Federal Railroad Administration
Office of Safety
Headquarters Assigned
Accident Investigation Report
HQ-2005-02

Norfolk Southern (NS)
Graniteville, South Carolina
January 6, 2005

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-2005-2

1.Name of Railroad Operating Train #1: NORFOLK SOUTHERN CORPORATION	1a. Alphabetic Code: NS	1b. Railroad Accident/Incident No.: NS019414
2.Name of Railroad Operating Train #2: NORFOLK SOUTHERN CORPORATION	2a. Alphabetic Code: NS	2b. Railroad Accident/Incident: NS019414
3.Name of Railroad Responsible for Track Maintenance: N/A	3a. Alphabetic Code: N/A	3b. Railroad Accident/Incident No.: N/A
4. U.S. DOT_AAR Grade Crossing Identification Number	5. Date of Accident/Incident: Month 01 / Day 06 / Year 2005	6. Time of Accident/Incident: 02:39: ☑ 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): 02

8. Cars Carrying HAZMAT	9. HAZMAT Cars Damaged/Derailed	10. Cars Releasing HAZMAT	11. People Evacuated	12. Division
14	5	1	5400	Piedmont

13. Nearest City/Town	14. Milepost (to nearest tenth)	15. State Abbr	15. State Code	16. County
Graniteville	R178.3	N/A	SC	AIKEN

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
50 F		4		1		4

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
Avondale Mills Gregg		1	0		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. Yes	1	192P00 5

28. Speed (recorded speed, if available) R - Recorded E - Estimated			Code	30. Method(s) of Operation (enter code(s) that apply)			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
E - Estimated	47	MPH	R	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): n N/A N/A N/A N/A		0

29. Trailing Tons (gross tonnage, excluding power units): 3520

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

34. Locomotive Units	a. Head End	Mid Train b. Manual	Mid Train c. Remote	Rear End d. Manual	Rear End c. Remote	35. 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	25	0	17	0	0
(2) Total Derailed	2	0	0	0	0	(2) Total Derailed	12	0	5	0	0

36. Equipment Damage This Consist	37. Track, Signal, Way, & Structure Damage	38. Primary Cause Code	39. Contributing Cause Code
1664696	75900	H702	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 2 Mi 9	Hrs 2 Mi 9

Casualties to:	46. Railroad Employees	47. Train Passengers	48. Other
Fatal	1	0	8
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: 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
	1	1. Yes	2	P22P00 5

55. Speed (recorded speed, if available) R - Recorded E - Estimated			Code	57. Method(s) of Operation (enter code(s) that apply)	57a. Remotely Controlled Locomotive? 0 = Not a remotely controlled; 1 = Remote control portable
E - Estimated	0	MPH	N/A	a. ATCS; b. Auto train control; g. Automatic block; h. Current of traffic; m.Special instructions; n. Other than main track	

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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
0			n 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)	NS4622	1	N/A		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	1	0	0	0	0	(1) Total in Equipment Consist	0	0	2	0	0
(2) Total Derailed	1	0	0	0	0	(2) Total Derailed	0	0	2	0	0

63. Equipment Damage This Consist	64. Track, Signal, Way, & Structure Damage	65. Primary Cause Code	66. Contributing Cause Code
592802	0	H702	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
0	0	0	0	Hrs 0 Mi 0	Hrs 0 Mi 0

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)	77. Was EOT Device Properly Armed? (1. Yes 2. No)
2	N/A

78. Caboose Occupied by Crew? (1. Yes 2. No) — N/A

Highway User Involved

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

80. Vehicle Speed (est. MPH at impact): 0

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: 0

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	88. Signaled Crossing Warning (See instructions for codes) Code	89. Whistle Ban Code
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		1. Yes 2. No 3. Unknown
Code(s): N/A N/A N/A N/A N/A N/A N/A		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 2. Side of Vehicle Approach 3. Opposite Side of Vehicle Approach — N/A	1. Yes 2. No 3. Unknown — N/A	1. Yes 2. No 3. Unknown — 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
0	1. Male 2. Female — N/A	1. Yes 2. No 3. Unknown — 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) — N/A

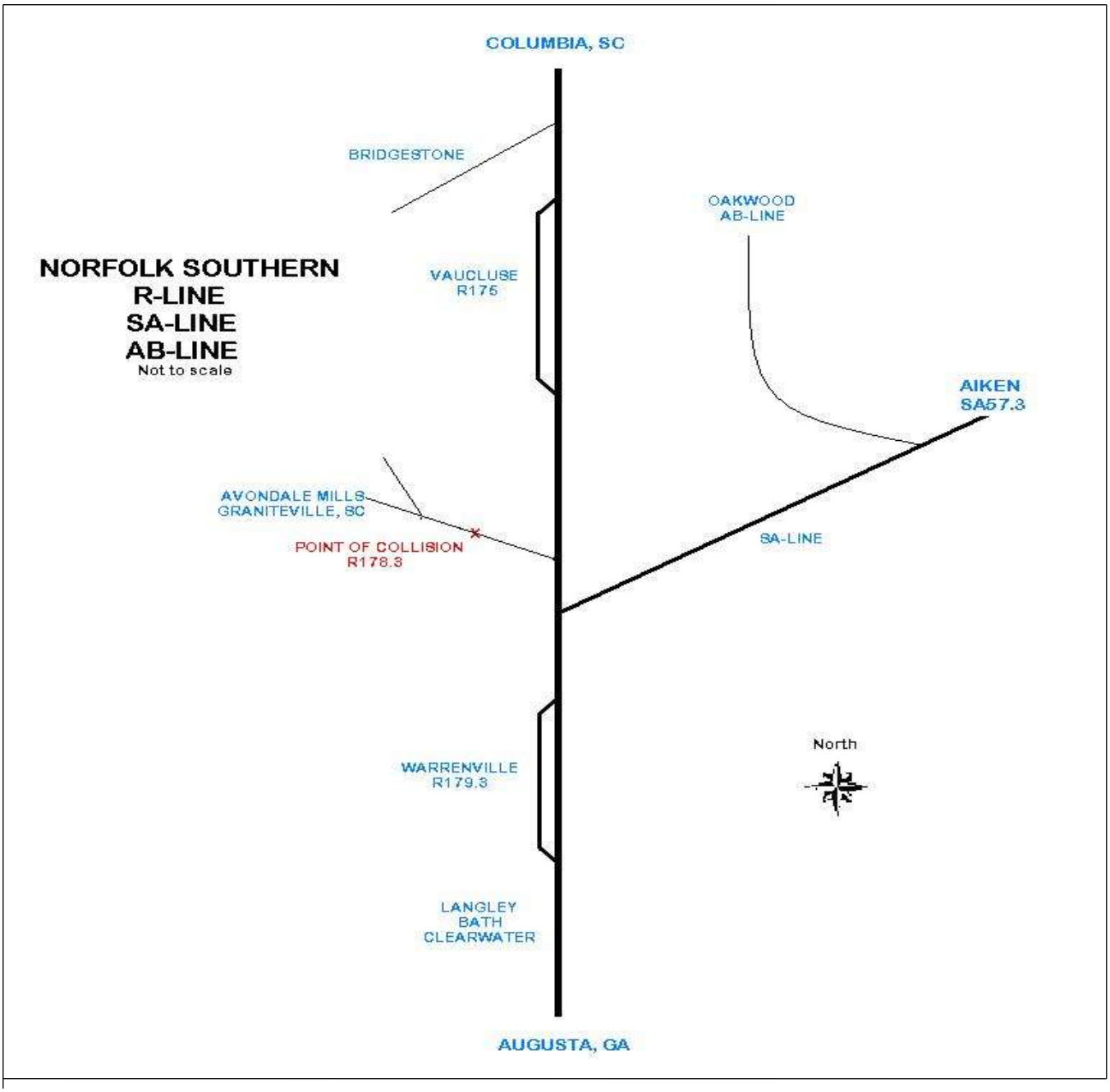
97. Driver Passed Standing Highway Vehicle Code	98. View of Track Obscured by (primary obstruction) Code
1. Yes 2. No 3. Unknown — N/A	1. Permanent Structure 2. Standing Railroad Equipment 3. Passing Train 4. Topography 5. Vegetation 6. Highway Vehicle 7. Other (specify in narrative) 8. Not obstructed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

101. Casulties to Highway-Rail Crossing Users	Killed	Injured	99. Driver Was Code	100. Was Driver in the Vehicle? Code
	0	0	1. Killed 2.Injured 3. Uninjured — N/A	1. Yes 2. No — N/A
			102. Highway Vehicle Property Damage (est. dollar damage): 0	103. Total Number of Highway-Rail Crossing Users (include driver): 0

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.

Graniteville
Derailment
Sketch.
JPG



109. SYNOPSIS OF THE ACCIDENT

On January 6, 2005, at 2:39 a.m., Eastern Standard Time (EST), a head-on collision occurred in the Avondale Mills Gregg Industry track on the Norfolk Southern Railway Company (NS) Piedmont Division in Graniteville, South Carolina, NS Milepost (MP) R178.3. The striking train was northbound NS freight train 192P005. The train consisted of two locomotives, NS 6653 and NS 6593, 25 loads and 17 empties and was operated by a locomotive engineer and conductor. The unattended standing train was NS train P22P005, consisting of locomotive NS 4622 and two coupled rail cars.

Train 192P005 was operating from North Augusta, Georgia to Summit, South Carolina. There were no stops or reported operating problems prior to the accident. As the train approached MP R178.3, the crew observed a main track switch lined for movement into the Avondale Mills Gregg Industry track. Train 192P005 entered the industry track operating at a recorded speed of 47 miles per hour (mph) and struck NS train P22P005. As a result of the collision, NS trains P22P005 derailed. The locomotives and the first 17 rail cars of train 192P005 also derailed. Five of these derailed cars contained hazardous material including four cars of chlorine gas. One of the chlorine cars was punctured resulting in a hazardous release.

Immediately following the collision, the engineer contacted, via radio, the NS Dispatch Center in Greenville, South Carolina. The conductor, meanwhile, evacuated the locomotive. The engineer evacuated the locomotive after completing the radio transmission. The engineer was taken from the accident site by a local resident and transported to Aiken Regional Medical Center in Aiken, South Carolina. The conductor was transported from the accident site by an evacuating mill employee and also taken to the Medical Center.

The release of the Chlorine gas resulted in nine fatalities and the evacuation of about 5,400 Graniteville area residents.

At the time of the accident it was dark, visibility was clear, and the temperature was 50° F.

The probable cause of the accident was the main track switch not being restored to the normal position after use. The normal position for the main track switch is lined and locked for movement on the main track.

110. NARRATIVE

Circumstances Prior to the Accident:

NS Train P22P005:

On January 5, at 7 a.m., the conductor and brakeman reported for duty at the NS Aiken Yard Office in Aiken, South Carolina. The locomotive engineer reported for duty at the same location at 8:32 a.m. The crew of train P22P005 conducted a job briefing discussing the objectives of the workday and specific movements they were to make. The crew performed a Class I (initial terminal) air brake test on their train, which consisted of one locomotive (NS 4622) and eight rail cars.

The conductor received and copied track warrant number 00779 from the NS train dispatcher at 8:11 a.m., giving train P22P005 authority to work the SA-line between MP SA 51.0 and Warrenville, South Carolina, MP SA 63.4. The SA-line is a single main track utilizing track warrant control as the method of operation. Timetable direction is east/west with a maximum authorized speed of 25 mph.

Train P22P005 departed east toward Warrenville on the SA main track. They left the SA main track at MP SA57 and entered the AB Industrial Lead to W. R. Grace Company, MP AB20. After completing their work assignment at W. R. Grace Company, train P22P005 returned to the SA main track and operated westward to the Rock Track, MP SA51, where they picked up and set off rail cars. They returned to the SA main track and operated east to the Aiken Yard Office where they stopped about 1 p.m., for lunch.

At 2:10 p.m., the conductor copied track warrant 00861 which gave train P22P005 authority to occupy and operate on the R-line main track between MP R185.0 and MP R171.0. Track Warrant 00779 remained in effect.

Train P22P005 operated south to the set off track at Warrenville, MP 180. They detached locomotive NS 4622 from the eight rail cars and operated the single locomotive to Bath, South Carolina, MP R185.0. They switched rail cars at Bath and added four cars to their train. They operated north to Langley, South Carolina, MP R182.0, to switch cars. They continued north toward Warrenville Siding, where they added two cars to their train. They continued north to the Bridgestone Lead, MP R171, and performed switching operations. At 5:50 p.m., they completed their duties at Bridgestone and operated train P22P005 south toward the Avondale Mills Gregg Industry Track.

About 6:10 p.m., train P22-05 stopped six car lengths north of the main track at Avondale Mills Gregg Industry switch. The conductor dismounted the train, threw the hand-operated derail to the open position, and unlocked the industry gates. He continued into the industry lining the route for his train. Train P22P005 pulled south stopping prior to the main track switch. The brakeman dismounted the locomotive and instructed the engineer to pull clear of the switch. The brakeman lined the switch for the Avondale Mills Greg Industry track. The brakeman protected the first highway-rail grade crossing north of the switch and instructed the locomotive engineer to shove the train north. The brakeman mounted the leading end of the north rail car and rode the shoving movement into the Avondale Mills Plant while the conductor protected the next highway-rail grade crossing.

At 6:20 p.m., the conductor radioed the Cimmaron Taxi Service taxi driver and told him to meet them at the Avondale Mills Gregg Industry. He arrived about 6:50 p.m. The conductor informed the engineer and brakeman they would not be able to operate to Warrenville Siding as planned because of their Hours of Service. The crew completed their switching then cleared the highway-rail grade crossing and mill gate by placing their rail cars in two separate mill tracks.

The engineer parked train P22P005 on the Avondale Mills Gregg Industry track about five car lengths north of the main track switch. Empty covered hopper cars PPGX 12119 and WITX 4760 were left coupled to the north end of locomotive NS 4622. The operating cab was on the south end of the locomotive.

The engineer began shutting down and securing the locomotive. The brakeman walked south from the mill closing one side of the gate as he passed through. He proceeded to the rail car coupled to the locomotive and applied the handbrake. He then boarded the locomotive to apply the handbrake and retrieve his luggage. The brakeman dismounted the locomotive and went directly to the Cimmaron Taxi which was parked adjacent to the locomotive. As the conductor walked south from the mill he closed and secured the other side of the gate and noted that it was 6:57 p.m. He walked to the locomotive where the engineer handed the luggage down to him. The engineer dismounted the locomotive and walked with the conductor to the taxi.

The train crew departed south over a highway-rail grade crossing located within 21 feet of the Avondale Mills Gregg Industry main track switch. According to the train crew they did not look toward the switch or discuss whether the main track switch had been restored to normal position.

At 7:15 p.m., the taxi arrived at the Aiken yard office. The engineer proceeded to his personal vehicle and departed the yard. The conductor and brakeman entered the Aiken yard office where the conductor completed his paperwork. About 7:50 p.m., the conductor instructed the brakeman to contact the NS dispatch office at Greenville, South Carolina, and clear track warrants 00861 and 00779. The brakeman contacted the NS dispatcher via telephone and cleared the track warrants, at 7:54 p.m.

Train 192P005:

Train 192P005 originated at Macon, Georgia destined for Columbia, South Carolina. On January 5 train192P005 consisting of two locomotives, 16 loads and 14 empties departed Macon at 1:30 p.m. En route, the head-end train telemetry device (HOTD) on the lead locomotive developed communication problems with the end of train telemetry device (EOTD). The train crew switched locomotive NS 6593 out of the lead position at McBeam, GA. They placed locomotive NS 6653 in the lead position, reestablishing proper communication between the HOTD and the EOTD. Train 192P005 arrived at the NS Nixon yard in Augusta, Ga, at 10:50 p.m.

The relieving crew of train 192P005 went on duty at 12:30 a.m., January 6, at Nixon Yard. The two-man crew consisted of a locomotive engineer and conductor. They operated the train from Nixon Yard to the NS Augusta Yard where they performed switching duties and added 12 cars to their train. Train 192P005 consisting of lead and controlling locomotive NS 6653 and NS 6593, 25 loads and 17 empties departed Augusta Yard at 2:05 a.m. The train consist showed 14 of the 25 loaded cars contained hazardous material. The train's trailing tonnage was 3,520 tons with a train length of 2,552 feet.

At 2:13 a.m., track warrant 00491 was issued to the crew of train 192P005 authorizing them to operate from Augusta, GA, MP R191.4, to Summit, South Carolina, MP R132.8. No other stops were made and there were no problems reported or recorded prior to the accident.

Approaching the collision site, MP R178.3, the maximum authorized speed is 49 mph. However, due to a left-hand one degree curve from MP R178.45 to MP R178.65, NS has a permanent speed restriction of 45 mph between MP R173.8 and MP R179.3. The grade at this point is relatively level. The locomotive engineer was seated at the controls on the left side (west) of lead locomotive NS 6653. The conductor was seated on the right side (east) of the locomotive cab compartment.

The weather was clear with a southwest wind of seven mph and a temperature of 50° F.

Norfolk Southern Timetable number 19, dated Sunday, June 20, 1999, direction is north and south. NS timetable direction is used for this report.

THE ACCIDENT

Northbound train 192P005 approached MP R178.3, operating about 48 mph, with the throttle in the number eight position. The locomotive engineer observed the main track switch lined for Avondale Mills Gregg Industry track. He placed the throttle in the idle position then initiated an emergency application of the automatic train air brake. At 2:39 a.m., train 192P005 entered the industry track at about 47 mph and collided with unattended train P22P005, parked and secured about 200 feet north of the main track switch. After impact both trains traveled north about 260 feet.

At 2:40 a.m., the engineer initiated an emergency call via radio to the NS dispatcher in Greenville, SC. He told the dispatcher the switch was lined for Avondale Mills Gregg Industry track and that they were derailed and needed an ambulance. The train dispatcher stopped all northbound and southbound trains and notified the NS Police Communication Center at Roanoke, Virginia. After this conversation the NS dispatcher attempted to contact the crew but was unsuccessful. There were no other conversations with any crew member of train 192P005.

The conductor was knocked to the floor from the impact of the collision. When he was getting off the floor, he heard the engineer calling the dispatcher. He and the engineer evacuated through the rear door on the west side of the locomotive. The conductor, who had a leg injury, lost sight of the engineer as they departed the locomotive. The conductor was picked up by a passing mill worker who was also evacuating the area. The engineer was picked up by a local resident four or five blocks north and east of the accident site at the corner of Church Street and Trolley Line Road. Both NS crew members were taken to Aiken Regional Medical Center.

Immediately after the derailment an employee of Avondale Mills, a company adjacent to the derailment site, telephoned 911 and reported the accident to the Aiken County Sheriff Dispatch Center. Avondale Mills comprises the Woodhead Plant, Stevens Steam Plant, Gregg Plant, Hickman Plant, and their Data Processing Facility.

At 2:40 a.m., the Aiken County Sheriff Dispatch Center alerted the Graniteville, Voucluse & Warrenville Fire Departments by initiating their emergency signal tone and radioed them that a train derailment had occurred with possible victims at the scene. They dispatched a sheriff deputy to the accident scene and called the NS emergency number, informing them of the derailment with product leakage.

At 2:44 a.m., the NS Railroad Police notified the Aiken County Sheriff Central Dispatch Center of the derailment in Graniteville, SC., requesting medical assistance for the two crew members. At that time they were unaware that hazardous materials were involved.

About 2:46 a.m., the Aiken County Dispatch initiated their reverse 911 call system notifying local residents and company employees near the accident site to leave the area. They also dispatched County Emergency Medical Services and Aiken County Hazardous Materials Unit to the scene. The Aiken County Sheriff established a Command Post at Aiken Plaza located at Richland University Roads in Aiken, South Carolina. By 4 a.m., the Aiken County Sheriff ordered evacuation of all people within and one mile radius of the accident site. This affected about 5,400 Graniteville residents. About 5 a.m., the NS Environmental Protection Department at Roanoke, Va., faxed a copy of the train consist for NS Train 192P005 and the emergency response information for handling Chlorine, Sodium Hydroxide Solution, and Cresol, to the Aiken County Sheriff Dispatch Center.

On the morning of the accident, the Aiken County Dispatch Center notified several county, state, and Federal agencies, including law enforcement, disaster and emergency services personnel of the South Carolina Department of Health and Environmental Control. Aiken County Emergency Services set up a decontamination center at the University of South Carolina in Aiken, for the people in the immediate area of the derailment site. In a joint effort with the American Red Cross, they established shelters for evacuees at Midland Valley High School, First Baptist Church of Aiken, and South Aiken High School. In addition, they provided 25 passenger vans and several public school buses to assist in transporting people to shelters or hotels. The shelters were only used about three days since most of the evacuees made arrangements to stay with relatives.

About noon, the South Carolina Governor proclaimed an Emergency Declaration, for the Graniteville, SC. area.

ANALYSIS AND CONCLUSION

Analysis:

Of the 5,400 people evacuated, 75 were admitted to local hospitals for treatment of pulmonary difficulties. Five hundred and fifty-four people were treated and released. Twenty-one to 26 of those treated returned to the hospital for further examination.

There were nine fatalities attributable to the collision and the resultant Chlorine gas release. All of the victims died of a pulmonary condition resulting from inhalation of the Chlorine vapors. Two employees of the Woodhead Plant were found at the rear of the facility. One person was found inside the plant, and a truck driver occupying his vehicle in front of the facility was also killed. One employee of the Stevens Steam Plant was found just outside the front door of the facility. Two employees of the Gregg Plant were found inside the facility. One local resident was found inside her house, and the engineer assigned to the train died at Aiken Regional Hospital.

Hazardous Materials Information for train 192P005:

Five of the 17 derailed rail cars, contained hazardous material. The loaded tank cars SBLX 14146, GATX 17105, and UTLX 900270 were positioned as the sixth, seventh, and ninth cars, respectively. These loaded tank cars contained chlorine, 2.3, UN1017, which is a poison inhalation hazard, Zone B. Positioned as the 8th derailed tank car was GATX 58326. Contents of this loaded tank car was described as Sodium hydroxide solution, 8, UN1824, II, classified as a corrosive material. Positioned as the 16th rail car was tank car GATX 31941 containing the residue of Elevated Temperature Liquid, classified as a class 9 material.

16th Car Gatx31941:

The 16th head car was tank car GATX 31941. The car contained the residue of Elevated Temperature Liquid N.O.S., classified as a miscellaneous hazardous material, Class 9. The car remained upright after the accident with only one set of wheels derailed. Neither the tank shell nor the jacket were damaged.

9th Car UTLX 900270:

The compromised hazardous material car, UTLX 900270, contained 180,000 lbs. of Chlorine. During the accident, the coupler from the 11th head car, CSXT 496430 carrying steel coils, struck the side of UTLX 900270 causing a 29- by 5- inch puncture in the tank shell. The puncture allowed 60 to 70 tons of liquid product to escape outside the tank, exposing residents, plant employees, railroad workers, and the environment to the poisonous Chlorine gas.

On January 9, a temporary polyethylene patch was placed over the puncture in UTLX 900270 by Hulcher Emergency Services and Specialized Response Solution (SRS) personnel in order to keep the product vapor inside the tank. On the morning of January 12, a more permanent patch constructed of 1/4 inch steel measuring 4- by 6- feet with valves and fittings, was placed over the punctured area and bolted directly to the tank shell. This allowed emergency personnel to unload product vapor from the tank car and into a bulk container of caustic solution for neutralization. This process was accomplished over several days.

8th Car GATX58326:

The 8th head car was GATX 58326, a specification DOT 111A100W1 tank car. The car contained 191,750 pounds of sodium hydroxide solution, classified as corrosive material. The car sustained dents to the right side of the tank shell and jacket. The “A” end stub sill was badly twisted, the cross key retainer broken, and the coupler missing.

The product, in GATX 58326, was siphoned from the car into a bulk container at the derailment site. Afterwards, the car was placed on flatcar OTTX 97273 for movement to Olin Corporation, in Augusta, GA.

7th Car GATX17105:

The 7th head car was GATX 17105, a specification DOT 105J500W tank car. The car contained 180,000 pounds of chlorine and also sustained severe damage to the jacket and tank shell during the derailment. The “A” end stub sill, coupler, and right side body bolster were missing. The “B” end stub sill was badly twisted. The left side body bolster on the “B” end and the right side body bolster on the “A” end were twisted. The tank shell sustained a dent on the left side at the “A” end. The protective housing was crushed, and the manway bonnet was missing.

6th Car SBLX14146:

The 6th head car was SBLX 14146, a specification DOT 105J500W tank car. The car contained 180,000 pounds of chlorine, and sustained severe damage to the jacket and tank shell during the derailment. The top shelf of the “B” end (hand brake end) coupler was broken off during the derailment and the head shield sustained a dent in the right lower quadrant. The “A” end stub sill was twisted and the knuckle pin was broken with the knuckle missing. The “A” end body bolster was badly twisted on both the left and right sides of the car. The left side body bolster was also twisted on the “B” end. The manway bonnet shielding the two liquid valves, two vapor valves, and the safety valve on top of the car appeared intact.

Hulcher Emergency Services and Specialized Response Solutions performed wrecking operations and the transferring of product from the damaged tank cars. The ruptured tank car, UTLX 900270, was hauled from the accident site to Union Tank Car in Altoona, Pennsylvania, for further assessment. The other four derailed hazardous material cars were placed on rail flatcars and hauled to Olin Corporation, in Augusta.

Track Information:

The Norfolk Southern Piedmont Division R-line is a 190.52 mile track segment, originating at a junction to a main track near Charlotte, North Carolina, extending through Columbia, South Carolina and ending in Augusta, Georgia. The R-line is north/south by timetable direction with numerous small towns and industries located along the track segment. The R-line is designed and maintained to comply with the Code of Federal Regulations Class IV standards which allows a maximum speed of 60 mph for freight trains. NS maximum authorized speed for the Columbia to Augusta segment is 49 mph with some restrictions along the way

The segment of the R-line at Graniteville is a single main track utilizing Track Warrant Control as the method of operation.

Track records and switch inspection:

On January 7, the NTSB, South Carolina Office of Regulatory Staff and Federal Bureau of Investigation (FBI) arrived at the accident site where they observed the switch for the Avondale Mills Gregg Industry track. The switch was inspected to determine how secure the latch and lock were and for proper fit of the switch points. No exceptions were taken. The FBI photographed the switch and switch lock before removing them from the site.

A track records inspection was performed for the R-line between Columbia, SC and Augusta. The time line for the inspection was November 9, 2004 to January 5, 2005. Federal Track Safety Standards require that Class 4 track be inspected twice weekly, and all switches shall be inspected on foot at least monthly. NS was in compliance with the frequency requirement.

Mechanical Inspection Train 192P005:

NS train 192P005 was operating with two locomotives at the time of the accident. The event recorder data file from locomotive NS 6653 was downloaded and provided to NTSB investigators. Because battery power was exhausted on locomotive NS 6593, the event recorder was removed and taken into custody by the NTSB.
Mechanical documents retrieved from locomotives NS 6653 and NS 6593 indicated the Class I air brake test and mechanical inspection had been performed as required.

The 26 non-derailed cars from train192P005 were moved from the accident site to Augusta for decontamination. On January 8, they were tested and inspected by the FRA, NTSB, and the South Carolina Office of Regulatory Staff. The cars' brake systems operated as required and the minor safety appliance defects noted during the inspection would not have significantly affected the performance of the train.

Event Recorder Data:

The event recorder data from locomotive NS 6653 indicated train 192P005 was traveling approximately 47 mph with the throttle in position eight approaching MP R78.3. The throttle was then reduced to position six and held at that position for about 30 seconds. The throttle was then reduced to position four with the speed at 48 mph. The data indicates the speed decreased from 48 mph to 42 mph within 27 seconds while the throttle remained in position four. About 2.9 seconds later, the throttle was placed in Idle simultaneously as the automatic air brake was placed in emergency braking. Train 192P005 traveled approximately 159 feet in 20 seconds while the speed decreased from 42 mph until the speed indicated 0 mph.

The event recorder removed from locomotive NS 6593 was shipped to the NTSB Vehicle Recorders Laboratory, Washington, D. C. The downloaded data supported the earlier data retrieved from locomotive NS 6653.

Sight Distance Test:

On March 29, sight distance tests were conducted using a locomotive similar to the locomotive on train 192P005. The locomotive was operating at a speed equal to the speed indicated by the train's locomotive event recorders at the time of the accident. Representatives from the FRA, NTSB, NS, United Transportation Union (UTU), and the Brotherhood of Locomotive Engineers and Trainmen (BLET) participated. The tests were conducted between 2 a.m., and 3 a.m. The weather was dark, cloudy, and 59° F, similar to the weather experienced by the 192P005 train crew at the time of the accident.

The locomotive testing engineer was seated in the operating cab on the left (west) side of test locomotive NS 6561. The UTU testing conductor was seated on the right (east) side, of the locomotive. A 14-inch diameter banner attached to a 7 foot-long shaft was mounted on top of the Avondale Mills switch. Approaching the collision site at MP R178.3, the locomotive testing engineer was operating northbound in a 1degree left-hand curve. As the locomotive came out of the curve into tangent track, the locomotive testing engineer was able to see the switch stand banner. The red reflection from the switch stand banner was visible to the engineer at a distance of 1,461 feet. It was first visible to the testing conductor at 1,339 feet. However, at these maximum site distances, they could not identify the reflection as a switch stand banner. The red reflection was not identified as a switch stand banner to either crew member until the train reached a point 566 feet south of the switch. The switch points could not be seen until the testing locomotive was 220 feet south of the switch stand banner. This sight distance would not have been sufficient for any train to have stopped in time to avoid a collision.

Main Street is adjacent and parallel to the NS main track for several blocks. In the accident area, the street crosses the industry track at grade in a southwesterly direction, west of the switch stand banner. The street measures 20 feet in width. From the center line of the street to the switch stand banner is 21 feet. The view from a vehicle crossing over the industry track to the switch stand banner is unobstructed.
Applicable NS Rules:

NS Piedmont Division Timetable No. 19, dated Sunday, June 20, 1999; NS Safety and General Conduct Rules dated December 30, 2002; and NS Operating Rules dated December 15, 1999, were in effect on January 5. Applicable rules:

- Operating Rule and Safety and General Conduct Rule GR-27 - "Undivided attention to duty is required. While on duty, employees must not engage in any activity that will interfere with or distract their attention from their work."

- Safety and General Conduct Rule GR – 32 (3) - "Job Briefing - Communication with employees to review the planned itinerary, procedures, and necessary safeguards for the task to be performed. A job briefing must always precede the task at the work site, be clearly understood, and be updated or modified as conditions change. If an individual is performing the task, he must participate in a job briefing."

- Operating Rule and Safety and General Conduct Rules: General Rule "B" - "Employees must be conversant with and obey the rules and special instructions. If in doubt as to their meaning, employees must apply to the proper authority for an explanation. ..."

- Operating Rules and Safety and General Conduct Rules: General Rule "M" - "... Employees must not do any work in a manner that will jeopardize their own safety or the safety of others. They must know that appliances, tools, supplies, and facilities used in performing their duties are in proper condition. If not, they must have them put in order before using them. It is the duty of every employee to examine them to determine their condition. ..."

- Operating Rules, General Regulations: GR-8 - "An employee subject to the Hour of Service Act must give the proper office sufficient advance notice if it becomes apparent that he cannot complete the trip or tour of duty within the lawful period."

- Operating Rule 101 - "Trains must be fully protected against any known condition that may interfere with safe passage."

- Operating Rule 104 - "The normal position for a main track switch is lined and locked for movement on the main track." "Such switches must be left in normal position after use, and locks must be tested to assure they are secured."

- Operating Rule 104 (a) - "The position of a switch or derail being used is the responsibility of the employee handling it. This, however, does not relieve other crew members of responsibility if they are in place to observe the positions of switches and derails. Switches and derails must be properly lined and secured after having been used..." "...Where trains or engines are required to be reported clear of main track, such report must not be made until switch and derail, if any, have been secured in normal positions."

NS Actions:

The three crew members of train P22P005 were dismissed from service after NS completed their investigation into the accident.

On January 14th , NS implemented the recommendations of FRA Safety Advisory SA 2005-01 and made them applicable to both train service and Maintenance-of-Way employees. The NS requirements are more extensive than the Safety Advisory recommendations. Employees reporting clear of a Track Warrant are required to inform the dispatcher of the total number of hand throw switches operated within the limits of the Track Warrant. The name and location of each of the switches must also be entered on a Switch Protection Awareness (SPA) form and retained by the employees until their next tour of duty.

Applicable FRA Regulations and Laws:

As result of the interviews and subsequent inspection of the hours of duty records of the P22P005 train crew, it was determined the locomotive engineer, conductor, and brakeman exceeded the Hours of Service Law, U.S.C. 21103, on January 5.

CONCLUSION:

FRA partnered with all Federal, State and local agencies, including NS personnel investigating this accident. FRA participated with all of the NTSB's accident work groups which investigated all aspects of the collision, including the interviews of citizens and railroad personnel. FRA's report, is based in part, on the information developed in these work groups. However, FRA is required to conduct an independent investigation and produce a separate factual report. FRA independently interviewed the NS P22P005 train crew, the Cimmaron taxi driver, and NS train dispatchers performing duties prior to and during the time of the accident. FRA reviewed NS records of train movements and track warrants, on all trains operating between Augusta and Columbia from January 4 through 6.

FRA determined that train P22P005 was the last train to operate on the main track between MP R185.0 and MP R171.0 prior to the collision on January 6. FRA further concludes, that the brakeman of train P22P005 was the last person to operate the Avondale Mills Greg Industry switch and the switch was never restored to the normal position for main track movement.

The probable cause of the accident was the main track switch not being restored to the normal position after use. The normal position for the main track switch is lined and locked for movement on the main track.