4520-10b0-8f9d30d30fec; and https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=ac32d5f9-f553-4d5c-ad36-575af5ea56de.)

[7] USNLM, *DailyMed*. (Accessed May 30, 2018, at: https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=e711e994-a489-d14b-9a50-60557b9ed137.

[8] OSA often results in fragmented sleep and subsequent daytime sleepiness and fatigue.

had his tonsils removed in 2014.[9] She reported that he did not use the machine after his tonsillectomy but continued to snore. According to information provided by the engineer's wife, he was provided a prescription, dated February 6, 2007, for a BiPAP device and associated mask and tubing. Records from a medical equipment supply company, dated February 9, 2007, indicated that the prescription was filled. NTSB found no evidence in the engineer's records of a sleep study that led to the prescription for a BiPAP device or any evidence of clinical follow-up on the engineer's compliance or use of the BiPAP machine.[10] During a 2011 physical examination for attending a Boy Scout camp, the striking train engineer noted an unspecified sleep disorder, but denied use of a CPAP device.

The most recent Federal Railroad Administration (FRA)-required medical certification examination of the striking train engineer also occurred on July 21, 2015. This examination documented bilateral hearing loss that required amplification to meet FRA hearing acuity requirements. The examination did not identify any abnormalities in the engineer's visual acuity, visual field, or color vision testing. The record of this examination did not include height, weight, or vital signs, nor did it contain a review of medications, medical history, or an evaluation of OSA risk.[11]

A record of a visit with his primary care provider dated October 23, 2015, indicated that the engineer was 68 inches tall and weighed 188 pounds, with a body mass index (BMI) of 28.6 kg/m2.[12] His most recent clinic record documented a telephone call with his primary care provider on May 13, 2016, during which he requested a prescription for armodafinil.[13] The treating physician had not previously prescribed this medication, but the engineer told the provider that he had taken the medication in the past and, "it helped him stay awake." The provider prescribed one tablet of armodafinil every morning with two refills. Pharmacy records revealed the engineer received 21 tablets (150 mg each) of armodafinil on May 25, 2016, 34 days before the accident.

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[9] BiPAP is an advanced positive airway pressure device used to treat OSA, which is a chronic disease in which patients experience episodes of airway obstruction while sleeping. BiPAP provides two distinct pressures: one for inhalation and the other for exhalation. Like a CPAP device, the air pressure generated by the BiPAP compressor is delivered through tubing to a mask that covers the nose or nose and mouth and helps prevent obstruction of the airway while sleeping.

[10] Because the family practice clinic where the striking engineer received the OSA diagnosis had a records retention policy that was limited to 7 years, the clinic no longer had copies of his records related to the diagnosis and treatment of his OSA. In addition, the treating physician no longer worked at the clinic.

[11] (a) P.E. Peppard, T. Yount, J.H. Barnet, M. Palta, E.W. Hagen, and K.N. Hla, "Increased prevalence of sleep-disordered breathing in adults," *American Journal of Epidemiology*, 177, no. 9 (2013): 6-14. (b) Risk factors for OSA include, male gender, age, obesity, hypertension, large neck circumference [greater than 16 inches in women and 17 inches in men], a waist-to-hip circumference ratio of greater than 1 inch for men and 0.85 inch for women, and snoring.

[12] (a) National Institutes of Health, *Aim for a Healthy Weight*. (Accessed on May 30, 2018, at https://www.nhlbi.nih.gov/health/educational/lose_wt/risk.htm). (b) *Body mass index* is an estimate of body fat based on height and weight, (a BMI between 25 and 29.9 kg/m2) is considered overweight and increases the risk of developing health problems, including heart disease, high blood pressure, type 2 diabetes, and OSA.

[13] According to USNLM, Armodafinil is a controlled substance used to treat excessive sleepiness associated with OSA, narcolepsy, and shift work disorder. Armodafinil is in a class of medications called wakefulness-promoting agents, working by changing the amounts of certain natural substances in the area of the brain that controls sleep and wakefulness. (Accessed on December 13, 2017, at http://medineplus.gov/druginfo/meds/a607067.html).

Armodafinil is a long-acting Schedule IV controlled stimulant.[14] The market name for armodafinil is Nuvigil. There was no evidence of the prescription being refilled. There was also no evidence of any past use of Armodafinil by the engineer or evidence of any follow-up evaluation for sleep disorders after he began using the medication in May 2016.

Striking Train (S-LACLPC1-26K) Conductor

A pre-employment examination of the 59-year-old male striking train conductor performed by the Atchison, Topeka and Santa Fe Railroad Company on March 26, 1990, included a review of medical conditions and a multisystem physical examination. This examination did not identify any significant medical conditions. According to the BNSF's most recent occupational health records, the striking conductor underwent his most recent FRA-required medical examination on February 10, 2014. The examination documented his corrected distant vision as 20/30 both eyes, 20/25 right, and 20/30 left. He met hearing standards. He had no abnormalities in visual field or color vision testing. The record did not include height, weight, vital signs, review of medications, medical history, or evaluation of OSA risk.

Postaccident toxicology testing conducted by the Federal Aviation Administration (FAA) Bioaeronautical Sciences Research Laboratory detected diphenhydramine in muscle and lung and temazepam 0.065 ug/g in lung; testing did not detect ethanol in the muscle or lung. Diphenhydramine is a sedating antihistamine used as a sleep aid and to treat allergy symptoms. It is available over the counter under the trade names Benadryl and Unisom. It carries a warning that states the medication "may impair mental and/or physical ability required for the performance of potentially hazardous tasks."[15] Compared to other antihistamines, diphenhydramine causes marked sedation, which is the basis for its use as a sleep aid. Diphenhydramine may alter mood and impair cognitive and psychomotor performance.[16] Temazepam is a Schedule IV controlled substance of the benzodiazepine class and is a sedative intended for the short-term treatment of insomnia. According to the medication patient warnings, the biologic half-life of temazepam, which ranges from about 3 to 13 hours, may influence the type and duration of hypnotic effects and the profile of unwanted effects during administration.[17] Additional warnings indicate that temazepam "… can be abused or lead to dependence" and that patients should "tell [their] doctor if [they] have ever abused or been dependent on alcohol." The possibility of interaction with other psychoactive drugs or alcohol is enhanced when drug half-lives are long, as the drug may

[14] *Schedule IV drugs*, substances, or chemicals are defined by the US Drug Enforcement Administration as drugs with a low potential for abuse and low risk of dependence. Some examples of Schedule IV drugs are Xanax, Soma, Darvon, Darvocet, Valium, Ativan, Tawlin, Ambien, and Tramadol. (Accessed on February 25, 2019, at http://www.dea.gov//druginfo/ds.shtml).

[15] Federal Aviation Administration Civil Aerospace Medical Institute, n.d.

[16] (a) J.M. Weiler, J.R. Bloomfield, G.G. Woodworth, A.R. Grant, T.A. Layton, T.L. Brown, D.R. McKenzie, T.W. Baker, and G.S. Watson, "Effects of fexofenadine, diphenhydramine, and alcohol on driving performance. A randomized, placebo-controlled trial in the Iowa Driving Simulator." *Annals of Internal Medicine* 132, no. 5 (2000): 354-63. (b) In a driving simulator study, a single 50-mg dose of diphenhydramine impaired driving ability more than a blood alcohol concentration of 0.1.

[17] *Half-life* means the amount of time it takes the body to reduce the administered drug level by half.

accumulate during periods of nightly administration and be associated with impairments of cognitive and/or motor performance during waking hours.[18] The patient warnings add:

> You may still feel drowsy the next day after taking [temazepam]. Do not drive or do other dangerous activities after taking [temazepam] until you feel fully awake. You may have withdrawal symptoms if you stop taking [temazepam] suddenly. Withdrawal symptoms can be serious and include seizures. Mild withdrawal symptoms include a depressed mood and trouble sleeping.

Diphenhydramine and temazepam are both central nervous system depressants and when used in combination, may enhance the adverse toxic effects of the individual medications.[19]

Following the striking train conductor's return to work after an illness in January 2013, the BNSF requested his personnel medical records, which documented a hospitalization on January 1, 2013, for a gastroesophageal bleed from esophageal varices secondary to alcoholic cirrhosis of the liver. Review of the conductor's medical records from his gastroenterologist dated September 2013 to February 2016, found that on February 2, 2016, his height was 75 inches, his weight was 272 pounds, and his BMI was 34 kg/m2. The records indicated routine follow-up of his alcoholic cirrhosis with esophageal varices. Treatment included alcohol avoidance and diuretic use. The physician's notes documented good compliance with the treatment. The conductor reported no fatigue, abdominal pain or swelling, jaundice, leg swelling, or weight change. The review of systems recorded that the conductor had no difficulties with concentration, and his neuropsychiatric examination documented his mood and affect as normal. He reported that he quit drinking alcohol in December 2012. The physician's assessment was alcoholic cirrhosis without ascites (stable), numbness and tingling in his extremities, and chronic insomnia. The conductor's usual prescribed medications at this time included 30 mg of temazepam at bedtime, 300 mg of gabapentin at bedtime, 20 mg of furosemide daily, and 100 mg of spironolactone daily.[20] Gabapentin is a central nervous system depressant and may cause sedation. It carries the warning, "Prescribers and patients should be aware that patients' ability to assess their own driving competence, as well as their ability to assess the degree of somnolence caused by gabapentin, can be imperfect." According to an interview with the conductor's wife, he routinely took temazepam, furosemide, spironolactone, but not gabapentin. She also said that he continued to have an occasional beer. The quantity and frequency were not determined.

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[18] USNLM, *DailyMed*. (Accessed May 30, 2018, at: https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=bc56f7fd-1aaf-48ff-8aa7-d467e59e1015).

[19] Lexicomp Online, *Lexi-Interact Online*. (Hudson, Ohio: Lexi-Comp, Inc., 2016).

[20] (a) Furosemide is a common diuretic use to treat fluid retention (edema) and high blood pressure and is also used to treat swelling liver disease or other medical conditions (USNLM, *DailyMed* [Accessed May 30, 2018, at: https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=ea623e21-e9fd-4ef1-843b-82cbc05af5bf&audience=consumer]). (b) Spironolactone is used to treat cirrhosis of the liver accompanied by edema and/or ascites (USNLM, *DailyMed* [Accessed May 30, 2018, at: https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=a7510768-8a52-4230-6aa0-b0d92d82588f]). (c) Gabapentin is an antiseizure medication and is also used to treat chronic pain (USNLM, *DailyMed* [Accessed May 30, 2018, at https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=a36432f9-bddd-4b22-be6d-ed6ac2b3846a&audience=consumer]).

Positive Train Control

Federal regulations govern the development, functionality, architecture, installation, implementation, inspection, testing, operation, maintenance, repair, and modification of positive train control (PTC).[21] Although passenger trains do not operate on the Panhandle Subdivision, this track segment met the regulatory requirements for PTC installation and implementation because of the gross ton miles BNSF carried over the subdivision and the transport of poison inhalation hazard (PIH) materials.[22] The BNSF vice president of safety, training, and operations support stated that the assets for PTC were in place on the Panhandle Subdivision at the time of the accident; however, implementation at that location was awaiting completion of three system programs.[23] BNSF received the last system program on June 20, 2016, and began verification and validation of the system and subsequent testing before final implementation. The BNSF vice president further stated that another challenge involved with PTC installation on the Panhandle Subdivision was an expansion project that included installing double track on most of the subdivision, which was not completed until October 2015. On November 8, 2016, PTC became functional on the Panhandle Subdivision.

Postaccident Actions

Effective January 15, 2018, BNSF implemented a policy change that restricts personnel use of certain medications (such as opioids and synthetic opioid drugs, benzodiazepine drugs, barbiturate drugs, and certain sleep aids) for at least 24 hours before reporting for duty in a safety-sensitive position.[24] This policy also restricts use of medications containing codeine, dihydrocodeine, diphenhydramine, hydrocodone, and oxycodone to at least 8 hours before reporting for duty in a safety-sensitive position. Employees are prohibited from taking any of the listed medications while on duty.)

In January 2018, BNSF revised its "Return to Work from Off-Duty Medical Condition" form. Before an employee may return to duty from some medical conditions, the employee and his physician/treatment provider must complete the form, and the BNSF Medical and Environmental Health Department must review it. Further, the BNSF Medical and Environment Health Department reviews additional information related to any sleep disorder. For more information, see the NTSB docket for this investigation.[25]

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[21] See 49 *CFR* Part 236, Subpart I – *Positive Train Control Systems*, Public Law 110-432, 122 Stat. 4854 (October 16, 2008), the Rail Safety Improvement Act of 2008 at 49 *United States Code* (*U.S.C.*) 20157, and the Positive Train Control Enforcement and Implementation Act of 2015, 49 *CFR* 236.1006(b)(4)(iii)(B), Public Law 114-73, 129 Stat. 568, 576-82 (October 29, 2015; 49 *U.S.C.* 20157(a)(1), (a)(2)(B), (k). Also, *Federal Register* Vol. 81, No. 39, February 29, 2016: 10126.

[22] BNSF transported 180 MGT and PIH on the Panhandle Subdivision in calendar year 2015.

[23] BNSF had installed wayside interface units, which communicated to the network operations center for PTC implementation, monitoring, and recording all power switch positions and signal aspects.

[24] Safety-sensitive positions listed in this policy include any employee who operates a BNSF-owned/leased vehicle or mechanized equipment; train, yard, and engine employees (engineers, conductors, brakemen, switchmen, etc.); mechanical; intermodal equipment operators; resource protection employees; crew haulers; bridge operators; and employees who dispatch trains.

[25] For more information, see NTSB Docket DCA16FR008.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the collision was the failure of the striking train (S-LACLPC1-26K) crewmembers to comply with signal indications requiring them to slow and stop their train before signal 5261 due to (1) the engineer's disengagement from operating, possibly due to fatigue arising from untreated obstructive sleep apnea, and insufficient sleep quality and quantity on the night preceding the collision, and (2) the conductor's disengagement from operating, possibly due to the effects of two sedating medications. A functional positive train control system would have prevented the collision.

For more details about this accident, visit www.ntsb.gov/investigations/dms.html and search for NTSB accident identification number DCA16FR008.

Report Date: June 11, 2019
