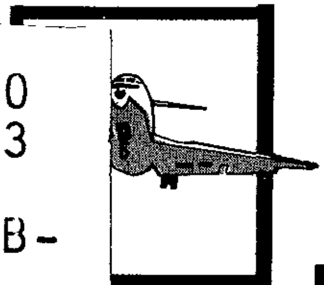

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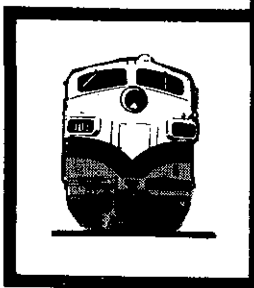
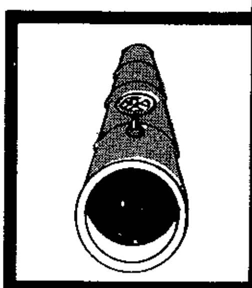


WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

**DERAILMENT OF SOUTHERN RAILWAY COMPANY
TRAIN NO. 2, THE CRESCENT
ELMA, VIRGINIA
DECEMBER 3, 1978**



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16. Abstract

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The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer to observe the track ahead because he was unnecessarily distracted by a transition problem, which led to his operation of the train into a 5°15' curve at a high speed. The high speed produced excessive lateral forces which caused the wheels of either the fourth locomotive unit or the first car to climb out of the gage, cross the head of the rail, and derail.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

Adopted: June 7, 1979

DERAILMENT OF SOUTHERN RAILWAY COMPANY TRAIN NO. 2, THE CRESCENT ELMA, VIRGINIA DECEMBER 3, 1978

SYNOPSIS

About 5:38 a.m. on December 3, 1978, as the Southern Railway Company's train No. 2, The Crescent, was passing through a 5°15' curve at Elma, Virgina, eight cars and four locomotive units were derailed. Six persons were killed, 41 persons were injured, and property damage was estimated to be $557,500.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer to observe the track ahead because he was unnecessarily distracted by a transition problem, which led to his operation of the train into a 5°15' curve at a high speed. The high speed produced excessive lateral forces which caused the wheels of either the fourth locomotive unit or the first car to climb out of the gage, cross the head of the rail, and derail.

INVESTIGATION

The Accident

The Southern Railway Company's northbound train No. 2, The Crescent, arrived at Monroe, Virginia, at 5:02 a.m. on December 3, 1978, from Atlanta, Georgia. The enginecrew arriving on The Crescent did not report any problems with the locomotive or train to the relieving enginecrew. The Crescent departed Monroe at 5:07 a.m., 7 minutes late, with four locomotive units and eight cars. Predeparture and en route inspections of the train disclosed no defects.

The engineer reported that the No. 1 engine of the lead locomotive unit failed to make transition 1/ properly between Monroe and Oakridge, Virginia, but that the trouble eventually cleared and the transition was completed.

1/ See Appendix A for a detailed explanation of transition.

He reduced speed to comply with the 50-mph speed limit through the equilateral turnout at Oakridge by using the airbrakes and by reducing the throttle to position No. 1 or No. 2. After passing Oakridge he operated the throttle to accelerate to the maximum authorized speed of 79 mph. He then saw the wheel slip-slide alarm light come on intermittently. Also, he again observed that the No. 1 engine of the lead unit was not making transition properly. He reduced the throttle slightly two times in an effort to complete the transition but the problem persisted.

The engineer had experienced a transition problem before, so he thought that tapping the shunt field contactor might eliminate the problem. He asked the fireman to use the wooden staff of a signal flag to close the contacts of the shunt field contactor, located in an electrical cabinet to the rear of the locomotive cab, to see if holding the contactor in an energized position would cause the transition to be completed. This action also failed, so he instructed the fireman to take the engine off the line. 2/ To do this, the fireman had to move from the operating cab to the engineroom, where he operated the controls to take the engine off line temporarily. Taking the engine off line also failed to complete the transition.

When the fireman returned to the cab, the engineer was turned away from observing the track ahead and was probing the shunt field contactor with the staff of the signal flag. At this time the fireman noted that the steam pressure to the train had dropped to 140 psi from 165 psi since leaving Monroe. He stated that he had been taught to maintain the steamline pressure at not less than 200 psi, without qualification relative to the length of the train. Therefore, with the approval of the engineer, he returned to the engineroom to start another steam generator to supplement the train's steam supply. The engineer did not mention an upcoming hotbox detector at milepost 140.3 nor did he suggest that the fireman remain in the cab to observe the roadway ahead.

The engineer continued to probe the shunt field contactor, and when he turned to observe the track to determine his location he saw that he was approaching a 5°15' curve which had a 45-mph speed limit. He knew that the train's speed was too fast to move around the curve, and he immediately made a service brake application, followed almost in a continuing move by an emergency application. The train derailed after moving about 570 feet into the 800-foot curve. (See figure 1.)

The lead unit separated from the other three locomotive units and continued northward 3,427 feet. The second and third units turned on their sides and stopped 594 feet and 372 feet respectively, from the point of the derailment along the west side of the track. The fourth unit buried itself in a dirt embankment at the end of a ravine, 285 feet

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2/ To manually remove the diesel engine from a power status to idle and then restore it to power status.

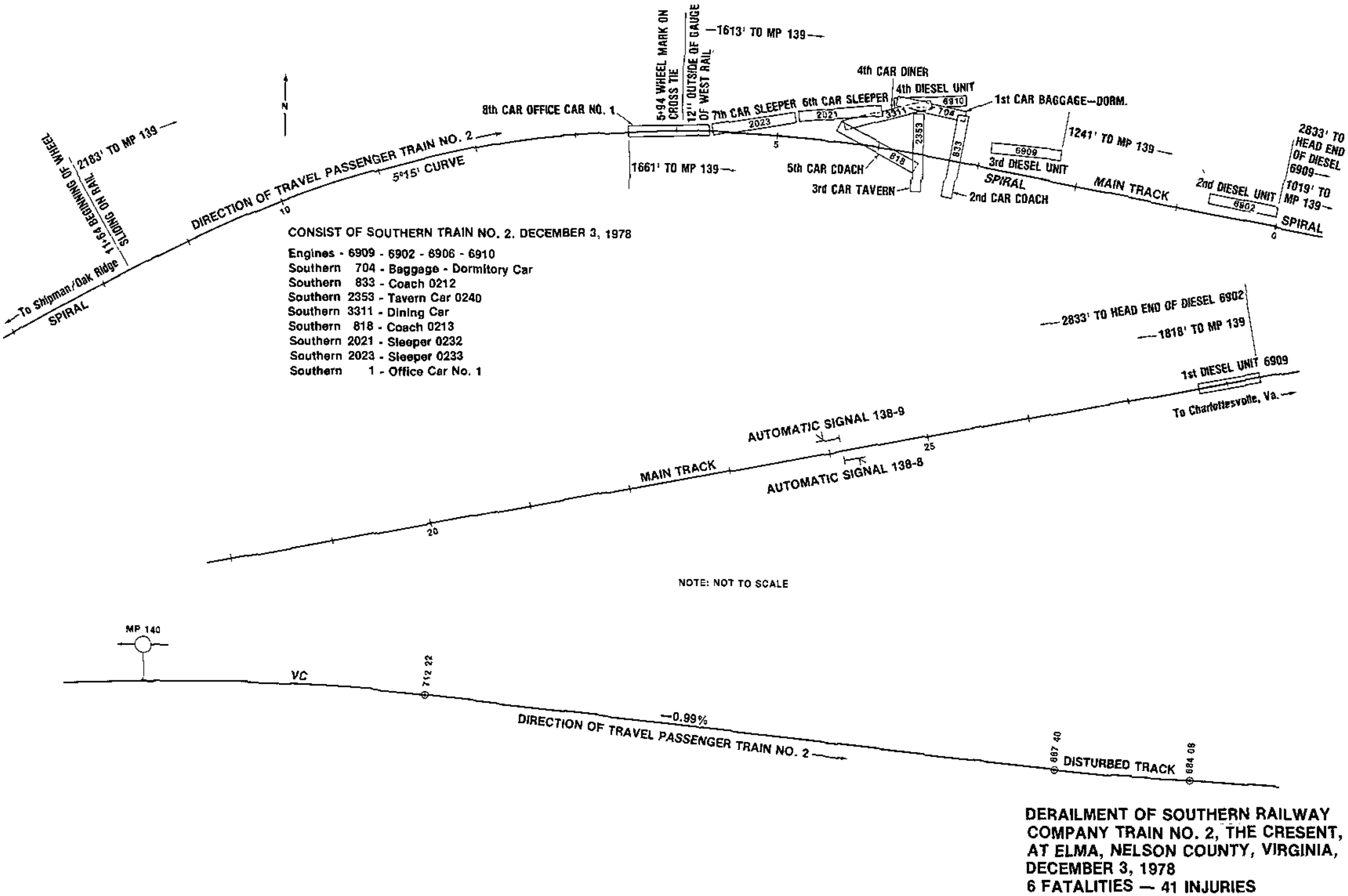


Figure 1. Plan of accident site.

from the derailment point and 64 feet west of the track. Its trajectory was nearly tangential from the derailment point to where it stopped in the bank.

The fourth locomotive unit and seven cars were contained in a 250-foot distance. Some cars overrode each other, while others jackknifed across the track. The first, a baggage car, was overturned and stopped on top of the fourth unit. The second car, a coach, was turned on its right side and was lying across the track. The third, a tavern car, jackknifed and stopped across the track. The fourth car, a diner, went into the ravine and was partially overridden by other cars. The fifth car, a coach, stopped across the track. The sixth and seventh, sleeping cars, were stopped on the side of the fill headed into the ravine, and the eighth, a business car, stopped on the track structure. (See figure 2.)

Immediately following the derailment a fire started between the dining car and the following car which onboard fire extinguishers were not adequate to extinguish. One of the responding fire departments eventually extinguished the fire.

Injuries to Persons

Injuries	Passengers	Crewmembers and Service Personnel
Fatal	4	2
Nonfatal	30	11
None	35	5

Damage

The lead locomotive unit sustained a broken rear coupler and a damaged No. 4 traction motor. The second unit had the front coupler broken and other substantial damage. The third and fourth units were destroyed. The first five cars were destroyed. The rear three cars were damaged moderately to slightly. The railroad estimated damage to the equipment to be $522,500.

About 467 feet of track and roadway were destroyed; the railroad estimated the damage to be $35,000.

Crewmember Information

The engineer had been dismissed for violating certain company operating rules three times between 1964 and 1966. In each instance he was reinstated with unimpaired seniority. At that time the Southern used a system of discipline that mandated dismissal for certain offenses. Under the current system those dismissals would have been suspensions. There is no disciplinary action on his personnel record

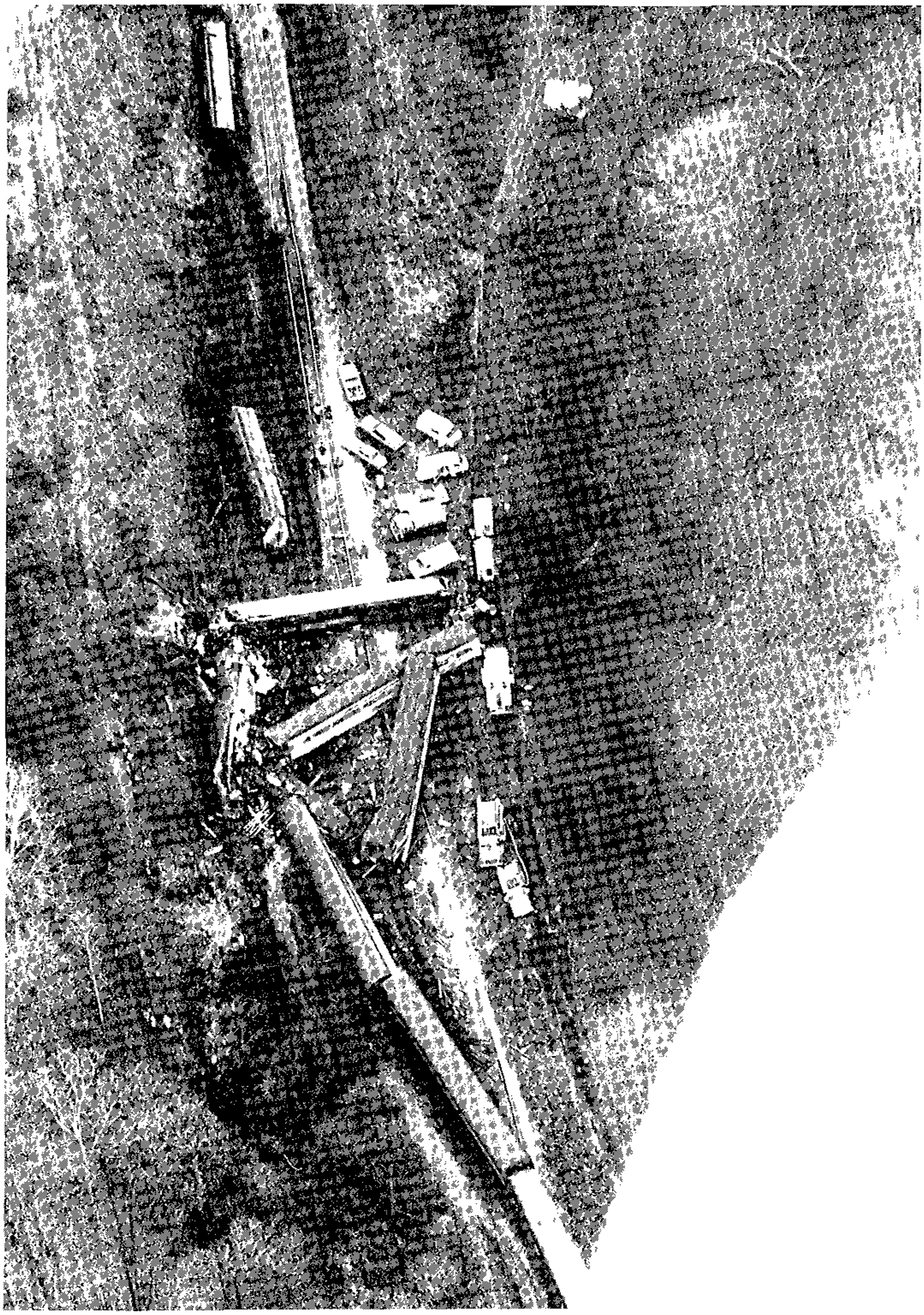


Figure 2. Aerial view of accident site.

from 1966 through 1978. Between January 4 and 17, 1978 a company physician disqualified him as an engineer because of hypertension. At the time of the accident the hypertension had been corrected and he was not taking medication. The engineer used corrective lenses only for reading. A blood test for alcohol and barbiturates was negative.

His operating record was assessed by the general manager of the Southern's Eastern Lines as good. The engineer had good knowledge of the operating rules, and he was thoroughly familiar with all speed restrictions en route. The records indicated that the engineer complied with all of the compliance checks made by supervisory personnel along the right-of-way, such as speed checks using radar, observance of slow orders, and torpedo response checks.

The fireman stated that in keeping with an accepted practice he made inspection tours through the enginerooms of the locomotive at Monroe and again at several other points where stops were made. He also said that even though the hotbox indicator at milepost 140.3 is defined by the rules as a fixed signal, it was being called only when actuated and was not being called according to rule 34 of the Southern operating rules. Rule 1057 requires that firemen keep a lookout for signals, etc. when other duties permit. There is no definition of other duties nor is there a priority assigned to his applying this rule. (See Appendix B.)

The traincrew had an uneventful trip from Washington, D.C. to Monroe, Virginia, on December 2, 1978, and had rested at a local motel during their layover. Each attested that the other appeared normal in all respects. Their activities before departure and the crew's operation of the train indicated that they were alert and there was no evidence of willful violation of rules or operational practices. (See Appendix C.)

Train Information

The Crescent was assembled at Atlanta, Georgia and consisted of four locomotive units and seven stainless steel cars equipped with type H tightlock couplers. The brakes were tested before departing from the coach yard and again at the Southern's Atlanta station. A 500-mile brake test required by the Federal Power Brake Law was made at Greenville, South Carolina. No exceptions were taken during any of the tests. Southern's business car No. 1 was added to the rear of the train at Spartanburg, South Carolina. The Crescent was inspected at Monroe and no defects were noted.

The locomotive consisted of four E-8 type diesel-electric units built by the Electro Motive Division of General Motors Corporation between 1951 and 1953. Each unit was powered by two EMD MODEL 12-567B 12-cylinder diesel engines and were propelled by electric traction motors on two of the axles of the three-axle trucks. Each unit weighed 328,870 lbs and was rated at 2,250 HP. They were equipped with the No. 24 type airbrake system.

Two cabinets which contained electrical components were located in the rear of the operating compartment. One, a high voltage cabinet, was kept locked. The other, a low voltage cabinet, was not locked and contained fuses and other equipment for use of the enginecrew. The low voltage cabinet also contained the shunt field and the battery field contactors, and other relays associated with transition. (See figure 3.)

Progressively, the traction motors are changed from a series to a parallel connection to the generator, at predetermined voltages, by the operation of relays and contactors. These configurations are appropriate for either a high torque/low speed or high speed/low torque operating situation. A transition failure is indicated to the engineer by an intermittent light on the wheel slip-slide detector light, the fluctuation of the ammeter, or the sound of the diesel engine. The engineer testified that he felt it was necessary to correct the transition problem with the No. 1 engine because the flashing wheel slip-slide indicator light was worrisome. Also, if he took the engine off-line, he would have no way of monitoring the loading of the locomotive since the ammeter, which is the load indicator, is connected only to the No. 1 engine. (See Appendix A.)

The four locomotive units were provided with speed recorder units. The recorder uses a standard 8-track tape cassette. The first locomotive unit had a defective recorder and no speed data was recorded. The three cassettes from the other locomotive units were processed and a tape produced. All three units recorded similar data. They showed stops at Lynchburg, Virginia and Monroe; they showed the slow speed of 50 mph required at Tye River and Oakridge for the equilateral turnouts; they showed the reduction in throttle made by the engineer when he was attempting to clear the locomotive's failure to make transition; and they showed a gradual acceleration from Oakridge to 80 mph at the point of derailment. There was no data recorded following the derailment. (See Appendix D.)

Track Information

The track structure was built on a fill at the point of the derailment and entered a cut at the north end of the fill. The 132-1b. RE, CWR rail was laid on 8-inch by 13-inch, double-shoulder tie plates on 9-inch by 7-inch by 8-foot 6-inch treated hardwood crossties. The rail was secured by one railholding spike each on the gage and field sides and one holddown spike on each side. The rail was box-anchored on alternate ties. The ties were well ballasted with crushed granite to a depth of 18 inches. The cribs were full and the shoulder ballast sections extended beyond the crosstie ends more than 12 inches. The track's construction and maintenance exceeded the minimum standards of the Federal Railroad Administration's (FRA) Track Safety Standards for a Class IV track.

The track is straight for about 2.7 miles to the entry spiral of the 5°15' curve on which the accident occurred. Approaching from the south is an ascending grade which varies from 1.15 percent to 0.73 percent

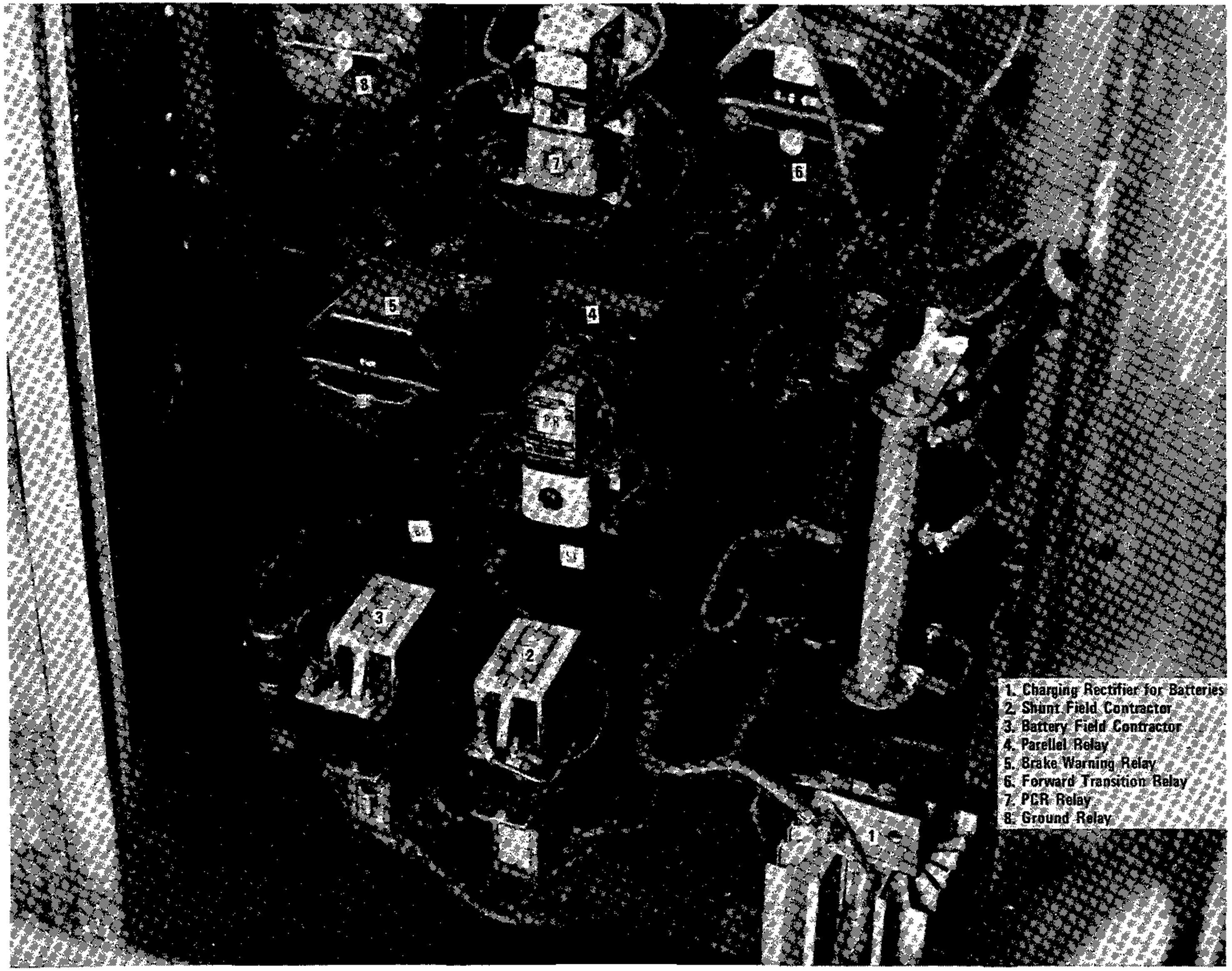


Figure 3. Interior view of low voltage cabinet.

for about 2 miles. It crests about 400 feet north of MP 140, and then becomes a descending grade varying from 0.99 percent to 0.95 percent which continues through the curve. The 800-foot curve has a design superelevation of 5 inches.

Northward there is about 200 feet of straight track leading to a 4°30' curve to the left. The 45-mph speed restriction of the 5°15' curve is the theoretical nominal speed which will provide optimum comfort for passengers. The maximum safe speed for an E-8 type locomotive on this curve is about 52 to 60 mph, and the theoretical overturning speed is 90 to 95 mph.

The FRA requires a Class IV track to be inspected two times per week. The Southern inspects the track through Elma four times per week. Inspection is made from a Hi-rail vehicle or a track car. In addition to the inspections the track is also tested by the FRA rail geometry car at least once a year and by the Southern's rail test car two times per year. A Sperry Rail Service test car tested the track through the Elma area on June 26, 1978 and there were no defects noted.

Method of Operation

Trains are operated through the accident area by signal indications of a centralized traffic control system. Between Monroe and Charlottesville, Virginia the track alternates from two tracks to one track about every 10 miles. The double and single track is signalled for traffic in either direction. The equilateral turnouts at each end of double track sections and crossovers at the midpoints are controlled by the train dispatcher at Greensboro, North Carolina. Trains are equipped with radios and the engineers have immediate access to the train dispatcher.

Supervisory personnel monitor the performance of train service employees frequently by riding the locomotive and observing their compliance with rules and also by making ground tests using torpedoes or timing their passage between known points to check their speed. Radar is also used for speed compliance checks.

On curves such as the one at the accident site where the 79-mph speed limit is not safe, Southern depends on an engineer to safely control his train. Speed control equipment is not feasible at such locations because it would require extensive resignaling on wayside equipment and on each locomotive.

Meteorological Information

On the morning of December 3, 1978, the weather between Monroe and milepost 138.5, north of the accident site, was clear and cool; the temperature was approximately 52° F. At 5:38 a.m. darkness prevailed, but visibility was good.

Medical and Pathological Information

The injuries to passengers and crewmembers included fractured skulls, spines, arms, ribs, and pelvises; back, shoulder, chest, leg, and ankle injuries; and cuts and abrasions. One passenger died from multiple trauma; one from a head injury; one from multiple trauma, evisceration, and a skull fracture; and one from multiple trauma and a chest injury. One crewmember died from multiple trauma and a skull fracture and another died from multiple trauma and head and chest injuries.

Survival Aspects

Rescue attempts to free trapped passengers were impeded because of the stainless steel metal used in the car construction. Ordinary cutting tools and hydraulic extricating equipment were almost useless in this effort. Special tools and special equipment were obtained and used to free the trapped passengers.

The most severe injuries were to those persons in the dining car at the time of the derailment. The crewmember who suffered third-degree burns and multiple fractures was pinned for 11 hours between a wall and the galley stove, which was torn loose from its anchoring and internal structural members. Another dining car employee and a passenger were fatally injured in the dining car. The flagman, who was also in the dining car at the time of the derailment, died of a heart attack after being freed. Three persons in the second car were killed. This coach was so badly crushed that it could not be determined if the passenger's deaths were caused by the crushing of the car or by their striking some of the structural members of the car. The dining car also was crushed so severely that documenting injury-producing elements was difficult. Many injured passengers had to be removed through the windows.

When the train derailed, the engineer immediately notified by radio the dispatcher in Greensboro who then summoned emergency help from Faber, Virginia. Subsequent calls went out to neighboring rescue and fire forces for assistance. About 17 rescue units, the Virginia State Highway Patrol, and the Nelson County Sheriff's Department responded to the alarm.

The Nelson County Rescue Squad was the first unit to arrive and the captain of that unit assumed control of rescue operations. Nelson County was especially equipped to respond to an emergency because of an active emergency preparedness plan. The plan was conceived in 1969 following hurricane Camille which caused much devastation in Nelson County. Its concept was expanded so that it could be adapted to most any catastrophic situation such as the accident at Elma. Because of this plan rescue personnel knew what was expected of them and how to fulfill their responsibilities. The mobile equipment of the Faber rescue squad was equipped with radios, with a choice of six frequencies, by which they communicated directly with the University of Virginia Hospital in Charlottesville, Virginia. The radio communications network also enabled them to maintain contact with the other rescue squads in the area, such as the Charlottesville/Albemarle squad.

The hospital had staged a mock disaster drill just weeks before the accident, and its staff was well prepared for the emergency. More then 150 persons participated in the rescue operation. Other hospitals in Charlottesville and Lynchburg also received patients.

The Southern had issued to passenger train service employees a booklet entitled "Passenger Train Crew Emergency Procedures" written by the Safety and Freight Claim Services Department, Personnel Administration. The booklet sets forth first aid procedures and actions that are to be followed in emergency situations. When the booklet was first issued, classes were held instructing passenger service employees on its application and contents. Since that time it has been updated and the updated material has been covered in annual rules classes. For example, one instruction was that a rag was to be tied to the door of a car if there were no injured persons in it. In the derailment at Elma the rescue squads found a rag tied to the doors of two cars. The significance of the rag had been explained to them by the conductor.

Tests and Research

In the postaccident tests and inspections, the track approaching and leaving the accident site was checked for defects and deviations from the FRA Track Safety Standards. A visual inspection and appropriate measurements for cross level and curvature were made and there were no condemnable defects found. The broken pieces of the west rail exhibited no preexisting defects. The breaks exhibited surfaces typical of overload fractures of which most were in a transverse plane. Only one portion exhibited shatter-type fractures.

The lead locomotive unit was tested for brake performance and transition. The brakes operated with no problems and the unit never failed to make transition during tests. Only the No. 1 diesel engine could be used during the tests because of the damaged traction motor driven by the No. 2 diesel engine. There had been no recorded problem with the No. 2 engine failing to make transition. Neither had there been any engine problems reported on the locomotive inspection report for the 30 days before the accident.

The brakes on the business car and the two sleepers were tested after the accident and no faults were detected. The undamaged brake valves from all other cars were removed and bench-tested by the Southern airbrake shop. There were no faults indicated.

ANALYSIS

The theoretical speed for a train powered by E-8 locomotive units to safely move around this curve was computed to be about 52 to 60 mph and the overturning speed was computed to be 90 to 95 mph. From the recorded speed and statements of the enginecrew, the train was close to the overturning speed as it entered the curve.

The dynamic forces produced as the train progressed through the curve increased to a point where the flanges of the wheels on the outside rail were forced upward, permitting the wheels to cross the top of the rail and drop to the ground. Wheel marks on the top of the rail indicated that this occurred. The rail was subsequently turned outward by the derailing cars. It could not be determined accurately which car or locomotive unit's wheels were the first to climb out of gage, but evidence points to either the fourth locomotive unit or the first car. This is supported by the almost tangential trajectory of the fourth locomotive unit and the first car to their final stopping point in the embankment at the north end of the ravine. Neither unit turned over as would be expected if the train had reached the overturning speed of the curve.

The manner in which the equipment came to rest on the west side of the curve, as opposed to the cars staying in line on the track structure, also was indicative of a high-speed derailment on a curve. The cars that jackknifed and stopped at varying angles, some nearly perpendicular to the track, were violently forced to those positions by the sharp decelerating forces caused by the application of brakes and the derailment. On most of the cars the tightlock couplers did not become uncoupled but as the cars were forced into a jackknife position at least one coupler shank broke on each car.

While the speed limit was 79 mph approaching the curve at Elma, an engineer would have had no trouble reducing the speed to the required 45 mph and controlling the speed of his train through the curve. There are other locations on the Southern system where 79 mph is not safe, and Southern depends on an engineer to safely control his train in those designated areas.

The engineer of the Crescent appeared to understand thoroughly the rules and regulations for the operation of his train, and he indicated that he was thoroughly familiar with the territory over which he was operating. The speed tape system used on the locomotive showing the speed variations from Monroe northward indicated that the engineer was alert and that he was obeying the speed restrictions. With the high degree of accuracy that the speed tape system exhibits, it constitutes a veritable foolproof system to validate or refute the performance of the train. The Safety Board, therefore, must conclude that the engineer was well qualified to operate The Crescent but that he apparently was distracted from his duty to safely control his train by attempting to correct the transition problem.

The maximum speed between Tye River and Oakridge is 79 mph. At that speed the transition would have been completed and the shunt field and battery field contactors would have been energized. Once the engines have completed transition (to full parallel), reverse transition to a series position normally will occur only if the throttle is put in the off position or if there is a wheel slip-slide situation. The engineer stated that he applied the train brakes to reduce speed for the equilateral turnout at Oakridge and that he put the throttle in position No. 1 or No. 2. The speed tape verifies his slowing to the authorized speed at Oakridge. Therefore, it is possible that as the train began accelerating, there was a wheel slip. The engineer stated that he saw the wheel slip-slide alarm light come on and begin flashing. The rails may have been damp, and there may have been a difference in the torque effort between the two pairs of driving wheels on the truck which could have caused the reverse transition. There is no way to determine why the engine failed to complete a transition after leaving Oakridge. The Safety Board believes that it may have been due to a continued intermittent wheel slip, or to a temporary circuit problem such as a failed relay or a contactor which cleared as a result of the accident. No such defective equipment was found after the derailment.

The engineer should not have allowed his attention to be so completely absorbed by the transition problem because there was ample power to handle the train without the No. 1 engine in the lead unit operating properly. However, he had been confronted with this problem before and from his past experience he felt that if he tapped the shunt field contactor, the problem would clear and he could return to the more important duty of observing the track ahead. When a simple tap failed to clear the trouble, he allowed himself to become distracted by the problem and momentarily lost his awareness of his train's location. The engineer stated that the wheel slip-slide light flashing in his face was a nuisance. His alternative was to take the No. 1 diesel engine off line. However, he felt by this action he would be handicapped in operating the train because he would no longer be able to monitor the loading of the locomotive. Therefore, he felt compelled to clear the transition problem. Obviously he was not fully aware of his speed and the distance he had traveled before turning back to observe the roadway to orient himself.

It is possible that the transition problem described by the engineer was present and cleared up so it was not detectable. Since the engineer had not operated the locomotive controls in a manner to cause it to change its transition status, some event occurred which caused a reverse transition and necessitated a forward transition at Oakridge. This could have been a wheel slip, discussed elsewhere, or a temporary fault in a contactor.

The fireman apparently understood the duties for which he was responsible. He had followed an unwritten rule, but an accepted practice, by his inspection of the locomotive leaving Monroe. He complied with the instructions of the engineer in trying to correct the transition problem. He maintained that with the steam pressure having dropped 25 psi between Monroe and a point south of the derailment that it was urgent to start another steam generator to increase the pressure, especially since the peak demand period was beginning. He claimed that he had been instructed at various times to maintain the steam pressure no lower than 200 psi, although the railroad's supervisory personnel testified that a lower pressure would be acceptable.

Even though the fireman voluntarily returned to the engineroom to start an additional steam generator, the engineer approved it. The engineer did not mention the upcoming hotbox detector nor did he suggest that the fireman remain in the cab to observe the roadway ahead. Since the fireman had been given no reason to be suspicious of the engineer's performance, he felt free to respond to his understanding of his duties relative to the steam generator. He did not consider remaining in the cab to observe signals, even though the engineer was turned away from observing the road ahead, a priority action. The Southern should emphasize the firemen's duties in order of priority to eliminate confusion. This becomes especially important with younger employees.

According to the enginecrew the aspect displayed by the hotbox detector at milepost 140.3 had been called only when it was actuated. Apparently the fireman and engineer did not consider the hotbox detector as a fixed signal in the context of Rule 34. With the frequency at which supervisors monitor the performance of locomotive engineers, this should have been a detectable failure that could have been corrected.

The injuries to persons in the diner in this accident are similar to those which the Safety Board has discussed in other accident reports. However, in this accident a great mass of the train was decelerated so sharply that it would be difficult to design against such forces. The service personnel and passengers quite often are on their feet and the momentum would hurl them about freely. The cook stoves are adequately secured for roughness encountered in routine service. The precautions provided by the restraining safety rail on the stove, a lip around the table top, and the coverings on the utensils are designed for forces developed during normal train operation. However, the forces incurred in this derailment were far from normal and disastrous results would be expected under the circumstances.

The rescue operation proceeded extremely well at the accident because of the disaster planning by those who responded. This is especially true of the Nelson County and Charlottesville/Albemarle Squads, the traincrew, and the University of Virginia Hospital at Charlottesville. The Nelson County Squad, in assuming command of the situation, followed guidelines established by the emergency preparedness plan adopted by Nelson County. The University of Virginia Hospital's recent mock disaster drill highlighted many of the type injuries suffered by The Crescent's passengers. The traincrew, primarily the conductor, had responded well to the training provided them by the Southern Railway. All who participated in the rescue operation were better equipped to cope with the situation because of the preparedness plan and the mock drills.

The manner in which the Faber squad implemented emergency procedures was exemplary and the Safety Board compliments them and all others who participated in the rescue operation for a job well done. The orderly manner in which the rescue operation proceeded lends credence to the many recommendations issued by the Safety Board supporting preparedness plans for accidents along railroad rights-of-way.

CONCLUSIONS

Findings

1. The train was being operated at excessive speed as it entered the 45-mph curve.
2. The wheel marks on the head of the rail are indicative of a wheel climb.
3. The array of the equipment after the derailment is indicative of a high-speed derailment.
4. The track was in good condition and did not cause or contribute to the accident.
5. There were no defects found with or in the equipment that would have caused or contributed to the accident.
6. The engineer was distracted from his duty to watch the track ahead by an engine problem.
7. The local emergency preparedness plan was an important factor in the early and successful evacuation of the injured passengers.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer to observe the track ahead because he was unnecessarily distracted by a transition problem, which led to his operation of the train into a 5°15' curve at a high speed. The high speed produced excessive lateral forces which caused the wheels of either the fourth locomotive unit or the first car to climb out of the gage, cross the head of the rail, and derail.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

June 7, 1979

APPENDIX A

EXPLANATION OF TRANSITION

When the locomotive begins to move a train, it requires a great amount of torque but not much speed capability. The high torque is obtained by the field winding configurations of the traction motors which require a high current at low voltage. The locomotive starts with the traction motors in a series configuration. At a predetermined voltage which is reached when the locomotive is moving about 24 mph, the windings of the traction motors are electrically changed to a parallel arrangement. The parallel arrangement gives less torque but greater speed capability and the current demand is decreased. Again, at another predetermined voltage which is reached at a speed of approximately 62 mph, some of the current is shunted around the field windings of the traction motors so that acceleration can continue. Once more the voltage is increased and the current is decreased. Contactors actuated by relays are used to automatically change the winding connections between the motors and the generators to obtain the proper configuration.

The shunt field contactor, when engaged, causes the battery field contactor to be energized. For the transition from stop to full speed to be completed, the contactors must operate in a predetermined sequence. The contactors will not reverse automatically when the locomotive slows its speed. A wheel slip causes the shunt field contactor to become de-energized which in turn causes the battery field contactor to drop out. Such action would cause the locomotive to make reverse transition, and necessitate beginning a forward transition again. Reverse transition will also occur at pertinent speeds if the throttle is placed in the off position.

APPENDIX B

Excerpts from the Southern Railway Company Operating Rules

1051. Firemen, hostlers, and the hostler helpers must observe all rules relating to their duties; see also Rule GR-3. to the extent applicable, rules for "engineers" govern hostlers, and rules for "firemen" and for "yard helpers" govern hostler helpers. (Effective April 15, 1973)

1050. Firemen are directly responsible to and must obey the orders of division and terminal officers. When assigned to trains or engines, firemen must obey the orders of engineers. Within shop limits, firemen must obey the orders of shop supervisors.

1052. Firemen must report for duty at the appointed times and places and must examine bulletin books when practicable. While on duty firemen must assist engineers in all ways necessary for proper performance of their engines. (Effective April 15, 1973)

1053. Firemen are jointly responsible with engineers for proper performance of engines, for proper display of train signals, and for protection of the front of their trains. (Effective April 15, 1973)

1057. Firemen must keep lookout for signals, obstructions, or defects of track or their trains, when other duties permit. (Effective April 15, 1973)

108. In the case of doubt or uncertainty, the safe course must be taken.

1014. For the safety of their trains engineers must keep vigilant lookout ahead and must frequently look back to rear.

GR-3. Rules are subdivided and captioned for convenience. They must be observed when they relate in any way to the proper discharge of the duties of any employee. (Effective July 7, 1975)

34. Employees located in the operating compartment of an engine must communicate to each other in an audible and clear manner by its name the indication of each signal affecting movement of their train or engine as soon as the signal is clearly visible or audible. It is the responsibility of the engineer to have each employee comply with these requirements, including himself.

It is the engineer's responsibility to have each employee located in the operating compartment maintain a vigilant lookout for signals and conditions along the track which affect the movement of the train or engine.

* * *

Definitions

Fixed Signal -- A signal of fixed location indicating a condition affecting the movement of a train or engine.

> Note - The definition of "Fixed Signal" includes switch, train order, block, interlocking, semaphore and other signals, stop signs, yard limit signs, speed limit signs, or other means for displaying indications that govern movements of trains or engines.

APPENDIX C

Crewmember Information of Southern Railway Company Train No. 2, December 3, 1978

James E. Smith, the engineer, was employed on June 14, 1941 as a fireman. He was promoted to engineer on January 26, 1951. He passed his last medical examination on January 16, 1978 and he had his vision and hearing tested on December 1, 1976. He last attended an operating rules class on January 21, 1978. The training he received to become an engineer was through on-the-job training.

Wayne L. Brown, the fireman and a qualified engineer, entered Southern Railway's service on November 17, 1973 as a trainman, but he established seniority as a fireman on May 16, 1976. He attended the Southern Railway Company's school for locomotive engineers at McDonough, Georgia, and he was promoted to an engineer on December 21, 1976. He last passed a medical examination in May 1976 and his vision and hearing were tested on May 4, 1976. He had one 30-day suspension on his record in 1977 for involvement in a derailment. He had not been qualified by supervision to operate a passenger train.

Leo A. Bailey, the conductor, was employed as a brakeman on December 31, 1945 and he was promoted to conductor in November 1960. He attended an operating rules class during January 1978, and he had passed a medical examination within the 16 months before the accident. He was qualified as a freight and a passenger conductor. His training was received on-the-job.

Howard L. Jackson, the flagman, died from a heart attack moments after he was extricated from the wreckage. Wesley V. Tomlin, the baggagemaster, was not available for interrogation at the Safety Board's formal investigation, and there are no personnel data on these two crewmembers.

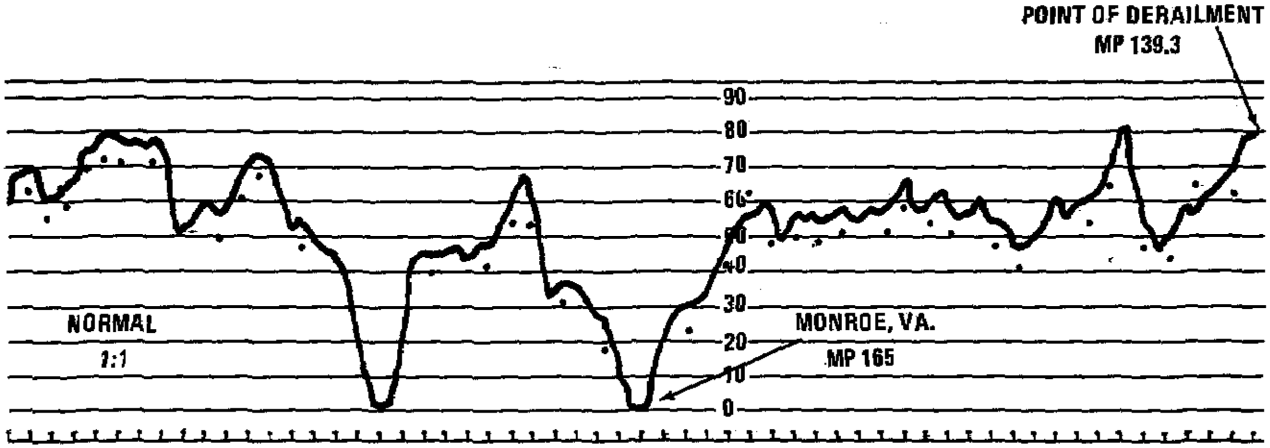
APPENDIX D

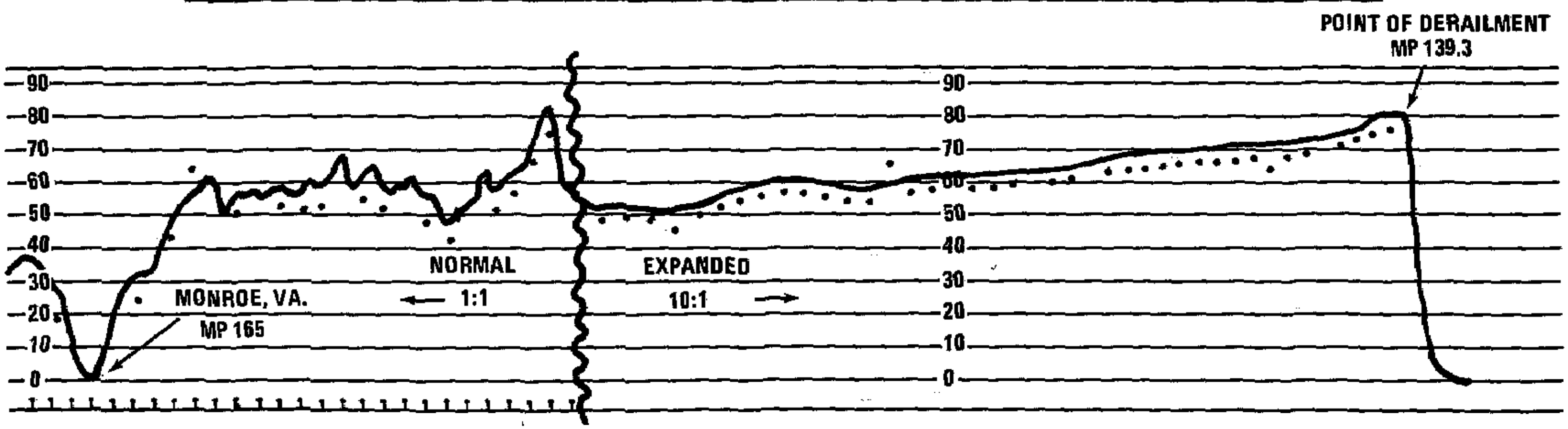
DESCRIPTION OF SPEED-RECORDING EQUIPMENT AND COPIES OF SPEED TAPES

The speed information on the E-8 locomotive unit is provided from a frequency generator mounted on the 5th axle, the idler axle. The generator frequency is fed into an electronic comparator which generates a very stable, crystal-controlled known frequency. The generator is compared to the known comparator frequency and the difference is calibrated in miles per hour. The output is recorded on the 8-track cassette which has a storage capacity of 8 hours. After 8 hours of preserved information the previous 8-hour data is erased and the current speed data is recorded.

Speed tape information is translated into useable information by calibrated playback units in the Southern's Test and Research Laboratory. Compensations can be made for wheel size due to the wear and other variables. When the cassette is played back the data is recorded on a graph-tape which contains all the recorded speed-distance data. The tape has calibration marks for distances in miles or tenths of a mile which can be related to a milepost on the roadway. The speed recorder system is reported to be accurate to $\pm$ 1/2 mph.

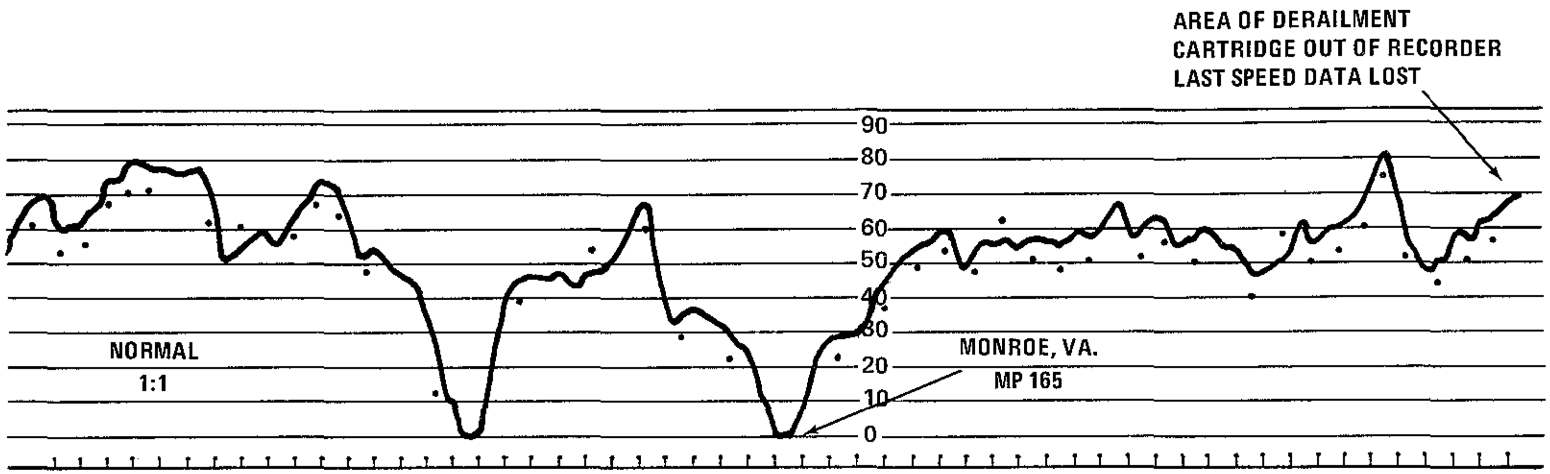
EXHIBIT 2G

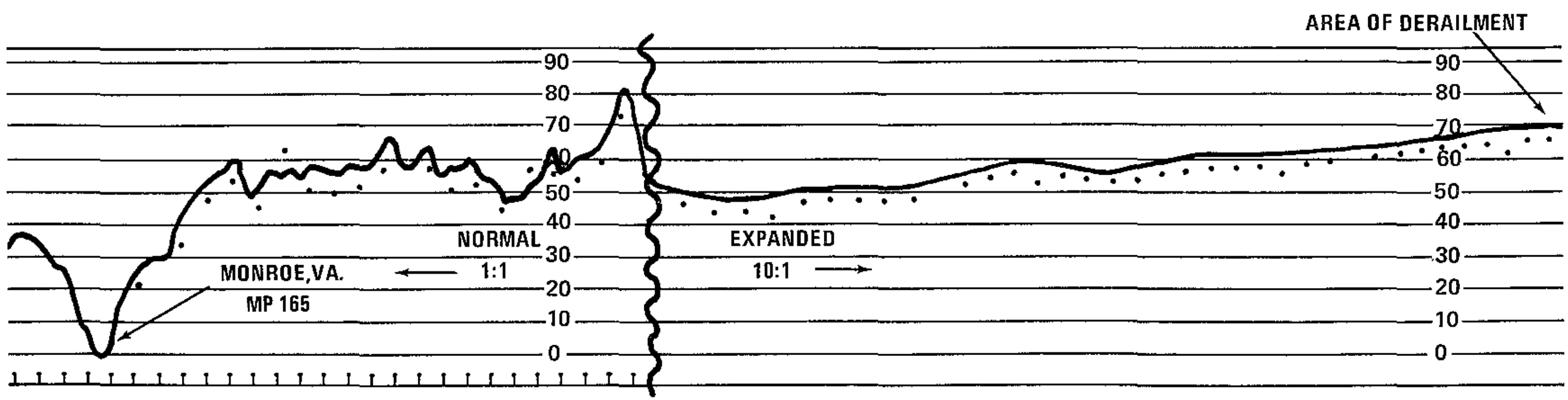




LOCOMOTIVE NO.	6902

EXHIBIT 2G-1





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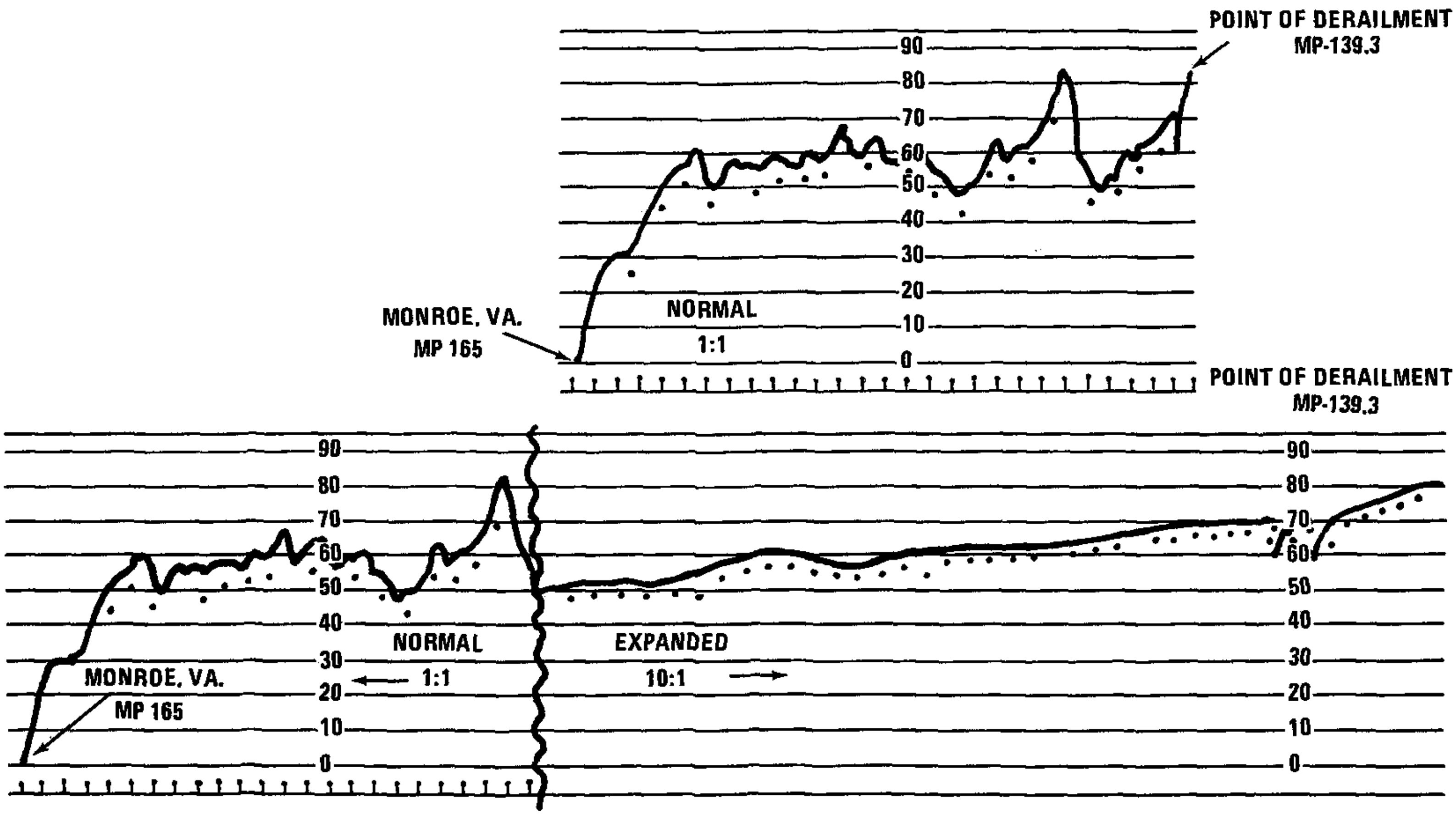

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