
# *Federal Railroad Administration*
# *Office of Safety*
# *Headquarters Assigned*
# *Accident Investigation Report*
# *HQ-2006-101*

## *Norfolk Southern*
## *Chattanooga, TN*
## *December 16, 2006*

***Note that 49 U.S.C. §20903 provides that no part of an accident or incident report 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.***

DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION

# FRA FACTUAL RAILROAD ACCIDENT REPORT

FRA File # HQ-2006-101

| | | |
|---|---|---|
| 1.Name of Railroad Operating Train #1: Norfolk Southern Corp. [NS ] | 1a. Alphabetic Code: NS | 1b. Railroad Accident/Incident No.: 027451 |
| 2.Name of Railroad Operating Train #2: N/A | 2a. Alphabetic Code: N/A | 2b. Railroad Accident/Incident: N/A |
| 3.Name of Railroad Responsible for Track Maintenance: Norfolk Southern Corp. [NS ] | 3a. Alphabetic Code: NS | 3b. Railroad Accident/Incident No.: 027451 |
| 4. U.S. DOT_AAR Grade Crossing Identification Number | 5. Date of Accident/Incident: Month 12 / Day 16 / Year 2006 | 6. Time of Accident/Incident: 06:30: ☑ AM ☐ PM |

7. Type of Accident/Indicent (single entry in code box): 1. Derailment; 2. Head on collision; 3. Rear end collision; 4. Side collision; 5. Raking collision; 6. Broken Train collision; 7. Hwy-rail crossing; 8. RR grade crossing; 9. Obstruction; 10. Explosion-detonation; 11. Fire/violent rupture; 12. Other impacts; 13. Other (describe in narrative): 01

| 8. Cars Carrying HAZMAT | 9. HAZMAT Cars Damaged/Derailed | 10. Cars Releasing HAZMAT | 11. People Evacuated | 12. Division |
|---|---|---|---|---|
| 24 | 4 | 0 | 0 | Central |

| 13. Nearest City/Town | 14. Milepost (to nearest tenth) | 15. State Abbr | 15. State Code | 16. County |
|---|---|---|---|---|
| Chattanooga | 0.7 | N/A | TN | HAMILTON |

| 17. Temperature (F) (specify if minus) | 18. Visibility (single entry) 1. Dawn 2. Day 3.Dusk 4.Dark | Code | 19. Weather (single entry) 1. Clear 2. Cloudy 3. Rain 4. Fog 5.Sleet 6.Snow | Code | 20. Type of Track 1. Main 2. Yard 3. Siding 4. Industry | Code |
|---|---|---|---|---|---|---|
| 65 F | | 1 | | 1 | | 1 |

| 21. Track Name/Number | 22. FRA Track Class (1-9, X) | Code | 23. Annual Track Density (gross tons in millions) | 24. Time Table Direction 1. North 3. East | Code |
|---|---|---|---|---|---|
| Main | | 2 | 34 | | 1 |

## OPERATING TRAIN #1

| 25. Type of Equipment Consist (single entry): 1. Freight train; 2. Passenger train; 3. Commuter train; 4. Work train; 5. Single car; 6. Cut of cars; 7. Yard/switching; 8. Light loco(s).; 9. Maint./inspect.car; A. Spec. MoW Equip. | Code | 26. Was Equipment Attended? 1. Yes 2. No | Code | 27. Train Number/Symbol |
|---|---|---|---|---|
| | 1 | | 1 | 162AA1 |

| 28. Speed (recorded speed, if available) R - Recorded E - Estimated | | | Code |
|---|---|---|---|
| | 22 | MPH | R |

29. Trailing Tons (gross tonnage, excluding power units): 11114

30. Method(s) of Operation (enter code(s) that apply): a. ATCS; b. Auto train control; c. Auto train stop; d. Cab; e. Traffic; f. Interlocking; g. Automatic block; h. Current of traffic; i. Time table/train orders; j.Track warrant control; k. Direct traffic control; l.Yard limits; m.Special instructions; n. Other than main track; o. Positive train control; p. Other (Specify in narrative)

| Code(s) | | | | |
|---|---|---|---|---|
| e | N/A | N/A | N/A | N/A |

30a. Remotely Controlled Locomotive? 0 = Not a remotely controlled; 1 = Remote control portable; 2 = Remote control tower; 3 = Remote control transmitter - more than one remote control transmitter: 0

| 31. Principal Car/Unit | a. Initial and Number | b. Position in Train | c. Loaded (yes/no) |
|---|---|---|---|
| (1) First involved (derailed, struck, etc) | N/A | 24 | no |
| (2) Causing (if mechanical cause reported) | 0 | 0 | N/A |

32. If railroad employee(s) tested for drug/alcohol use, enter the number that were positive in the appropriate box.

| Alcohol | Drugs |
|---|---|
| N/A | N/A |

33. Was this consist transporting passengers? (Y/N): N/A

| 34. Locomotive Units | a. Head End | Mid Train b. Manual | Mid Train c. Remote | Rear End d. Manual | Rear End c. Remote |
|---|---|---|---|---|---|
| (1) Total in Train | 3 | 0 | 0 | 0 | 0 |
| (2) Total Derailed | 0 | 0 | 0 | 0 | 0 |

| 35. Cars | Loade a. Freight | Loade b. Pass. | Empty c. Freight | Empty d. Pass. | e. Caboose |
|---|---|---|---|---|---|
| (1) Total in Equipment Consist | 93 | 0 | 34 | 0 | 0 |
| (2) Total Derailed | 26 | 0 | 7 | 0 | 0 |

| 36. Equipment Damage This Consist | 37. Track, Signal, Way, & Structure Damage | 38. Primary Cause Code | 39. Contributing Cause Code |
|---|---|---|---|
| 74700 | 80000 | H520 | N/A |

| Number of Crew Members | | | | Length of Time on Duty | |
|---|---|---|---|---|---|
| 40. Engineer/ Operators | 41. Firemen | 42. Conductors | 43. Brakemen | 44. Engineer/Operator | 45. Conductor |
| N/A | 0 | 1 | 0 | Hrs 10 Mi 20 | Hrs 10 Mi 20 |

| Casualties to: | 46. Railroad Employees | 47. Train Passengers | 48. Other |
|---|---|---|---|
| Fatal | 0 | 0 | 0 |
| Nonfatal | N/A | 0 | 0 |

| 49. EOT Device? 1. Yes 2. No | | 50. Was EOT Device Properly Armed? 1. Yes 2. No | |
|---|---|---|---|
| | 1 | | 1 |

51. Caboose Occupied by Crew? 1. Yes 2. No: N/A

## OPERATING TRAIN #2

| 52. Type of Equipment Consist (single entry): 1. Freight train; 2. Passenger train; 3. Commuter train; 4. Work train; 5. Single car; 6. Cut of cars; 7. Yard/switching; 8. Light loco(s).; 9. Maint./inspect.car; A. Spec. MoW Equip. | Code | 53. Was Equipment Attended? 1. Yes 2. No | Code | 54. Train Number/Symbol |
|---|---|---|---|---|
| | N/A | | N/A | N/A |

| 55. Speed (recorded speed, if available) R - Recorded E - Estimated | | | Code |
|---|---|---|---|
| | N/A | MPH | N/A |

57. Method(s) of Operation (enter code(s) that apply): a. ATCS; b. Auto train control; g. Automatic block; h. Current of traffic; m.Special instructions; n. Other than main track

57a. Remotely Controlled Locomotive? 0 = Not a remotely controlled; 1 = Remote control portable

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| 56. Trailing Tons (gross tonnage, excluding power units) | c. Auto train stop<br>d. Cab<br>e. Traffic<br>f. Interlocking | i. Time table/train orders<br>j.Track warrant control<br>k. Direct traffic control<br>l.Yard limits | o. Positive train control<br>p. Other (Specify in narrative)<br>Code(s) | 2 = Remote control tower<br>3 = Remote control transmitter - more than one remote control transmitter |
|---|---|---|---|---|
| N/A | | | N/A N/A N/A N/A N/A | N/A |

| 58. Principal Car/Unit | a. Initial and Number | b. Position in Train | c. Loaded (yes/no) | 59. 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) | N/A | N/A | N/A | | N/A | N/A |
| (2) Causing (if mechanical cause reported) | N/A | N/A | N/A | 60. Was this consist transporting passengers? (Y/N) | N/A | |

| 61. Locomotive Units | a. Head End | Mid Train b. Manual | Mid Train c. Remote | Rear End d. Manual | Rear End c. Remote | 62. Cars | Loade a. Freight | Loade b. Pass. | Empty c. Freight | Empty d. Pass. | e. Caboose |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Total in Train | N/A | N/A | N/A | N/A | N/A | (1) Total in Equipment Consist | N/A | N/A | N/A | N/A | N/A |
| (2) Total Derailed | N/A | N/A | N/A | N/A | N/A | (2) Total Derailed | N/A | N/A | N/A | N/A | N/A |

| 63. Equipment Damage This Consist | 64. Track, Signal, Way, & Structure Damage | 65. Primary Cause Code | 66. Contributing Cause Code |
|---|---|---|---|
| N/A | N/A | N/A | N/A |

| Number of Crew Members | | | | Length of Time on Duty | |
|---|---|---|---|---|---|
| 67. Engineer/ Operators | 68. Firemen | 69. Conductors | 70. Brakemen | 71. Engineer/Operator | 72. Conductor |
| N/A | N/A | N/A | N/A | Hrs N/A Mi N/A | Hrs N/A Mi N/A |

| Casualties to: | 73. Railroad Employees | 74. Train Passengers | 75. Other |
|---|---|---|---|
| Fatal | N/A | N/A | N/A |
| Nonfatal | N/A | N/A | N/A |

| 76. EOT Device? | 77. Was EOT Device Properly Armed? | 78. Caboose Occupied by Crew? |
|---|---|---|
| 1. Yes 2. No N/A | 1. Yes 2. No N/A | 1. Yes 2. No N/A |

## Highway User Involved

79. Type — Code: N/A
C. Truck-Trailer. F. Bus J. Other Motor Vehicle
A. Auto D. Pick-Up Truck G. School Bus K. Pedestrian
B. Truck E. Van H. Motorcycle M. Other (spec. in narrative)

80. Vehicle Speed (est. MPH at impact): N/A

81. Direction geographical) — Code: N/A
1.North 2.South 3.East 4.West

82. Position — Code: N/A
1.Stalled on Crossing 2.Stopped on Crossing 3.Moving Over Crossing
4. Trapped

86a. Was the highway user and/or rail equipment involved in the impact transporting hazardous materials? — Code: N/A
1. Highway User 2. Rail Equipment 3. Both 4. Neither

## Rail Equipment Involved

83. Equipment — Code: N/A
1.Train(units pulling) 3.Train (standing) 6.Light Loco(s) (moving)
2.Train(units pushing) 4.Car(s) (moving) 7.Light(s) (standing)
5.Car(s) (standing) 8.Other (specify in narrative)

84. Position of Car Unit in Train: N/A

85. Circumstance — Code: N/A
1. Rail Equipment Struck Highway User
2. Rail Equipment Struck by Highway User

86b. Was there a hazardous materials release by — Code: N/A
1. Highway User 2. Rail Equipment 3. Both 4. Neither

86c. State here the name and quantity of the hazardous materials released, if any.
N/A

| 87. Type of Crossing Warning | 1.Gates | 2.Cantilever FLS | 3.Standard FLS | 4.Wig Wags | 5.Hwy. traffic signals | 6.Audible | 7.Crossbucks | 8.Stop signs | 9.Watchman | 10.Flagged by crew | 11.Other (spec. in narr.) | 12.None |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code(s) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | | | | | |

| 88. Signaled Crossing Warning (See instructions for codes) Code | 89. Whistle Ban Code |
|---|---|
| N/A | 1. Yes 2. No 3. Unknown N/A |

| 90. Location of Warning Code | 91. Crossing Warning Interconnected with Highway Signals Code | 92. Crossing Illuminated by Street Lights or Special Lights Code |
|---|---|---|
| 1. Both Sides<br>2. Side of Vehicle Approach<br>3. Opposite Side of Vehicle Approach<br>N/A | 1. Yes<br>2. No<br>3. Unknown<br>N/A | 1. Yes<br>2. No<br>3. Unknown<br>N/A |

| 93. Driver's Age | 94. Driver's Gender Code | 95. Driver Drove Behind or in Front of Train and Struck or was Struck by Second Train Code | 96. Driver Code |
|---|---|---|---|
| N/A | 1. Male<br>2. Female<br>N/A | 1. Yes 2. No 3. Unknown N/A | 1. Drove around or thru the Gate<br>2. Stopped and then Proceeded<br>3. Did not Stop<br>4. Stopped on Crossing<br>5. Other (specify in narrative)<br>N/A |

| 97. Driver Passed Standing Highway Vehicle Code | 98. View of Track Obscured by (primary obstruction) Code |
|---|---|
| 1. Yes 2. No 3. Unknown N/A | 1. Permanent Structure 2. Standing Railroad Equipment 3. Passing Train 4. Topography 5. Vegetation 6. Highway Vehicle 7. Other (specify in narrative) 8. Not obstructed N/A |

| 101. Casulties to Highway-Rail Crossing Users | Killed | Injured |
|---|---|---|
| | N/A | N/A |

| 99. Driver Was Code | 100. Was Driver in the Vehicle? Code |
|---|---|
| 1. Killed 2.Injured 3. Uninjured N/A | 1. Yes 2. No N/A |

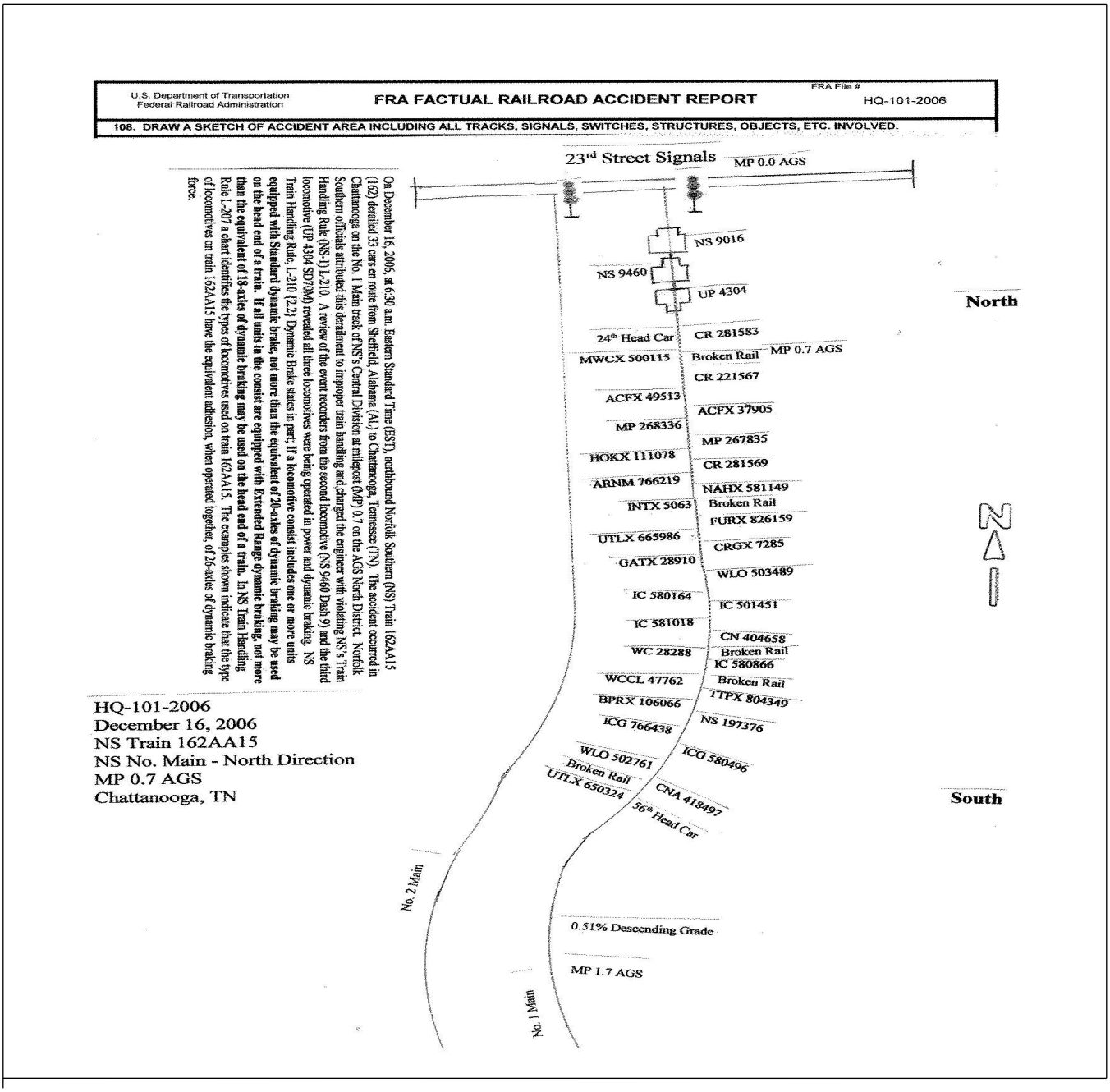
| 102. Highway Vehicle Property Damage (est. dollar damage) | 103. Total Number of Highway-Rail Crossing Users (include driver) |
|---|---|
| N/A | N/A |

| 104. Locomotive Auxiliary Lights? Code | 105. Locomotive Auxiliary Lights Operational? Code |
|---|---|
| 1. Yes 2. No N/A | 1. Yes 2. No N/A |

| 106. Locomotive Headlight Illuminated? Code | 107. Locomotive Audible Warning Sounded? Code |
|---|---|
| 1. Yes 2. No N/A | 1. Yes 2. No N/A |

108. DRAW A SKETCH OF ACCIDENT AREA INCLUDING ALL TRACKS, SIGNALS, SWITCHES, STRUCTURES, OBJECTS, ETC., INVOLVED.

HQ-2006-
101
sketch.jpg



109. SYNOPSIS OF THE ACCIDENT

On December 16, 2006, at 6:30 a.m. Central Standard Time (CST), northbound Norfolk Southern (NS) Train 162AA15 derailed 33 cars en route from Sheffield, Alabama (AL) to Chattanooga, Tennessee (TN). The accident occurred in Chattanooga on the NS Central Division at milepost (MP) 0.7 on the AGS North District (Chattanooga Terminal). The method of operation at this location is Automatic Block System (ABS) and Remote Control (RC). The maximum authorized speed for this location is 25 miles per hour (mph).

The train crew for Train 162AA15 consisted of an engineer and a conductor. Both crew members reported for duty in Sheffield at 7:10 p.m. on December 15, 2006. Sheffield is the home terminal for both crew members. The train consisted of three locomotives, NS 9016, NS 9460, UP 4304, 127 cars (93 loads and 34 empties). The train was 7,185 ft in length and weighed 11,685 tons.

The engineer was operating from lead Locomotive NS 9016. It was reported that the engineer advised NS officials that he was operating with the dynamic brakes fully applied as the train entered a 3-degree right- hand curve and was operating at a recorded speed of 23 mph when the derailment occurred. The engineer said he made a minimum reduction with the automatic brake and several minutes later the train came to a complete stop. An emergency brake application did not occur. The engineer said he had a good reading from the rear-end telemetry device, but when he released the brakes and tried to continue northward there was no movement. The conductor walked the train and discovered that the 24th through the 56th cars had derailed.

There was a total of 24 hazardous material cars in the train and four derailed. All cars derailed were standing upright with no hazardous material spillage and there were no injuries. The NS mechanical department reported $74,700 in equipment damage and the engineering department reported $80,000 in track damage.

At the time of the derailment, weather conditions were clear, dark, and 65°F.

The probable cause of the derailment is the use of dynamic brakes with excessive axles.

110. NARRATIVE

Circumstances Prior To The Accident

The crew for Train 162AA15 consisted of an engineer and conductor. On December 15, 2006, at 7:10 p.m., both crew members reported for duty in Sheffield. Sheffield is the home terminal for both crew members. Prior to reporting for duty each crew member received more than the statutory off-duty period. Their train consisted of three locomotives, NS 9016, NS 9460, UP 4304, 127 cars (93 loads and 34 empties). The train was 7,185 ft long and weighed 11,685 tons.

The locomotives for Train 162AA15 were located in the locomotive shop and the crew performed a locomotive inspection. The train's consist was located in two separate tracks in the departure yard. They made up their train, received a Class 1 brake test by the mechanical department, and departed Sheffield about 9:30 p.m. Prior to departing Sheffield, the train crew conducted a job briefing with the train dispatcher and reviewed their train bulletins. Their orders indicated they would encounter two slow orders en route.
Leaving Sheffield Yard the train operates on the NS Memphis East District from MP 402.8A to Stevenson, AL, MP 281.1A. The method of operation on the Memphis East District is Track Warrant Authority (TWA) and ABS. From Stevenson to Wauhatchie, TN, MP 248.1A, the NS operates under trackage rights over CSX Transportation (CSX) for a distance of 34 miles. The method of operation for trains operating on CSX between these two locations is Traffic Control Systems (TCS) and the maximum authorized speed on CSX is 60 mph. At Wauhatchie, NS trains will transfer back to the NS (MP 5.5) and operate on NS AGS North District (Chattanooga Terminal) to Chattanooga. The method of operation on the AGS North is TWA and ABS to MP 5.3 with a maximum speed of 50 mph. MP 5.3 to MP 0.0 is referred to as the Chattanooga Terminal and the method of operation is RC and ABS. The maximum authorized speed is 25 mph.

Train 162AA15 approached the derailment site traveling in a northward direction and received a clear signal at North Tunnel, MP 3.0. The engineer and conductor were located in the operating compartment of Locomotive NS 9016. The engineer was seated at the controls on the right side of the locomotive and the conductor was seated in the front seat on the left side of the locomotive. The train exited the North Tunnel on single main track at MP 2.2.

At MP 2.1, Train 162AA15 entered no. 1 main track traversing a 1.5-degree left-hand curve with a .09 descending grade. At MP 2.0, the track is tangent. At MP 1.9, the train entered a 1-degree right-hand curve, on a .06 ascending grade, and exiting the curve to MP 1.8 the track is the tangent. At MP 1.7, the train entered a 3-degree right-hand curve on a .51 ascending grade. The train exited the curve at MP 1.2 onto tangent track with a .22 ascending grade. At MP .07, the train entered a 3-degree right-hand curve with a .66 descending grade.

The timetable direction for this movement is south to north and the geographical direction is west to east. Timetable direction will be used throughout this accident.

The Accident

Train 162AA15 received a clear signal at North Tunnel, MP 3.0 AGS. The event recorder located on the lead locomotive indicated Train 162AA15 was traveling at 23 mph. Near MP.39, the train's speed began to increase and the engineer made a service application of the train air brakes. As the speed decreased, the engineer released the train air brakes, but left the train dynamic brakes applied. The train speed reached 5 mph, the engineer applied power (throttle position 3), and the amperage increased to 1,016 amps when the train stalled. After the engineer applied power and the train did not move, he concluded a problem existed somewhere in the train. The conductor dismounted the locomotive and walked back to inspect the train. He reported finding an air leak between the 10th and 11th cars. He reconnected the hoses and made sure the air hose gaskets were sealed. He continued his inspection and discovered the 24th through the 52nd cars were derailed, but remained upright. He notified the engineer who contacted the train dispatcher about the derailment.

Analysis and Conclusion

A review of the event recorder data from the lead locomotive (NS 9016) revealed the locomotives were placed in idle from power at MP 1.0 AGS with the train speed at 23 mph. The locomotives remained in idle to MP 0.56 AGS where the dynamic brake was applied with the speed of the train maintaining 23 mph through this entire section. The dynamic was allowed to build amperage gradually from MP 0.56 AGS to MP 0.39 AGS reaching maximum amperage on the lead unit of 712 amps and the speed of the train remaining at 23 mph.

NS officials attributed this derailment to improper train handling according to NS Train Handling Rule (NS-1) L-210. A review of the event recorders from the second locomotive (NS 9460) and the third locomotive (UP 4304) revealed all three locomotives were being operated in power and dynamic braking. The rear end of Train 162AA15 was cresting a 0.51 percent descending grade at MP 1.7 AGS (as the dynamic brakes reached the maximum amperage) and the first service automatic brake application was initiated.

The dynamic brakes for each of the locomotives operated on Train 162AA15 were all on line and providing retarding force to control train speed. The retarding force (adhesion) produced by these three locomotives (when operated in unison) exceeded the amount of adhesion allowed by NS. NS Train Handling Rule, L-210 [2.2] Dynamic Brake states in part, a locomotive consist includes one or more units equipped with standard dynamic brake, the equivalent of 20-axles of dynamic braking may be used on the head end of a train. If all units in the consist are equipped with extended range dynamic braking, not more than the equivalent of 18-axles of dynamic braking may be used on the head end of a train. NS Train Handling Rule L-207 identifies the types of locomotives used on Train 162AA15. The example shown indicates that the type of locomotives used for Train162AA15 have the equivalent adhesion, when operated together, of 25-axles of dynamic braking force.

Fatigue Analysis:

FRA uses an overall effectiveness rate of 77.5 percent as the baseline for fatigue analysis, which is equivalent to a blood alcohol content (BAC) of 0.05. At or above this baseline, we do not consider fatigue as probable for any employee. Software sleep settings vary according to information obtained from each employee. If an employee does not provide sleep information, FRA uses the default software settings.

The information for two employees follows:

Engineer assigned to Train 162AA15;
Sleep setting Excellent at Home - Good Away
Overall Effectiveness = 52.40 %
Lapse Index = 10.0
Reaction Time = 191
Chronic Sleep Debt =12.08
Hours of Continuous Wakefulness = 24.52
Time of Day (military) = 0630
BAC Equivalent = >0.08
Conclusion: Fatigue was probable for this employee.

Conductor assigned to Train 162SS15
Sleep setting Excellent at Home - Good Away
Overall Effectiveness = 48.47
Lapse Index = 10.0
Reaction Time = 206
Chronic Sleep Debt = 13.43
Hours of Continuous Wakefulness = 24.52
Time of Day (military) = 0630
BAC Equivalent = >0.08
Conclusion: Fatigue was probable for this employee.

FRA obtained fatigue related information, including a 10-day work history, for the engineer and conductor operating Train 162AA15. FRA concluded fatigue was a probable cause for the engineer and conductor of Train 162AA15.

The probable cause of the derailment is the use of dynamic brakes with excessive axles.