Federal Railroad Administration
Office of Railroad Safety
Accident and Analysis Branch

Accident Investigation Report
HQ-2017-1239

Amtrak 501
DuPont, Washington
December 18, 2017

Note that 49 U.S.C. §20903 provides that no part of an accident or incident report, including this one, made by the Secretary of Transportation/Federal Railroad Administration under 49 U.S.C. §20902 may be used in a civil action for damages resulting from a matter mentioned in the report.

SYNOPSIS

On December 18, 2017, at 7:33 a.m., PST, southbound National Railroad Passenger Corporation (Amtrak) Passenger Train Number 501 (Train 501) derailed in an 8-degree, 22-minute, left-hand curve at Milepost (MP) 19.86 on the Central Puget Sound Regional Transit Authority, Sounder Commuter Rail (Sound Transit) Lakewood Subdivision, in DuPont, Washington. The lead locomotive and 12 cars derailed, with some sliding down an embankment, and some landing on the southbound lanes of Interstate 5, colliding with several highway vehicles.

Train 501 is part of the Amtrak Cascades passenger train service funded by the States of Washington and Oregon. The Cascades passenger train service operates between Vancouver, British Columbia, and Eugene, Oregon, using Talgo, Inc. (Talgo) passenger equipment.

DuPont, Washington, is located approximately 18 miles southwest of Tacoma, Washington. Sound Transit is the host railroad to Amtrak on the Lakewood Subdivision, which is approximately 20 miles in length from Tacoma to DuPont. Train 501 was traveling from Seattle, Washington, to Portland, Oregon, over the Point Defiance Bypass track between Tacoma and DuPont. Train 501 was the first revenue passenger train on the upgraded track between Lakewood and Nisqually, Washington.

Sound Transit utilizes a traffic control system (TCS) under the control of the Burlington Northern Santa Fe Railway Company (BNSF) Centralia North dispatcher located in Ft. Worth, Texas, as the method of operation on the Lakewood Subdivision.
Train 501 was traveling in a southward direction as described in Sound Transit Timetable Number 2, issued on November 13, 2017. Timetable directions are used throughout this report.

The derailment resulted in three Amtrak passenger fatalities, 74 Amtrak passenger injuries, five injured Amtrak employees, one injured Talgo employee, and eight injuries to motorists driving south on Interstate 5. The only hazardous material release was an undetermined amount of spilled diesel fuel. Amtrak reported $25,406,000 in equipment damages, and Sound Transit reported $425,000 in track and signal damages.

Amtrak cancelled three Cascades passenger trains on the day of the derailment, and re-routed trains over the previously-used BNSF Seattle Subdivision between Tacoma and Olympia, Washington, on an amended schedule. The new station at Freighthouse Square in Tacoma was closed after the derailment (its first day of operation), and the old Tacoma Station at the previous location was re-opened.

Freight rail operations over the derailment site on the Lakewood Subdivision resumed after bridge and track repairs were completed on January 4, 2018. Amtrak anticipates resuming passenger operations over the Lakewood Subdivision when a positive train control (PTC) system is operational on Amtrak equipment.

An active PTC system would have likely prevented this accident.

The derailment occurred at 7:33 a.m., PST, around dawn in rainy weather conditions, and the temperature was 48º F.

The Federal Railroad Administration (FRA) determined that the probable cause of the derailment was Cause Code H604 - Train outside yard limits, in block signal or interlocking territory, excessive speed.

FRA determined additional probable contributing factors to be Cause Codes H999 – Other train operation/human factors; H199 – Employee physical condition, other; and M599 – Other miscellaneous cause.

U.S. Department of Transportation
Federal Railroad Administration

FRA FACTUAL RAILROAD ACCIDENT REPORT

FRA File #HQ-2017-1239

TRAIN SUMMARY

1. Name of Railroad Operating Train #1	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
Amtrak (National Railroad Passenger Corporation)	ATK	150985

GENERAL INFORMATION

1. Name of Railroad or Other Entity Responsible for Track Maintenance	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
Sounder Commuter Rail	SCR	SCR171218

2. U.S. DOT Grade Crossing Identification Number	3. Date of Accident/Incident	4. Time of Accident/Incident
	12/18/2017	7:33 AM

5. Type of Accident/Incident
Derailment

6. Cars Carrying HAZMAT	7. HAZMAT Cars Damaged/Derailed	8. Cars Releasing HAZMAT	9. People Evacuated	10. Subdivision
0	0	0	0	Lakewood

11. Nearest City/Town	12. Milepost *(to nearest tenth)*	13. State Abbr.	14. County
Du Pont	19.9	WA	PIERCE

15. Temperature (F)	16. Visibility	17. Weather	18. Type of Track
48 ˚F	Dawn	Rain	Main

19. Track Name/Number	20. FRA Track Class	21. Annual Track Density *(gross tons in millions)*	22. Time Table Direction
Main	Freight Trains-60, Passenger Trains-80		South

23. PTC Preventable
Yes

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FRA FACTUAL RAILROAD ACCIDENT REPORT

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OPERATING TRAIN #1

1. Type of Equipment Consist:	2. Was Equipment Attended?	3. Train Number/Symbol
Passenger Train-Pulling	Yes	Amtrak 501

4. Speed (recorded speed, if available) R - Recorded E - Estimated	Code	5. Trailing Tons (gross excluding power units)	6a. Remotely Controlled Locomotive? 0 = Not a remotely controlled operation 1 = Remote control portable transmitter 2 = Remote control tower operation 3 = Remote control portable transmitter - more than one remote control transmitter	Code
78.0 MPH	R			0

6. Type of Territory

Signalization:
Signaled

Method of Operation/Authority for Movement:
Signal Indication

Supplemental/Adjunct Codes:
Q

7. Principal Car/Unit	a. Initial and Number	b. Position in Train	c. Loaded (yes/no)	8. If railroad employee(s) tested for drug/alcohol use, enter the number that were positive in the appropriate box	Alcohol	Drugs
(1) First Involved *(derailed, struck, etc.)*	WDTX 1402	1			0	0
(2) Causing *(if mechanical, cause reported)*				9. Was this consist transporting passengers?		Yes

10. Locomotive Units (Exclude EMU, DMU, and Cab Car Locomotives.)	a. Head End	Mid Train b. Manual	Mid Train c. Remote	Rear End d. Manual	Rear End e. Remote	11. Cars (Include EMU, DMU, and Cab Car Locomotives.)	Loaded a. Freight	Loaded b. Pass.	Empty c. Freight	Empty d. Pass.	e. Caboose
(1) Total in Train	1	0	0	0	1	(1) Total in Equipment Consist	0	12	0	0	0
(2) Total Derailed	1	0	0	0	0	(2) Total Derailed	0	12	0	0	0

12. Equipment Damage This Consist	13. Track, Signal, Way & Structure Damage
25406000	425000

14. Primary Cause Code
H604 - Train outside yard limits, in block signal or interlocking territory, excessive speed

15. Contributing Cause Code
H999 - Other train operation/human factors (Provide detailed description in narrative)

Number of Crew Members				Length of Time on Duty	
16. Engineers/Operators	17. Firemen	18. Conductors	19. Brakemen	20. Engineer/Operator	21. Conductor
1	0	2	0	Hrs: 2 Mins: 33	Hrs: 2 Mins: 33

Casualties to:	22. Railroad Employees	23. Train Passengers	24. Others
Fatal	0	3	0
Nonfatal	5	74	9

25. EOT Device?	26. Was EOT Device Properly Armed?
No	N/A

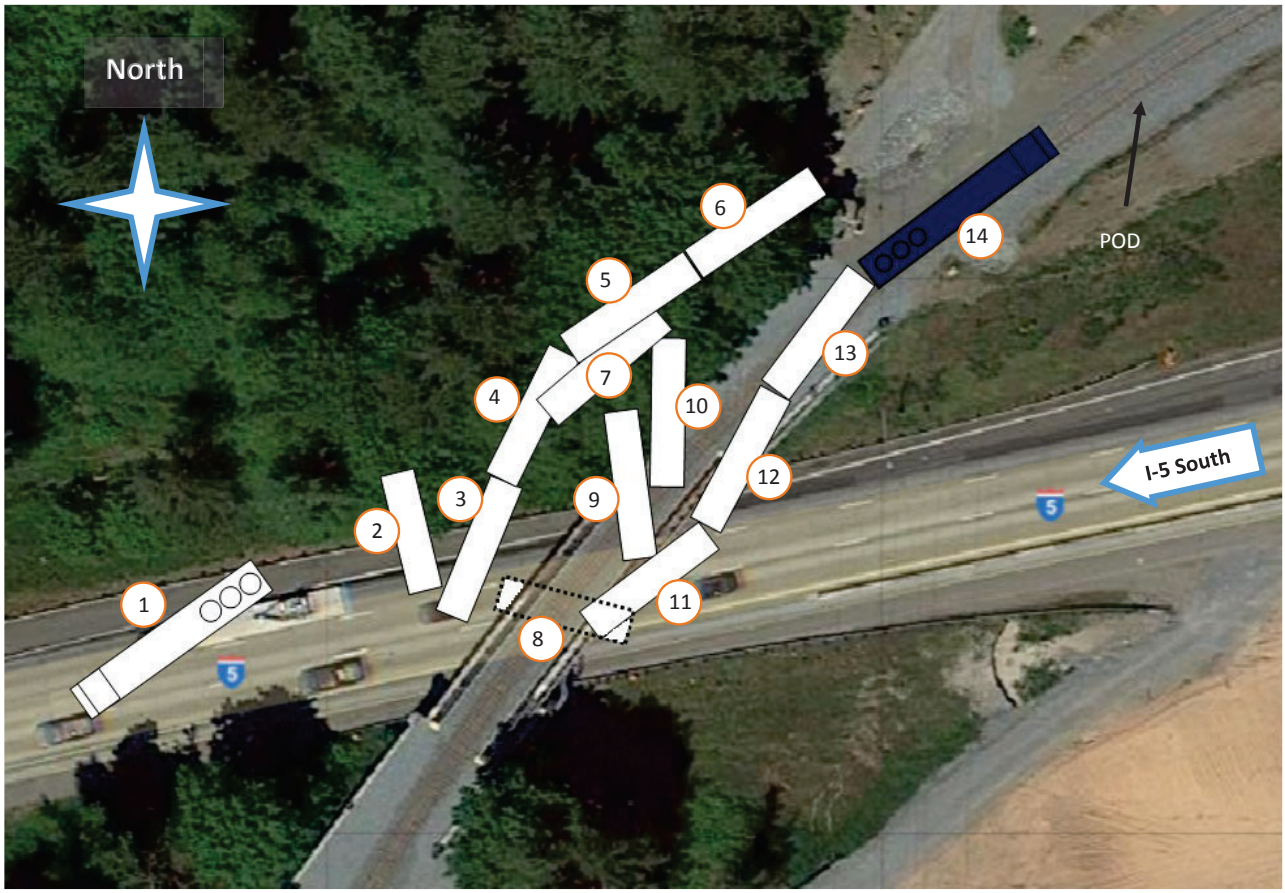
27. Caboose Occupied by Crew?
No

28. Latitude	29. Longitude
47.082418000	-122.675154000

SKETCHES

Sketch - ATK 501

HQ-2017-1239 Amtrak Derailment at Du Pont, Washington December 18, 2017



Amtrak Cascades Train 501 Consist Information

1. WDTX 1402 - SC-44 Charger Locomotive (on freeway)
2. ATK 7903 - Talgo Series 6 Power car (beside bridge)
3. ATK 7454 - Talgo Series 6 Business car (beside bridge)
4. ATK 7554 - Talgo Series 6 Bus. car ADA (beside bridge)
5. ATK 7804 - Talgo Series 6 Dining car (beside track)
6. ATK 7303 - Talgo Series 6 Bistro car (beside track)
7. ATK 7504 - Talgo Series 6 coach car ADA (beside track)
8. ATK 7424 - Talgo Series 6 coach car (under bridge)
9. ATK 7423 - Talgo Series 6 coach car (derailed on bridge
10. ATK 7422 - Talgo Series 6 coach car (derailed on bridge)
11. ATK 7421 - Talgo Series 6 coach car (hanging off bridge)
12. ATK 7420 - Talgo Series 6 coach car (hanging off bridge)
13. ATK 7102 - Talgo Series 6 Baggage car (beside track)
14. ATK 181 - P-42 GE Locomotive

**** WDTX 1402 Lead Locomotive heading timetable South **** **Not to Scale**

Sound Transit Lakewood Subdivision POD at MP 19.86

NARRATIVE

Circumstances Prior to the Accident

A National Railroad Passenger Corporation (Amtrak) train crew consisting of an Engineer, Conductor, and a Qualifying Conductor reported for duty on December 18, 2017, at 5:00 a.m., PST, at Amtrak Division Headquarters in Seattle, Washington. The crew had received the statutory off-duty period prior to reporting for duty. Portland, Oregon, was the home terminal for the Engineer. Seattle was the home terminal for the Conductor and the Qualifying Conductor. The crew was assigned to operate southbound Amtrak Passenger Train Number 501 (Train 501) from Seattle to Portland. A Talgo, Inc. (Talgo) employee was also assigned to Train 501 as an onboard technician.

Train 501 consisted of 2 locomotives (with 1 locomotive in the lead and 1 locomotive on the rear), 10 passenger cars, 1 baggage car, and 1 power car, which provides onboard power for the train. The power car was located directly behind the lead locomotive. The lead locomotive was manufactured by Siemens Industry Incorporated (Siemens), and the rear locomotive was manufactured by General Electric. The passenger cars, baggage car, and power car were all manufactured by Talgo. Amtrak performed a Class I initial terminal air test on Train 501 in Seattle before departing the Seattle King Street station at 6:09 a.m., PST.

The Engineer was seated at the controls on the right (west) side of lead locomotive WDTX 1402, and the Qualifying Conductor was seated on the left (east) side of the lead locomotive. The Qualifying Conductor was riding in the lead locomotive cab to qualify on the territory's physical characteristics. The Conductor was positioned in the dining car, which was the fourth car from the lead locomotive.

In the accident area, trains operate on single main track owned and maintained by the Central Puget Sound Regional Transit Authority, Sounder Commuter Rail (Sound Transit). Trains operate over the Lakewood Subdivision by signal indication through a traffic control system (TCS) controlled by a Burlington Northern Santa Fe Railway Company (BNSF) dispatcher, located in Ft. Worth, Texas.

Train 501 was traveling in a southward direction as described in Sound Transit Timetable Number 2, issued on November 13, 2017. Timetable directions are used throughout this report.

Approaching the accident location at Milepost (MP) 19.86 from the north, starting at MP 19.2, there is a half-mile section of tangent track, followed by an 8-degree, 22-minute, left-hand curve at the derailment site, and then a short section of tangent track for approximately 500 feet, followed by a 6-degree, 55-minute, right-hand curve.

The grade is a 1.26-percent descending grade from MP 19.2 to MP 19.62, followed by a 1.53-percent descending grade from MP 19.62 to the accident site at MP 19.86. The descending grade continues past the accident site for another mile.

The Accident

According to event recorder data, combined with images from the outward-facing camera from the lead locomotive, Train 501 passed a clear signal at Control Point (CP) 188 at MP 18.76 at 7:32:58 a.m., PST. At 7:33:23 a.m., PST, as Train 501 passed under the Mounts Road overpass at MP 19.62, the intermediate signal at MP 19.7 was visible ahead with a clear signal indication. The train's speed at the time of the screenshot was 82 mph, with Train 501 reaching 83 mph a few seconds later. At 7:33:44 a.m., PST, Train 501 passed a 30-mph permanent speed restriction sign on the right at 79 mph. At 7:33:48 a.m., PST, the event recorder stopped, with a last speed readout for the train of 78 mph.

The derailment occurred at 7:33 a.m., PST, around dawn in rainy weather conditions, and the temperature was 48º F.

The point of derailment (POD) was near the intermediate signal at MP 19.86, where Train 501 derailed on a left-hand curve (curve 19A1) traveling at a recorded speed of 78 mph on mainline track, with a permanent posted speed restriction of 30 mph. The curve led into a rail bridge over Interstate 5.

The lead locomotive derailed to the right (north) of the track and traveled down an embankment, knocking over trees and brush, and coming to rest upright 452 feet from the POD. The lead locomotive and cars one through six went down the embankment and came to rest south of the rail bridge over Interstate 5. The seventh car landed on the southbound lanes of Interstate 5 under the rail bridge. The eighth and ninth cars were derailed and remained upright on the roadbed of the rail bridge over Interstate 5. The 10th through 12th cars derailed on the north side of the rail bridge, with two of these cars hanging off the rail bridge over Interstate 5. The rear locomotive did not derail and remained on the track. Fourteen vehicles traveling southbound on Interstate 5 collided with parts of the train that landed on Interstate 5.

Emergency response reports indicate police personnel from the City of DuPont and emergency personnel from Joint Base Lewis-McChord were officially on scene at the derailment within 11 minutes. Individuals who were driving to work, including military personnel from Joint Base Lewis-McChord, also stopped to assist the injured as volunteers. Numerous emergency calls were made by passengers on the train requesting assistance.

Police and fire departments from Joint Base Lewis-McChord, DuPont, West Pierce Fire and Rescue, Tacoma, the Pierce County Sheriff's Office, and the Lakewood Police Department, along with personnel from the Washington State Patrol, assisted with the emergency response. Overall, more than 50 agencies from Pierce and Thurston Counties responded to the derailment of Train 501. Officials from Amtrak and a team of Federal Railroad Administration (FRA) Inspectors from FRA Region 8 also arrived at the derailment. The NTSB personnel arrived at the accident site later in the day.

The Engineer, Qualifying Conductor, and Talgo employee sustained significant injuries during the derailment. The Conductor and two Amtrak train attendants were also injured. Despite his injuries, the Conductor made his way to the rear locomotive and notified the BNSF dispatcher of the derailment over

the locomotive radio. Seventy-four of the 77 passengers reported injuries of all types, and three passengers were fatally injured in the derailment. Eight injuries were reported by people in vehicles struck by the train cars landing on Interstate 5.

Amtrak reported $25,406,000 in equipment damages to FRA, and Sound Transit reported $425,000 in track and signal damages. Amtrak reported to the Washington State Department of Ecology that an undetermined amount of diesel fuel spilled from Amtrak power car 7903 as it slid down the embankment. The power car had a fuel tank capacity of 132 gallons. Amtrak arranged an environmental contractor to clean up the spill at the derailment site.

Amtrak cancelled three Cascades passenger trains on the day of the derailment and re-routed trains over the previously-used BNSF Seattle Subdivision between Tacoma and Olympia, Washington on an amended schedule. The new Amtrak station at Freighthouse Square in Tacoma was also closed because of the accident (on its first day of operation), and the old station at the previous location in Tacoma was re-opened.

Freight rail operations over the derailment site on the Lakewood Subdivision resumed after bridge and track repairs were completed on January 4, 2018. The Washington State Department of Transportation (WSDOT) has stated Amtrak anticipates it will resume passenger operations over the Lakewood Subdivision in spring 2019, when a positive train control (PTC) system will be operational on Amtrak equipment.

Post-Accident Investigation

In conducting its post-accident investigation, FRA worked with representatives from the NTSB, Amtrak, Sound Transit, WSDOT, Washington State Utilities and Transportation Commission (Washington UTC), Siemens, Talgo, Brotherhood of Locomotive Engineers and Trainmen, the International Association of Sheet Metal, Air, Rail and Transportation Workers, and Stacy & Witbeck (the track contractor to Sound Transit).

The investigation team formed working groups to perform inspections, review records, and perform analysis of all aspects related to the accident. FRA used the analysis to form conclusions and establish the probable cause and probable contributing factors of the accident.

Analysis and Conclusions

Analysis—Crew Fatigue: FRA uses an overall effectiveness rate of 77.5 percent as the baseline for fatigue analysis. FRA does not consider fatigue as probable for any employee at or above this baseline. FRA obtained and analyzed the 10-day work history for the crew of Train 501, which included the Engineer, the Conductor, and the Qualifying Conductor.

Results of the analysis indicated fatigue was not probable for any of these employees at the time of the accident.

Conclusion: FRA determined fatigue did not contribute to the cause or severity of this accident.

Analysis—FRA Post-Accident Toxicological Testing: The accident met the criteria for FRA Post-Accident Toxicological Testing as required under Title 49 Code of Federal Regulations (CFR), part 219, subpart C.

FRA Post-Accident Forensic Toxicology Result Reports indicate the two employees tested, the Engineer and Conductor, had negative test results. Although this was a three-person crew consisting of an Engineer, Conductor, and Qualifying Conductor, the Qualifying Conductor was not tested. Due to his medical condition in the hours following the derailment, the Qualifying Conductor was unable to consent to the specimen collection; therefore, the hospital did not draw specimens. FRA has no evidence indicating drugs or alcohol contributed to the cause or severity of the accident.

Conclusion: FRA determined that it is unlikely drugs or alcohol contributed to the cause or severity of the accident.

Analysis—Locomotive Event Recorder: FRA obtained and analyzed a copy of the locomotive event recorder data for the lead locomotive. FRA's analysis of this event recorder data revealed the following:

During the 10 minutes before the derailment, the speed of Train 501 ranged just above and below 80 mph. Throttle positions for this time ranged between T6 and idle.

Train 501 was traveling at a speed of 78 mph when it derailed as it entered the 30-mph permanent speed restriction for the left-hand, 8-degree, 22-minute curve at MP 19.8. This 30-mph permanent speed restriction was published in Sound Transit Timetable No. 2, issued November 13, 2017. The recorded speed of 78 mph in the derailment area exceeded the 30-mph speed limit by 48 mph.

While the inward-facing camera indicated an overspeed alarm sound at 7:33:20 a.m., PST, (approximately 27 seconds before the derailment), it should be noted the only alarm indication that would show up on an event recorder download would be the traction motor amperage. This is the case because, when an overspeed alarm is triggered and the locomotive is providing tractive effort, the alarm would stop the production of tractive effort, which would then be represented on the locomotive download in the traction motor amperage record. As the train entered the accident site, the throttle position was in idle and not producing traction motor amperage; therefore, the traction motor amperage was already 0, and could not indicate the presence of an overspeed alarm on the locomotive download.

Conclusion: FRA determined that excessive speed while entering the 8-degree, 22-minute curve at MP 19.8 was the probable cause of the accident (Cause Code H604 – Train outside yard limits, in block signal or interlocking territory, excessive speed).

Analysis—External-Facing Locomotive Camera: FRA viewed the external-facing locomotive camera footage from the lead locomotive at the NTSB offices in Washington, D.C.

FRA verified that the trackside 30-mph permanent advanced warning speed sign, placed 2 miles before the speed restriction, and the 30-mph permanent speed restriction sign where the derailment occurred, were properly placed and visible from the lead locomotive. The milepost signs were also properly placed and visible. The signals at MP 18.8 and MP 19.86 were visible and operated as intended.

Conclusion: FRA determined the presence and location of the signage and signals for the permanent speed restriction did not contribute to the cause or severity of the accident.

Analysis—Internal-Facing Locomotive Camera/Audio: FRA viewed the internal-facing camera/audio footage from the lead locomotive at the NTSB offices in Washington, D.C.

The internal-facing camera/audio footage indicates that the Engineer and Qualifying Conductor were engaged in non-operational conversation as the train approached the accident site. The Engineer moved the throttle to idle at 7:33:19 a.m., PST, then three beeps sounded, and a warning light consistent with the locomotive overspeed traction lockout illuminated on the Engineer's dual-screen control panel at 7:33:20 a.m., PST. On the left screen, this was indicated as a flashing text on the lower left side and an illuminated warning on the mid-right side. On the right screen, this was indicated as an illuminated warning underneath the speedometer. The Qualifying Conductor's screen was dark at this point, as the screen on the Qualifying Conductor's side of an SC44 Charger locomotive enters a sleep mode and darkens without input from the Qualifying Conductor.

Overall, the internal-facing camera/audio footage establishes the following timeline leading up to the derailment:

At 7:33:06 a.m., PST, the Engineer's left hand was observed on the throttle, and his right hand on the automatic brake handle. The Engineer turned his head towards the Qualifying Conductor and began a non-operational conversation. The train speed was 81 mph, and the throttle was at T1. The Qualifying Conductor was observed turning his head toward the Engineer.

At 7:33:09 a.m., PST, the Engineer and Qualifying Conductor looked forward as they continued having a non-operational conversation, and the outward-facing camera shows the sign for MP 19 was visible ahead of the locomotive in the right-side right-of-way. The train was traveling 80 mph. The Qualifying Conductor was observed leaning back in his seat as he spoke.

At 7:33:10 a.m., PST, the train passed the sign for MP 19 while traveling 81 mph.

At 7:33:12 a.m., PST, the intermediate signal at MP 19.86 first came into view. The train was at MP 19.3 traveling 81 mph.

At 7:33:19 a.m., PST, the Engineer moved the throttle from T1 to Idle. The train speed was 82 mph.

At 7:33:20 a.m., PST, a warning light consistent with the locomotive overspeed traction lockout

illuminated on the Engineer's control panel. The Engineer moved the automatic brake handle to the minimum position. The non-operational conversation between the Engineer and Qualifying Conductor continued. The train speed was 82 mph.

At 7:33:21 a.m., PST, the Engineer looked left in the direction of the Qualifying Conductor.

At 7:33:24 a.m., PST, the conversation between the Engineer and the Qualifying Conductor paused.

At 7:33:26 a.m., PST, the Engineer looked to the right in the direction of the display, then looked forward, and then looked to the right again. The Qualifying Conductor looked down at the desk, then looked forward. The train speed was 83 mph.

At 7:33:29 a.m., PST, the Engineer resumed the conversation, then his sentence trailed off as he looked in the direction of the left display, and then down at the desk. His left hand was still on the throttle in idle position, and his right hand was resting on the automatic brake handle in the minimum position. The train speed was 82 mph.

At 7:33:34 a.m., PST, the Engineer looked again to the right, then forward. Concrete bench walls were visible on both sides of the train leading up to the Mounts Road overpass at MP 19.62. The speed restriction sign at the entry to the curve was visible ahead of the train at MP 19.72. The train speed was 81 mph.

At 7:33:38 a.m., PST, the train passed under the Mounts Road overpass at MP 19.62. The signal at MP 19.86 was clearly visible ahead of the train. The Engineer looked to the right, then forward again, with his left hand on the throttle in the idle position, and his right hand resting on the automatic brake handle in the minimum position. The train speed was 80 mph.

At 7:33:41 a.m., PST, the Engineer stated, "We just tripped the overspeed," and then leaned forward and began to push the automatic brake handle forward. Over a period of two seconds, the Engineer pushed the automatic brake handle to the Handle Off position, and looked down at the automatic brake handle. The Engineer removed his hand from the automatic brake handle, reached for the independent brake handle, and then reached back to the automatic brake handle. The Qualifying Conductor was leaning back in his seat and looking forward. The train speed was 80 mph.

At 7:33:44 a.m., PST, the Engineer stated an expletive, the Engineer leaned left with his left hand next to the throttle and his right hand on the automatic brake handle. The brake handle remained in the handle off position. The Qualifying Conductor was leaning back in his seat and looking forward. Neither crewmember initiated an emergency brake application. The train speed was 79 mph.

At 7:33:46 a.m., PST, the Engineer leaned left and slid out of his seat with his left hand off the desk. The train was entering the curve at MP 19.8. The train speed was 78 mph.

At 7:33:47 a.m., PST, the Engineer stated, “Aww we’re dead,” as he dove to the left. The Qualifying Conductor put his hand on the desk and began to lean to the left. The train began to rotate to the right, off the tracks. The train speed at the time of derailment was 78 mph.

Conclusion: FRA concluded that the Engineer and Qualifying Conductor carried on a non-operational conversation leading up to the accident. The Engineer and Qualifying Conductor did not communicate the name of each signal affecting their train as required by Amtrak’s Pacific Northwest Division General Order 2017-S07 (General Order 2017-S07) at I(C)(1)(a). The Engineer did not slow the train as required for the 30-mph permanent speed restriction beginning at MP 19.8. Neither the Engineer nor the Qualifying Conductor initiated an emergency brake application.

FRA identified the Engineer and Qualifying Conductor’s non-operational conversations, and subsequent loss of situational awareness, likely impacted the train operation and is a probable contributing factor in the accident (Cause Code(s) H999 – Other train operation/human factors and H199 – Employee physical condition, other).

Analysis—Engineer Certification: The Engineer of Train 501 was an Amtrak-certified engineer, in possession of a valid certification card with an issue date of March 25, 2015. Examination of documents regarding the Engineer’s locomotive engineer certification revealed no deficiencies.

Beginning on August 24, 2013, the Engineer (previously a conductor) began receiving extensive training as a Student Engineer. The training’s subject matter included signals and signal indications on the Union Pacific Railroad Company (UP) and BNSF. Other subjects included: air brake exercises and required brakes tests; identification of components on specific types of locomotives; changing operating ends on various types of locomotives; mechanical components; General Code of Operating Rules (GCOR) Seventh Edition; UP and BNSF timetables and operating rules; and courses on Automated External Defibrillator, Cardiopulmonary Resuscitation, and hearing loss.

The Engineer also completed training on the physical characteristics of Amtrak’s Pacific Northwest Division routes, including the route specific to the territory the Engineer was working on the day of the accident.
The Engineer received a passing score on all training.

The Engineer’s training and the covered subject matter followed the procedures outlined in Amtrak’s program for certifying the qualifications of locomotive engineers, dated April 2014, which FRA had reviewed and approved under Title 49 CFR part 240, subpart B.

Conclusion: FRA determined the Engineer’s certification did not contribute to the cause or severity of the accident.

Analysis—Conductor’s Certification: The Conductor on Train 501 was certified as a conductor in accordance with Amtrak’s program for certifying the qualifications of conductors, which FRA reviewed

and approved under Title 49 CFR part 242, subpart B. However, General Order 2017-S07 at I(A)(3)(c) requires conductors qualifying on a new territory to receive "the minimum number of head end trips as established for that territory before being examined on the physical characteristics," and must document the trips using "a Temporary Train Authorization Permit." FRA's investigation revealed that Amtrak failed to establish the minimum number of head end trips on the Lakewood Subdivision that would be required for each conductor, and the Conductor on Train 501 did not receive any head end trips. Instead of head end trips, Amtrak only provided qualifying trips when its conductors were located in the passenger compartment. Further, the Conductor's physical characteristics test violated Amtrak's Part 242 program because it did not include adequate questions to sufficiently measure a conductor's knowledge of the physical characteristics of the territory on which they served as a conductor, as required by Title 49 CFR §§ 242.121(c)(4)(iv), (c)(5). The test did not include any questions pertaining to the physical characteristics of the Lakewood Subdivision that would aid the conductor in identifying any locations or landmarks. All six physical characteristics questions on the test were derived directly from Sound Transit Timetable No. 2. The test also lacked any question either on the curve at MP 19.8 where the derailment occurred, which was the most demanding physical characteristic of the subdivision, or locations and landmarks that the conductor could use to determine that the train was approaching the curve.

Conclusion: FRA determined the Conductor's certification was a probable contributing factor to the cause and severity of the accident (Cause Code H999 – Other train operation/human factors).

Analysis—Operating Rule Compliance: The maximum authorized speed for Train 501 was 30 mph at the accident location. FRA reviewed operating rules governing employees, specifically GCOR, BNSF System Special Instructions - All Subdivisions, BNSF Signal Aspects and Indications, and General Track Bulletin Number 23705 issued to Train 501 on December 18, 2017. FRA also reviewed Sound Transit's Timetable Number 2 (issued November 13, 2017), Sound Transit General Orders 1-3, and Amtrak's operating rules. Sound Transit is the host railroad for Amtrak on the Lakewood Subdivision, which is approximately 20 miles in length from Tacoma to DuPont.

GCOR Seventh Edition, BNSF System Special Instructions, and BNSF Signal Aspects and Indications are in effect on the Sound Transit Lakewood Subdivision. The Engineer, Conductor, and Qualifying Conductor were all qualified on the applicable operating rules.

FRA's review determined the Conductor on Train 501 failed to remind the Engineer of a Track Bulletin Form C temporary speed restriction located at MP 21.3, approximately 1.5 miles past the POD. General Order 2017-S07 and GCOR 1.47(A), Conductor Responsibilities, required the Conductor to provide the Engineer this notification no later than two miles in advance of the restriction. In this case, that reminder was required no later than MP 19.3, which was approximately half a mile before the POD.

FRA's review also determined the Engineer and the Qualifying Conductor failed to comply with GCOR 1.47(C)(2), All Crewmember's Responsibilities, and General Order 2017-S07, both of which require crewmembers in the engine control compartment to communicate clearly to each other the name of

signals affecting their train. The Engineer and the Qualifying Conductor did not communicate the name of signals at MPs 15.47, 16.97, CP 188, and MP 19.86.

FRA determined the Conductor failed to conduct a job briefing with the Engineer about the curves at Sumner, Stewart, and MP 19.8 in accordance with General Order 2017-S07.

Per Sound Transit's Timetable No. 2, Talgo trainsets were required to make a 49-mph reduction in speed, from 79 mph to 30 mph, to safely proceed through the Lakewood Subdivision curve at MP 19.8. The event recorder data clearly supports that the Engineer failed to make any normal operational adjustments to slow Train 501 that would be expected of an engineer whose train was approaching a significant speed reduction. Further, there is no evidence to suggest that the Engineer initiated an emergency application of the train's air brakes with the Automatic Brake Valve and, as a result, Train 501 entered the 30-mph curve at 78 mph.

The Qualifying Conductor, riding in the lead locomotive cab of Train 501, also failed to initiate an emergency application of the train's air brakes with the Emergency Brake Valve when the accident became imminent. The Qualifying Conductor therefore failed to comply with GCOR Rule 1.47(C), which requires crewmembers in the engine control compartment to be alert for signals, communicate to each other any restrictions, and take proper action to ensure safety. As the Engineer failed to take proper action to comply with the speed restriction at MP 19.8, Rule 1.47(C) required the Qualifying Conductor to act to ensure safety, which in this case would have included initiating an emergency brake application.

On March 14, 2018, Amtrak submitted to FRA the FRA F 6180.54 Accident Report, which stated the cause of the accident was excessive speed.

Conclusion: The crew of Train 501 was not operating in compliance with several railroad operating rules and practices, and did not take normal or emergency measures to abide by Sound Transit's permanent speed restriction.

FRA determined the failure by the crew to comply with applicable rules and regulations related to train speed constituted the probable cause of the accident (Cause Code H604 – Train outside yard limits, in block signal or interlocking territory, excessive speed). Other crew failures to comply with applicable rules and regulations constituted a probable contributing factor in the accident (Cause Code H999 – Other train operation/human factors).

Analysis—Cell Phone Usage: FRA reviewed copies of the cell phone records for the Engineer and Qualifying Conductor.
Analysis of the cell phone records conducted by FRA revealed that no calls, texts, or data usage occurred during the time the Engineer or Qualifying Conductor was operating the train between Seattle and the accident site.

Conclusion: FRA determined cell phone usage by the Engineer or Qualifying Conductor did not

contribute to the cause or severity of this accident.

Analysis—Track: The NTSB, FRA, Amtrak, and Stacy & Witbeck formed a track working group of qualified personnel to evaluate the track conditions involved in this derailment. The POD was determined to be on single main track at MP 19.86 on the west rail of curve 19A1. The POD was identified on the west rail by the presence of a short continuous mark on the top of the rail, beginning at the gage corner and progressing diagonally across the top of the rail. Such markings are consistent with wheel climb due to the high lateral forces caused by overspeed conditions. Rail marks and damaged track structure beyond the initial wheel rail mark were designated as "post-POD" damage, or primary disturbed track. There were other significant visible markings on the rails and track structure both before and after the identified POD. FRA designated these damages as "secondary" disturbances from the run-in and derailment of trailing equipment.

Curve 19A1 is identified on the track charts as an 8-degree, 22-minute, left-hand curve with a designed super elevation of 2 ½ inches in the full body of the curve. The 136-pound continuous welded rail in the curve is supported by non-defective, effectively distributed wooden crossties spaced 19 ½ inches apart (measured from the center of a crosstie to the adjacent crosstie's center). The rails are affixed to the ties sitting in 7 3/4 x 16-inch Pandrol tie plates. The rails are fastened to the crossties through the tie plates with elastic type fasteners (McKay fasteners on concrete crossties; e-clips fasteners on wood crossties) to hold the rail in place and prevent longitudinal rail movement. Both in the vicinity of the curve and tangent track preceding the curve, every crosstie was box anchored; no rail movement was noted throughout the area prior to and through the curve. The track was supported by igneous rock ballast. FRA did not observe any conditions that would affect the cant of the rail.

On December 18 and 19, 2017, the track working group conducted a walking inspection of track damages following the accident. The POD was identified, and Stacy & Witbeck and Amtrak took track measurements for gage, crosslevel, and alignment. FRA and the NTSB observed and verified the measurements, finding no exceptions for Class 2 track. Track measurements were taken at marked stations on 15-foot, 6-inch intervals beginning at MP 19.86 at the POD, and extending north throughout to the beginning of the accident curve onto tangent track. All the track geometry measurement figures are unloaded measurements.

The track field inspection noted the following:

The FRA maximum measurement allowed for gage in FRA Class 2 track (which has a maximum authorized speed of 25 mph for freight trains and 30 mph for passenger trains) is 57 3/4 inches. Investigators determined the widest gage both prior to and including the POD was 56 7/8 inches; or about 7/8 of an inch under the FRA maximum allowable limit. Note: The gage measurement at the POD was affected when the west rail unseated and rolled outward in disturbed track.

The FRA maximum allowed deviation for alignment measured with a 62-foot chord in FRA Class 2 track

is 3 inches for both tangent and curved track. It was determined the greatest alignment deviation prior to disturbed track on the spiral section of the curve was 7/8 of an inch, or 2 1/8 inches under the FRA maximum allowable limit. Investigators also determined the greatest alignment deviation prior to disturbed track on tangent track was 5/16 of an inch, or 2 11/16 inches under the FRA maximum allowable limit.

The maximum allowable deviation from zero crosslevel at any point on tangent or reverse crosslevel elevation on curves may not be more than 2 inches for Class 2 track. Investigators determined from the field notes measurement data that the maximum crosslevel deviation on the spiral portion of the curve was 1/16 of an inch; or 1 15/16 inches under the FRA maximum allowable limit. Investigators determined the greatest alignment deviation prior to disturbed track on tangent track was 1/8 of an inch; or 2 7/8 inches under the FRA maximum allowable limit.

FRA examined track inspection records for the Lakewood Subdivision from October through December 15, 2017. During this time period, on behalf of Sound Transit, Stacy & Witbeck inspected all main line tracks a minimum of two times per week, as required by FRA regulations under Title 49 CFR part 213, which require twice weekly inspections of FRA Track Classes 2 – 4. The track in the accident area was last inspected on December 15, 2017, by a Stacy & Witbeck track inspector qualified in accordance with FRA regulations. The track inspector noted no defects within the limits of the accident curve or the area that includes the derailment footprint.

On behalf of Sound Transit, Stacy & Witbeck also contracted and operated a hi-rail geometry vehicle over the Lakewood Subdivision on December 6 and 7, 2017. The geometry data indicated only one exception located at MP 1.18. The exception was noted as wide gauge of 58.04 inches on main track 2 near the Portland Avenue bridge on FRA Class 2 track. The exception was repaired the next day. In the curve analysis section of the same report, the accident curve at MP 19.8 registered no defects, and the analysis calculated that the curve supported operating speeds up to 39 mph for Talgo passenger trainsets, and 34 mph for non-Talgo passenger trainsets, although the maximum allowable passenger operational speed was 30 mph under FRA regulations. The maximum degree of curvature that was measured by the track working group in the post-accident investigation was 7-degrees, 30-minutes. This measurement was different from, but within tolerance of, the documented 8-degree, 22-minute curve in the provided track charts. The maximum measured elevation was 2.37 inches.

On January 23, 2017, an ultrasonic rail test was conducted on the Lakewood Subdivision. Herzog Services, Inc., conducted this inspection on behalf of Sound Transit. No defects were recorded in the vicinity of the accident or on the other portions of the Lakewood Subdivision.

Curve 19A1 at the POD was properly super-elevated (banked) for the posted timetable speed. No geometry defects were discovered during the post-accident inspection, and the prior internal rail inspections did not find any exceptions near the POD.

Conclusion: FRA determined track conditions did not contribute to the cause or severity of this accident.

Analysis—Locomotive and Passenger Car Consist Validation: Train 501 consisted of one controlling locomotive, one power car, 10 passenger cars (including two business cars, one dining car, one bistro car, and six coach cars), one baggage car, and one trailing locomotive. The train weighed approximately 925,240 pounds and was about 649 feet in length.

The railroad equipment involved in the accident was lead locomotive WDTX 1402, owned by WSDOT and operated and maintained by Amtrak under a lease agreement. WDTX 1402 is a Siemens Charger 4400 horsepower diesel-electric alternating current (AC) locomotive, commonly referred to as a SC-44 locomotive, and is powered by a Cummins QSK95 16-cylinder, four-stroke tier 4 emission engine. The locomotive unit measures 71.5 feet long, 10 feet wide, and 14.4 feet high, and weighs approximately 267,000 pounds.

Amtrak operates a fleet of Talgo Series 6 trainsets on its Cascades route. The specific trainset involved in the accident is called the Mount Adams trainset. The Mount Adams trainset is owned by WSDOT and operated and maintained by Amtrak under a lease agreement. Amtrak owns the bistro car.

The Talgo Series 6 trainsets on Amtrak's Cascade route are a fleet of single-level intercity railroad passenger trainsets built by Talgo in 1998 and placed in revenue service in 1999. Each Talgo Series 6 trainset is an articulated trainset with a total of 12 cars: 10 assorted passenger cars, one power car at one end, and one baggage car at the other. Each wheelset is two separate stub axles held within a truck with vertical towers that support the car's suspension. This elevated suspension supports the cars from the top, which allows the cars to passively tilt while negotiating curves and provides for increased passenger comfort at high cant deficiencies over conventional rail cars. The power car provides head-end power when needed.

The Talgo Series 6 car body structures are made from welded extruded aluminum, including the walls and roof. The cars are connected by articulated joints supported by a single wheelset truck. The Talgo Series 6 baggage and power cars are each 15 feet, 1 ¼ inches tall, and 9 feet, 7 ¾ inches wide. The remainder of the cars in the trainset are each 10 feet 10 inches tall and 9 feet 7 ¾ inches wide (relative to the railhead). The baggage and power cars are each 38 feet, 7 inches long; the baggage car weighs 37,000 pounds, and the power car weighs 43,000 pounds. The coach cars, dining car, bistro car, and business cars are each 43 feet, 1 inch long and weigh 31,000 pounds. The entire Talgo Series 6 trainset, without the locomotives, weighs approximately 390,000 pounds and is about 508 feet long.

The floors of the Talgo Series 6 cars contain a relatively rigid "pusher" section that transitions to the regular extruded floor structure. Between each car is a single weight-bearing articulated truck equipped with anti-climber components, support brackets, a car crush element, and a floor pusher.

Trailing locomotive ATK 181 is owned, operated, and maintained by Amtrak. ATK 181 is a General Electric (GE) P-42-8 4250 horsepower diesel-electric direct current (DC) locomotive, commonly known as a Genesis locomotive, and is powered by a GE 7FDL 16-cylinder, four- stroke engine. The locomotive unit measures 69 feet long, 10 feet wide, and 14.8 feet high, and weighs approximately 268,240 pounds.

The equipment involved in the accident was properly documented, and identified as follows:

Position	Initial Number	Description
1	WDTX 1402	Lead Locomotive
2	ATK 7903	Power Car
3	ATK 7454	Business Car
4	ATK 7554	ADA Business Car
5	ATK 7804	Dining Car
6	ATK 7303	Bistro Car
7	ATK 7504	ADA Coach Car
8	ATK 7424	Coach Car
9	ATK7423	Coach Car
10	ATK 7422	Coach Car
11	ATK 7421	Coach Car
12	ATK 7420	Coach Car
13	ATK 7102	Baggage Car
14	ATK 181	Rear Locomotive

The train was therefore configured in accordance with FRA's special approval to operate the Talgo Series 6 cars on the Lakewood Subdivision under Title 49 CFR § 238.203(d). See Docket No. FRA-1999-6404, available at www.regulations.gov.

Conclusion: FRA determined the locomotives and equipment in Train 501 did not contribute to the cause or severity of the accident.

Analysis—Equipment Pre-Accident Inspection: Train 501 originated in Seattle. The consist was equipped with lead locomotive WDTX 1402, the Mount Adams trainset, and trailing locomotive ATK 181, which passed a Class I air brake test and received a calendar day inspection by qualified maintenance persons (QMP) on December 18, 2017. Due to an issue with the lead locomotive (WDTX 1402) and the rear locomotive (ATK 181), a Siemens technician in Seattle disconnected the multiple-unit (MU) cable to the rear locomotive. This prevented the rear locomotive from providing tractive effort in correspondence with the lead locomotive. While this would have decreased the available tractive effort, the disconnected MU cable did not contribute to the cause or severity of the accident.
Conclusion: FRA determined all required pre-departure tests were performed and did not contribute to

the cause or severity of the accident.

Analysis—Equipment Post-Accident Inspections: The NTSB, FRA, Amtrak, Washington UTC, Talgo, and Siemens formed a mechanical group of qualified personnel to evaluate the mechanical condition of the equipment involved in this derailment.
Investigators assembled at the Joint Base Lewis-McChord military base approximately five miles from the derailment site. All 12 cars and the Siemens Charger locomotive involved in the derailment were transported by flatbed trailers and offloaded in a large fenced-off area of the military base. The undamaged P-42 locomotive (rear locomotive) was moved to the Sounder Yard in Lakewood, Washington. The damage documented on the Talgo trainset was extensive. Most of the trainset's truck assemblies became dislodged during the accident or were removed prior to being transported to Joint Base Lewis-McChord. The damage to the Talgo trainset braking system was too extensive to make field repairs for an air brake test.

Upon examination of the derailed locomotive WDTX 1402, it was noted that most of the train-line pneumatic connections on the front and rear were bent, partially damaged, or torn off, some of them upstream of their exterior cut-out cock. Those connections, specifically the brake pipe, could not be easily closed and used for testing via the exterior glad-hand connections. The locomotive central computer unit (CCU), traction control unit (TCU), and operator displays were removed from the locomotive, and the locomotive right-side battery box was missing as a result of damage that occurred in the accident. For testing purposes, an external air compressor had to be connected to feed main reservoir pressure into the locomotive and the compressed air supply regulated at 110 PSI brake pipe (BP) pressure delivered through a split feed into the brake rack. A single car test device was connected to imitate the locomotive brake handle. Only the brake cylinder (BC) pressure generation via the triple valve and the emergency bypass function in the computer controlled brake (CCB2) were tested due to the system being unpowered, as the CCU and TCU were absent. (The external air compressor is only used as a backup in regular service as the 16 portion of the CCB2 is generating BC pressure electronically when the unit is fully operational.) During the post-accident tests and inspections, the emergency and automatic brakes were applied and released. All the locomotive disk brake units applied and released. The NTSB and Washington UTC were not present during the WDTX 1402 brake test.

Investigators observed testing of rear locomotive ATK 181 by an Amtrak QMP. An automatic cab self-test and a locomotive daily air brake departure test were performed, with FRA noting no exceptions.

Overall, WDTX 1402 disk brake units (DBU) applied and released during service and emergency applications. The Mount Adams Talgo trainset was not tested due to extensive damage. ATK 181 passed the air brake departure test and automatic cab self-test in accordance with Amtrak procedures DXBD-10-0003 and DXBD-11-0003. The team took no exceptions to the test results.

Investigators examined all the wheels, brake rigging, brake pads, brake shoes, and discs on Train 501. All the components inspected complied with all applicable Federal regulations. The wheel treads showed

no evidence of slid flats or shelled spots. All undamaged brake rigging appeared normal, and all brake pads, brake shoes, and discs were within the applicable tolerance.

Conclusion: FRA determined the equipment did not contribute to the cause or severity of the accident.

Analysis—Emergency Lighting and Public-Address Systems: The emergency lighting in the Talgo Series 6 trainsets is powered by 110V DC batteries located in the power car and baggage car. The public address (PA) system is powered by the same sets of batteries. PA handsets are in the power car, bistro car, and baggage car. The main amplifier is in the power car, and there is a small amplifier in the bistro car that works for the bistro and dining cars. The cars that were separated from the baggage and power car were not illuminated immediately after the accident.

Conclusion: FRA determined both systems functioned as designed and did not contribute to the cause or severity of the accident.

Analysis—AMTRAK Locomotive ATK 181 Event Recorder: The preliminary review of the accident event recorder data from the locomotive showed only BP pressure and speed instead of all nine parameters. Further investigation revealed that the MU cable was removed from the rear of the lead locomotive at King Street Station in Seattle the morning of December 18, 2017, due to compatibility issues between the GE P-42 locomotive (rear locomotive) and the Siemens Charger locomotive (lead locomotive). Because of the MU cable being removed, the event recorder on ATK 181 did not receive the additional seven parameters from the lead locomotive.

Additionally, FRA's investigation determined that the removed MU cable meant that the wheel slip/slide alarm for the rear locomotive would not be shown in the cab of the controlling (lead) locomotive, WDTX 1402. This condition did not comply with FRA requirements for slip/slide alarms in Title 49 CFR § 229.115(a).

Conclusion: FRA determined Train 501 was not in compliance with Title 49 CFR § 229.115 Slip/slide alarms, but the non-compliance did not contribute to the cause or severity of the accident.

Analysis—Signal and Train Control (S&TC): The method of operation on Sound Transit's Lakewood Subdivision is a traffic control system (TCS). The subdivision is single main track from CP 10.62 through MP 21.3. The signal system on the subdivision consists of color light signals at 13 controlled points and 7 intermediate signals. The last controlled point prior to the POD at MP 19.86 is CP 188 at MP 18.76. The nearest signal to the POD is intermediate signal at 19.86 (Intermediate Signal 19.86).

On December 18, 2017, FRA and the NTSB started post-accident inspections at Intermediate Signal 19.86 and CP 188. Inspections were carried out over five days, resulting in multiple inspection reports. Intermediate Signal 19.86 consists of a signal bungalow and two signal masts spaced 185 feet apart due to the curvature of the track. Both signal masts were completely destroyed by the derailment, and two track wires were damaged. The signal bungalow at Intermediate Signal 19.86 was not damaged and was

confirmed to be locked. No other signal damage occurred. The track wire damage was repaired, and prior to any other repairs, the track circuits at the accident location were shunted with a .06-ohm shunt. The 1ATR relay was tested with no exception taken.

All applicable tests were performed at CP 188, including time locking, timer verification, and loss of shunt timing. The VSTOP relay operation, lamp-out downgrades, and coded track operation were also checked. There are no switches at CP 188 or in the block between CP 188 and Intermediate Signal 19.86. Bulb voltages at CP 188 were checked with the following results for the southbound signal: Red, 11.14V; Yellow, 7.9V; and Green, 8.08V. Ground tests were performed on all busses at CP 188, with no exceptions taken. New signals were installed at Intermediate Signal 19.86 after the derailment, and tests for insulation resistance and grounds were observed with no exceptions taken.

Vital equipment logs were downloaded at Intermediate Signal 19.86 and CP 188. Equipment logs show the train was operating on a clear aspect at CP 188, and there was a clear aspect at Intermediate Signal 19.86 at the time of the derailment.

FRA reviewed historical test and inspection records, with no exceptions taken. Sound Transit's software management control plan (SMCP) was audited, comparing software revisions at CP 188 and Intermediate Signal 19.86 with the revisions shown in Sound Transit's inventory. No exceptions were taken.

Conclusion: FRA determined the signal system did not contribute to the cause or severity of this accident.

Analysis—Sight Distance Evaluation: On January 16, 2018, FRA and the NTSB investigators performed a sight distance observation on the Lakewood Subdivision. Investigators performed several onboard observation trips between MP 11.74 to the curve at MP 19.8, utilizing a Siemens Charger locomotive. Additionally, observations were conducted from the interior of an Amtrak Superliner passenger coach and an Amtrak P-42 locomotive simulating the territory familiarization training received by Amtrak engineers and conductors on the Lakewood Subdivision. Observation runs were initiated at 5:30 a.m., PST, and completed at 8:00 a.m., PST, so investigators were able to observe operating conditions in night, dawn, and daylight conditions. The permanent speed warning sign (required under GCOR 5.5) located two miles in advance at MP 17.8 was readily visible and gave the proper warning of the 30-mph permanent speed restriction at MP 19.8 that was depicted in the timetable and track chart. Several runs were made at both low speed and high speed, and no stopping problems were observed on the descending grade going into the curve at MP 19.8.

FRA took no exceptions to the ability to view the permanent speed warning sign located two miles before the curve at MP 19.8 from the cab of the lead locomotive. All signals, speed restriction signs, switch targets, milepost signs, and whistle boards were visible from both locomotives used in the observation, in both darkness and daylight, and their locations matched the information depicted in the Sound Transit

timetable.

FRA determined the Conductor would have been unable to determine the train's location and proximity to the permanent speed restriction due to his limited visibility from the coach car.

Conclusion: FRA determined that sight distance from the cab of the lead locomotive did not contribute to the cause or severity of this accident.

Analysis—FAST Act: Section 11406 of the Fixing America's Surface Transportation Act (FAST Act) (Pub. L. No. 114-94), enacted on December 4, 2015, addresses Speed Limit Action Plans, requiring each intercity passenger and commuter railroad, by March 2, 2016, to survey its entire system and identify each main track location where there is a reduction of more than 20 mph from the approach speed to a curve, bridge, or tunnel, and the maximum authorized operating speed for passenger trains at that curve, bridge, or tunnel. Each intercity passenger and commuter railroad was further required to submit to FRA (as delegated by the Secretary of Transportation), by June 30, 2016, a speed limit action plan identifying such locations and describing appropriate actions to enable warning and enforcement of the maximum authorized speed for passenger trains. *See* Pub. L. No. 114-94, Section 11406(b).

Amtrak's FAST Act Speed Limit Action Plan indicated Amtrak planned to require communication between the locomotive engineer and another qualified crewmember when its trains approached speed restrictions falling under FAST Act requirements on routes not owned by Amtrak, and that instructions specifying such would be issued in general orders and tailored specifically for such routes. Before the December 18, 2017, accident, Amtrak's most recently issued version of its General Order 2017-S07 for the applicable Pacific Northwest Division was effective September 5, 2017. That most recent version of the relevant general order did not identify the curve at MP 19.8 on the Lakewood Subdivision (which involved a reduction of more than 20 mph from the approach speed to the maximum speed for the curve) as subject to its FAST Act instructions. Before commencing passenger service on the Lakewood Subdivision, Amtrak was required to update General Order 2017-S07 under Amtrak's Fast Act Speed Limit Plan, item 2, approved by FRA. However, Amtrak did not do so, and thus failed to comply with its FRA-approved plan required by the FAST Act.

Similarly, Sound Transit's June 28, 2016, FAST Act Speed Limit Action Plan describes the practices it implemented for meeting FAST Act requirements. Sound Transit's plan describes its procedures as continuing requirements, using the present tense, not as completed actions. That is, Sound Transit's plan "requires" signs to be placed in advance of permanent speed restrictions, the speed shown in the timetable or in a general order, an additional sign placed two miles in advance of the location where the lower speed takes effect, and Sound Transit's track inspectors to inspect the signs as part of a periodic track inspection. Like Amtrak's plan, Sound Transit's plan was approved by FRA with the understanding that Sound Transit was implementing procedures that would continue its obligation to implement these same procedures on future routes meeting the FAST Act conditions and concerns. Although Sound Transit was not required under the FAST Act to add MP 19.8 on the Lakewood Subdivision to its original

plan because this location did not exist at the time Sound Transit had the obligation to submit that plan, FRA views Sound Transit's plan as describing a continuing obligation to comply with the practices it assured FRA it was implementing when it sought FRA approval. The Sound Transit Timetable No. 2, effective November 13, 2017, does not instruct crewmembers to communicate the permanent speed restriction at the southbound curve at MP 19.8, although such instruction was included for a northbound curve at MP 3.4 that was identified in Sound Transit's Speed Limit Action Plan. Thus, Sound Transit failed to comply with its FRA-approved plan required by the FAST Act.

Amtrak and Sound Transit did not update their general orders or timetables to identify the dangerous speed condition in the curve at MP 19.8 on the Lakewood Subdivision as necessary to comply with their FRA-approved plans required by the FAST Act.

Conclusion: FRA determined non-compliance with FRA-approved plans required by the FAST Act was a probable contributing factor to the accident. (Cause Code M599 – Other miscellaneous cause.)

Analysis – Positive Train Control: PTC is a processor-based/communication-based train control system designed to prevent certain train accidents. With limited exceptions and exclusions as described within Title 49 CFR part 236, subpart I – *Positive Train Control Systems*, PTC is required to be installed and implemented on Class I railroad main lines over which any poisonous- or toxic-by-inhalation (PIH/TIH) hazardous materials are transported, and on any railroad's main lines over which regularly scheduled passenger intercity or commuter operations are conducted.

PTC technology is capable of automatically controlling train speeds and movements should a train operator fail to take appropriate action for the conditions at hand. PTC systems required to comply with subpart I must reliably and functionally prevent:
• Train-to-train collisions;
• Overspeed derailments;
• Incursion into an established work zone; and,
• Movement through a main line switch in the improper position.
The Lakewood Subdivision was not equipped with an active PTC system. The deadline for PTC implementation was December 31, 2018, with the possibility for two additional years if certain requirements were met. Both Amtrak and BNSF met the requirements for an extension and their alternate schedules for full PTC implementation by December 31, 2020, have been approved by FRA.

Conclusions: FRA determined that PTC did not contribute to the cause or severity of the accident; however, an active PTC system would have likely prevented the accident.

Overall Conclusions
FRA determined Train 501 entered the 30-mph permanent speed restriction at MP 19.8 traveling at 78 mph, which led to the accident. The 30-mph permanent speed restriction was published in the Sound Transit Timetable No. 2, effective November 13, 2017, but was not identified as subject to crew

communication requirements that were implemented under Sound Transit's FAST Act submission or Amtrak's written instructions.

FRA also determined the Engineer and Qualifying Conductor lost situational awareness of their location and the actions that were required of them by the 30-mph permanent speed restriction. Specifically, the Engineer and Qualifying Conductor failed to identify the advance warning sign at MP 17.8, failed to name and communicate the signals on the Lakewood Subdivision as required by General Order 2017-S07, were engaged in a non-operational conversation, and failed to initiate an emergency brake application. Additionally, the Engineer failed to recognize and appropriately respond to overspeed alarm warnings.

FRA determined the Conductor failed to conduct a job briefing with the Engineer about the curves at Sumner, Stewart, and MP 19.8 in accordance with General Order 2017-S07. The Conductor also failed to remind the Engineer of the Track Bulletin Form C, Speed Restriction on the Lakewood Subdivision at the last station, or two miles prior to the speed restriction at MP 21.3 in accordance with GCOR 1.47(C)(3) Conductor Responsibilities and the General Order 2017-S07.

FRA found the physical characteristics training provided by Amtrak did not provide for Conductors to have at least one head end ride in accordance with General Order 2017-S07.

An active PTC system would have likely prevented the accident.

Probable Cause

FRA determined the probable cause of the derailment was Cause Code H604 – Train outside yard limits, in block signal or interlocking territory, excessive speed.

Contributing Factors

FRA determined additional probable contributing factors to be Cause Codes H999 – Other train operation/human factors; H199 – Employee physical condition, other; and M599 – Other miscellaneous cause.