Federal Railroad Administration
Office of Safety
Headquarters Assigned
Accident Investigation Report
HQ-2006-04

Norfolk Southern (NS)
Lincoln, Alabama
January 18, 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-2006-4

1.Name of Railroad Operating Train #1: Norfolk Southern Corp. [NS]	1a. Alphabetic Code: NS	1b. Railroad Accident/Incident No.: 023913
2.Name of Railroad Operating Train #2: Norfolk Southern Corp. [NS]	2a. Alphabetic Code: NS	2b. Railroad Accident/Incident: 023913
3.Name of Railroad Responsible for Track Maintenance: Norfolk Southern Corp. [NS]	3a. Alphabetic Code: NS	3b. Railroad Accident/Incident No.: 023913
4. U.S. DOT_AAR Grade Crossing Identification Number	5. Date of Accident/Incident: Month 01 / Day 18 / Year 2006	6. Time of Accident/Incident: 04:17: ☐ 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): 03

8. Cars Carrying HAZMAT	9. HAZMAT Cars Damaged/Derailed	10. Cars Releasing HAZMAT	11. People Evacuated	12. Division
12	2	2	560	Alabama

13. Nearest City/Town	14. Milepost (to nearest tenth)	15. State Abbr	15. State Code	16. County
Lincoln	757.9	N/A	AL	TALLADEGA

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
53 F		2		1		3

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
Siding Coosa & Embry		3	39.1		3

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. Yes	1	226A11 7

28. Speed (recorded speed, if available) R - Recorded E - Estimated			Code
E - Estimated	53	MPH	R

29. Trailing Tons (gross tonnage, excluding power units): 3583

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	1	N/A
(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
0	0

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	3	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	49	0	0	0	0
(2) Total Derailed	21	0	1	0	0

36. Equipment Damage This Consist	37. Track, Signal, Way, & Structure Damage	38. Primary Cause Code	39. Contributing Cause Code
2235100	89000	H299	H605

Number of Crew Members 40. Engineer/ Operators	41. Firemen	42. Conductors	43. Brakemen
N/A	0	2	0

Length of Time on Duty 44. Engineer/Operator	45. Conductor
Hrs 3 Mi 2	Hrs 3 Mi 2

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: 1

50. Was EOT Device Properly Armed? 1. Yes 2. No: 1

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

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
	1	1. Yes	1	22RA11 6

55. Speed (recorded speed, if available) R - Recorded E - Estimated			Code
E - Estimated	0	MPH	R

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 d. Cab e. Traffic f. Interlocking	i. Time table/train orders j.Track warrant control k. Direct traffic control l.Yard limits	o. Positive train control p. Other (Specify in narrative) Code(s)	2 = Remote control tower 3 = Remote control transmitter - more than one remote control transmitter
6046			e N/A N/A N/A N/A	0

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)	TTGX9 75015	83	yes		0	0
(2) Causing (if mechanical cause reported)	0	0	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	2	0	0	0	0	(1) Total in Equipment Consist	9	0	0	0	0
(2) Total Derailed	0	0	0	0	0	(2) Total Derailed	3	0	8	0	0

63. Equipment Damage This Consist	64. Track, Signal, Way, & Structure Damage	65. Primary Cause Code	66. Contributing Cause Code
210000	0	H299	H605

Number of Crew Members				Length of Time on Duty	
67. Engineer/ Operators	68. Firemen	69. Conductors	70. Brakemen	71. Engineer/Operator	72. Conductor
3	0	1	0	Hrs 2 Mi 42	Hrs 2 Mi 42

Casualties to:	73. Railroad Employees	74. Train Passengers	75. Other
Fatal	0	0	0
Nonfatal	0	0	0

76. EOT Device? 1. Yes 2. No | 1

77. Was EOT Device Properly Armed? 1. Yes 2. No | 1

78. Caboose Occupied by Crew? 1. Yes 2. No | 2

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) 2.Train(units pushing) 3.Train (standing) 4.Car(s) (moving) 5.Car(s) (standing) 6.Light Loco(s) (moving) 7.Light(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 — Code(s): N/A N/A N/A N/A N/A N/A N/A
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

88. Signaled Crossing Warning (See instructions for codes) — Code: N/A

89. Whistle Ban — Code: N/A
1. Yes
2. No
3. Unknown

90. Location of Warning — Code: N/A
1. Both Sides
2. Side of Vehicle Approach
3. Opposite Side of Vehicle Approach

91. Crossing Warning Interconnected with Highway Signals — Code: N/A
1. Yes
2. No
3. Unknown

92. Crossing Illuminated by Street Lights or Special Lights — Code: N/A
1. Yes
2. No
3. Unknown

93. Driver's Age: N/A

94. Driver's Gender — Code: N/A
1. Male
2. Female

95. Driver Drove Behind or in Front of Train and Struck or was Struck by Second Train — Code: N/A
1. Yes 2. No 3. Unknown

96. Driver — Code: N/A
1. Drove around or thru the Gate
2. Stopped and then Proceeded
3. Did not Stop
4. Stopped on Crossing
5. Other (specify in narrative)

97. Driver Passed Standing Highway Vehicle — Code: N/A
1. Yes 2. No 3. Unknown

98. View of Track Obscured by (primary obstruction) — Code: 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

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

99. Driver Was — Code: N/A
1. Killed 2.Injured 3. Uninjured

100. Was Driver in the Vehicle? — Code: N/A
1. Yes 2. No

102. Highway Vehicle Property Damage (est. dollar damage): N/A

103. Total Number of Highway-Rail Crossing Users (include driver): N/A

104. Locomotive Auxiliary Lights? — Code: N/A
1. Yes 2. No

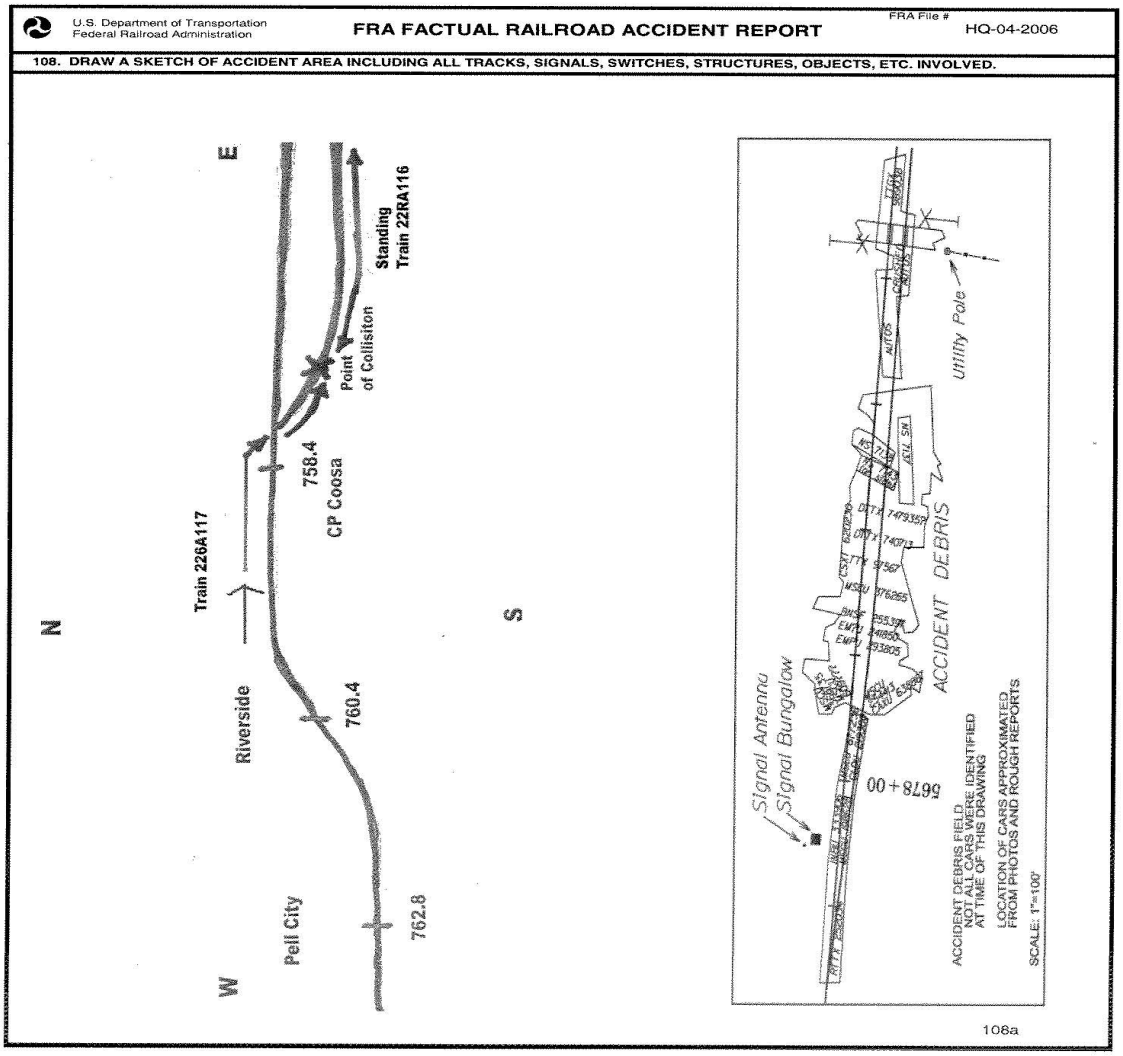
105. Locomotive Auxiliary Lights Operational? — Code: N/A
1. Yes 2. No

106. Locomotive Headlight Illuminated? — Code: N/A
1. Yes 2. No

107. Locomotive Audible Warning Sounded? — Code: N/A
1. Yes 2. No

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

HQ-04-
2006
sketch.jpg



109. SYNOPSIS OF THE ACCIDENT

On January 18, 2006, about 4:17 p.m. CST eastbound Norfolk Southern Railroad (NS) intermodal freight Train 226A117 struck the rear of NS freight Train 22RA116, which was stopped in the siding at milepost (MP) 757.9 near Lincoln, Alabama. Both trains were operating on the Alabama Division, East End District, between Birmingham, AL and Atlanta, Georgia.

The last four auto-rack cars of Train 22RA116 caught fire after they were struck by Train 226A117 and three auto-rack cars derailed. Train 226A117's three locomotives and the first seven cars derailed. Four of these cars were multi-unit articulated cars and three were single platform cars. All 21 platforms derailed. Three crew members of the striking train received non-life threatening injuries. There were no injuries to the crew of Train 22RA116.

There was a release of 285lbs of Sodium Cyanide, 6.1, UN 1689, PG I, RQ from two damaged intermodal containers located on the fourth car in Train 226A117. A precautionary evacuation of a ½mile was ordered. The evacuation zone effected about 224 households, with an estimated potential evacuation of 560 persons.

NS estimates the equipment damage to Train 22RA116 is $210,000 and the equipment damage to Train 226A117 is $2,235,100. The damage to track, signal, and wayside structures is estimated to be $89,000. Total damages are estimated to be $2,534,100.

The accident took place during daylight. The weather conditions were sunny and clear, and the temperature was 53°F.

The probable cause of the accident was the failure of Train 226A117 crew members to recognize an imperfectly displayed signal indication at Signal-7604 (Riverside-MP 760.4) and take appropriate action as required by NS operating rule NS-27. Contributing to the accident was the train crew's failure to operate their train in accordance with the most restrictive indication at Signal-7604 (Riverside), NS-309C, proceed at Restricted Speed.

110. NARRATIVE

Circumstances Prior to the Accident

Train NS 226A117

On January 18, 2006, at 1:15 p.m. CST, the crew of Train 226A117 went on duty in Earnest Norris Yard, Birmingham, AL (MP 791.0). The crew consisted of an engineer, conductor, and a conductor trainee. This was the home terminal for all three crew members. The engineer was off duty for about 2½ months with a broken left ankle. Both the conductor and the conductor trainee had been off the previous 24 hours. The three crew members held a job briefing prior to departure going over the train consist, bulletins, and the slow orders for the trip.

The train consisted of three locomotives (NS 7137, NS 7138, NS 7143), 23 cars (22 loads and 1 empty), 3,583 trailing tons, and was 4,580 feet in length. It was an eastbound intermodal through freight, scheduled to operate on the Alabama Division, East End District, between Birmingham, AL and Atlanta, GA. The train received a Class I train air brake test at the originating location, Memphis, Tennessee, on January 18, 2006.

Train 226A117 departed Earnest Norris Yard at 2:50 p.m. on an approach signal behind Train 198A516. At 3:05 p.m., Train 198A516 took a diverging route at Henry Ellen (MP 783.7). Train 226A117 was now operating behind Train 22RA116.

As the train approached the collision point, MP 757.9, the locomotive engineer was seated at the controls inside the cab of the lead engine, NS 7137, with the short hood forward. The conductor trainee was seated in the front seat on the opposite side of the locomotive cab, and the conductor was seated directly behind the trainee.

Approaching the accident area from the west at MP 758.75, the main track is tangent for about 1,850 feet, a 3-degree right-hand curve with 3½ inches of super elevation for about 1,850 feet becoming tangent near MP 758.0 (CP Coosa). The track consists of 132 lbs continuous welded rail (CWR) secured onto wooden crossties with 18 inch tie plates and the grade is 0.12-percent ascending. At CP Coosa, there is a No. 20 right hand turnout leading from the main track into a siding located to the south of the main track. The siding extends eastward from CP Coosa to CP Embry, a distance of 8,780 feet, as shown in the current NS Timetable.

Train NS 22RA116

On January 18, at 1:35 p.m., the three man crew of NS Train 22RA116 went on duty in Earnest Norris Yard, Birmingham, AL (MP 791.0). The crew consisted of an engineer trainee, an engineer, and a conductor. This was the home terminal for all three crew members. The engineer trainee and the engineer had both gone off duty on the previous day at 8:58 a.m. and 4:55 p.m. respectively. The conductor had 17½ hours of rest prior to starting his duty shift.

The train consisted of two locomotives (UP 4562, NS 9795), 81 cars (73 loads and 8 empties), 6,046 trailing tons, and was 8,277 feet in length. It was an eastbound through freight train operating on the Alabama Division, East End District, between Birmingham and Atlanta. The train received a Class I train air brake test at the originating location, New Orleans, Louisiana on January 17, 2006.

Train 22RA116 departed on January 18, 2006 at 2:20 p.m. The train made a prearranged stop at Leeds (MP 781.9) to pick up a road foreman of engines who was going to conduct operational testing on the engineer trainee. As the train was pulling to a stop at Leeds, an NS employee notified the conductor that a car door was

of engines, the conductor drove the road foreman's vehicle to Lincoln, AL where he planned to get back on the train. Train 22RA116 was stopped at Leeds for 10-15 minutes before continuing eastbound.

Train 22RA116 was operated by the engineer trainee, who was seated at the controls of the lead locomotive, UP 4562, with the short hood forward. The engineer was seated on the north side of the cab and the road foreman of engines was seated behind the engineer.

Train 22RA116 had clear signals from Lovick (MP 787.7) to Pell City (MP 762.8). They received an approach signal at Signal-7604 (Riverside) and a diverging approach signal at CP Coosa. The engineer trainee operated the train into the siding, but failed to activate the distance counter of the head telemetry device (HTD). Therefore, he was not sure if the rear car had cleared the main track or the signal circuits. He stopped the lead locomotive just east of an old road crossing near the east end of the siding. The road foreman of engines said that most trains stop at this location because of a curve in the siding that makes it difficult to start a standing train.

The railroad timetable and geographic directions are east and west. The maximum authorized speed for intermodal freight trains operating on the East End District is 60 miles per hour (mph). Intermodal train speed is restricted to 55 mph through curves between MP 763.2 and MP 758.0 (CP Coosa). The method of train operations is governed by signal indication of a traffic control system (TCS).

The Accident

At 4:17 p.m., CST, Train 226A117 rounded the curve west of CP Coosa and the crew realized the Coosa main line track switch was lined for the siding. They placed the train air brakes into emergency and braced for the collision. The train was traveling at a recorded speed of 53 mph when it struck the rear of Train 22RA116, in the siding at MP 757.9.

The collision derailed the rear three bi-level, loaded auto-rack cars in Train 22RA116. The auto-rack cars and automobiles caught fire along with the fourth rear auto-rack car, which was not derailed. The three locomotives and the first seven cars in Train 226A117 were derailed. The first, third, and sixth cars were multi-unit articulated cars consisting of five platforms each. The fifth car was articulated, consisting of three platforms. The second, fourth, and seventh cars were single platform type cars. The first six cars were loaded with intermodal containers and the seventh car was loaded with one trailer.

Local emergency responders were notified about 4:20 p.m. and arrived on-scene within five minutes. The local Lincoln Fire and Rescue Department began to suppress the fire. The conductor on Train 226A117 informed the incident commander their train contained sodium cyanide and fire suppression efforts were ceased. Everyone was immediately pulled back. Initially a hazardous-material team assessed the situation and reported that none of the hazardous material containers were breached and no product released. A precautionary evacuation of ½-mile was ordered. The evacuation zone effected about 224 households, with an the estimated potential evacuation of 560 persons.

Both crews were transported to Citizens Baptists Hospital in Talladega, AL. Under Federal Railroad Administration (FRA) guidelines, NS managers arranged for post accident toxicology testing of both train crews, the road foreman of engines, and the train dispatcher. All toxicology test results were negative.

A release of hazardous materials was discovered during recovery and cleanup efforts. The sixth car, DTTX 750538, and the fourth car, VTTX 97567, in Train 226A117 were loaded with 20 foot intermodal containers containing Sodium Cyanide, 6.1, UN 1689, PG I, RQ. The material was in a solid form, shaped into small white briquettes, similar in size to charcoal briquettes. There were ten intermodal containers in DTTX 750538 and nine of these were undamaged. The containers were moved to a staging area, inspected, and transported out by truck. The tenth container (MSCU 60949) was damaged, but no product was released from the packages inside the container. The packages were trans-loaded and trucked back to the Dupont plant in Memphis, TN.

Two containers located on VTTX 97567 were damaged in the derailment. Container MSCU 376266 had an estimated release of 35 lbs of sodium cyanide, both on the ground and inside the container. Container TPHU 681321 was loaded with 165, 30-gallon capacity drums, each weighing 220 lbs. Five drum lids were opened during the derailment and material was released onto the ground. These containers were moved to a staging area and trans-loaded. During the process, some drums fell out of the container. There was a release of product from the damaged drums, both inside the container and on the ground. These drums were placed into another container and transported to the Dupont plant in Memphis, TN. The estimated release was 250 lbs. All the sodium cyanide was recovered and the material was removed from the site by 2 a.m. on January 21, 2006.

Analysis And Conclusions

Train NS 226A117

According to interviews and taped radio conversations, the crew of Train 226A117 received clear signal indications at Henry Ellen (MP 783.7), Central (MP 782.7), Leeds (MP 781.9), an approach signal indication at Brompton (MP 776.2), then a clear signal indication at Roberts (MP 768.8), and approach signal indications at Eden (MP 765.4) and Pell City (762.8). There is no captured recordings of the crew's radio broadcast of the signal indication at Riverside (MP 760.4). However, all three crew members stated in post accident interviews that the signal indication was "clear".

Between Brompton and Roberts, the crew overheard a radio conversation between the dispatcher and the crew of Train 22RA116, telling them they would be going in the siding at the CP Coosa, and Train 226A117 would pass them on the main track.

Train NS 22RA116

According to the interview of the engineer trainee, he heard a crew member on Train 226A117 call an approach signal at " Pell City" and then a "clear" at "Riverside" via the radio. He said at this point he assumed that the rear of his train was clear of CP Coosa.

Mechanical Inspections

The event recorder onboard the lead locomotive of Train 226A117 (NS 7137) was destroyed by fire. The event recorders from the two trailing locomotives, NS 7138 and NS 7143, were removed and information downloaded remotely. Event recorder data revealed the train was traveling 34 mph when it passed Pell City (MP 762.8). Train speed was reduced to about 4-8 mph as the train reached MP 761.02. Train speed began to increase near MP 760.7, passing signal-7604 (Riverside) at 4:13 p.m., at 19 mph and increasing as the train approached CP Coosa.

Mechanical documents were retrieved from the two trailing locomotives and a brake test was conducted on the remaining cars, which were not derailed. No conditions were noted during the inspections that would have caused or contributed to this accident.

Track Information

The track structure, geometry, and records of track maintenance were examined and no exceptions were noted. The location where the lead locomotive for Train 22RA116 (UP 4562) stopped in the siding was identified by locomotive sand from an emergency brake application and other debris. A distance of 8,277 feet, based on the train consist, was measured off westward to determine if the standing train was fouling the CP Coosa OS circuit at the west end of the siding. It was established that the rear of the train was clear of the main track, but 80 to 84 feet short of clearing the track circuits at CP Coosa, which prevented the switch and signals from changing to allow main track movements.

Signal system

The method of train operation in the accident area is governed by a traffic control signal system. Trains operate over a single main track with passing sidings. Trains are dispatched and the signal system is controlled from the NS centralized traffic control (CTC) center located at Irondale, AL. General Railway Signal (GRS) color light type signals are installed to the right of the track governed. Signal-7604 (Riverside) is a two-unit signal on a high mast arranged to provide two aspects by coded track circuits, GE-Harmon Electro code II-C controls. The signal is located 2.5 miles west of the absolute signal installed at CP Coosa and conveys information for track conditions and advanced signal indications for the approach to CP Coosa, MP 758.0. Direct current track circuits are utilized to control the color light type signals located at CP Coosa.

Post accident operational testing of signal system

Preliminary operational testing of the signal system was conducted beginning at CP Coosa, the point of collision. Prior to testing the integrity of the signal equipment, an inspection of the vital signal relay contact positions, power-operated switch machine (switch-1), and the eastbound absolute signal aspects (signal-1E) were conducted. With the on-station (OS) occupied by the derailed trains, the eastbound 3 position signal, governing movements over the power-operated switch, displayed a stop signal indication (red/red/red-aspects). It was determined that at the time of collision at CP Coosa, there existed a bridge signal that contained two westbound signals (1WA and 1WC). The signals governed westbound train movements for the main track and from the siding to the main track. The signals were located at the end of the siding east of the power-operated switch and were destroyed as a result of the derailed trains. Prior to initial testing of signal-1E, arrangements were made to compensate for the destroyed westbound signals (1WA and 1WC).

CP Coosa

Test equipment was utilized to recreate the signaling circumstances reported prior to and at the time of the train collision at CP Coosa. The eastbound absolute signal was set to display the indication for the first eastbound train to enter the signaled siding. The signal indication displayed was a diverging approach (red/yellow/red-aspect). The eastbound intermediate approach signal located at MP 760.4 (Riverside) was observed during the tests. In addition, the simulation of both train movements was tested. The signals at CP Coosa and the eastbound approach signal functioned as intended. Subsequent tests at CP Coosa included all FRA required periodic tests and inspections associated with the signal system.

The focus of the investigation then moved to the eastbound intermediate approach signal-7604 (Riverside). Eastbound approach signal-7604 is located to the right (south) of the track governed. The signal is equipped with two color light signal units on a high mast at this location. The signal is equipped with two signal units (A) and (B) arranged to display two aspects that convey a single signal indication for eastbound train movements. The crew of the second train (226A117) reported that this signal displayed a clear signal (green/red-aspect) indication during the final eastward approach to CP Coosa. During the investigation, the eastbound signal-7604 displayed a restricting indication (red/red-aspect). The aspects were clearly visible for a considerable distance approaching the signal location from the west. At this time, the OS track at CP Coosa was de-energized. Test equipment was utilized to allow all possible signal indications to be displayed and tested at signal-7604. Tests included all required FRA periodic tests, inspections, and more. The signal equipment functioned as intended.

The signal system investigation continued at MP 762.8 (Pell City). The crew of Train 226A117 reported an approach (yellow-aspect) at eastbound signal-7628. With signal-7604 displaying a restricting indication, signal-7628 displayed an approach (yellow-aspect) indication. Signal tests revealed that this signal location functioned as intended.

All equipment and circuitry were tested and found to be working as intended. An inspection of the carrier's FRA required tests and inspection records pertaining to the signals system involved revealed no deficiencies. The focus and preview of the signal-light units were found to be adjusted to optimal preview. Lamp voltages were measured and found at acceptable levels.

Signal preview and sight distance

During the investigation, a locomotive with similar characteristics to the destroyed lead locomotive in Train 226A117 was used for re-enactment. This locomotive was used to preview and measure signal sight distance at both CP Coosa and the eastbound approach signal-7604. At CP Coosa, approaching the eastbound absolute signal from the west, sight distance is restricted by a 3-degree right-hand curve. The investigation continued with the use of the locomotive unit and laser technology measuring devices. The locomotive unit was moved to a laser measured distance of 880 feet west of CP Coosa. It was determined that this was the first point of view for eastbound train crew members of the absolute signal at CP Coosa.

At eastbound intermediate signal-7604 there exists a left-hand curve about 1,200 feet west of the location. Sight distance and preview protocols were established in order to perform the tests with a similar weather condition and time period of the accident. National Transportation Safety Board (NTSB) investigators accessed calculations made by a local professor of astronomy who provided the corrected sun times to ensure that the signal and surrounding area would be receiving sunlight from about the same angle as the accident date and time.

The investigative team agreed to perform the tests for a period of 20-30 minutes prior to the accident time and 20-30 minutes after the accident time. As the eastbound locomotive unit approached the eastbound signal-7604, the signal first came into view about 1,231 feet. The red over red aspects were in view at this point and time. The eastbound locomotive was moved closer and at the point of 1,189 feet west of the signal the top green aspect gave the appearance of illumination. At this point, both red aspects remained clearly illuminated with a slightly illuminated green aspect on the top signal unit. Signal-7604 is not designed to display a signal indication consisting of three aspects. Therefore, the green, over red, over red aspect results in an imperfectly displayed signal indication. The bottom aspect on this signal mast was mounted out of line or offset from the aspect mounted on the top light signal units.

In accordance with the NS operating rules, signal indications and definitions, a more favorable aspect than red displayed on the lower offset light unit indicates take the siding after next signal. This signal indication may be obeyed if displayed in combination with a single more favorable aspect displayed by the top unit. Signal-7604 is designed to display only two aspects at all times, not three. It was determined that the sun's position and light reflection, present at the time of the accident, caused a phantom green aspect.

At the time of the accident, eastbound signal-7604 contained a General Railway Signal (GRS) model-D-1 color light type with multiple aspect light units. Each light unit contains a double-lens combination, which produces an aspect of one color. The outer lens is 8 inches in diameter and is designed with a 4-inch focus and a 40-degree horizontal spread light deflecting bulls eye or hot spot. The clear lens deflects part of the main beam downward and through an angle of 40-degrees. The inner color lens is 5-½ inches in diameter. The lamp bulbs are 10 volt, 25 watt incandescent filament-type bulbs. Signal-7604 contains five aspect positions, which are as follows:

A-Top unit	B-Bottom unit (offset)
Top-aspect-green	Top- aspect-green
Middle-top-aspect-yellow	Lower-aspect-red
Lower-top-aspect-red	

This signal is geographically positioned with all aspects facing the earth's west horizon. During the time period just prior to the accident, it was determined that the sun's angle was approaching the earth's western horizon at an angle of 45 degrees in relation to the position of the eastbound signal. The brightness of the sun's rays reflected through the outer clear lens of the green aspect top signal unit. The reflection of sunlight caused the green aspect to give an appearance of illumination. At the time of this occurrence, only the red-top aspect and the red-bottom aspect were designed to be illuminated. Sunlight reflected through the outer clear lens caused the inner green lens to appear to be somewhat illuminated. During this time, both the top signal unit's red aspect and the offset bottom red aspect remained clearly illuminated. Signal-7604 is not designed to display this combination of aspects. The signal units are arranged to display two aspect combinations at a time, not three. The resultant sunlight reflection condition, qualifies the signal aspects as "Imperfectly Displayed." The combination and position of green/red/red aspects displayed on the signal light units are not a qualified signal indication in accordance with NS operating rules.

Contributing factors

According to the Federal Railroad Administration's investigation; train 226A117 crew members failed to operate their train in accordance with the most restrictive indication at Signal-7604 (Riverside), NS-309C, proceed at Restricted Speed.

Restricted Speed - A speed that will permit stopping within half the range of vision, short of train, engine, obstruction, railroad car, men or equipment fouling track, Stop signal, derail or switch lined improperly and looking out for a broken rail, but not exceeding 20 mph.

Probable cause

FRA's investigation concluded that the probable cause of the accident was the failure of Train 226A117 crew members to recognize an imperfectly displayed signal indication at Signal-7604 (Riverside-MP 760.4) and take appropriate action as required by NS operating rule NS-27. This signal should not have been acknowledged by the train crew of Train 226A117 as a qualified signal indication.

(NS-27...A signal imperfectly displayed, a signal functioning erratically, the absence of a light, a white light displayed where a color light should be, or the absence of a signal at a place where a signal is usually shown, must be regarded as the most restrictive indication that can be given by that signal and must be promptly reported to the dispatcher, control station or yard master...)