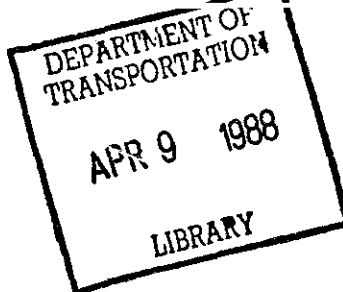


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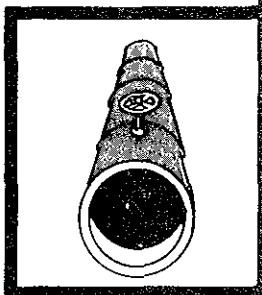
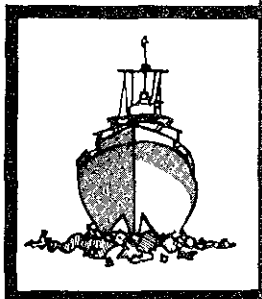
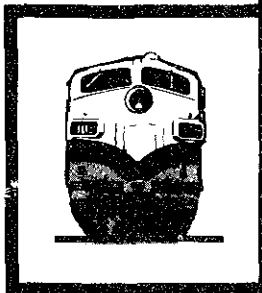


# **NATIONAL TRANSPORTATION SAFETY BOARD**

WASHINGTON, D.C. 20594

## **RAILROAD ACCIDENT REPORT**

**DERAILMENT OF AMTRAK PASSENGER TRAIN 8  
OPERATING ON THE SOO LINE RAILROAD,  
FALL RIVER, WISCONSIN  
OCTOBER 9, 1986**



NTSB/RAR-87/06



**UNITED STATES GOVERNMENT**

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16 Abstract <p>On October 9, 1986, eastbound Amtrak passenger train 8 derailed in Fall River, Wisconsin. The train was to cross over from the eastward to the westward track in the town of Fall River. Train 8 entered the crossover at 70 mph and the locomotive units overturned. The authorized speed for the crossover was 10 mph. Two locomotive units and 10 passenger cars derailed, the fireman was killed, two crewmembers were injured seriously, and two received moderate injuries. Of the 215 passengers on board, 26 were injured.</p> <p>The National Transportation Safety Board determines that the probable cause of this accident was the Soo Line Railroad's procedures for crossing trains over on main line tracks which defeated the protection of the signal system. Contributing to the accident was the heavy workload of the dispatcher and operator. Also contributing to the accident was the lack of adequate industry and Federal rules regarding the functioning and testing of radio systems used in dispatching trains.</p>					
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## EXECUTIVE SUMMARY

On October 9, 1986, eastbound Amtrak passenger train 8 derailed in Fall River, Wisconsin. The train was to cross over from the eastward to the westward track in the town of Fall River. Train 8 entered the crossover at 70 mph and the locomotive units overturned. The authorized speed for the crossover was 10 mph. Two locomotive units and 10 passenger cars derailed, the fireman was killed, two crewmembers were injured seriously, and two received moderate injuries. Of the 215 passengers on board, 26 were injured.

The major safety issues concern the dangerous procedure being used to cross trains over at Fall River, the lack of testing of radios used in train operations for long distances, and the heavy workload of the train dispatcher and operator.

The National Transportation Safety Board determines that the probable cause of this accident was the Soo Line Railroad's procedures for crossing trains over on main line tracks which defeated the protection of the signal system. Contributing to the accident was the heavy workload of the dispatcher and operator. Also contributing to the accident was the lack of adequate industry and Federal rules regarding the functioning and testing of radio systems used in dispatching trains.

As a result of its investigation, the Safety Board issued recommendations to the Soo Line Railroad to require crewmembers to test the radio at predetermined points, to equip main line switches with electric locks to prohibit the operation of the switch after a train has passed the last signal before a crossover, and to provide train dispatchers and operators with reasonable breaks and days off. In addition, the Safety Board issued recommendations to the Federal Railroad Administration to modify their regulations regarding the testing of radios, to regulate when dispatchers and operators are provided days off and breaks, and to study the selection process, training, duties, and responsibilities of train dispatchers. The Safety Board also issued recommendations to the National Railroad Passenger Corporation to determine if safe practices are being used and operating rules are being followed aboard Amtrak passenger trains, to install electrically locked switches on the main line tracks, to establish a testing procedure for the radio system, and to establish safeguards to prevent contract railroads from using unsafe practices to qualify for on-time incentive payments.

NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D. C. 20594

RAILROAD ACCIDENT REPORT

Adopted: December 12, 1987

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DERAILMENT OF AMTRAK PASSENGER TRAIN NUMBER 8  
OPERATING ON THE SOO LINE RAILROAD  
FALL RIVER, WISCONSIN  
OCTOBER 9, 1986

INVESTIGATION

The Accident

At 7:01 a.m., c.d.t., October 9, 1986, the Soo Line Railroad Company (Soo) engineering department took the eastward track of the main line out-of-service between milepost 145.0 at Astico, Wisconsin, and the facing point switch <sup>1/</sup> of the crossover at Watertown, Wisconsin, located at milepost 131.1. The engineering department was replacing two highway grade crossings and conducting other programmed track maintenance in the out-of-service area. The last programmed track maintenance on the westward track was performed from September 25, 1986, to October 8, 1986. October 9, 1986, was the first day the eastward track was out of service. Milepost 153.5 in Fall River, Wisconsin, was the last eastward to westward crossover before the out-of-service area. The track out-of-service order allowed 8 1/2 miles of the eastward track to be left in service east of the crossover at Fall River. Instructed by a train dispatcher in Milwaukee, a switchtender was assigned on October 9 to the Fall River crossover to expedite the movement of trains by operating the crossover switches.

A copy of train order number 11, an order to take the track out-of-service, was to be issued by the operator at Portage, Wisconsin, to the conductor and engineer of each eastbound train arriving at Portage (appendix C). The order established the limit for eastbound trains operating on the eastward track to milepost 145.0 (figure 1); any eastbound train arriving at this point could not proceed further eastward.

At 9 a.m., eastbound freight train 200 arrived at Portage. (See figure 1a.) The engineer and conductor received train order no. 11 and another order that allowed them to operate on the westward track. Eastbound freight train 204 arrived at Portage at 9:10 a.m., and the engineer and conductor of that train also received a copy of train order no. 11. However, train 204 was held at Portage by the dispatcher to await the arrival of eastbound train 210. The train dispatcher stated that he wanted train 200 to depart Portage on the westward track and train 210 to depart Portage before train 204 on the eastward track. He further explained that train 210 would pass train 200 en route to Fall River, 24 miles east of Portage, and would cross over to the westward track before train 200 was allowed to proceed east of Fall River. Train 200 was a cabooseless train.

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<sup>1/</sup> A track switch, the points of which face traffic approaching in the direction for which the track is signaled.

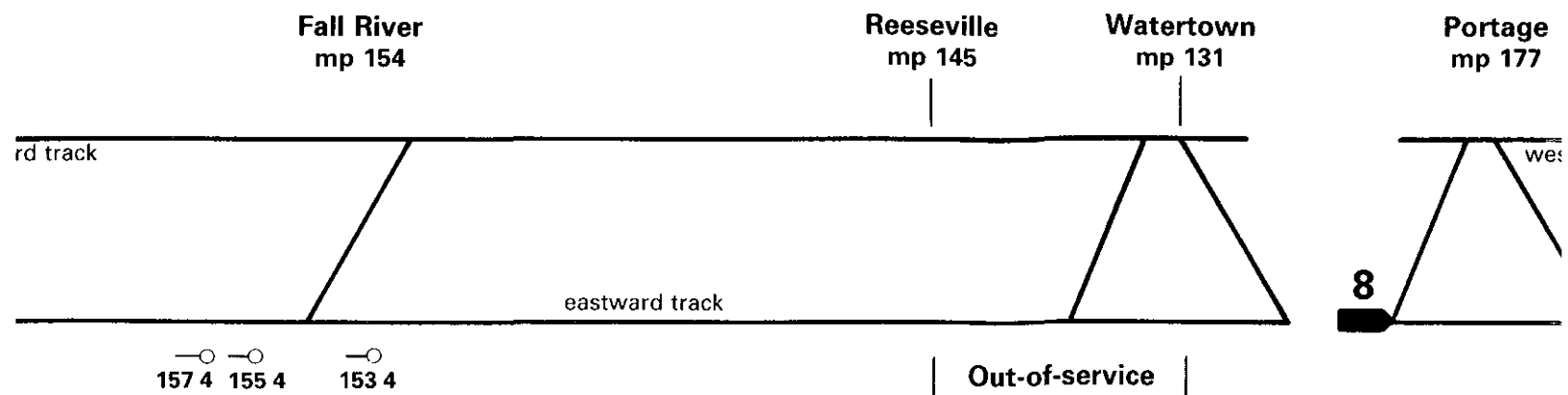
At 9:55 a.m., train 200 departed Portage eastbound on the westward track and train 210 departed eastbound on the eastward track. A road foreman, the engineer's supervisor, took over the controls of the locomotive of train 210 at Portage. The crew of train 200 had received an order that allowed the train to proceed only to Fall River and wait there so that it would not interfere with the movement of train 210. At 10:15 a.m. the dispatcher advised the switchtender that train 210 would be the next train to arrive at Fall River (figure 1b). The switchtender suggested a crossover procedure that might expedite the movement of the train; he stated that the train dispatcher agreed with this suggestion. The crossover procedure consisted of delaying the positioning of the crossover switches until a train passed the last wayside signal, 2 miles west of the crossover at Fall River. According to the switchtender, this procedure would display continual green signals that would allow the engineer to operate at a higher speed until nearing Fall River. The engineer would then slow his train at his own discretion, rather than obey the speed restrictions imposed by the signals that would have been displayed had the switches been operated before the train passed the signal.

Train 210 passed train 200 about 15 miles east of Portage. Several minutes later, the engineer and conductor of train 210 received an order by radio from the operator at Portage to cross over to the westward track at Fall River. The road foreman, who was operating the controls, made a radio check with the switchtender at Fall River and advised him that train 210 had not yet reached the two signals west of Fall River. He did advise the switchtender that he would contact him when he was past the signals so that the switchtender could operate the crossover switches.

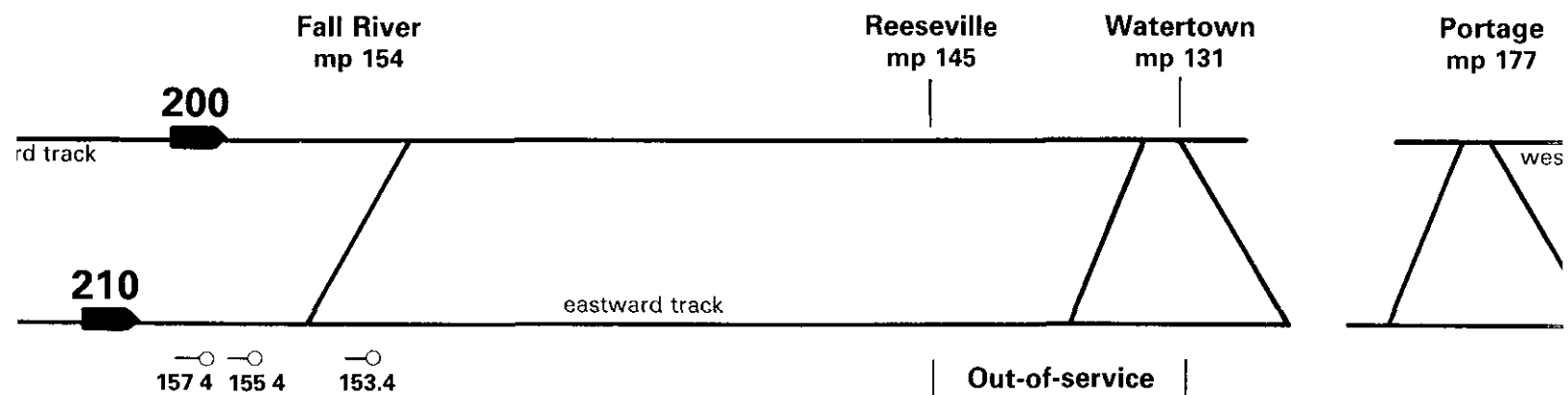
After the locomotive of train 210 passed signal 155.4 (the last signal before Fall River), the road foreman radioed the switchtender at Fall River to reverse the switches of the crossover to allow his train to cross over to the westward track and to continue eastbound. Immediately after receiving that communication, the switchtender stated that he heard the locomotive horn sound a warning for a grade crossing east of signal 155.4 and that he reversed the switches as he had been instructed. Within minutes, train 210 arrived at Fall River, and at 10:59 a.m. it had completed the crossover move from the eastward to the westward track (figure 1c). Meanwhile, train 200 arrived and stopped at Fall River; the switchtender stated he overheard the engineer and conductor receive an order from the operator at Portage allowing train 200 to proceed eastbound on the westward track. By this time the switchtender had lined the switches to the crossover in the normal position, so that as soon as the order to proceed was complete, train 200 could depart.

Train 204 departed Portage at 10:40 a.m. on the eastward track and its engineer and conductor were instructed to stop at Fall River to receive a train order. Train 204 arrived at Fall River about 11:30 a.m. and stopped; the switchtender overheard on his portable radio that the engineer and conductor of train 204 had received an order that would allow the train to cross over to the westward track at Fall River. The switchtender then reversed the switches to allow train 204 to proceed. Train 204 completed the crossover to the westward track at 11:34 a.m. (figure 1d), and the switchtender then lined the switches to the normal position.

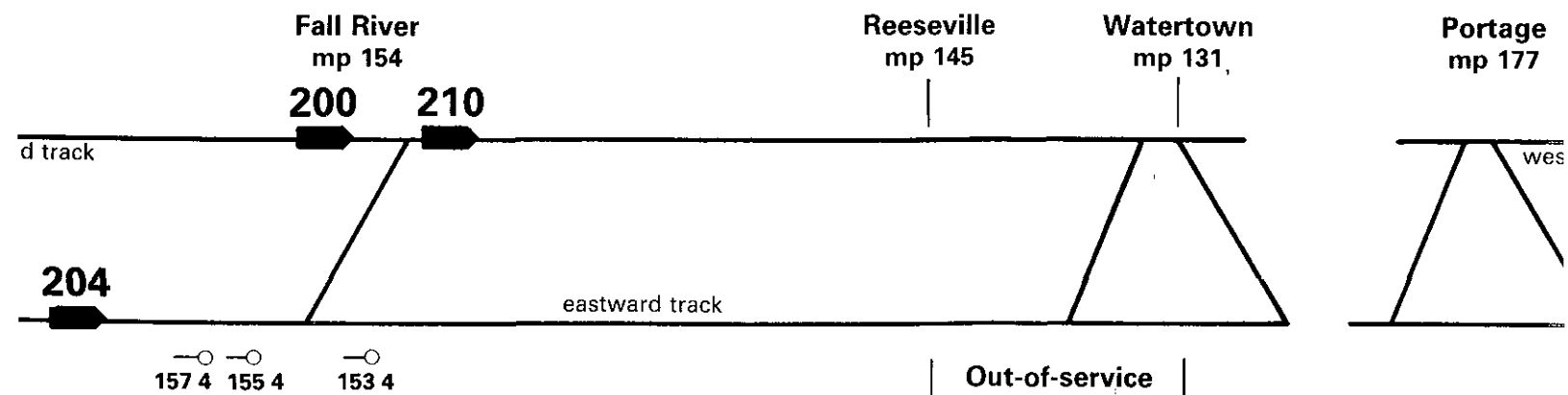
Following the crossover of train 204, the switchtender called the train dispatcher and inquired if the National Railroad Passenger Corporation (Amtrak) passenger train 8 would be the next train arriving at Fall River. The dispatcher replied, "Ok, No. 8 will be next, and I will tell him about that signal there."



**(a) 9 a.m.**

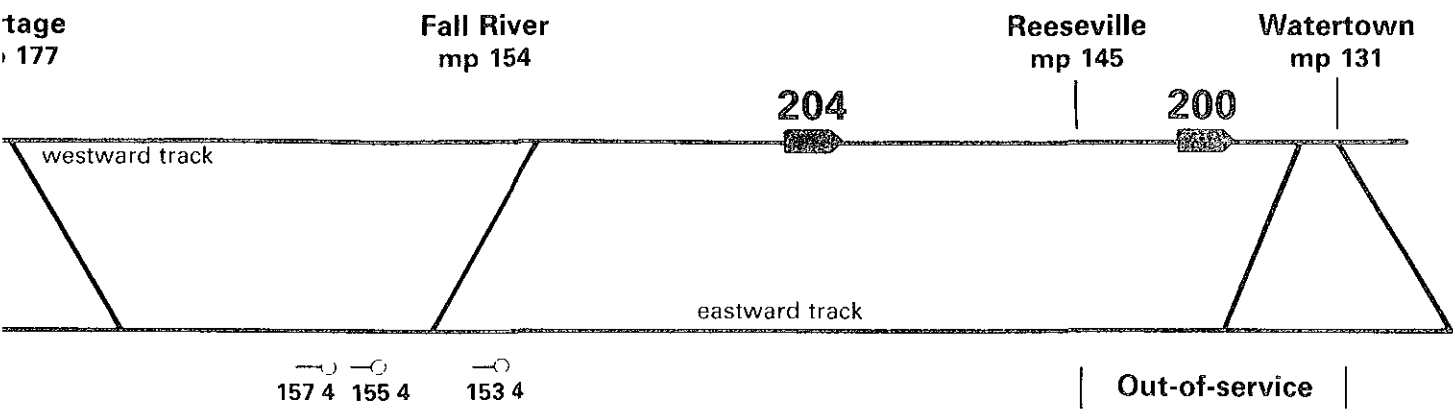


**(b) 9:55 a.m. - 10:15 a.m.**

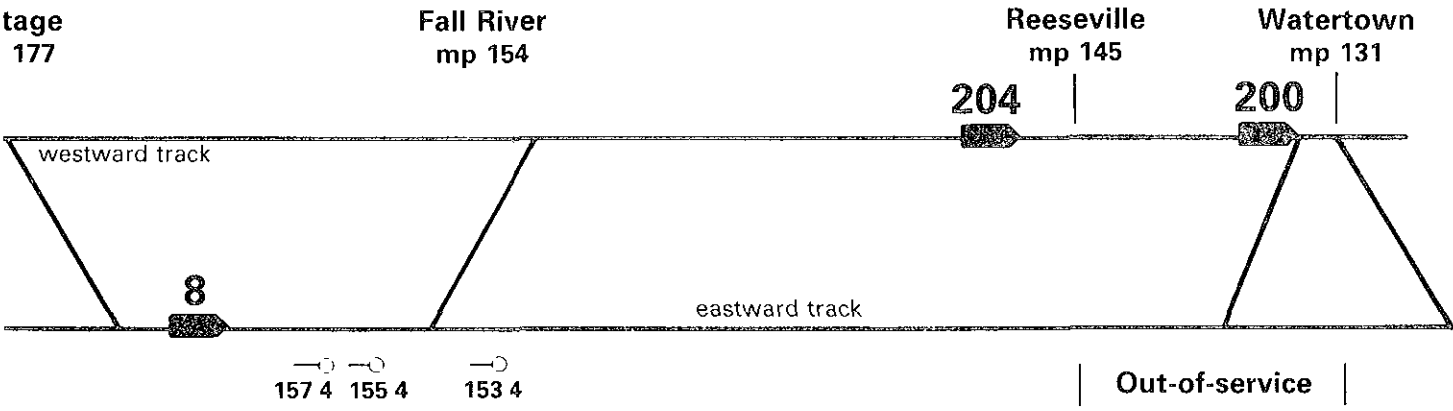


**(c) 10:59 a.m.**

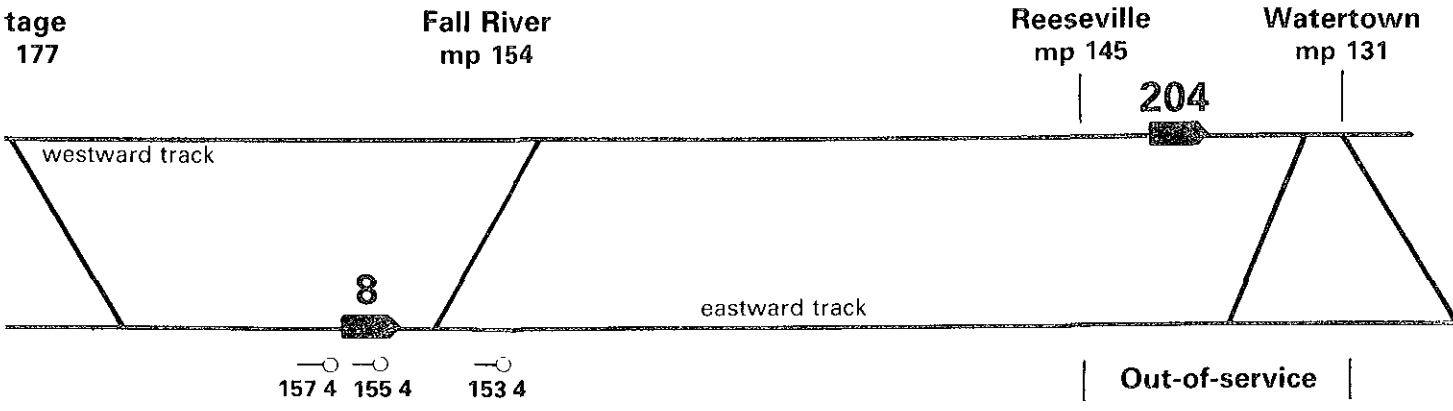
Figure 1. - - Track conditions for train movement o



(d) 11:34 a.m. - 11:56 a.m.



(e) 11:59 a.m.



(f) 12:19 p.m.

not to scale

nt on October 9, 1986 (Watertown Subdivision).



Train 8 departed La Crosse, Wisconsin, 25 minutes late at 10:13 a.m. The engineer stated he tested the radio by making a voice communication with the conductor of his train and that between La Crosse and Portage he had communicated with a dispatcher at Milwaukee, which he estimated to be about 5 to 6 miles (through a relay station). The engineer stated he heard one radio transmission with a train ahead. He further stated he thought that transmission he heard was for the train that had already crossed over at Fall River, and he thought that the eastward route was being cleared for his train.

Train 8 arrived at Portage, a regular station stop, at 11:56 a.m. The operator at Portage delivered a clearance card and four orders to the engineer and conductor (appendix C). Besides train order no. 11, two of the orders were speed restrictions in the area of the out-of-service area and the other order was a speed restriction farther east of the out-of-service area. Train order no. 11 allowed the engineer to operate his train on the eastward track only to milepost 145. Then train 8 departed at 11:59 a.m., 8 minutes late (figure 1e). After departing Portage the engineer operated the train at 70 mph, the authorized speed for a passenger train in that area. The train dispatcher started to broadcast an order to the operator at Portage at 12:10 p.m. to be delivered to train 8 by radio. That order would permit train 8 to cross over at Fall River. However, the dispatcher stated that he then became involved in locating other trains on the division. At that time, the switchtender called the train dispatcher to inquire about the location of train 8 and was advised that it had departed Portage at 11:59 a.m. The switchtender asked the train dispatcher, "Do you want me to operate the same as with 210?" The train dispatcher replied "Yes." At 12:13 p.m. the dispatcher instructed the operator at Portage, "Okay. Say Portage, tell number 8 about that signal at Fall River, and let the switchtender know so when he goes by it he can throw the switch." However, the engineer of train 8 and switchtender stated they did not receive these instructions from the Portage operator. The Portage operator stated he did not remember getting those instructions from the dispatcher. However, at that time he was trying to locate the trains on the westward track for the dispatcher. The switchtender stated that he was on the dispatcher's line waiting to talk and heard the dispatcher give the instructions to the Portage operator.

At 12:19 p.m. (figure 1f) the dispatcher completed train order no. 52 to the operator at Portage that would give train 8 permission to cross over at Fall River (appendix D). The operator stated that he immediately began trying to contact the engineer of train 8 by radio, but that he received no response. However, the engineer on train 8 stated that he and the fireman received the radio transmission from the operator and acknowledged it. The fireman continued to acknowledge the radio transmissions from the operator but received no indication that the operator was receiving his calls. The fireman also called to a crewmember on the train and requested a radio check to determine if the crewmember could receive his transmission. Using a portable radio, the crewmember said, "Yes, but you are scratchy." The operator stated that he did not hear any response from train 8 and so notified the dispatcher. The operator was also switching from the Portage radio base station to the Watertown base station in an attempt to communicate with train 8. The dispatcher instructed the operator to stop train 8 at Fall River and to come to the wayside phone to receive the order. The dispatcher also attempted to communicate with train 8 using the radio at the Watertown base station. A track foreman in a Soo truck at the work site near milepost 145 overheard the operator on the radio in the truck attempting to contact train 8 and heard what he believed was a faint response. The track foreman radioed the operator and informed him that train 8 was responding. As train 8 continued east, the two signals approaching Fall River were green, indicating to the engineer that the signal blocks ahead were clear and that he could continue to operate the train at the authorized speed. The engineer reduced the speed of the train to 65 mph

for a curve at milepost 162 to about milepost 160. After exiting the curve, he increased his speed to 70 mph. The engineer of train 8 stated that since he had train order no. 11, which gave him authority to operate at track speed to milepost 145 and since he had not received any further order, he would continue to milepost 145. He further stated that before he arrived at milepost 145, he expected the track would be released and train order no. 11 would be annulled. As train 8 entered Fall River, the engineer and fireman heard an unidentified voice on the radio state, "Portage operator, if you can hear me, number 8 is answering you." The operator then broadcast on the radio for train 8 to stop at Fall River and for someone to come to the wayside telephone.

The switchtender stated that he heard the train whistle sound a warning at the road crossing east of the last signal before Fall River and knew by the location of the whistle that train 8 had passed the signal. The operator at Portage had not told the switchtender that he was unable to contact train 8 by radio. The switchtender then called on his portable radio saying, "Number 8, have you got your orders?" He stated that he heard someone respond, "Number 8 . . .," followed by a message lost in static. The switchtender also stated that he believed he had received an affirmative answer and that he had been told by the dispatcher that train 8 would be advised about the crossover move. He then lined and locked the crossover switch of the eastward track. While he was walking to the other switch to line it, train 8 began sounding the whistle for the grade crossing at Main street (figure 2).

The engineer of train 8 heard the operator requesting him to stop the train at Fall River. However, when the message was received, train 8 was in Fall River and only about 1,400 feet west of the crossover switch. The engineer stated that he did not know why he was to stop, and he began to make a normal brake application. However, as he began to make the brake application he saw that the switch for the crossover was reversed and placed the train brakes in emergency. He stated that he shouted a warning to the fireman that they were going to cross over. The normal speed for crossing over is 10 mph; the train speed was 70 mph as the locomotive entered the crossover. Meanwhile, recognizing that an accident was imminent, the switchtender jumped into a ditch parallel to the track. The locomotive went through the first switch at approximately 12:21 p.m., but as it entered the second switch, it overturned. The second locomotive also overturned, and the following 10 cars derailed and came to rest in various positions. Following the derailment, the switchtender stated that he tried four times, unsuccessfully, to contact the train dispatcher by the wayside telephone and then finally succeeded in contacting the operator at Portage.

The fireman was seated on the left side of the first locomotive cab. The locomotive overturned to the north side of the track structure and onto its left side. The fireman was killed, two train crewmembers were injured seriously, and two received moderate injuries. Of the 215 passengers on board, 26 were injured.

### Injuries

	<u>Soo Line Crewmembers</u>	<u>Amtrak Personnel</u>	<u>Passengers</u>	<u>Total</u>
Fatal	1	0	0	1
Serious/moderate	4	1	0	5
Minor/none	<u>1</u>	<u>11</u>	<u>215</u>	<u>227</u>
Total	6	12	215	233



### Damage

The lead locomotive unit slid on its left side and down an embankment after overturning (figure 3). The door on the left side came open and the left side of the cab interior was filled with rain-soaked dirt. The front of the locomotive was moderately damaged with some of the steel sheets pushed inward, and it was pierced with several sections of cast-iron pipe culvert. The left side of the locomotive was extensively damaged with the side torn and pushed inward, and the roof was buckled. The second locomotive had been coupled to the lead locomotive with the rear end leading, and when it overturned to the north of the track structure, turned on its right side. The right side of this unit was torn and pushed inward and the roof was buckled. The first car behind the locomotives was a material handling car (U.S. mail). This car overturned and was destroyed because of the extensive damage.

The baggage car, next in line, also overturned. This car was extensively damaged; both ends of the car were crushed. The following car, a coach/dorm car, sustained extensive damage as a result of the collision with other cars during the derailment. This car did not overturn but jackknifed from the train, went over the embankment, and was leaning to one side. The roof of the car was crushed inward about 4 feet, and the side of the car at seat locations 1, 5, 9, and 13 was torn away; the windows were also torn away. At seats 13 and 14 the sidewall was crushed inward about 15 inches, crushing the window seat armrest (figure 4). The window frame was twisted with the outside glass missing, but the inside Lexan window remained in place (figures 5, 6, and 7).

Seven cars, the 4th through the 10th, derailed but did not overturn or leave the track structure. These cars received moderate damage to the undersides of the cars. The five private cars at the rear of the train did not derail.

About 500 feet of track near milepost 153.7 were destroyed. In addition, signal 153.7 was demolished. The damage was estimated as follows:

Equipment	\$1,807,000
Track	99,000
Signals	18,000
Total	<u>\$1,924,000</u>

### Crewmember Information

The train crewmembers were qualified for their respective assignments by Soo. Each of the crewmembers had passed the company operating rules examination and a physical examination and were qualified in the physical characteristics of the railroad.

The engineer had been off duty for 2 days before the day of the accident. He was scheduled to operate train 8 every third day out of La Crosse, Wisconsin, at 9:48 a.m. with a scheduled arrival in Milwaukee at 1:23 p.m. His assignment required that he return on train 7, scheduled to depart Milwaukee at 4:15 p. m., and arrive back in La Crosse at 7:38 p.m. The fireman's assignment was the same as the engineer's and he worked the same rotation.

The conductor's assignment required that he take charge of train 8, scheduled to depart St. Paul, Minnesota, at 7:15 a.m. and scheduled to arrive at Chicago, Illinois, at 3:08 p.m. Off duty in Chicago for 23 hours, the conductor would then report the following day to take charge of train 7 scheduled to depart Chicago at 2:45 p.m. and to arrive in

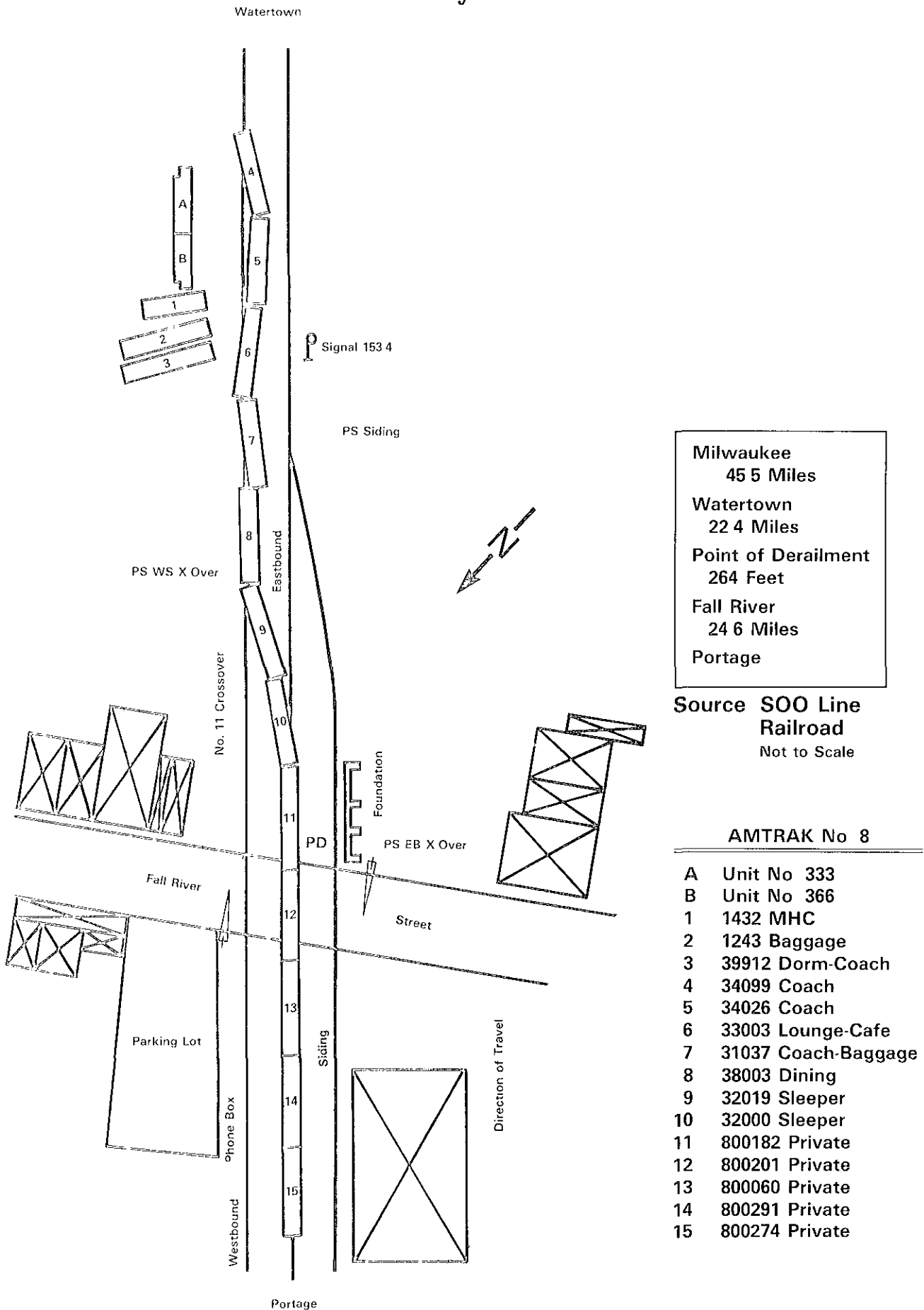
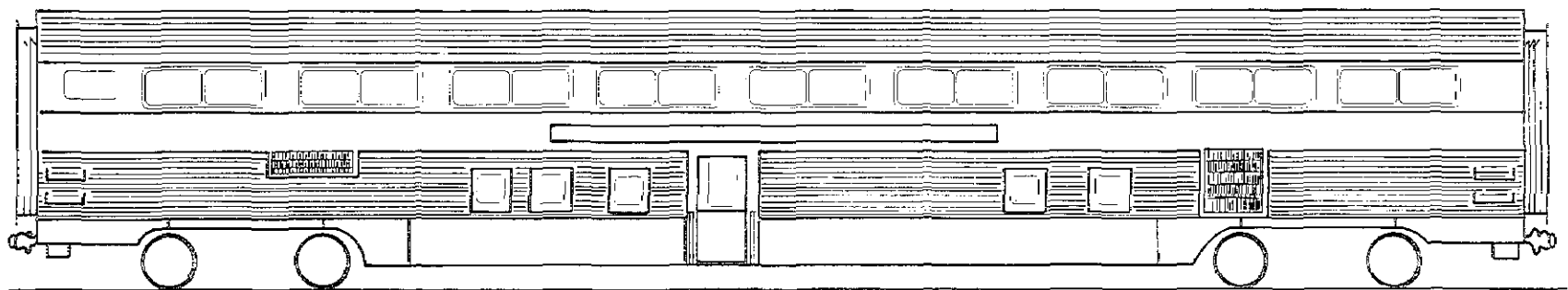


Figure 3.--Accident site at Fall River, Wisconsin.



Conductor's Table

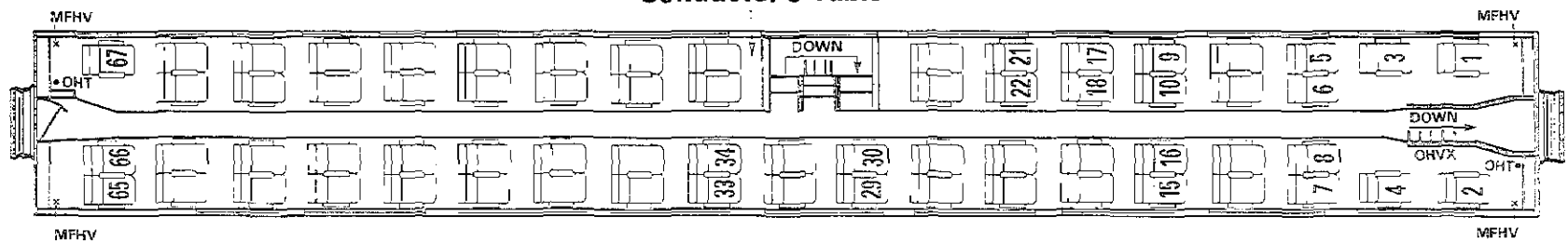


Figure 4.--Diagram of coach/dorm car.

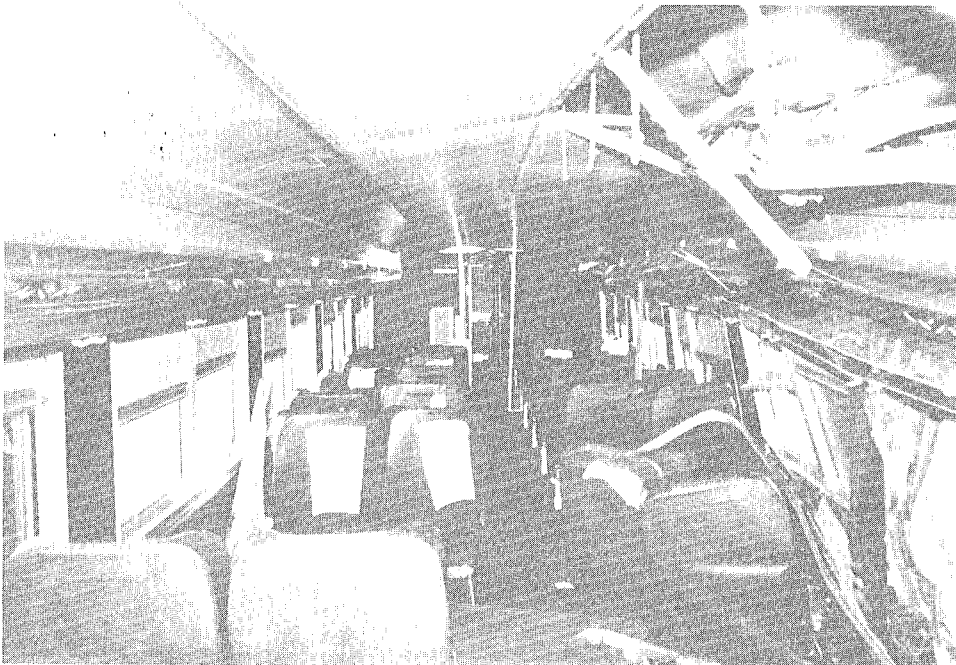
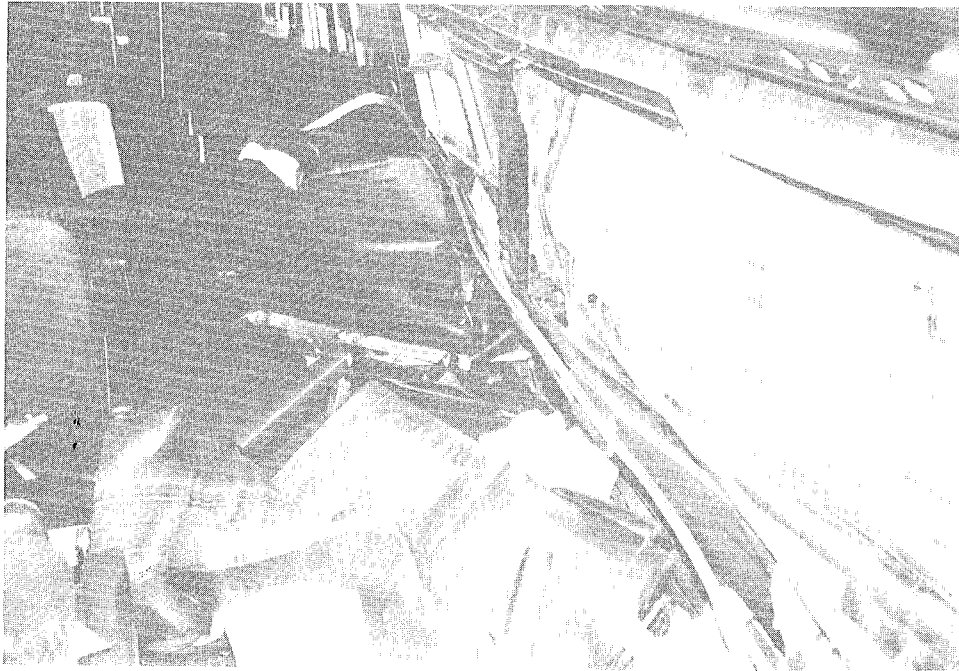


Figure 5.--Foreward end interior of coach/dorm car;  
seats 1-2 and 9-10 are in the aisle (top).

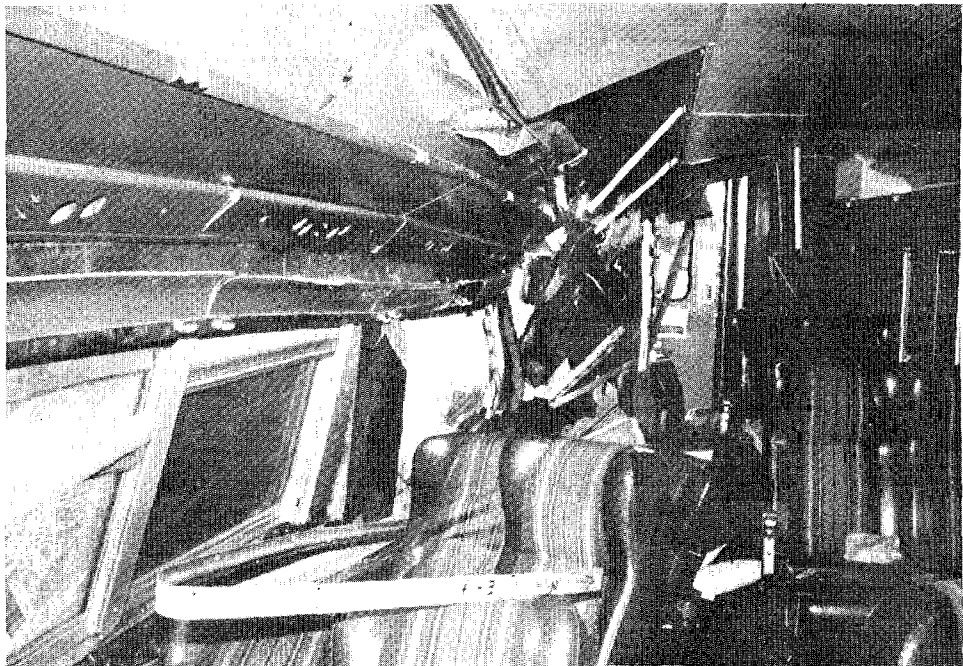


Figure 6.--Rear end interior of coach/dorm car;  
bent metal trim strip at seat 29-30.



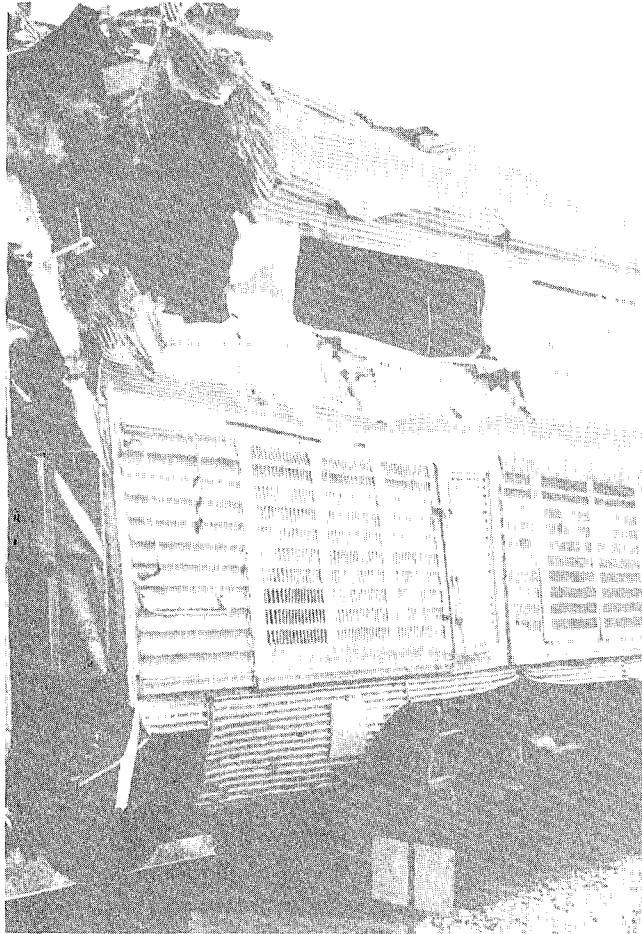


Figure 7.--Dorm/coach car No. 39912 exterior damage.

St. Paul at 10:38 p.m. He was then off duty for 2 days between assignments. The two brakemen and the baggageman assigned to the train worked the same schedule as the conductor and on the same rotation.

On the days preceding the accident, the switchtender worked approximately 10 1/2 hours a day. He began work at 6:30 a.m. and estimated that he completed work at 5:00 p.m. on October 6, 5:15 p.m. on October 7, and 5:45 p. m. on October 8. He stated that on the day of the accident, he worked his regular assignment and felt well rested. The switchtender stated he manipulated the trailing switches of a crossover movement first in East Rio in 1986 and then in Reeseville the same year and that the Fall River assignment was the first in which he manipulated the leading end switch of a crossover movement.

The train dispatcher's normal work schedule was from 8 a.m. to 4 p.m., Wednesday through Sunday. His responsibility included the Watertown subdivision, Tomah subdivision, Green Bay subdivision, and other branch line subdivisions (more than 396.5 miles). He stated that he often was required to work on his assigned days off. In fact, he worked on Monday, one of his two rest days, before the accident. Despite working on his assigned day off, the dispatcher said he felt well rested on the day of the accident.

The train dispatcher further stated that the workload had been hectic when the track work began in the spring and into the summer and fall; many times the track was out-of-service at three different locations. He said he had worked a substantial amount of overtime in 1986--working extra hours, 12 hours a day, and working 6 and 7 days a week through 1986. Because of a shortage of help, the dispatcher had not been able to take a full week off in the 9 months preceding the accident. He stated that the workload had increased substantially since Soo took over in 1985. In addition, more trains and territory had been added to his responsibility. The dispatcher described his work as nonstop and that it had been that way through the spring, summer, and fall. But he said that the workload had been higher than normal the week preceding and the day of the accident. He stated that on the day of the accident, he had to issue 9 D-R train orders 2/ and further stated, "A lot of times we do not even put out 10 orders in 24 hours anymore--10 D-R orders in 24 hours."

The dispatcher further stated that he had not taken a lunch or bathroom break because of the workload on the day of the accident. However, he stated that it was not unusual to miss lunch breaks and postpone bathroom breaks. He stated he felt that he was busy and stayed in his chair for long periods of time to take care of the many activities that were going on, that he did not take lunch breaks, and that he postponed bathroom breaks for long periods even after he felt the need for such a break. The dispatcher said, "There are a lot of times I did not go to the toilet when I should have for an hour, hour and 15 minutes, because of the workload." On the day of the accident he had only been away from his desk for 1 minute to get a cup of coffee during his entire tour of duty which began at 8 a.m. He had gone without a bathroom break for approximately 4 hours and 21 minutes when the accident occurred.

The dispatcher stated that working such heavy workload days without a day or two off each week reduced his performance capability. He further stated that he felt stressed because of all the responsibilities required by his job and that he believed Soo management had not tried to relieve the tension of the job.

The chief train dispatcher, the dispatcher's immediate supervisor, agreed with the dispatcher's description of the workload of dispatchers in Milwaukee. The chief

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2/ Order providing for train movement against the current of traffic.

dispatcher also stated that during the summer when all the track work was being performed, it was not uncommon for a dispatcher not to be able to eat his lunch or to take a quick break to go to the bathroom.

In discussing the changes that have effected the dispatcher's work, the chief train dispatcher stated:

We have had a change of territory at least two, three times since I have been working in the office, and I would more or so say to the present territory, that the dispatcher has, it was increased in the last year to 6 months, train-wise, four or five trains. The elimination of the operator at the cut off and moving the operator's panel from the cut off to the dispatcher's office has added to the workload of the dispatchers.

The chief train dispatcher added that there had been two day shift train dispatchers in Milwaukee, but that the second job had been abolished in the latter part of 1983.

When questioned about the dispatchers working without days off, working long hours, and delaying vacations, the chief dispatcher replied, "I am just getting short of people who want to take the job as train dispatcher. I have some operators out here that could probably be a dispatcher. I have train enginemen that could probably come up and take the job, but they do not want it. . . because of the stress put on a dispatcher." The chief dispatcher was also asked if he was concerned not only about the health of the dispatchers, but also the quality of the operations.

I was not only worrying about Jim [the dispatcher], I was worrying about the rest of the dispatchers. They were not getting their vacations, they were not getting their days off. There were sometimes when one of the persons laid off 3/ sick and I had to work them 12 hours, which is a requirable violation, but I had to do it. I had nobody else to work.

He further stated that he considered this workload pressure a safety issue. Regarding the rest break, the chief train dispatcher stated that the dispatchers can go anytime they feel like it. He also advised that there could be occasions resulting in train delay if they had to leave their station for that or for other reasons: "I have done this myself, where you get so involved in the work and what is going on you do not realize it. You are afraid to get up to even leave the office for fear something might go wrong with what is taking place right now." The chief train dispatcher said that safety depends on an alert dispatcher.

The chief dispatcher further stated he had never filed a written report to his superiors in connection with the dispatcher workload. But he had discussed the conditions in the Milwaukee dispatcher's office with the division superintendent, and the superintendent agreed that the dispatcher's officer was busy. They also discussed the availability of extra train dispatchers. The superintendent stated:

It is very impractical to have someone available to sit down in the chair when the train dispatcher has to eat lunch or go to the restroom or whatever, and other than trying to keep down the number of train

3/ When an emergency arises, and it is necessary to hold a dispatcher because no relief is available, it is reportable to the FRA but it is not a punishable violation.

orders, . . . I really did not think that it was advisable or a good business decision, if someone is thinking of putting on another dispatcher in the office at Milwaukee . . . I do not really think it would require that, although there is a good workload there. It is not impossible though."

When the assistant general manager was asked about the dispatcher workload at Milwaukee he replied, "To the best of my knowledge, I'm not aware of unsafe conditions. Busy, yes." When asked how he would become aware of a problem in the working conditions, he advised, "I would be made aware through a complaint from the organization to the management." The dispatcher stated that the union had written letters of complaint to the Soo management. However, in meetings with the Soo management the union advised that a dispatcher in the Chicago office had been dismissed and that in order to reinstate him, the labor relations department of Soo required that the filed complaint about the working conditions at the Milwaukee dispatcher's office be withdrawn. The union agreed to this stipulation.

The operator and switchtender stated that the dispatcher was not receptive to suggestions and was abrupt when issuing instructions and train orders. The dispatcher stated that many times he does not have time to discuss his reasons for issuing orders. The tape of communications indicated the dispatcher was constantly communicating with no opportunities for discussions.

The operator's assignment was from 7:59 a.m. to 3:59 p.m. 5 days a week, Tuesday through Saturday. He stated he often worked his scheduled off-duty days, but he did not work his days off or additional hours during the week of the accident.

The operator also stated that he had heavy workload and that it had increased over the past several years. He believed that one reason for the increased workload resulted from the closing of surrounding stations that started in 1972 with the closing of the New Lisbon station and continued to the time of the accident. He stated that he felt he is now doing the work that used to be done by several people.

The operator explained that his primary duty was to work with the train dispatcher to expedite train movements, to deliver train orders issued by the train dispatcher, and to monitor the hot box detectors and to stop trains if any irregularities were noted in the hot box detector readout. He further stated that he had to monitor 5 hot box detectors, 5 radio base stations, and 10 telephones. In addition, he sells Amtrak train tickets, answers questions from the public on the phone regarding Amtrak trains and schedules, and checks portable radios in and out to train crewmembers. When explaining the duties he performs he stated:

I operate the test patch board, the telephone test board for the wire chief in Milwaukee when he calls upon me to do that. I operate the interlocking plant at Portage junction. I work with the train dispatcher all day long [reporting times trains pass] every hot box detector, copying train orders, relaying messages, etc. I get train information, location reports for numerous maintainers, signal maintainers, linemen, and section men. All types of maintenance people call me for train information. I distribute paychecks and expense checks. I make change constantly, all day long for the vending machines. I relay messages for various officials to and from the roundhouse, the car department, various section crews, various maintainers, and messages from one official to another via the radio. I make air tests on trains where I

have to go out and monitor the rear of the train as they make an air test. I keep track of the Madison Short line when they want to use Soo Line and when they leave our track, tie up the Madison yard engine, coal trains information, arrivals, spot times, figures, releases. I keep track of the trains that are coming towards Portage, the power, and the crews. I handle the yard engine through the plant numerous times a day. The yard engine always wants to go somewhere. And then when I am not busy, I do janitor work.

The operator stated that he occasionally takes a 20 minute break on Saturdays to eat his lunch, but on other days of the week he is unable to find time to eat. He stated he generally ate lunch while he worked.

### Train Information

Amtrak train 8 operates daily from Seattle, Washington, to Chicago, Illinois. On the day of the accident, the train consisted of 2 locomotive units and 15 passenger cars in the following order: 2 locomotive units, 1 material handling car (U.S. mail), 1 baggage car, 1 dorm/coach, 2 coaches, 1 lounge/coach, 1 coach/baggage, 1 dining car, 2 sleeping cars, and 5 privately owned business cars.

The two locomotive units were built by the Electro-Motive Division (EMD) of the General Motors Corporation and were type F40PH. The locomotive units were rated as 3,000 hp diesel-electric passenger locomotives. Each locomotive unit was equipped with 26L brake equipment, Pulse Electronics, Inc., Train Sentry II Alerter, and overspeed limit control with a warning whistle. The units were also equipped with a Pulse Electronics, Inc., eight-event recorder system that recorded the elapsed time, distance, speed, traction motor current, throttle position, automatic brake application, and horn. The locomotive units were also equipped with speed indicators and twin seal-beam headlights. Each locomotive unit had collision posts designed integrally with the low front hood welded to the underframe and a protective horizontal bar attached to the front cab wall over the fireman's controls. The locomotive's doors were opposite each other, one on each side of the cab behind the engineer's and fireman's positions.

Both locomotive units had been overhauled less than a month before the accident; the lead unit on September 17, 1986, and the second unit on September 26, 1986. No failures or problems were reported with either locomotive unit between the time they left the rebuild shop and the accident. Each had received regular daily inspections and a 15-day inspection as scheduled.

The original Motorola 8-channel radios had been replaced in each locomotive unit with an ALPHA Clean Cab Series radio furnished by Aerotron, Inc. The ALPHA Clean Cab Series radios are solid-state, synthesized 45/25 watt locomotive transceivers. The radio operating frequencies may be selected from any of the 97 U.S. and Canadian railroad frequencies in the 150.8 to 174 MHz range. The ALPHA Clean Cab radios are built to meet the Association of American Railroads (AAR) Clean Cab requirements. The locomotive units were each equipped with one Sinclair Air Radio Laboratory "Excaliber" VHF antenna.

The material handling car, used to transport U.S. Mail, was destroyed in the accident. The baggage car was about 70 feet long with two doors on each side to load and unload baggage. The car was also equipped with a door on each end for employees to enter and exit the car.

The dorm/coach car was a former Atchison, Topeka, and Santa Fe high-level coach. It was 85 feet long and constructed of stainless steel. The car had an upper level with 64 coach seats--two seats on each side of the center passageway. Stairways to the lower level were located near the middle end of the car. On the lower level there were two lavatories, and a crew room; each end of the car was used for equipment. This car was used as a dorm car for the traincrew and for the on-board Amtrak service personnel.

The two coach cars were of the superliner type. Each car was 85 feet long and constructed of stainless steel. The upper level had 62 coach seats with leg rests; the lower level had 15 coach seats. On the lower level, there were six lavatories, and an equipment storage area at each end of the car. A stairway connecting the two levels was located near the center of the car. On each side of the car on the lower level there was a center entrance door; on the upper level there were end-doors that permitted access to the other cars.

The lounge/coach car was of the same construction and design as the superliner coach. This car had 72 seats both swivel, fixed, and booth-type seats on the upper level. This car also had a beverage station next to the stairway on the upper level of the car. The coach/baggage car was of the same construction and design as the superliner coach. It had 78 coach seats on the upper level and had a secure luggage storage area on the lower level. The sleeping cars were also of the same construction as the superliner coach. There were 44 berths on the upper level. The five privately-owned business cars were older vintage one-level cars. Each car was constructed of steel and had interiors equipped to the owner's specifications.

### **Track Information**

The eastward main track structure consisted of 132-pound six-hole jointed rail of 39-foot lengths manufactured in 1975. Ties were 7-inch by 9-inch by 8-foot 6-inch-treated timber with 7-inch by 14-inch-double shoulder tie plates with four spikes per plate (two rail-holding and two plate-holding). The rail was box-anchored with four pair of anchors per rail at each rail joint. The ballast section was approximately 12 to 18 inches of crushed limestone and granite.

The crossover at Fall River was a number 11, 132-pound jointed rail, facing point crossover with 22-foot-switch points. The switches were manually operated, parallel throw, low-switch stands with locked foot release and red/green reflective targets (figure 8). The switch operation had circuit controls to the signal system. The closure rails were fully anchored from the heel blocks to the frog. The crossover was renewed in 1984. Track maintenance included out-of-face tie replacement and surfacing in 1979 and out-of-face surfacing in 1983 and 1984.

The track met or exceeded the minimum Federal Railroad Administration (FRA) Track Safety Standards for class 4 track. The maximum operating speeds of class 4 track is 80 mph for passenger trains and 60 mph for freight trains. Track inspection is performed twice a week to comply with FRA class 4 requirements. The last inspection before the derailment was performed on October 7, 1986.

Soo timetable number 2, dated April 27, 1986, limited passenger trains to 70 mph and freight trains to 50 mph while operating on the eastward main track. Special instructions in the timetable provided for a 10-mph speed restriction "through turnout of all switches" except where another speed is prescribed.

The out-of-service order of October 9, was required because the maintenance-of-way department was undercutting a highway grade crossing at milepost 144.5. A maintenance gang was surfacing between milepost 137 and 139 with three tampers and two ballast regulators, and a maintenance gang was replacing a highway grade crossing at milepost 135.4. The work limits were flagged as required by rule 10, 10(A) and 10(C) of the General Code and Soo timetable. For eastbound movements, red flags were at milepost 145.0 and yellow/red flags were at milepost 147.0. The only crossover between Fall River and Watertown was a eastward trailing point cross over at Reeseville.

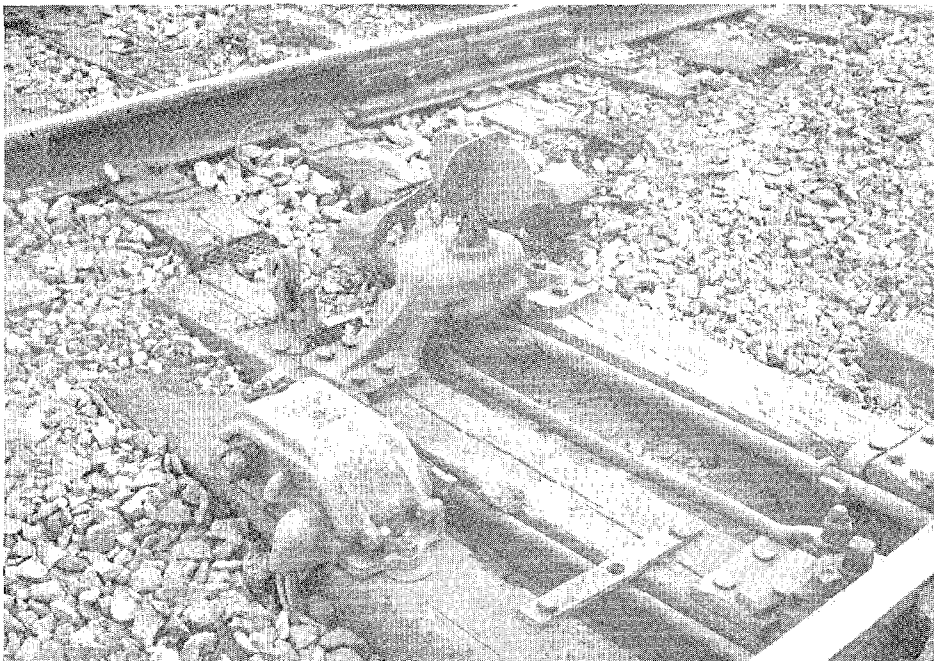


Figure 8.--Low switch stand at Fall River.

The track gradient in the vicinity of the accident scene was 0.5 percent descending eastward from a vertical curve at milepost 154.4 for approximately 1,000 feet through Fall River, then 0.5 percent descending for approximately 4,400 feet to milepost 152.6.

The alignment of the double track was tangent between milepost 154.4 and 150.6. The facing point crossover located at Fall River had the eastbound point of the switch at approximately milepost 153.5. A trailing point turnout to a siding off the eastward track was approximately 376 feet east of the eastbound crossover.

The Soo tracks pass through Fall River from northwest to southeast. Fall River Street crosses the tracks at grade approximately 50 feet west of the crossover. Fall River Street is a protected grade crossing with automatic crossing gates combined with flashing light signals. A passive protected grade crossing (railroad warning crossbucks) at Swarthout Road is approximately 3,736 feet west of Fall River Street and a protected grade crossing (automatic gates combined with flashing light signals), CTH "CD" (figure 2), is approximately 7,099 feet west of Fall River Street.

### Signal System

Trains are governed by an automatic block signal system (ABS) between Portage and Watertown. The ABS signal system is a two-block system using colored lights on wayside signals. The eastward track is signaled for eastbound movement only. The last signal on the eastward main track approaching Fall River is signal 155.4. Signal 155.4 is a high mast search light target signal with a number plate. The signal is approximately 10,511 feet west of the facing point crossover at Fall River. The second signal west of the Fall River crossing is signal 157.4 and the third signal west of Fall River is signal 159.2.

When the Fall River crossover switches are reversed for a crossover movement, signal 155.4 will display the following aspect:

<u>Aspect</u>	<u>Name</u>	<u>Indication</u>
Red	Restricted- Proceed	Stop; then proceed at restricted speed.

Signal 157.4 would then display the following aspect:

<u>Aspect</u>	<u>Name</u>	<u>Indication</u>
Yellow	Approach	Proceed-prepared to stop at next signal, trains exceeding 40 mph immediately reduce to that speed.

Signal 159.2 would then display the following aspect:

<u>Aspect</u>	<u>Name</u>	<u>Indication</u>
Green	Clear	Proceed

When the switches to the crossover at Fall River are in the normal position the signals at mileposts 155.4, 157.4, and 159.2 would all display green (clear) aspects for movement on the eastward track.



### Method of Operation

This portion of the railroad had previously been owned by the Chicago, Milwaukee, St. Paul, and Pacific Railroad Company, but in 1985 it became a part of Soo. The location of this accident was on the Watertown subdivision of the Southern division of Soo. A train dispatcher, located in Milwaukee, Wisconsin, was responsible for all train movements on the 195 miles of main line track from LaCrosse to Milwaukee including the area between Portage and Watertown. The dispatcher stated that he planned for the movement of trains around the out-of-service section of track by crossing over eastbound trains, after the switchtender in Fall River had lined the switches. The dispatcher further stated that he intended to use the westward track for eastbound movements. Trains would then cross back over to the eastward track at the westward to eastward crossover located at Watertown. The train dispatcher also stated that this required that another train order to be issued to allow an eastbound train to cross over and run on the westward track.

The chief dispatcher advised that before track maintenance began in the spring, no refresher training or instructions on how trains were going to be handled were given to the dispatchers.

The chief train dispatcher stated that the reason Soo did not take the track out of service at the crossover and allow an 8.5-mile section of track to remain in service east of the crossover was in the event of two eastbound trains approaching the crossover and a decision to expedite the second train. In such an event, the first eastbound train could enter the 8.5-mile section of in-service track and allow the following eastbound train to cross over. The first eastbound train could then be backed up and then continue through the crossover onto the westward track. The chief train dispatcher also stated that it would require additional time for the track maintenance crew to go the additional 8.5 miles westward to put up a yellow flag in advance of the location where train movement is restricted if the out-of-service location was at the crossover. He further stated that the train order for the westward track would require restricted train speed 4/ from Fall River to Watertown to protect the men working on the eastward track if the track were taken out of service at the Fall River crossover.

The chief dispatcher stated that because Amtrak train 7 departed Milwaukee at 4:16 p.m. and operated on the westward track, the crew of train 7 would often get a track out of service when they left Milwaukee. But, after departing Milwaukee, the track would be released and the order would be annulled allowing train 7 to operate unrestricted. The chief dispatcher further advised that engineers of trains are not given advice on the extent of track work being performed or how long the track will be out of service. He also stated that many times track maintenance crews make adjustments to track that takes an hour or less.

The switchtender reported for duty at Fall River at 6:30 a.m. on the day of the accident. He had a handheld radio with an approximate 2-mile range and a wayside telephone for communications. The wayside telephone allowed him to communicate with either the train dispatcher, 68 miles east at Milwaukee, or the train operator, 24 miles west of Fall River in Portage.

4/ A speed that will permit stopping within one half the range of vision; short of train, engine, railroad car, stop signal, derail or switch not properly lined, looking out for broken rail, not exceeding 20 mph.

The road foreman who operated train 210 stated that he did not know a switchtender was on duty at Fall River until after leaving Portage. However, following the accident he testified, "I could have gotten the information [that the switchtender was on duty at Fall River] while still in LaCrosse during a conversation with someone in the dispatcher's office."

Amtrak trains operate on this portion of track by contract with Soo. The contract between Amtrak and Soo is based on a 1971 agreement with revisions. The basic agreement provides for the assumption of certain liabilities, both by Amtrak and Soo. When an accident occurs, Amtrak is responsible for damage to its equipment, for any injuries to Amtrak employees and passengers, and for any liability to the passengers in the event of an injury. Soo is responsible for any damages to its right-of-way, signals, tracks, switches, and railroad equipment. Soo is also responsible for third party losses such as buildings along the right-of-way owned by other property owners or for trespassers.

The contract also provides for the payment of other monies by Amtrak for track maintenance. The operating railroad is also given an opportunity to earn extra money by maintaining specific levels of service for on-time performance of Amtrak passenger trains. The incentive for on-time performance is calculated on a monthly basis--in any month a railroad must achieve an 80 percent on-time performance for a train before qualifying for incentive payments. From January 1, 1986, through December 31, 1986, Soo earned \$15,470 for the on-time performance of train 8. Train 8 had an on-time performance of 60 percent for the year. In 1986, train 7 received \$73,043 for 75 percent on-time performance. The engineer and dispatcher both stated that they believed Soo received substantial payments for on-time performance. The engineer further stated that arrival of train 8 at Chicago within 10 minutes of the schedule would qualify as being on-time.

The operating train crewmembers were employed by Soo when they operated the Amtrak trains. However, after the accident on February 18, 1987, the operating train crewmembers became employees of Amtrak. During the investigation Amtrak representatives indicated that Amtrak supervisors were on trains to oversee train handling. When questioned the Amtrak general manager stated that, "... in the basic agreement and subsequent amended agreements... [the railroads] have total operating supervisory and controls over the operation of Amtrak trains on their property."

The general manager for Amtrak also stated that when the operating crewmembers became Amtrak employees, additional Amtrak supervisors would then be assigned to monitor the operation of trains 7 and 8. This monitoring would be in conjunction with the host railroad's management of employees, and they would be qualified by the carrier (host railroad) in the operating rules and practices of that railroad and the physical characteristics over which the trains operate. However, the train dispatchers, operators, and switchtenders would still be employed by Soo.

Trains are operated over the Watertown subdivision by an ABS system and under the direction of a train dispatcher at Milwaukee who is assisted by an operator at Portage, timetables, train orders, and bulletin orders.

The timetable specifies that rule 251 is in effect on the double track between Milwaukee and Portage. Rule 251 states:

Movement Governed: Within defined limits on designated tracks so specified in the timetable, or by special instructions, trains will run with the current of traffic governed by block signals without regard to timetable superiority. Verbal and message instructions will be issued by the train dispatcher.

Soo and Amtrak trains operating over the Watertown subdivision are equipped with radio transceivers. The timetable indicates that road channel 4 is to be used. A train crewmember on the locomotive can communicate with the dispatcher, operator, and other trains.

Train orders can be issued by radio and the following rules of 49 CFR 220.61(2) and the General Code of Operating Rules apply:

521. Transmitting Train Orders: When train orders are transmitted by radio, they must be transmitted in accordance with applicable operating rules, and the following:

- (1) The train dispatcher or operator shall call the addressees of the train order and state his intention to transmit the train order.
- (2) Before the train order is transmitted, the employe to receive and copy the train order shall state his name, identification, location, and that he is prepared to receive a train order. Train orders may not be copied by an employe operating the controls on an engine of a moving train. Train orders may not be transmitted to the crew of a moving train, when in the judgement of either the conductor, the engineer, or the train dispatcher, the train order cannot be received and copied without impairing the safe operation of the train.
- (3) Train orders shall be copied in writing by the receiving employe in the format prescribed in the operating rules.
- (4) Except as provided by rule 514, before a train order is acted upon, both the conductor and engineer must have a written copy of the train order and make certain that the train order is read and understood by other members of the crew.
- (5) Except as provided by rule 514, a train order transmitted by radio which has not been made complete may not be acted upon and must be treated as though not sent.
- (6) Information contained in a train order may not be acted upon by persons other than those to whom the train order is addressed. Complete must not be given to a radio transmitted train order for other trains until response "complete" has been acknowledged by the train being restricted.

The engineer of train 8 stated that the procedure for copying a train order being transmitted by radio requires that the crewmember operating the locomotive cannot copy the order, but that another crewmember will copy the order. He further stated that when an order is received by radio, the crewmember who copies the order must get a blank form from his grip and find a flat surface on which to write. The engineer also stated that it is necessary to stand in order to copy the order because there is too much vibration to write the order when seated. The crewmember copying the order must identify himself, the location of the train, and indicate that he is prepared to copy the order. The operator then transmits the order, and it is copied by the onboard crewmember. At the end of the transmission, the crewmembers must read back the order to the operator. The conductor stated that when onboard the train, he will often hear the order being given by the operator and copy it on what ever paper is available. However, he further stated that many times he cannot read back the order because of the limited range of the portable radios on board the train. When this occurs the conductor will then read the order to the crewmember on the locomotive, and when they are satisfied they both have the same order, the crewmember on the locomotive will read the order back to the operator explaining that the conductor has the order also. The operator stated he will then contact the dispatcher and advise him that both the conductor and engineer have the order. The dispatcher will then make the order complete and the operator will relay to the train crew that the order is complete. It is only then that the crewmembers can obey the requirements of the train order. However, the engineer stated that if he had not received a complete message from the operator and had arrived at the location where the order required action, he would stop the train until further necessary information was received. The engineer stated that under the best conditions, it takes at least 3 to 4 minutes to copy a radio-transmitted train order.

Rule 514 of the General Code of Operating rules states:

Not Understood or Completed: Any radio communication which is not understood or completed in accordance with these rules must not be acted upon and must be treated as though not sent.

Exception: If any information is received which would affect the safety of employes, the public, or damage to property; the safe course must be taken, and, if necessary, movement stopped until an understanding has been reached.

According to Soo operating rules, whenever a train is to be crossed over and run against the current of traffic it is necessary for the dispatcher to issue a D-R train order (appendix D). A written order can be delivered to the engineer and conductor by an operator or communicated by radio to them by the train dispatcher or an operator. This D-R train order can be given any time in advance of the train's arrival at the crossover and designates that the engineer has permission to cross over and occupy the track between points named in the order and gives right over opposing trains. The dispatcher stated that he did not attempt to deliver a D-R train order to train 8 before it left Portage because he was busy with train 200. Train 200 was still eastbound on the westward track and the dispatcher could not let train 8 cross over until train 200 was further advanced because train 200 did not have a caboose. Soo timetable special instructions (91) states:

... Outside block system limits, following trains, including work extras, are not permitted to occupy the main track within the limits of a freight or intermodal train without a caboose.

Train 200 was between Reeseville and Watertown followed by train 204 between Fall River and Reeseville. Because train 200 was a caboosless train the dispatcher stated he could not advance train 8 beyond Fall River until train 200 had crossed over to the eastward track at Watertown so that train 204 could advance beyond Reeseville into a clear block.

Due to the operating rules at the time of the accident, the dispatcher stated that he could not have issued a D-R train order to train 8 at Portage to advise the engineer and conductor that the train was to cross over at Fall River. However, following the accident, Soo had made some changes that helped communications. One of the changes made was that when a track is taken out of service, the train crew is notified in advance that they must communicate with the switchtender at the designated location before passing the location. The second change was that Soo arranged for the dispatcher to issue a D-R train order in advance and notify the train crew not to pass the point designated until they receive permission from the dispatcher.

The dispatcher estimated the running time for train 8 from Portage to Fall River at 21 minutes. The dispatcher issued D-R train order no. 52 to the operator at Portage, to be relayed to train 8 and also to the operator at Duplainville. He stated he authorized the Portage operator to issue the order to the crew of train 8 at 12:18 p.m. The authorization as stated by the dispatcher did not appear on the voice tape of the conversations between the dispatcher and operator. The Portage operator stated he stayed on the line until the order was made complete at 12:19 p.m.

The dispatcher estimated that by allowing the trains to proceed by the green signals and operating the switch saved about 5 to 6 minutes in the trains' running time. The practice of allowing a train to pass the signals before operating the switches of the crossover was a long-time practice by Soo and predecessor company management. However, Soo management stated it is not a written instruction and had not received formal approval by management. The dispatcher stated he became aware of the practice in 1980 when he was appointed to the dispatcher position in Milwaukee. The general manager of operations control stated that he was aware of the practice, and he thought the practice had started in 1978. He further stated that he thought the procedure was put into practice to prevent train delays in areas of extremely heavy track work activity. The road foreman stated that the justification for the practice was that it was in place and it worked. The assistant general manager, Southern Terminals, stated when asked about the origin of this procedure:

I have not been able to determine where or how it was born. I think it was back in 1978 or 1979 or 1980. Milwaukee Road got . . . a lot of money to fix up our railroad. It was in rather bad condition and we had a lot of people out there on the track. We had track out of service in a lot of places. We were trying to get the track fixed up so we could operate trains on it. And there was an awful lot of activity and I think some of these things were born out of necessity to keep moving when you had that much track work going on and that much disruption in the operation. I think the thing was kinda like topsy I guess. It grew, and the practice was observed by probably a number of people, including officers, and was not found to be in violation of any of the operating rules, and it was established and there never was any problems with it. It worked successfully.

He further stated that it would have been a safer procedure to have put the train orders out at Portage and then updated them as the train proceeded.

An Amtrak supervisor of operating rules stated that he was not satisfied that proper safeguards were employed in the procedure being used when the accident occurred. He felt that had advance notification been given the train crew, they would have expected to be diverted at the crossover at Fall River.

The assistant general manager, southern terminals, commented on the precautions that were taken to provide for the safety of train operations without the normal functioning of the signal:

. . . well, there was a procedure that had been established that was well known to almost all employees, including number 8's engineer who indicated that he had knowledge of this procedure and that the DR would be issued, contact would be made. In this case, there was a couple of parts of that whole procedure that were not in place. They were unable to establish communications, or good communications between the switchtender and number 8, and number 8 did not have this DR order.

The assistant general manager also considered the precautions that were taken inadequate. He further stated that since Soo did not have instructions on the procedure that was in place before October 9, instructions were written and given to train crews and to switchtenders to prevent this accident from occurring again. He further stated that if those precautions, as outlined in the instructions issued following the accident, had been in place, the accident may not have taken place.

At the Safety Board public hearing the FRA was asked about a safety assessment that had been performed in 1984 on the Northeast Corridor of Amtrak, noting some similarities to the procedure being used by Soo. The FRA testified:

. . . we found that operators at this temporary block stations had been instructed to position the crossover switches for the crossover movement of an approaching train only after the train had come into view so that the train did not operate at restricted speed in the block that includes the crossover. That instruction, we felt was intended to expedite the movement of trains; however, we also felt that it circumvented the protection afforded by the automatic block signal system and the operating rules, and we felt that the extra precautions that were taken to protect that deficiency should be examined closely.

Rule 611 in the General Code of Operating Rules states:

Altering Equipment: Employees are prohibited from altering, nullifying, changing design of, or in any manner restricting or interfering with the normal intended function of any device or equipment on locomotives, cars, or other railroad property without proper authority except in case of emergency, in which case report must be made to proper officer.

The rules for the testing of radios in the General Code of Operating Rules are as follows:

515. Testing: Radios used in train operation, outside yard limits, must be tested at the point where the train is originally made up.

516. Operative Radios: Engineers and conductors must test the radios at least once each tour of duty to ensure the radios are working.

517. Test Transmissions: Radio tests must consist of an exchange of voice transmissions with another radio and the quality and readability of its transmission must be ascertained.

There is no requirement by carrier rules or Federal regulation establishing a minimum distance between radios for the transmission test. Soo management stated that it would be permissible for an engineer to test the locomotive radio by making a transmission test with the conductor using a portable radio standing beside the locomotive. According to Soo management, such a test would satisfy the requirement of rule 517.

Rule 513 of the General Code of Operating Rules states:

Misuse: Radio communications must not be used to avoid compliance with any rule.

Rule 104(B) of the General Code of Operating Rules states:

Main Track Switches: . . . On main track switches so equipped, the target will show red when lined in other than its normal position.

The engineer of train 8 stated that he had a "general idea" that Soo management wanted to get train 8 over the railroad as quickly as possible. He further advised that "between La Crosse and Portage you can make up about 20 minutes if running late, but from Portage east it was very difficult to make up time because the schedule is so tight." The train dispatcher stated, ". . . the railroad did want to keep Amtrak on schedule because of the incentive fee they receive, at least that is the opinion I have for them. They wanted you to make every effort to keep the train on time." The assistant general manager, southern terminals, stated, ". . . well, I think we are all aware - my superiors, it is cash that can be generated by running the trains on time and as long as we have them anyway, we feel that we may as well try to make what we can off of it. But not to the tune of forsaking the safety of the operation." Amtrak's general superintendent stated that ". . . that would be purely speculation on my part . . ." when asked his view regarding the necessity for the incentive fee. He indicated, however, that at least two major railroad systems with Amtrak service have contracts with Amtrak that do not provide for on-time incentives.

#### Meteorological Information

The National Weather Service, Madison, Wisconsin (Truax Field), 25 miles south of Fall River, reported that at the time of the accident the weather was clear, temperature 50 degrees F, wind northeast at 11 mph, and visibility 10 miles.

#### Survival Aspects

Interviews of the railroad and rescue personnel indicated the fireman's body was found buried in the dirt on the left side of the cab. The rescue personnel indicated the fireman had apparently been seated in the fireman's seat because it was directly under his body when he was located.

All of the injured train crewmembers were located in the coach/dorm car. On the inside of this car, the left side seat 15-16 was torn from its mounting. The luggage rack above seat 33-34 was displaced upward 4 inches and showed evidence of body contact. At seat 29-30 the window glass was fractured with twisting striations. Seat 21-22 had the right side interior sidewall collapsed approximately 6 inches. Seats 17-18 and 13-14 were bent inboard and partly collapsed. Seats 9-10 and 1-2 were torn free and were lying in the aisle (figure 4).

The conductor of the train was seated in seat 35-36 at a table with a wall in front of him. During the derailment, the conductor was thrown back two rows and fell to the floor. He suffered a bruised right hand and left leg.

A brakeman seated in seat 33-34 was found after the accident with both feet hooked under the foot rest of the aisle seat. The adjacent window was shattered and evidence on the window frame indicated that the brakeman had struck it. He was evacuated through the window and transported by ambulance to Columbus Hospital. He was later transferred by helicopter to the University of Wisconsin hospital and admitted in critical condition with a closed head injury.

Another brakeman, who was attempting to contact the Portage operator by portable radio when the derailment occurred, was seated next to a window in an attempt to get better reception. He suffered major chest trauma and was admitted to Columbus Hospital.

An Amtrak service attendant was walking in the aisle when the derailment occurred. Although he did not recall how he was injured, he suffered a fractured left wrist. The baggageman was seated on the left side near the center of the coach/dorm car. He suffered a lacerated right hand and a head contusion. He was admitted to Columbus Hospital.

The employees in the coach/dorm car could not evacuate that car following the derailment because both ends of the car were extensively damaged and the doors could not be opened. Rescue workers removed the critically injured crewmembers from the coach/dorm car. The car was leaning badly to the left side which precluded the use of the left side exit doors. It was necessary for the injured to be removed through the right window exits by manually hoisting them up and out of the car. The injured were then lowered to the ground by passing them hand to hand or by assisting them down the ladders.

Most of the minor injuries in the passenger cars were the result of impacts that occurred when unrestrained passengers were thrown forward into the seatbacks in front of them. Personal belongings fell from the overhead baggage racks causing additional injuries.

There were no reported malfunctions of any of the emergency windows. Most of the passengers were evacuated through the end doors into the next car, then through the vestibule doors, and off the train. Passengers stated that the on-board service employees provided excellent evacuation instructions. They were instructed to remain calm, to leave their luggage on board, and to gather at a specified safe location after the evacuation.



## Emergency Response

The evacuation and rescue was initiated by the Amtrak on-board service employees before rescue units arrived. The crew was assisted by passersby and uninjured passengers. The operating train crewmembers in the overturned coach/dorm car required rescue because the doors could not be used. There were no laddering devices onboard the train.

The Fall River police chief stated that as soon as he arrived at the scene, he immediately advised the dispatcher at the Columbia County Sheriff's department that he had observed three cars and two engines of the train go over the embankment; he requested that at least five ambulances and rescue personnel from surrounding communities respond. The quick response by rescue forces was a result of the prompt notification by the Fall River police chief.

The city of Fall River Fire Department was notified of the derailment by the Fall River police chief. The fire station was located on North Main Street, 1/4 mile north of the accident site. The Fall River emergency medical services team arrived at the scene at 12:25 p.m. The rescue personnel used ladders and spine boards to evacuate injured crewmembers from the coach/dorm car. Access to the car interior was gained through the end doors and through the emergency exit windows. The crewmembers with minor injuries were assisted down the ladders. The more seriously injured crewmembers inside the coach/dorm car were removed through the open windows.

A command post with a commander and a triage area was not established and some difficulties were experienced with communications among the agencies involved. However, the Fall River police chief's squad car was used as the communications center because the car was equipped with radio communications to the county sheriff and fire departments. Arrangements were made with the Fall River High School principal and his staff to convert the school into an emergency receiving station. Schoolbuses were used to transport passengers. The Red Cross and staff members from the Columbia County Department of Social Services responded to the emergency. Two doctors attended to mostly bruises and abrasions suffered by the passengers. So officials obtained buses to transport uninjured passengers to Chicago and Milwaukee.

Fire/rescue services responded from the following communities:

### Fall River Fire Department

Personnel: 12 firefighters  
5 emergency medical technicians (EMT)

Equipment: 1 pumper  
1 rescue truck  
1 firetruck  
1 ambulance

### Columbus Fire Department

Personnel: 1 firechief  
2 captains  
7 firefighters (2 EMT)

Equipment: 2 rescue vans

Randolph Fire Department

Personnel: 1 assistant chief (EMT)  
2 firefighters (1 EMT)

Equipment: 1 firetruck with rescue equipment (1-ton truck)

Rio Fire Department

Personnel: 1 firechief  
5 firefighters  
4 EMT  
1 assistant coroner (EMT)

Equipment: 1 firetruck (1-ton truck)  
1 pumper/ladder truck

Portage Ambulance Service responded with two units and four EMTs. The Pardeeville Ambulance Service responded with one unit and two EMTs.

The Pardeeville Fire Department was not notified by the Columbia County sheriff's office although they are members of the County Mutual Aid Agreement. One EMT did respond to the accident scene but not as an official member of the Pardeeville Fire Department.

The Wisconsin State patrol had 14 troopers and 2 sergeants at the scene for approximately 3.5 hours (1:20 to 5:00 p.m.). The State patrol personnel began arriving on scene at approximately 1:20 p.m. The chief of the Fall River Police Department requested that the State Patrol secure the perimeter (roadway access from highway 16 south of the derailment and route D north of the derailment) and to assign personnel to walk along the tracks to secure the property and to prevent injury to onlookers. At 4:30 p.m., the roadway was barricaded by the County Highway Department. Snow fences were installed east and north of the crossing. Soo police had arrived from Milwaukee and the Amtrak cars were secured. The privately owned cars were transported back to Portage to clear the intersection. At 7:00 p.m., all State patrol personnel were released.

A Wisconsin State patrol sergeant reported that the only problems experienced were with radio and telephone communication capabilities. State vehicle radios were on a different frequency than the Columbia County emergency radios. Also, the telephones in the small community were being dominated by the media which had arrived on-site. As a result, a State patrol official had to leave his radio in order to stay current with events at the derailment, to locate and communicate with Columbia county officials, and to locate an available telephone to keep State patrol headquarters staff informed of the situation.

Columbia County has a disaster plan and it was implemented; Fall River was an active participant in that plan.

A critique of the rescue activities was held at Columbus Community Hospital on October 14, 1986. This critique was scheduled so that participants from different agencies could discuss problems and concerns regarding this accident. The following were problems identified by the agencies:

1. lack of a command post;
2. lack of a triage officer;
3. difficulty in identifying rescue personnel;
4. lack of communications between rescue personnel and the hospital;
5. triage tags were used for the first few injured and then discontinued; and
6. poor radio communications system.

The Columbia County Hospital External Disaster Plan had been in effect since March 1974 and had been revised 11 times; the latest revision date was April 1986. The shift supervisor initiated the plan when notified of the derailment. Critical personnel were contacted and asked to assist at the hospital immediately. Beaver Dam Community Hospital Disaster Plan was put into effect by the supervisor in charge after being notified by the county sheriff's office of the derailment.

A new disaster plan has been developed and changed from a county disaster plan to a Columbus area disaster plan. The areas of concern noted during the critique of this accident are addressed in this new plan. It includes the procedure for establishing a command post, holding areas, and triage station. The radio problems identified in this accident has also been corrected so that all individuals involved will be operating on the same radio channel. This plan and the Columbus area emergency forces has been coordinated by the Columbus Community Hospital and plans are now being made to conduct emergency drills using the new plan.

Except for two all on-board service employees of Amtrak, train 8 had completed superliner emergency evacuation training. Following the fire onboard Amtrak passenger train 11, the Coast Starlight, near Gibson, California, on June 23, 1982, 5/ the Safety Board issued a recommendation to Amtrak.

#### R-83-72

Include both Amtrak supervisory personnel and onboard service personnel in refresher training programs covering the changes in Amtrak emergency procedures. Arrange with all railroads over which Amtrak trains are operated emergency training for traincrew employees qualified for assignment to passenger service.

The Safety Board was pleased to see evidence of emergency procedure training in this accident as demonstrated by the Amtrak personnel on board train 8. The Safety Board classified this recommendation as "Closed--Acceptable Action" following a response from Amtrak on June 3, 1986.

#### Tests and Research

The voice tape of the train dispatcher's communications was reviewed after the accident, and it indicated that the dispatcher was continually making decisions, giving instructions, and issuing train orders affecting train movements.

Following the accident, an attempt was made to conduct a brake test of the re-railed cars before they were removed from the accident site. However, the equipment was too badly damaged for a conclusive postaccident brake test. When the train air brake equipment had been inspected and tested by Soo engineers on the morning before departure at 6:59 a.m. in Minneapolis, no defects were found in the system.

5/ Railroad Accident Report--"Fire Onboard Amtrak Passenger Train No. 11, Coast Starlight, Gibson, California, June 23, 1982" (NTSB/RAR-83)/03).

Following the derailment, the signal system including the circuit control of the facing point switch of the crossover at Fall River was inspected and tested. The signal system functioned as designed, including when the switch was lined to the diverging route. The westbound signal of the westward main track, signal 153.7, was demolished at the time of the derailment. This signal was not involved in the movement of train 8.

Investigators noted impact marks and breakage of the right hand switch point approximately 12 inches in length on the eastbound turnout of the crossover after the accident. The curved closure rail had been rolled over with wheel and flange marks evidenced in the web area. The toe block of the frog was cracked, but the frog was intact with only minor damage. The westbound side of the crossover was destroyed. A trailing point turnout to a siding located approximately 376 feet east of the point of switch of the eastbound turnout of the crossover was destroyed.

Tests of the lead locomotive unit radio were conducted following the derailment and while the locomotive was still laying on its side. The first test was conducted using a portable antenna with a magnetic connection because the coaxial cable (coax) to the antenna mounted on the locomotive unit had been damaged in the accident. The tests indicated that it was possible to communicate with the operator at Portage. The second test was conducted using a by-pass coax to the antenna. Again, voice communication could be made with the operator at Portage. After the locomotive was rerailed and moved to the Amtrak locomotive facility at Beach Grove, the coax to the antenna was traced and found broken at the base of the windshield center post. The antenna, coax, roof connection, and handset from the radio system were removed and sent to the Safety Board's laboratory for further testing.

The antenna removed from the lead locomotive was cleaned and examined. Continuity was measured from the center of the female connection to the antenna coax to ground. It was extremely difficult to get continuity without placing the probe to the depth of the center hole and pushing. It measured .05 ohms. Pin to pin on the ohmmeter measured from 0.0 to 0.02 on the 2K ohm scale. On the 200 ohm scale, no continuity could be measured. The base of the antenna, the ferric metal, the base of the slotted aluminum antenna, and the bolts were corroded.

At approximately 5 inches above the coax connector, there was a set screw hole and inside the hole was a set screw that could be removed with a 3/32-inch allen wrench. There was no sealant in the hole when examined in the laboratory. The set screw was loose and came out easily. Inside the antenna, there was a connector which was a piece of coax with the sheath removed. When the set screw was examined, investigators found evidence of arcing and copper plating. The stub showed evidence of arcing (figure 9). When the set screw was tightened, the antenna showed normal continuity.

The radio removed from the lead locomotive was sent to the radio maintenance facility at the Amtrak facility in Chicago. The radio was bench tested and was found to be functioning as designed. The base station radio at Portage was tested, and it transmitted and received normally.

The two portable radios that the crewmembers had been using on board train 8 were tested following the accident. Both radios tested and functioned as designed. However, one of the radios had 1.25 inches broken off the antenna. The portable radio used by the switchtender was tested following the accident. Bench tests determined the switchtender's radio functioned normally. However, the antenna connector pin was found to be broken after the bench test was completed. It could not be determined if the connector pin was broken before or during the process of removing the antenna for testing.

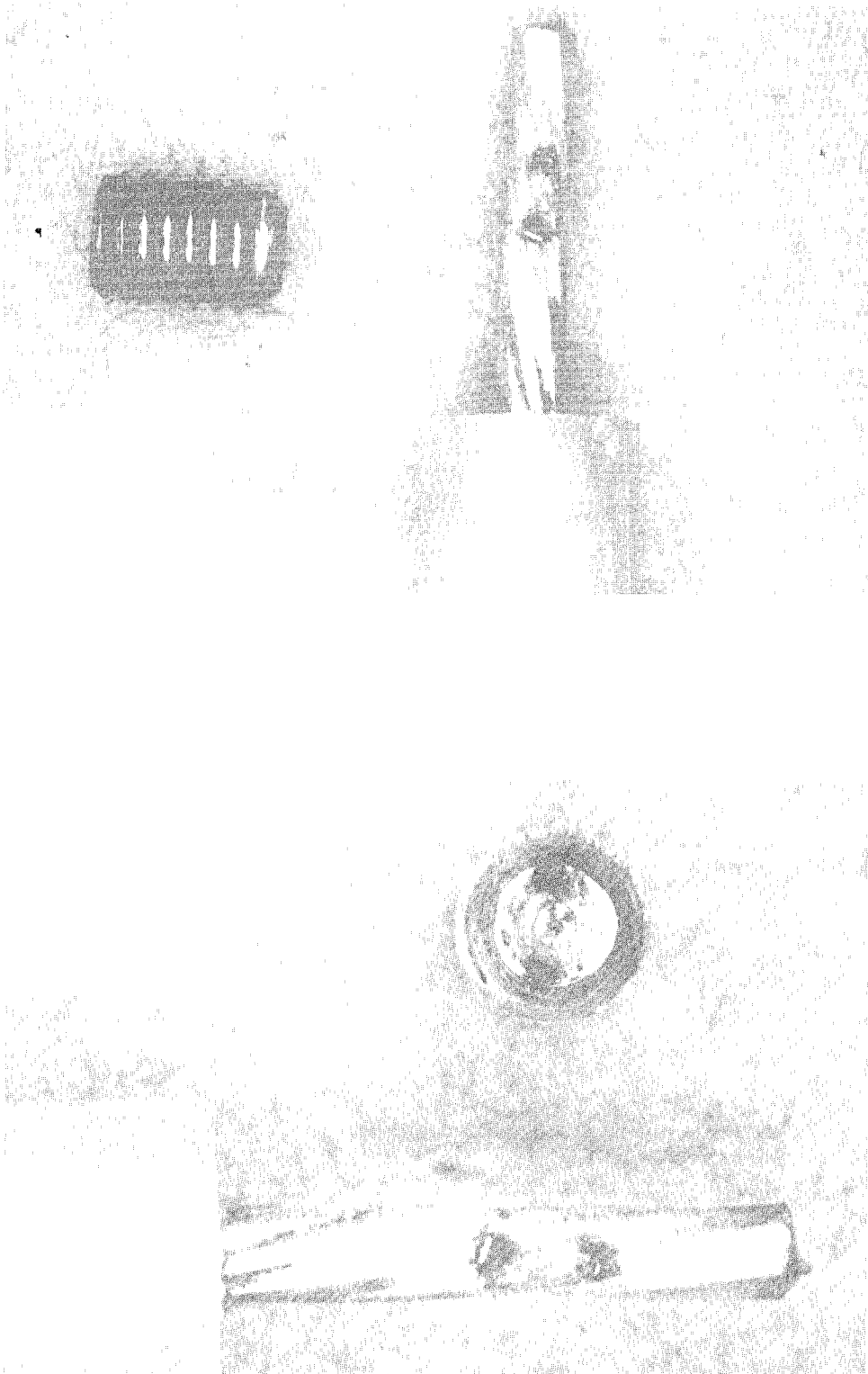


Figure 9.--Set screw and connective portion of stub.

On October 14, 1986, a radio test was conducted as Amtrak train 8 for that day passed through the accident site. Investigators were located at the Portage base station, Fall River (with the switchtender's radio and another portable radio), and on the lead locomotive of train 8. Radio transmissions were made each 1/2 mile between Portage and Main Street in Fall River. One portable radio at Fall River began to receive transmissions when the train was at milepost 157.4 (4 miles west of Fall River). However, the switchtender's portable radio with the antenna connector pin broken only began to receive radio transmissions when the train was at milepost 155 (1 1/2 miles from Fall River).

To determine radio signal strength of the Portage and Watertown base stations, tests were conducted between Portage and Fall River. Readings were taken every 1/10 mile with a portable signal strength meter on a Hy-rail vehicle. <sup>6/</sup> A communication gap could not be found at any location. The signal from Portage was loud and clear until the Hy-rail vehicle was adjacent to a grain elevator in Fall River. At that time, the signal could still be heard, but it was noisy. At all locations tested, both Portage or Watertown transmissions could be heard loud and clear.

### **Toxicological Testing**

The switchtender, dispatcher, operator, and each of the train crewmembers provided samples for toxicological testing. All samples were tested for 11 substances: cannabinoids (limit: 100 ng/ml), barbiturates, benzodiazepines, amphetamines, opiates, pheniramines, cocaine, methaqualone, phencyclidine, propoxyphene, and ethyl alcohol. All toxicological test results were negative.

## **ANALYSIS**

### **The Accident**

Each of the freight trains preceding train 8 received information after leaving Portage that prepared them either to cross over at Fall River or to stop at Fall River for instructions. Train 210, which was being operated by a road foreman, had received information at LaCrosse that a switchtender would be on duty at Fall River and that it was likely they would cross over. Minutes after train 210 departed Portage, the crew was notified to cross over at Fall River; the road foreman handled the train expecting to cross over after communicating with the switchtender. Trains 200 and 204 proceeded to Fall River with the instruction to stop for additional train orders before proceeding beyond that point.

However, the engineer of train 8 did not have any advance notification or train order to indicate that they were to cross over at Fall River. Moreover, he did have a train order authorizing him to proceed unrestricted to milepost 145. The statement made by the road foreman that the engineer handled his train properly given the information he had would indicate that the engineer could not be expected by Soo or Amtrak management to operate his train any differently than he did. The engineer's statement that he operated his train expecting that the track out-of-service order would be lifted before he arrived is an indication that from his experience in this area, he had learned to expect that he would continue unrestricted. All year long until the day of the accident, there was track work on the westward track. The engineer operated train 7 on the return trip from Milwaukee on the westward track, and because the track was cleared before his arrival, the out-of-service order would be lifted. However, train 8 operated through this

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<sup>6/</sup> A vehicle with retractable flanged wheels so it can be used either on the highway or the track.

area at midday when the track work was being performed. Since engineers on Soo are not told the extent of track work being performed, it was reasonable for the engineer of train 8 to believe that the out-of-service order would be lifted before his arrival because that is what occurred on each of his other trips. Not only did the engineer not have any information indicating there would be a crossover at Fall River, the signals approaching Fall River indicated that the track ahead was clear. The signal located immediately east of the switch to the crossover also displayed a green (clear) aspect and was visible to the engineer as he exited the curve west of Fall River, indicating that he would continue east on the eastward track. The Safety Board concludes that based on the information that had been furnished to him, the engineer operated train 8 properly.

The switchtender operated the switch of the crossover after train 8 passed the signals west of Fall River because he believed that the engineer of train 8 had been advised to cross over at Fall River. The switchtender believed that the engineer was aware of the crossover move because the dispatcher had told the switchtender that he would instruct the engineer about the intended move. The switchtender also had overheard the conversation between the dispatcher and the operator when the dispatcher instructed the Portage operator to tell train 8 about the crossover move intended for Fall River. However, the switchtender should not have assumed that the engineer of train 8 had received instructions to cross over and should not have operated the switch of the crossover until he had made definite radio contact with the engineer and established an understanding of the crossover procedure. If the switchtender had not operated the switch, train 8 would have proceeded into the 8.5 miles of track before the out-of-service location. The train would then have had to be backed west of Fall River and then crossed over resulting in considerable delay, but the accident would not have occurred.

When the switchtender lined the switch after train 8 passed the two green signals, the engineer had no way of knowing the condition of the switch until he could see the points of the switch. There was a low switch target on the cross over switch about 102 feet from the center of the grade crossing at Main Street in Fall River. However, because it was low and close to the grade crossing, it could not be seen by the engineer to warn him in sufficient time to bring the train to a stop before entering the switch.

#### Method of Operation

The dispatcher told the operator to notify the engineer of train 8 about the crossover move and that a switchtender was on duty at Fall River. However, the dispatcher also gave the operator instructions to locate train 200 because the dispatcher could not give a train order to train 8 until train 200 was off the westward track at Watertown. After locating train 200, the operator notified the dispatcher. The dispatcher then finished the train order intended for train 8. The operator did not have time to contact train 8 until the train order had been given to him and, therefore, did not give the instructions about the expected crossover move to train 8 as instructed by the dispatcher. The dispatcher knew that it only took 21 minutes for train 8 to travel the distance between Portage and Fall River, and he should not have attempted to give the train order to cross over 20 minutes after train 8 departed Portage. Instead, he should have only instructed train 8 to stop and copy the order. The method for copying a train order by radio takes time to be completed. The Safety Board believes that the engineer's estimate of 3 to 4 minutes to accomplish copying a train order by radio can be done only under the most favorable conditions.

There was sufficient time for Soo to notify all the trains that they would cross over. Taking the track out of service at 7:01 a.m. was not a decision made that day but, rather, it was a long-range planned project. But even if Soo had waited until the day the work

was to begin to plan for train handling, it was still 2 hours before the freight trains began to arrive at Portage and 4 hours before the arrival of passenger train 8. The Safety Board believes there was enough time to notify all eastbound train crews arriving at Portage that there was a switchtender on duty at Fall River and that it was likely that they would be crossed over at that point. With instructions of that type, the order would have prepared the engineers to proceed to cross over, and they would have handled their trains accordingly. An alternative would have been for Soo to issue train orders for all eastbound trains on the eastward track to cross over at Fall River. Since all trains passed through Portage where an operator was on duty, train orders advising that they would cross over at Fall River would have prepared the engineers for a crossover. If necessary, an updated train order could have been issued at or before the trains arrived at Fall River. This would have given the engineers information that would allow them to operate their trains with an understanding that a move would be made at Fall River.

However, the dispatcher's intention to issue the train order to train 8 to cross over at Fall River by radio was based on the location of other trains. Because train 200 was a caboosless train, the dispatcher could not issue the D-R order for train 8 to cross over until train 200 was crossed back to the eastward track at Watertown. Therefore, the dispatcher stopped when he originally began to give the order for train 8 to check on the locations of trains 200 and 204. When he did give the order for train 8 to cross over, he stated that he had released the Portage operator at 12:18 p.m. to relay the order to train 8. However, this was not supported by the voice tape of the conversations between the dispatcher and operator. The operator stayed on the message line until the order was completed at 12:19 p.m. The dispatcher delayed issuing the order so that it could be issued without a second order being issued as the conditions changed. These decisions were probably made by the dispatcher to expedite the movement of train 8. It was probably also an attempt by the dispatcher to reduce his heavy workload and the ensuing number of orders he would be required to issue. By the time of the accident, he had already issued nine D-R orders--an unusually high number. If a train order had been issued to the conductor and engineer of train 8 at Portage advising that it was to cross over at Fall River, this accident would not have occurred.

The operator only had a radio to communicate with train 8 after it departed Portage. If he had known that the engine crew of train 8 could hear but not respond on the radio, the operator could have issued instructions to stop before train 8 reached the crossover. Because of the critical nature of the order and the short time available, the dispatcher should have instructed the operator to broadcast "stop" instructions before issuing the train order as required by operating rule 521(2) and 49 CFR Part 220. When the radio communications failed, the operator and dispatcher had no means available to stop the train, since the procedure that was being used at Fall River depended on radio communications to issue the train order.

The switchtender, by not operating the switch of the crossover, was the last person that could have prevented this accident. However, the operator did not notify the switchtender that radio contact could not be established with train 8. Two failures occurred: first, communications failed; and, second, the switchtender operating the switch to the crossover assumed that the engineer of train 8 had heard and understood that the train was to cross over at Fall River.

Although the crossover procedure was understood by most of the individuals involved in this accident, it was a dangerous procedure. Expediting the movement of trains by eliminating the protection of the signal system is, in the Safety Board's view, an antthesis of safe operating practices. If the switches of the crossover had been lined for the



crossover before the arrival of train 8, the engineer would have been required to slow the train and comply with the signal indications. This would have further delayed train 8, which was already late leaving Portage by 8 minutes. Because of the published schedule, the engineer had said it was difficult to make up time lost east of Portage. Due to the track work being performed on the eastward track, the trains were required to run on the westward track causing additional delays. Because this procedure was understood and condoned by Soo management and because they failed to take action to prohibit its use, it was an implicit endorsement of the method.

The Safety Board believes that Soo management should have recognized the danger of this crossover procedure and should have taken action to prohibit its use. However, the procedure did expedite the movement of trains and Amtrak's incentive for on-time performance of trains may have been the factor that caused Soo management to accept this method of operation. Soo Line management officials stated that although they wanted to make as much as possible from the on-time incentive payments, they did not want to forsake safety to keep Amtrak trains on schedule. Since train 8 was only 8 minutes late leaving Portage, Soo employees may have believed that train 8 could still be qualified as on-time when it arrived in Chicago, thereby qualifying for the on-time incentive. The engineer of train 8 understood that management wanted to expedite train 8 and that Soo collected "considerable money" for on-time performance. The train dispatcher indicated he also understood the railroad wanted to keep Amtrak train 8 on schedule. It is possible that the implied emphasis by Soo management to keep train 8 on schedule affected the performance of the individuals involved in the movement of the train, and this impression led them to believe that on-time performance was the most important factor.

Following an investigation of an Amtrak passenger train collision and derailment at Wilmington, Illinois, on July 28, 1983, 7/ the Safety Board issued a recommendation to Amtrak:

R-84-37

Review the possible contribution of the on-time incentive program in encouraging contractor railroads operating practices which may cause a degradation of safety, and modify the program as appropriate.

Amtrak responded that there was no evidence or indication that the carriers violated safe operating practices to enhance their on-time performance. The Safety Board classified the recommendation as "Closed--Unacceptable Action" when it became apparent that Amtrak was not going to take any positive action to determine why speed violations, that had been documented in Safety Board investigations, continued to occur. The Safety Board believes that the employees involved believed that the Soo received considerable money from the incentive program for on-time performance and that this belief had a direct influence on the decisions to allow this unsafe procedure to be used at Fall River.

7/ Railroad/Highway Accident Report--"Collision of Amtrak Passenger Train No. 301 on Illinois Central Gulf Railroad with Marquette Motor Service Terminals, Inc., Delivery Truck, Wilmington, Illinois, July 28, 1983" (NTSB/RHR-84/02).

### Radio Communications

The use of radios in train operations has led to the transmitting of train orders to on-board personnel by train dispatchers and operators. Numerous rules on the use of radios, as required by 49 CFR Part 220, have been included in the operating rules by all railroads to provide safeguards when transmitting train orders. However, the train dispatcher involved in this accident exercised poor judgement by not allowing sufficient time for the train order to be received and copied before the train arrived at the point of restriction. The Safety Board believes this constituted a violation of operating rule 521(2) and 49 CFR 220.61 (2).

The crewmember's test of the radios was insufficient to ensure reliable transmissions of train orders. While Soo believes that it is in accordance with its rules that a voice test of the radio can be made between the conductor and engineer even if the conductor is standing beside the locomotive, the Safety Board does not believe that this test is valid. The proper preparation and the transmission and understanding of train orders are mandatory for the safe operation of trains. While long-distance transmission testing is not required by the operating rules or by 49 CFR Part 220, the Safety Board further believes that the FRA should take action to require the long-distance testing of radios used in train service.

Presently there are neither carrier operating rules nor regulations in 49 CFR Part 220 that require the testing of radio antennas. The locomotive in this accident had been in the heavy overhaul program less than a month before the accident, but because Amtrak does not test radio antennas unless they fail in service, it is most likely the locomotive left the shop with the antenna problems that were discovered at the Safety Board laboratory. When the antenna was tested at the Safety Board, the transmissions were weak, intermittent, or nonexistent. The faulty antenna was the reason the locomotive engineer was unable to communicate with the operator at Portage. Therefore, the FRA should establish requirements for the testing of the entire radio system on all locomotives, including the antenna.

Because the Safety Board has long been concerned about the application of radio use and improved communications, it has made several recommendations about these issues. Safety recommendations have been issued to the FRA requiring radio equipment on trains, addressing the need for compatibility of radios between railroad properties and issuing standards governing the use of radios in industry.

In its report of the derailment of Amtrak train 60, the Montrealer, near Essex Junction, Vermont, on July 7, 1984, 8/ the Safety Board issued a recommendation to the FRA on January 15, 1986:

#### R-85-129

Establish regulations that address the issues surrounding the use of radios for operational purposes on trains to include, but not be limited to, requirements for radios to be installed on trains; usage requirements for inter- and intra-train communications; usage requirements for dispatching and control operations; frequency compatibility requirements; and maintenance, inspection, and testing requirements.

8/ Railroad Accident Report--"Derailment of Amtrak Passenger Train No. 60, the Montrealer, on the Central Vermont Railway Near Essex Junction, Vermont, July 7, 1984" (NTSB/RAR-85/14).

As a result of the accident at Chase, Maryland, on January 4, 1987, between the Amtrak Colonial No. 94 and 3 Conrail locomotive units, the Safety Board has issued a recommendation to Amtrak:

R-87-3

Require all locomotives allowed to enter and operate on the high speed passenger train trackage of the northeast corridor to be equipped with an operable radio capable of train-to-train and train-to-fixed station communications.

On April 7, 1987, Amtrak responded to the Safety Board's recommendation and indicated that it had no objection to this recommendation with respect to locomotives. Amtrak further indicated that the following instruction was implemented by a bulletin order effective on February 2, 1987:

Trains and engines are not to be dispatched from their initial terminal without working locomotive radio on the leading end of the movement. When a locomotive radio failure occurs en route, a portable radio must be provided on the leading end of the movement at the next location where portable radios are available.

Trains and engines entering Amtrak territory from foreign railroads must be equipped with a working radio on the leading end of the movement. The exception to this rule is when New Jersey Transit or Long Island Rail Road trains do not have functioning radios on the head end of multi-unit trains. In this situation, an operating employee must be assigned to a functioning radio within the consist and be in communication with the engineer by intercom.

The Safety Board noted that while the issuance of this bulletin order was in line with the intent of its recommendation, the Safety Board requested to be informed if the goal of train-to-train and train-to-fixed-station communications had been achieved and if Amtrak had verified that the railroads had complied with the bulletin order.

Track Maintenance

Track maintenance work in progress between milepost 145 and the facing point cross over at Watertown on the eastward track required that the track be out of service all day. Track maintenance personnel testified at the public hearing that the track could not have been returned to service in short notice because of the nature of the work. This work did not directly contribute to the accident, however, it was because of this work that the train had to be rerouted over the westward track. The rerouting of traffic around a track maintenance work site that is properly flagged is not in itself an unsafe procedure when traincrews are instructed by train orders in a timely manner.

The Safety Board is concerned with the visibility of the low switch stand target of the crossover and the absence of an electric switch lock on a mainline cross over. The low switch stand target was reflectorized so that the target displayed a red aspect indicating the crossover was positioned for a diverging route to the westward track. However, the target was dirty and not readily visible because of its proximity to the grade crossing. (The top of the switch target was approximately 12 inches above the top of rail.) It may not have been seen by the traincrew because of its position. Also,

signal 153.4 in advance of the crossover was displaying a clear aspect. Since no instructions were received to use the crossover, the traincrew would not have been expecting the switch to be different from its normal position.

The switchtender received his authority to operate the switch directing the train from the eastward track to the westward, but the method of operation used circumvented the safeguards inherent in the signal system. A system that allows a switch to be operated regardless of the location of a train has the concomitant risk that it can be operated immediately in front of any train. One system that prevents the operation of the switch when a train is closely approaching is a switch that is electrically locked at the time a train passes the signal preceding the switch. The Fall River crossover had never been equipped with electric locks. If the railroad had equipped the crossover switches with electric locks, the dispatcher would have had to arrange for the switch to be unlocked so that it could be operated manually by the switchtender. An unlocked situation could not be arranged if a train was in the affected signal block that would change the indication provided by the last signal the traincrew received. If electric locks had been provided on the crossover switches, this accident would not have occurred.

### **Amtrak Oversight of Contract Carriers**

The Safety Board is concerned that Amtrak is not making sufficient safety checks of trains operated by contract railroads. Amtrak should not allow high-speed passenger trains to operate in areas where switches are not electrically locked unless the speed of the train is reduced so engineers can stop the train safely if those switches are not properly lined. In Harvey, Illinois, on October 12, 1979, 9/ a head-end collision occurred when an Amtrak passenger train, diverted to a side track, collided with a freight train that was waiting to enter the main track after the passenger train passed. In that accident, a switchtender had mistakenly operated the switch moments before the passenger train arrived at that point and after the passenger train had passed the last signal.

The Safety Board is also concerned about the procedure of allowing passenger train 8 to pass the signals on green (clear) indications and then operating the switch. When the FRA's special study on the Northeast Corridor 10/ illustrated the danger of the procedure, Amtrak should have reviewed every route to ascertain if this dangerous procedure was being performed elsewhere.

The issue of Amtrak monitoring the operations of its contract railroads to determine adherence to safe practices and compliance with operating rules has been addressed in previous Safety Board reports of accident investigations in terms of crew performance. As a result of its investigation of an Amtrak train derailment on the Illinois Central Gulf Railroad at Springfield, Illinois, on October 30, 1980, 11/ the Safety Board recommended that Amtrak "in cooperation with the Illinois Central Gulf Railroad, develop a program of close surveillance of the operation of its trains on ICG's Alton District which includes the compliance of traincrews with speed restrictions and signal aspects, as well as the

9/ Railroad Accident Report--"Head-end Collision of Amtrak train No. 392 and ICG Train No. 51 at Harvey, Illinois, on October 12, 1979" (NTSB-RAR-80-03).

10/ Federal Railroad Administration, Safety Assessment, National Railroad Passenger Corporation, Northeast Corridor, 1984.

11/ Railroad Accident Report--"Derailment of Amtrak Passenger Train No. 21 on the Illinois Central Gulf Railroad, Springfield, Illinois, October 30, 1980" (NTSB/RAR-81/05).

monitoring of locomotive speed recorder tapes." In response, Amtrak informed the Safety Board that it had an on-going coordinated program with ICG to monitor locomotive speed and event recorder tapes and enginecrew performance for Amtrak trains operating between Chicago, Illinois, and St. Louis, Missouri.

The Safety Board again addressed this topic in Safety Recommendation R-84-43 issued to Amtrak as a result of the Board's investigation of the collision of an Amtrak train with a delivery truck in Wilmington, Illinois, on July 28, 1983. That recommendation called for Amtrak to improve the cooperative program with the ICG Railroad for monitoring enginecrew performance and enginecrew compliance with operating rules. Amtrak again informed the Safety Board that it had discussed this issue with the ICG and that, as a result, a program has been placed in effect involving radar monitoring of Amtrak trains by Amtrak and ICG supervisory personnel. Amtrak also indicated that it had planned to add two additional transportation supervisor positions in St. Louis that would result in increased on-board monitoring of both train and enginecrew personnel.

The Safety Board is concerned that although Amtrak supervises its train crewmembers, it does not have sufficient control over how the trains will be directed or how Soo will route trains on its railroad. It is not enough that Amtrak supervises the operating employees on the train. The Safety Board believes Amtrak must assume an oversight role in the operation of their trains to detect dangerous procedures and correct any unsafe practice involving their trains. The Safety Board further believes that Amtrak should review and amend or renegotiate its contracts to include the right to conduct audits or to review all practices and operations of its contract railroads, not just crew performance, to eliminate unsafe practices.

#### Personnel Performance and Training

The switchtender was given more responsibility than is normal for that position; the dispatcher was communicating instructions to the switchtender and was expecting him to function much like an operator. The instructions given to the switchtender were more general in nature and he was expected to make decisions based on this general information rather than being given specific instructions by the dispatcher to perform a task at a given time. The switchtender had been a switchman/brakeman and conductor, and all of his experience was in train service. One of the indications of his inexperience was when he reversed the switches for train 8 to cross over. He lined the facing switch on the eastward track, the first switch of the crossover for the approaching train, as if he had been on a train that had stopped in order to operate the switches. If he had turned the trailing switch on the westward track first, he would not have had to turn his back to the approaching train. In this position, he could have seen train 8 approaching at high speed, and he could have let the train go straight on the eastward track and avoided this accident. In his experience as a switchtender, this was the first day he had worked the leading end of a crossover operation.

The Soo had not provided the switchtender any training for his position. His training should have included instructions in train lineups, reporting of train movement times, radio procedures, and operation of switches.

There is ample evidence of high workload and stress as background factors for the dispatcher in this accident. The Safety Board is disturbed that these factors appear to be a normal part of the job. In a widely cited questionnaire survey of different occupations,

Caplan, Cobb, Franch, Harrison, and Pinneau, <sup>12/</sup> discuss job pressures in the workplace that are relevant to issues of worker health. The report concluded that train dispatchers are subject to relatively high workload pressures and that more demands on mental concentration are placed on dispatchers than air traffic controllers. (The researchers selected these two occupations for comparison because both are involved in the "monitoring and dispatching of major conveyances in the nation's transportation system.") Two witnesses (the operator and the switchtender) characterized the dispatcher as less than open to suggestions from fellow workers. A review of the audio tape from the day of the accident, however, did not portray the dispatcher as acting inappropriately. While possibly abrupt compared to other dispatchers, the dispatcher was under a heavy workload and was behaving within bounds appropriate to the task. There is no clear evidence that personality considerations for the dispatcher were a factor in the accident.

The dispatcher indicated that he was often so busy that he had to postpone restroom breaks for long periods. Both the dispatcher and the chief dispatcher indicated that the dispatcher position at Milwaukee was extremely busy. Both agreed that the workload had been extremely heavy from the spring up to the time of the accident. However, there is no indication that Soo management eased the workload at Milwaukee. The superintendent stated he thought it was impractical to have a relief position for the dispatcher and that it was not a good business decision to assign another dispatcher in the Milwaukee office. Soo management argued that the dispatcher position is a critical safety-related position. Therefore, it would not have been unreasonable to establish a relief dispatcher position on the day shift to assist during those months when track work is being performed. Instead of correcting the workload problems at Milwaukee after receiving the union complaint, the Soo management coerced the dispatchers union into withdrawing the complaint. This action is an indication that Soo management apparently was willing to accept a potentially dangerous situation rather than spend the necessary funds to provide for a dispatcher relief position.

According to standard medical literature, <sup>13/</sup> the conscious need for rest and toilet breaks occurs long before the physical capacities of the human body have been reached. For a healthy 30-year-old male, the type of chronic postponement described by the dispatcher would not generally raise concerns of medical issues. At the same time, however, medical authorities agreed that a tremendous psychological discomfort can be associated with this type of postponement based on a wide variety of sensory inputs. For a worker with heavy job responsibilities, these physical sensations are almost certainly a source of distraction and by their presence may add to the general stress of the situation. The Safety Board believes the FRA should modify its "Hours of Service" regulations to provide for reasonable days off and necessary rest breaks for safety-critical positions such as dispatchers.

There is little background literature available on the position of operator. However, the evidence suggests that this job (which is being gradually eliminated by the railroad industry through the use of radio orders) appears to be subject to stress. As described by the operator, the job included a curious collection of responsibilities. The operator's primary tasks were to deliver train orders and to monitor the hot box detectors. Both of these tasks are critical to the safe functioning of the railroad and are potentially competing since the operator must physically leave the radio transmitter and the message

<sup>12/</sup> Caplan, R.D., Cobb, S., French, V. R. P. Jr., Van Harrison, R., and Pinneau, S.R. Jr., "Job Demands and Worker Health," Survey Research Center, Institute for Social Research, University of Michigan, 1980.

<sup>13/</sup> Guyton, A.C., "Textbook of Medical Physiology," Philadelphia, W.B. Saunders, 1981; Campbell, M.F., "Urology (Volume 3)," Philadelphia, W.B. Saunders, 1963.

line to the dispatcher to monitor the detectors. The other assigned tasks, such as janitorial duties, may require the operator to be out of hearing range of the radio. The operator stated that his supervisor occasionally "...looks in the window," but that otherwise he is left alone while carrying out his duties. He noted that other operators do not bid on his job and that his workload has increased as the railroad closed nearby stations and transferred responsibilities to his position.

In a 1974 FRA report, 14/ the possible safety dangers of "streamlining" railroads by cutting personnel and transferring duties to the remaining employees. In this accident there is a possible warning that this streamlining may have gone too far and that the heavy workload of the dispatcher and operator contributed to the accident. The operator was instructed to tell the crew of train 8 about the crossover plans, but in the flurry of radio communications and tasks that he was also required to complete, he did not have an opportunity to comply. For both the operator and the dispatcher, there was a more direct effect of workload in that they both were so occupied, they may not have had a chance to think carefully about the operation and to recognize the developing danger of the situation.

The operator also stated that he had difficulty in carrying out his critical jobs because of people walking through his area or patrons making requests at the station window (his work station is in the middle of a small railroad station and is not isolated from the general public or other employees).

The Safety Board believes that the FRA should take action to require that both dispatchers and operators receive days off and allowance breaks during their tour of duty.

The Safety Board believes that the failure of Soo management to fill the position of relief dispatcher may be the lack of a vigorous recruitment program. Further, the position of dispatcher may be difficult to fill because of Soo management's inattention to the position and the lack of attempts to correct the tension presently associated with the job. The Safety Board has been concerned about this situation and has made recommendations regarding dispatchers' working conditions. Following an accident on February 9, 1981, at Germantown, Maryland, 15/ the Safety Board made the following recommendation to the Baltimore and Ohio Railroad:

R-81-71

Evaluate the workloads carried by the Old Main Line and the Baltimore terminal dispatchers to determine if they are manageable. If either is not, adjust the workloads so that each dispatcher has a manageable assignment.

On April 6, 1983, the Safety Board classified this recommendation as "Closed--Acceptable Action."

14/ Devoe, D. B., "An Analysis of the Job of Train Dispatcher," Report no. FRA-ORD&D-74-37, Washington, D.C., U.S. Department of Transportation, 1974.

15/ Railroad Accident Report--"Head-On Collision Between Baltimore and Ohio Railroad Company Train No. 88 and the Brunswick Helper Near Germantown, Maryland, February 8, 1981" (NTSB-RAR-81-6).

On August 11, 1981, the Safety Board investigated an accident in Beverly, Massachusetts. 16/ As a result of its investigation the Safety Board issued a recommendation to the Boston and Maine:

R-82-30

When it becomes necessary to divert a train from its normal route, require the dispatcher to inform all employees who will handle the diverted train of the planned move and further require that the operators handling a diverted train report the train's passing times to each other.

On May 28, 1982, the Safety Board classified this recommendation as "Closed--Unacceptable Action."

Following its investigation of the accident of a Metro-Dade County Transportation Administration train accident on April 29, 1984, in Miami Florida, the Safety Board made the following recommendation:

R-84-27

Limit the duty time of rail attendants (train operators), train controllers, and train dispatchers to not more than 12 hours in a 24-hour period and not more than 60 hours in a 7-day week.

On January 11, 1985, the Safety Board classified this recommendation as "Closed--Acceptable Action."

Following an accident on the Burlington Northern Railroad on June 14, 1984, at Motley, Minnesota, 17/ the Safety Board issued a recommendation to the Burlington Northern:

R-85-43

Establish and document aptitude and other performance oriented selection/screening criteria which assure that individuals such as train dispatchers are capable of fulfilling the requirements of that position.

On April 10, 1987, the Burlington Northern responded further to the Safety Board's recommendation indicating that it had been working with an independent firm to establish selected/screening criteria and that it was in the process of administering a differential aptitude test to 50 candidates who have applied for dispatcher training classes. The recommendation is currently classified as "Open--Acceptable Action." A recommendation was also issued to the FRA:

16/ Railroad Accident Report--"Head-On Collision of Boston and Maine Corporation Extra 1731 East and Massachusetts Bay Transportation Authority Train No. 570 on Former Boston and Main Corporation Tracks, Beverly, Massachusetts, August 11, 1981" (NTSB-RAR-82-1).

17/ Railroad Accident Report--"Head-On Collision of Burlington Northern Railroad Freight Trains Extra 907 East, Near Motley, Minnesota, June 14, 1984" (NTSB/RAR-85/06).



R-85-47

In conjunction with the Association of American Railroads, initiate a program designed to establish and document aptitude and other performance oriented selection/screening criteria training, and testing procedures for individuals to be employed in safety-critical positions such as train dispatcher.

On May 22, 1986, the FRA responded that the record clearly shows that there is not a need for Federal action on this issue and that allocations of resources to a formal rulemaking on the matter would be counterproductive, diverting these resources from areas where they can have a more direct and productive influence on safety. The Safety Board classified this recommendation as "Closed--Unacceptable Action."

A further recommendation was issued to the AAR:

R-85-48

In conjunction with the Federal Railroad Administration initiate a program designed to determine and document aptitude and other performance oriented selection/screening criteria, training, and testing procedures for individuals to be employed in safety-critical positions such as train dispatcher.

On July 18, 1985, the AAR responded, "We believe the industry, as a whole, is doing a good job of selection/screening and the overall record will support this position." The Safety Board has classified this recommendation as "Open--Unacceptable Action" because of the AAR response.

Following an investigation of an accident on July 10, 1986, at North Platte, Nebraska, 18/ the Safety Board issued a recommendation to the Union Pacific Railroad:

R-87-22

Monitor the activities and workloads of dispatchers to determine that they are able to perform their duties, which are critical to the safety of train movements.

To date, the Union Pacific Railroad has yet to respond to this recommendation.

Therefore, the Safety Board believes accident investigations have indicated a need for a thorough study of the selection process, training, duties, and responsibilities of dispatchers is needed for the railroad industry. The Safety Board recommends that a more current study by the FRA should be conducted because of the mergers, consolidations, and elimination of operator positions to determine if the workload of dispatchers is beyond the normal job stress levels, and if so, to determine the methods necessary to reduce the stress of the dispatcher position. Also, because of Soo management's belief that it is difficult to obtain individuals for the dispatcher position, include in the study the methods used to select and train dispatchers.

18/ Railroad Accident Report--"Rear-End Collision and Derailment of Two Union Pacific Freight Trains Near North Platte, Nebraska, on July 10, 1986" (NTSB/RAR-87/03).

### Survival Factors

The Safety Board has issued recommendations to both the FRA and to Amtrak regarding improvement in the design of passenger car interiors, in particular improvements in baggage retention devices. As a result of an Amtrak derailment at Wilmington, Illinois, on July 28, 1983, the Safety Board issued a recommendation to Amtrak:

#### R-84-40

Correct the identified design deficiencies in the interior features of existing and new passenger cars, which can cause injuries in accidents, including the baggage retention capabilities of overhead luggage racks, inadequately secured seats, and inadequately secured equipment in food service

These identified design deficiencies were again highlighted in the Safety Board's investigation of the accident in Woodlawn, Texas, on November 12, 1983, <sup>19/</sup> which prompted the Board to reiterate Safety Recommendation R-84-40 to Amtrak. In its March 13, 1985, response to this recommendation Amtrak indicated that while some modifications were being made to the interior of its cars, it did not plan to retrofit the overhead luggage racks in its existing cars with retention devices. However, following the Safety Board's investigation of the accident at Essex Junction, Vermont, in which overhead luggage falling from the racks was again documented as a common cause of injuries, the Safety Board issued a recommendation to Amtrak:

#### R-85-128

Develop and install effective retention devices on its overhead luggage racks to prevent the dislodging of luggage and other articles in a collision and/or derailment.

In response to this recommendation, Amtrak indicated that it would be investigating the use of vertical dividers as a means to restrain luggage and would forward a status report to the Safety Board after the investigation was completed. On September 22, 1987, Amtrak informed the Safety Board that "test luggage restraints have been installed on three car sets. Luggage restraints have been approved by Federal agencies. Material has been ordered and will be delivered by October 31, with installation to begin thereafter. We estimate installation will take 6 years to complete."

The Safety Board believes that 6 years is too long for the installation of luggage restraints because of the number of passenger injuries caused by luggage being thrown about the car. In addition, the Safety Board has noted that test luggage restraints have sharp protruding edges that are potentially dangerous. The Safety Board has previously addressed the need to eliminate sharp edges on fixtures in passenger cars that could injure passengers in accidents. Therefore, the Safety Board believes that additional testing and design changes for luggage restraints are necessary.

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<sup>19/</sup> Railroad Accident Report--"Derailment of Amtrak Train No. 21, (The Eagle) on the Missouri Pacific Railroad, Woodlawn, Texas, November 12, 1983" (NTSB/RAR-85-01).

The fireman, seated in the left seat on the locomotive, died as a result of asphyxiation. He was completely covered with rain-soaked dirt that entered through the window and the cab of the locomotive when the door opened. The fireman probably would have probably survived this accident if the dirt had not entered the cab, and the dirt would not have entered the cab if the door had remained securely closed and the window had remained intact. The Safety Board has long been concerned that locomotive crewmembers are not being afforded protection in accidents through improved locomotive crashworthiness. This concern led the Safety Board to issue recommendations to the FRA to establish requirements for locomotive cabs to provide protection for crewmembers. The most recent recommendation was made to the FRA on September 9, 1987, following the Union Pacific train accident at North Platte, Nebraska.

#### R-87-23

Promptly require locomotive operating compartments to be designed to provide crash protection for occupants of locomotive cabs.

#### Emergency Response

The initial notification and response of the fire, police, and emergency medical services was timely due to the quick action of the Fall River police chief. However, the lack of a command post and triage area caused some problems in the rescue, such as the inability to adjust the response to the needs at the scene. An on-scene commander in a central command post could have requested the specific number and types of units and personnel needed. Another problem that could have been eliminated had there been an on-scene commander would have been the establishment of communications between the rescue personnel and the hospital.

In addition, if there had been a triage officer at the accident site, classification of the injured with the proper triage tags could have been maintained instead of being discontinued. The Safety Board was notified, following the accident that a critique was held at Columbus Community Hospital on October 14, 1986. The critique identified problems that has been addressed in the next revision of the Columbus County Disaster Plan, now designated the Columbus Area Dispatch Plan.

### **CONCLUSIONS**

#### Findings

1. The procedure used to cross trains over at Fall River was known and understood not only by the involved employees but also by Soo Line management who considered it to be an acceptable procedure.
2. The trains preceding train 8 were given instructions that they would cross over at Fall River, and they safely crossed over.
3. The train order to be given to the crew of train 8, instructing them to cross over at Fall River, was delayed to allow preceding trains to move to Watertown and Reevesville in order that train 8 could be operated unrestricted to that point, minimizing delay.
4. The engineer of train 8 had not been advised that his was to cross over, and therefore, he had not reduced the speed of the train; train 8 was being operated at a speed too great to cross over at Fall River safely.

5. The engineer of train 8 operated the train in accordance with the train orders issued to him.
6. Amtrak incentive payments for on-time performance encouraged the Soo railroad to take unnecessary risks to achieve on-time performance.
7. The procedure being used by the Soo Line to cross trains over at Fall River required that the train radio operate properly.
8. The radio antenna on the locomotive of train 8 was defective which prevented transmission to the operator at Portage.
9. When radio communication with train 8 failed, the dispatcher and operator had no other available means to contact train 8.
10. The switchtender operated the crossover switch believing that train 8 had been instructed to cross over and that radio communication had been made with train 8.
11. The switch target at the Fall River crossover was too low to be seen by the engineer of train 8 and, therefore, it did not alert the engineer that the switch was lined for the crossover.
12. The signal system was circumvented when train 8 was allowed to pass the signals before the switch was thrown.
13. Passengers were injured from secondary impacts with interior surfaces and from unrestrained baggage.
14. The fireman died because the left front door and window failed and allowed rain-soaked dirt to enter the locomotive cab.
15. The workload, long hours, and few days off of the dispatcher and operator had a direct relation to this accident.
16. The quick response and notification by the Fall River police chief resulted in the arrival of rescue personnel.

#### **Probable Cause**

The National Transportation Safety Board determines that the probable cause of this accident was the Soo Line Railroad's procedures for crossing trains over on main line tracks which defeated the protection of the signal system. Contributing to the accident was the heavy workload of the dispatcher and operator. Also contributing to the accident was the lack of adequate industry and Federal rules regarding the functioning and testing of radio systems used in dispatching trains.

## RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board made the following recommendations:

--to the Soo Line Railroad:

Establish at each crew change point a requirement for the testing of the radio by crewmembers to a predetermined point that would be equal to the farthest point the radio would be required to transmit and receive. (Class II, Priority Action) (R-87-61)

In cooperation with the National Railroad Passenger Corporation (Amtrak) equip all main line switches on routes used by Amtrak passenger trains with electric locks to prohibit the operation of the switch after a train has passed the last signal before a crossover. (Class II, Priority Action) (R-87-62)

Provide train dispatchers and operators at a minimum one off-duty period of 24 hours during any 7-day consecutive work period, a mandatory lunch break, and an additional break in the first half of the shift and one break in the second half of the shift in any 8-hour tour of duty. (Class II, Priority Action) (R-87-63)

--to the Federal Railroad Administration:

Modify the regulations for the testing of radios used in operations to be tested at each crew change location to determine that the radio will transmit and receive over a distance equal to the longest distance between base stations on the route the train is to travel. (Class II, Priority Action) (R-87-64)

Revise the Hours of Service regulations for train dispatchers and operators to provide at a minimum one off-duty period of 24 hours during any 7-day consecutive work period, a mandatory lunch break, and an additional break in the first half of the shift and one break in the second half of the shift in any 8-hour tour of duty. (Class II, Priority Action) (R-87-65)

Conduct a thorough study of the selection process, training, duties, and responsibilities of train dispatchers to determine if the workload is beyond the normal job stress level and determine what selection and training standards are used for train dispatchers. Establish selection and training standards and limits of workload for dispatchers. (Class II, Priority Action) (R-87-66)

--to the National Railroad Passenger Corporation:

Review and amend or renegotiate its contracts to include the right to conduct audits or review all practices and operations of its contract railroads, not just crew performance, with the goal of eliminating unsafe practices. (Class II, Priority Action) (R-87-67)

In cooperation with the railroads that operate Amtrak passenger trains, install electrically locked switches on the main line tracks that would prohibit the operation of the switch after a train has passed the last signal before the switch. (Class II, Priority Action) (R-87-68)

Establish a testing procedure at each periodic inspection, not to exceed 92 days, at an adequate facility for the complete radio system and antenna on Amtrak locomotives to include continuity and reflect levels. (Class II, Priority Action) (R-87-69)

Establish safeguards to prevent contract railroads from using unsafe practices to qualify for on-time incentive payment for on-time performance of Amtrak passenger trains. (Class II, Priority Action) (R-87-70)

**BY THE NATIONAL TRANSPORTATION SAFETY BOARD**

/s/ JIM BURNETT  
Chairman

/s/ PATRICIA A. GOLDMAN  
Vice Chairman

/s/ JOHN K. LAUBER  
Member

/s/ JOSEPH T. NALL  
Member

/s/ JAMES L. KOLSTAD  
Member

December 12, 1987

## **APPENDIXES**

### **APPENDIX A**

#### **INVESTIGATION AND HEARING**

##### **Investigation**

The National Transportation Safety Board was notified on October 9, 1986, that a derailment of an Amtrak passenger train had occurred on the Soo Line Railroad at Fall River, Wisconsin. A Safety Board member, five investigators from the Washington office, and one investigator from the Chicago field office were immediately dispatched to the accident site.

Committees for operations, mechanical, track and signal engineering, emergency response and human performance were established for conducting the investigation.

The Safety Board was assisted in the investigation by the Soo Line Railroad Company, the National Railroad Passenger Corporation, the Brotherhood of Locomotives Engineers, the United Transportation Union, the American Train Dispatchers, and Aerotron, Incorporated.

##### **Public Hearing**

A public hearing was conducted in Madison, Wisconsin, on January 14, 15, and 16, 1987, to take sworn testimony to obtain the facts of the accident from all individuals involved in the accident.

**APPENDIX B**  
**PERSONNEL INFORMATION**

Loren R. Bright, Engineer

Loren R. Bright, 58, engineer of train 8, had been operating trains as an engineer since 1954. He had been operating regularly for 4 years as the engineer on train 8.

Walter F. Day, Fireman

Walter F. Day, 50, fireman of train 8, was promoted to engineer in 1965. However, he had been working as the fireman on train 8.

James Rickard, Conductor

James Rickard, 46, conductor, promoted to that position in 1966, had been working on Amtrak passenger trains irregularly for 10 years. He had been assigned regularly to train 8 for 5 years.

Daniel Stanley, Switchtender

Daniel Stanley, 32, switchtender, began employment with the railroad in 1974 and was promoted to conductor in 1977. He applied for and was awarded the position of switchtender on September 25, 1986.

James T. Malek, Train Dispatcher

James T. Malek, 30, train dispatcher, had been employed by the railroad since June 1975 and was promoted to train dispatcher in February 1979. He was qualified for the position of train dispatcher by the Soo Line Railroad.


Arnie Sturm, Operator at Portage

Arnie Sturm, 38, operator at Portage, began his employment with the railroad in 1966 as an operator. He was qualified for the position of operator by the Milwaukee Railroad, the predecessor to the present owner, the Soo Line Railroad.



APPENDIX C

CLEARANCE CARD AND TRAIN ORDERS GIVEN TO TRAIN 8  
AT PORTAGE, WISCONSIN, ON OCTOBER 9, 1986

CLEARANCE  SOO LINE RAILROAD <sup>46°</sup> TEMPERATURE

TO: Portage Oct 9 1986

At Portage STATION DATE

Clearance  
No 4 (Rule 97 (A)) TO Portage (Terminating Station per Rule 97 (A))

I have 4 orders for your Train

No	7	10	11			
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No						
----	--	--	--	--	--	--

SLOW ORDERS

No	569					
----	-----	--	--	--	--	--

No						
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No						
----	--	--	--	--	--	--

No						
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Do Not leave before	M.	TIME OK'D	1135A	M.
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DISPATCHER JTM OPERATOR Summ

**SOO LINE RAILROAD**  
**(FORM Y)**

FORM 10  
Rev 2-85

Train Order Number 9

STATION PORTAGE DATE OCT 9 19 86  
TO C&E EASTWARD TRAINS

MEN AND EQUIPMENT ON	BOTH	TRACKS
BETWEEN	MP 110.0	
AND	MP 114.0	
BETWEEN	PEWAUKEE	AND OCONOMOWOC
FROM	701 A	M UNTIL 330 P M
ALL TRAINS ON THIS TRACK PROCEED THROUGH		
THESE LIMITS AT RESTRICTED SPEED UNLESS A		
DIFFERENT SPEED IS VERBALLY AUTHORIZED BY		
EMPLOYEE IN CHARGE OR ENTIRE TRAIN HAS		
PASSED A GREEN FLAG		
FOREMAN	DOUGLAS	IN CHARGE OF THIS ORDER
		RJK

MADE COMPLETE - TIME 1144 M. Free OPERATOR



800 LINE RAILROAD  
(FORM Y)

FORM Y  
Rev 2-86

Train Order Number 10

STATION PORTAGE DATE OCT 9 10 86  
TO C&E EASTWARD TRAINS

MEN AND EQUIPMENT ON WESTWARD TRACK

BETWEEN MP 131.2

AND MP 145.0

BETWEEN WATERTOWN AND ASLICO

FROM 701 A M UNTIL 501 P M

ALL TRAINS ON THIS TRACK PROCEED THROUGH

THESE LIMITS AT RESTRICTED SPEED UNLESS A

DIFFERENT SPEED IS VERBALLY AUTHORIZED BY

EMPLOYEE IN CHARGE OR ENTIRE TRAIN HAS

PASSED A GREEN FLAG

FOREMAN SCHROEDER IN CHARGE OF THIS ORDER

RJK

WDE COMPLETE - TIME 1124 M. Heel OPERATOR



SOO LINE RAILROAD

Form 19  
Rev 2-86Train Order Number 11

STATION PORTAGE DATE OCT 9 19 86  
TO C&E EASTWARD TRAINS

AFTER 701AM EASTWARD TRACK OUT OF SERVICE BETWEEN MP 145.0 AND FACING POINT  
CROSSOVER WATERTOWN BETWEEN ASTICO AND WATERTOWN  
RJK

MADE COMPLETE - TIME 2:41 A M ACEL OPERATI



SOO LINE RAILROAD

Form 19  
Rev 2-86

Train Order Number 569

STATION PORTAGE DATE SEPT 26 19 86  
TO C & E EASTWARD TRAINS

BETWEEN VOLTZ AND REESEVILLE ON BOTH TRACKS DO NOT EXCEED 10 MPH BETWEEN  
MP 138.0 AND MP 139.0

J T M

MADE COMPLETE - TIME 313P Sturm OPERATOR

APPENDIX D

D-R ORDER NO. 52

Form 19

CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC RAILROAD COMPANY

TRAIN ORDER NO. 52

PORTAGE

OCT 9

19 06

Station

Date

To C & E NO 8 VIA RADIO

NO 8 ENGINE ANTRAK 333 HAS RIGHT OVER OPPOSING TRAINS  
ON WESTWARD TRACK FALL RIVER TO WATERTOWN  
MAIN TRACK OCCUPIED REESEVILLE TO WATERTOWN  
BY EXTRA 2014 EAST

J T M

Made

Time

M

Opp.