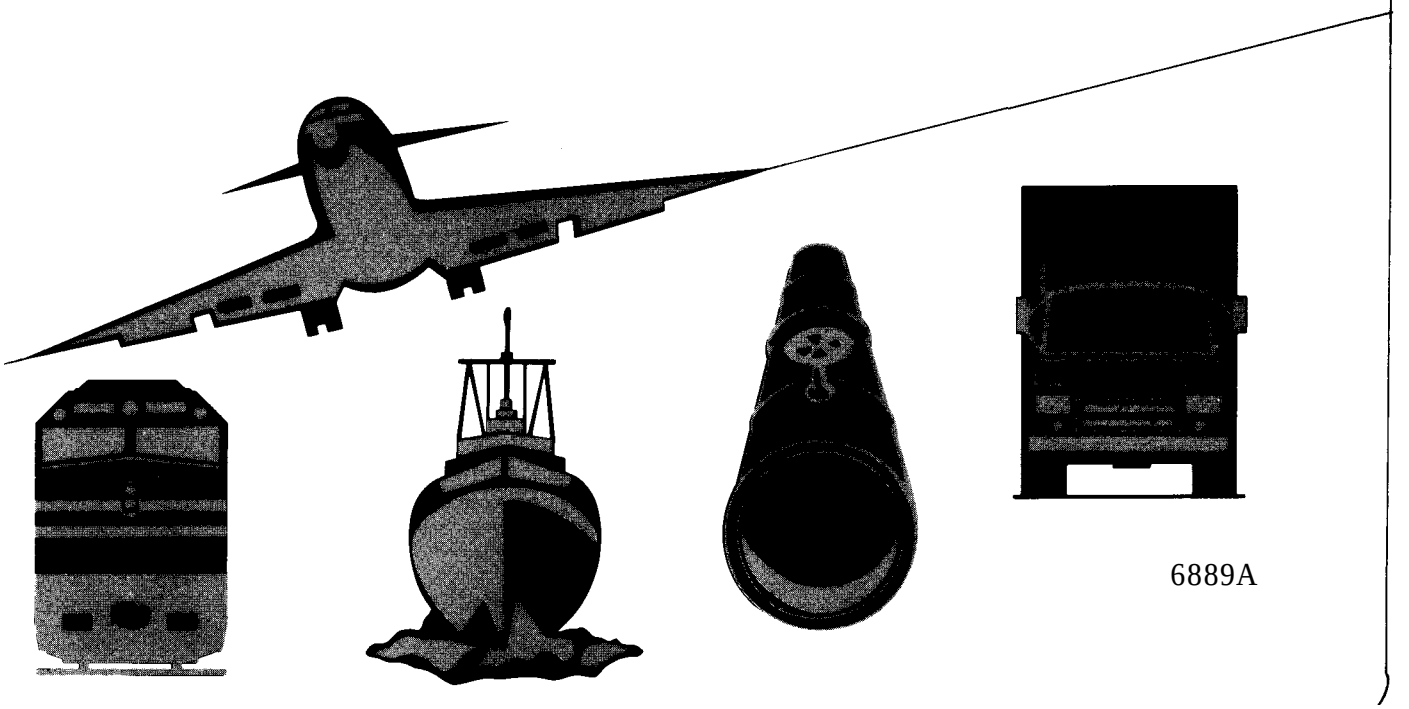
PB98-916302
NTSB/RAR-98/02

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, DC 20594

RAILROAD ACCIDENT REPORT

**COLLISION AND DERAILMENT
OF UNION PACIFIC RAILROAD
FREIGHT TRAINS 5981 NORTH AND 9186 SOUTH
IN DEVINE, TEXAS
ON JUNE 22, 1997**



6889A

Abstract: On June 22, 1997, Union Pacific Railroad (UP) freight trains 5981 North and 9186 South collided head-on in Devine, Texas. The conductor from 5981 North, the engineer from 9186 South, and two unidentified individuals who may have been riding on 5981 North were killed. The engineer from 5981 North received minor injuries, and the conductor from 9186 South was seriously burned.

The major safety issues discussed in this report are the train dispatcher's performance and workload, the adequacy of management oversight of the dispatcher apprentice program and dispatching operations, the sufficiency of the Federal Railroad Administration (FRA) oversight of dispatching operations, the effectiveness of conditional track warrant control authority, the adequacy of disaster preparedness, the crashworthiness of locomotives and event recorders, and the merits of positive train separation control systems.

As a result of its investigation, the National Transportation Safety Board issued safety recommendations to the UP, the FRA, and the Texas Railroad Commission. In addition, the Safety Board reiterated a safety recommendation to the FRA.

COLLISION AND DERAILMENT

OF UNION PACIFIC RAILROAD

FREIGHT TRAINS 5981 NORTH AND 9186 SOUTH

IN DEVINE, TEXAS

JUNE 22, 1997

RAILROAD ACCIDENT REPORT

Adopted: May 19, 1998
Notation 6889A

NATIONAL
TRANSPORTATION
SAFETY BOARD

Washington, DC 20594

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EXECUTIVE SUMMARY

At 10:52 p.m. on June 22, 1997, Union Pacific Railroad (UP) freight trains 5981 North and 9186 South collided head-on in Devine, Texas. The trains were operating on a single main track with passing sidings in dark (nonsignalized) territory in which train movement was governed by conditional track warrant control authority through a dispatcher. The conductor from 5981 North, the engineer from 9186 South, and two unidentified individuals who may have been riding on 5981 North were killed in the derailment and subsequent fire. The engineer from 5981 North received minor injuries, and the conductor from 9186 South was seriously burned. Estimated damages exceeded $6 million.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the third-shift dispatcher to communicate the correct track warrant information to the traincrew and to verify the accuracy of the read-back information because the UP management had not established and implemented workload policies and operational procedures to ensure a safe dispatching system and the Federal Railroad Administration (FRA) had failed to provide standards and oversight in all aspects of train dispatching operations. Contributing to the accident was the lack of an installed positive train separation control system that would have prevented the trains from colliding by automatically intervening in their operation because of inappropriate actions being taken.

The major safety issues discussed in this report are the train dispatcher's performance and workload, the adequacy of the UP management oversight of the dispatcher apprentice program and dispatching operations, the sufficiency of the FRA oversight of dispatching operations, the effectiveness of conditional track warrant control authority, the adequacy of disaster preparedness, the crashworthiness of locomotives and event recorders, and the merits of positive train separation control systems.

As a result of its investigation, the Safety Board makes recommendations to the UP, the FRA, and the Texas Railroad Commission. In addition, the Safety Board reiterates a safety recommendation to the FRA.

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INVESTIGATION

Accident Narrative

About 10:52 p.m. on June 22, 1997, Union Pacific Railroad (UP) freight trains 5981 North and 9186 South[1] collided head-on in dark (nonsignalized) territory at milepost (MP) 290.4 in Devine, Texas.[2] The collision occurred on a single main track at the north end of a concrete ballast deck bridge. (See figure 1.) Five locomotive units and 20 freight cars derailed, and a fire ensued. The engineer from 9186 South, the conductor from 5981 North, and two unidentified individuals received fatal injuries. The conductor from 9186 South sustained serious injuries, and the engineer from 5981 North received minor injuries.

Earlier that day at 2:30 p.m., train 5981 North had departed Laredo. (See figure 2.) Train 5981 North was given authorization by track warrant[3] from the second-shift train dispatcher[4] to proceed to Callaghan (MP 385.3), the first station after Laredo. (See figure 3 for blank standard UP track warrant form.) At Callaghan, the 5981 North met a southbound train and was authorized by the dispatcher to proceed to Gardendale (MP 339.5), where it was stopped and met another southbound train. While 5981 North was stopped, the U.S. Border Patrol apprehended two suspected illegal immigrants who were riding the train. Leaving Gardendale about 6:45 p.m., train 5981 North proceeded to the side track at Derby (MP 321.5), where eight ballast cars were added to the train. The engineer said that after these cars were added and the proper air test was performed, the train proceeded to and entered the siding at Melon (MP 318.0).

At that time, the engineer of train 5981 North requested automobile transportation and was driven to a nearby store to purchase food. The conductor remained with train 5981 North. As the engineer was returning to the train, he overheard an exchange on a railroad radio installed in the car; in this exchange, the dispatcher authorized the second of the two trains being met at Melon to proceed farther south beyond Melon. The engineer stated that after he boarded the locomotive, the conductor received the track warrant authorization from the second-shift train dispatcher at 9:18 p.m. instructing the train to depart Melon and proceed to Gessner (MP 278.5), where 5981 North would be required to take (enter) the siding.

At 10:30 p.m., the third-shift train dispatcher issued a track warrant instructing 5981 North to proceed from Gessner to San Antonio after meeting 9186 South at Gessner. Train 5981 North was instructed to enter the siding at Gessner so that 9186 South could pass on the main track. At Devine, the 5981 North crew noted a bright glow on the horizon, and both the engineer and the conductor rose from their respective seats trying to identify this glow. At that moment, the headlight of an oncoming locomotive came into view. The engineer of 5981 North said he placed the train into emergency braking, exited the rear door of the control compartment, and jumped from the locomotive. The conductor exited the forward door of the control compartment and either jumped or was thrown from the locomotive.

Earlier at 9:56 p.m. on June 22, 1997, train 9186 South had been authorized by track

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[1]The UP designated them as freight trains MLDLI and ZYCMX, respectively.

[2]All train movements and locations are within Texas except where specified otherwise.

[3]A track warrant is given via radio by or through proper railroad personnel to govern train movements. The Federal Railroad Administration interprets track warrants as train orders by radio. Until 1985, train orders were written instructions to govern the movements of a train issued by the train dispatcher through the telephone to on-line train order operators, who in turn typed these instructions for delivery to the traincrews of passing trains. These instructions involved the transmitting, typing, and repeating of their contents. In 1985, the train order method for train movements was discontinued and replaced by the track warrant system on most railroads.

[4]Dispatchers for the Austin subdivision work either a first (6:30 a.m. to 2:30 p.m.), second (2:30 to 10:30 p.m.), or third (10:30 p.m. to 6:30 a.m.) shift at the UP Harriman Dispatch Center in Omaha, Nebraska.

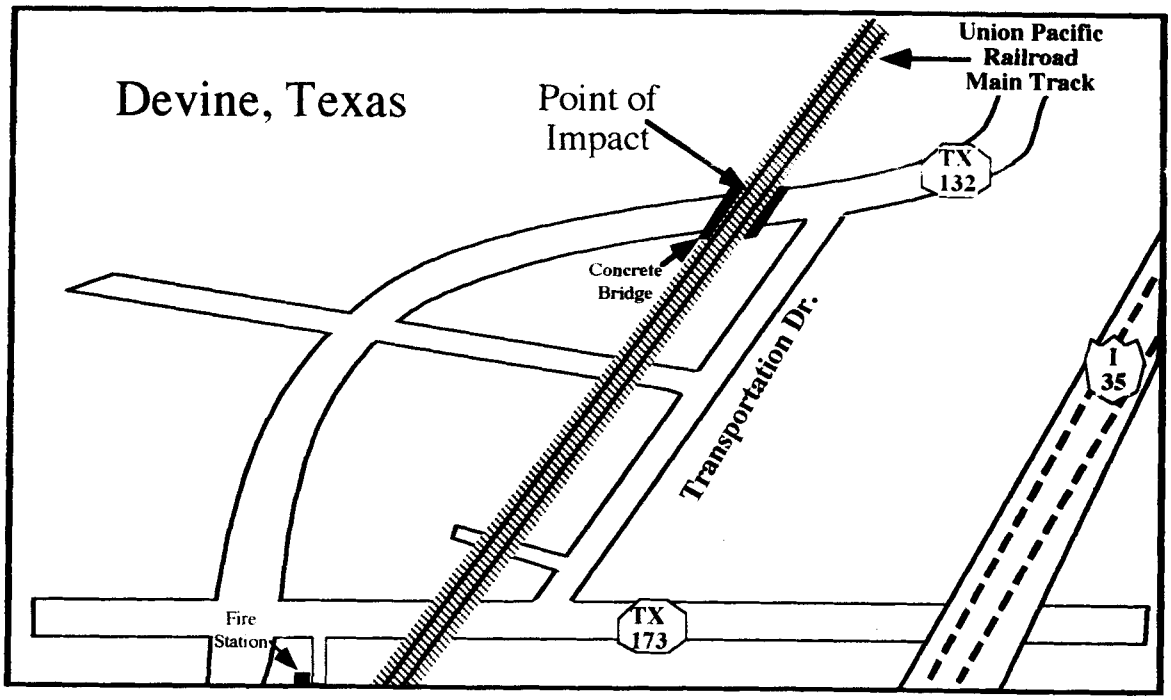


Figure 1—Point of impact between trains 5981 North and 9186 South at Devine.

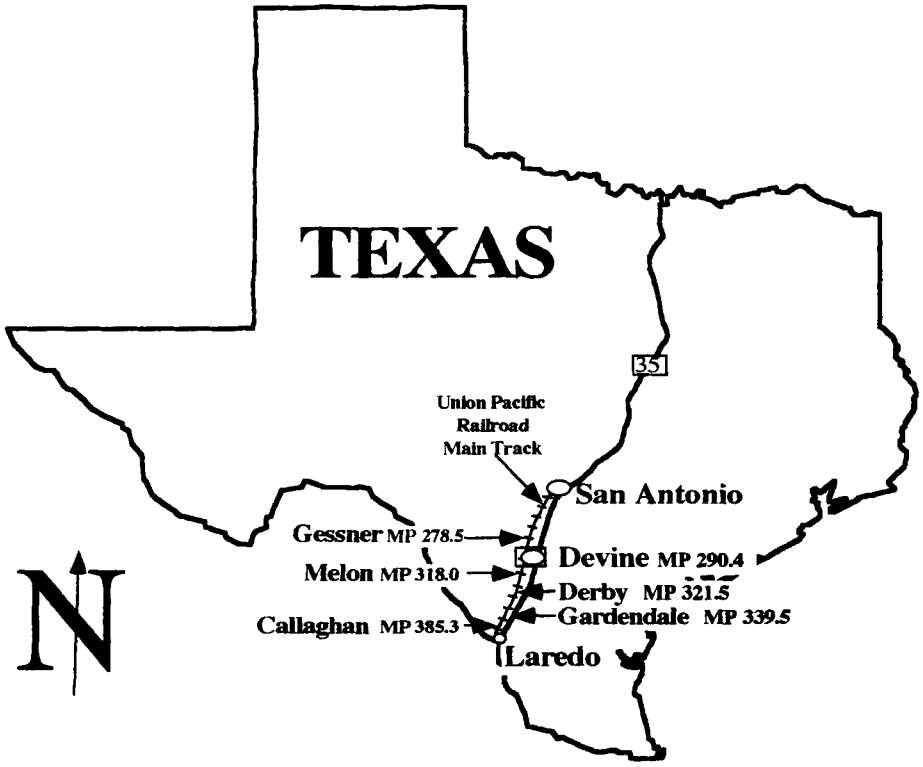


Figure 2—Map of accident route.

UNION PACIFIC RAILROAD
TRACK WARRANT

FORM 20805
(Rev. 4-94)

No. _____ _____ , 19 ____

To: _____ At _____

(Mark "X" in box for each item instructed)

1. ☐ Track Warrant No. _____ is void.
2. ☐ Proceed from _____ To _____
   On _____ Track _____ Subdivision /Branch
4. ☐ Work between _____ and _____
   On _____ Track _____ Subdivision /Branch
5. ☐ Not in effect until _____.
6. ☐ This authority expires at _____.
7. ☐ Not in effect until after arrival of _____ At _____
   _____ At _____
   _____ At _____
8. ☐ Hold Main Track at last named point.
9. ☐ Do not foul limits ahead of _____
10. ☐ Clear Main Track at last named point.
11. ☐ Between _____ & _____ make all movements at restricted speed. Limits occupied by train or engine.
12. ☐ Between _____ & _____ make all movements at restricted speed. Limits occupied by men or equipment.
13. ☐ Do not exceed _____ MPH between _____ & _____
14. ☐ Do not exceed _____ MPH between _____ & _____
15. ☐ Flag protection not required against following trains on the same track.
16. ☐ Track Bulletins in effect: ____ , ____ , ____ , ____ , ____ , ____ ,
    ____ , ____ , ____ , ____ , ____ , ____ , ____ , ____ , ____ .
17. ☐ Other specific instructions: _____
    _____
    _____
    _____
18. ☐ Joint with:
    _____ Between _____ & _____
    _____ Between _____ & _____
    _____ Between _____ & _____

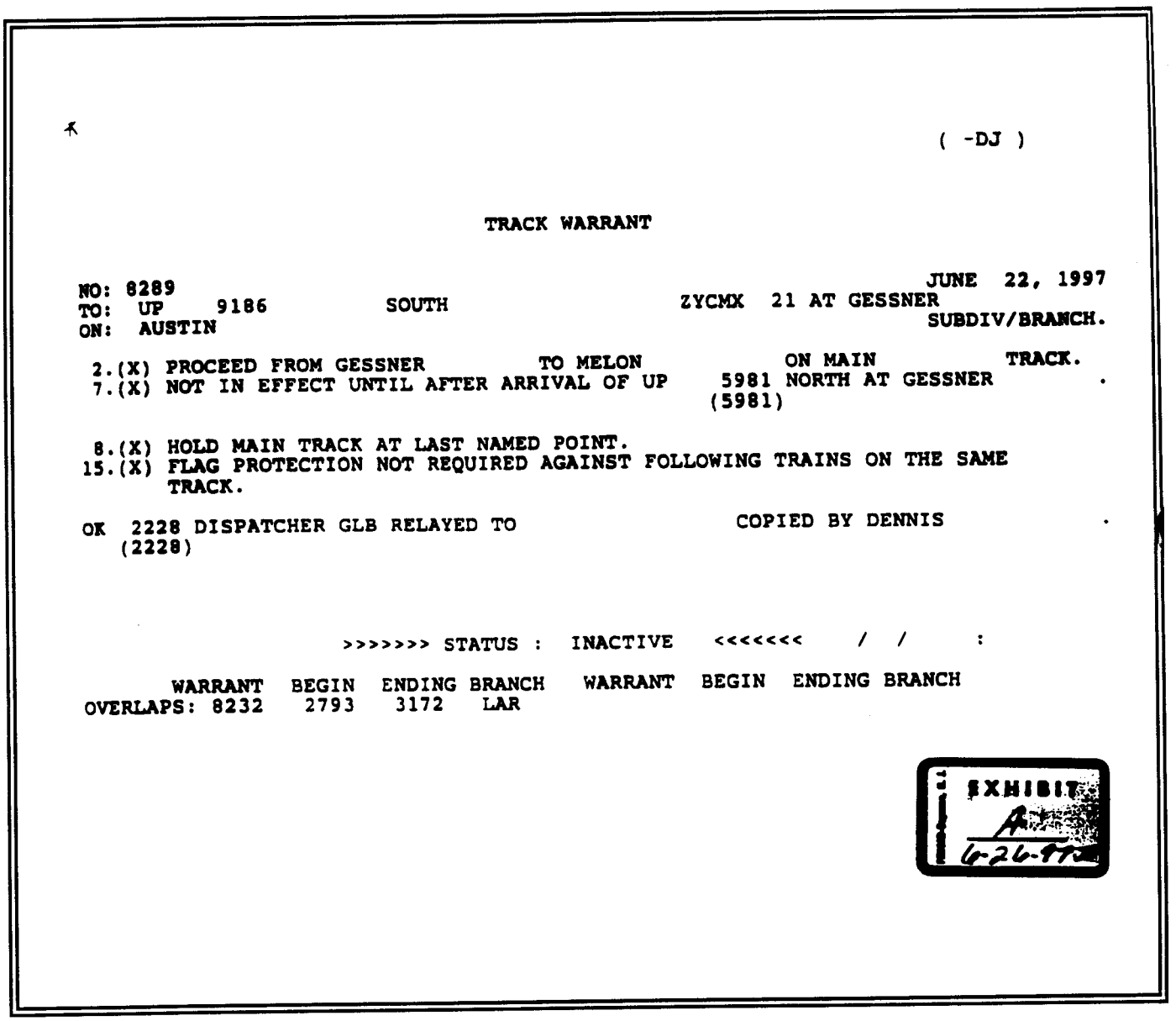
OK _____ Dispatcher _____

Relayed To _____ Copied By _____

Limits Reported Clear at _____

By _____

Figure 3—Blank Union Pacific Railroad track warrant form.



(-DJ)

TRACK WARRANT

NO: 8289 JUNE 22, 1997
TO: UP 9186 SOUTH ZYCMX 21 AT GESSNER
ON: AUSTIN SUBDIV/BRANCH.

2.(X) PROCEED FROM GESSNER TO MELON ON MAIN TRACK.
7.(X) NOT IN EFFECT UNTIL AFTER ARRIVAL OF UP 5981 NORTH AT GESSNER .
(5981)

8.(X) HOLD MAIN TRACK AT LAST NAMED POINT.
15.(X) FLAG PROTECTION NOT REQUIRED AGAINST FOLLOWING TRAINS ON THE SAME TRACK.

OK 2228 DISPATCHER GLB RELAYED TO COPIED BY DENNIS .
(2228)

>>>>>>> STATUS : INACTIVE <<<<<<< / / :

	WARRANT	BEGIN	ENDING	BRANCH	WARRANT	BEGIN	ENDING	BRANCH
OVERLAPS:	8232	2793	3172	LAR				

EXHIBIT A 6-26-97

Figure 4—Printed copy of track warrant 8289.

warrant 8261 from the second-shift train dispatcher to proceed to Gessner, departing San Antonio about 10:10 p.m. The train was authorized by track warrant 8289 (see figure 4) from the third-shift dispatcher at 10:28 p.m. to proceed from Gessner to Melon. Train 9186 South passed the Gessner siding and entered the city of Devine. At some point, the crew saw the oncoming northbound train, and both the engineer and the conductor jumped from the lead locomotive as the trains collided.

The printed copy[5] of track warrant 8289 (see figure 4) contained four elements: (box 2) Proceed from Gessner to Melon on main track, (box 7) Not in effect until after arrival of 5981 North at Gessner, (box 8) Hold the main track at last named point [Melon], and (box 15) Flag protection not required against following trains on the same track. According to the voice recordings between the 9186 South crew and the third-shift train dispatcher, the instructions contained three elements: (box 2) Proceed from Gessner to Melon on main track, (box 8) Hold the main track at last named point, and (box 15) Flag protection not required against following trains on the same track. In the voice recordings, 9186 South was authorized to proceed from Gessner to Melon (box 2); absent from the voice recordings was "not in effect until after arrival of 5981 North at Gessner" (box 7).

The third-shift (relieving) dispatcher reported that during the shift changeover between 10:15 and 10:20 p.m., he discussed with the second-shift (departing) dispatcher how many trains were operating and their status. The majority of the UP trains on the Austin subdivision at that time were on the San Antonio to Laredo territory, and a National Railroad Passenger Corporation (Amtrak) train was operating from Temple to Taylor. The third-shift dispatcher stated that several radio calls were coming in and "it was busy," which was "probably an average night for that position." His first radio conversation was at 10:20:37 p.m. with the Amtrak traincrew. During this conversation, the third-shift dispatcher cleared and voided the track bulletin item that had been previously issued to the Amtrak train. The conversation ended at 10:21:50 p.m. The next radio communication was initiated at 10:24:10 p.m. by the traincrew of UP IYCLD, which was operating on the Austin subdivision. The traincrew "gave up" its track warrant to the dispatcher, who then created a new track warrant directing the train to proceed from Gardendale on the main track of the Austin subdivision. This conversation ended at 10:26:03 p.m.

At 10:26:05 p.m., the dispatcher called train 9186 South, and the conductor responded immediately. The dispatcher said, "Yeah, let me get you an 'after-arrival' there at Gessner while I have a minute, over." The conductor responded, "All right, ready." When communicating track warrant instructions to a traincrew, dispatchers are required to read the information, as it is presented on the screen, and to verify the accuracy of the information, comparing the oral read-back from the traincrew with the information shown on the screen. The third-shift dispatcher then transmitted the track warrant information to 9186 South, omitting the instruction "not in effect until after arrival of 5981 North at Gessner" (the box 7 instruction on the track warrant). The third-shift dispatcher later said that he could not recall whether he had included the box 7 instruction (to remain at Gessner) on the track warrant when formally transmitting authorization to 9186 South by voice. The recorded radio transcripts of the transmission of this track warrant between the dispatcher and the 9186 South traincrew did not include this instruction. The conductor repeated the information to the dispatcher, and the dispatcher okayed the read-back information despite the omission of the box 7 instruction that was on the computer screen display. Their conversation ended at 10:28:10 p.m. Four seconds later, the dispatcher called train 5981 North and accurately relayed the track warrant (8290) information for that train to its conductor. Their conversation ended at 10:30:04 p.m. (See appendix A for transcript of track warrants 8289 and 8290.)

See the Operations Information section for more information about UP dispatching techniques.

[5]Generated from the train dispatcher's work station computer, as displayed on the screen when the instructions were radio-issued to the crew.

Injuries*

Type	5981 North Crew	9186 South Crew	Unidentified	Total
Fatal	1	1	2	4
Serious	0	1	0	1
Minor	1	0	0	1
Total	2	2	2	6

*Based on the injury criteria (49 Code of Federal Regulations 830.2) of the International Civil Aviation Organization, which the National Transportation Safety Board uses in accident reports for all transportation modes.

Railroad Damage

Two locomotive units and 14 cars were derailed from train 9186 South; both locomotive units and 2 cars were destroyed. Three locomotive units and six cars were derailed from train 5981 North; one locomotive unit and five cars were destroyed.

The estimated costs were:

Locomotives	$ 4,150,000
Cars	501,300
Track	40,000
Structures	900,000
Lading	320,000
Clearing	103,767
Total	$ 6,015,067

Personnel Information

Third Shift Dispatcher -- The 39-year-old train dispatcher began working for UP as a section man in 1975, and he transferred in 1979 to the signal department, where he worked as the systems signal man in Salt Lake City, Utah. He became a signal maintainer in Caliente, Nevada, in April 1990; an electronics technician at the Harriman Dispatch Center (HDC)[6] in February 1994; and then an apprentice train dispatcher in May 1996.

According to the third-shift dispatcher, his training began at the HDC with a 3-week class in the railroad operating rules, including the dispatching and air brake rules. He stated that because he had replaced a trainee who had dropped out, his training had been shorter than that of other dispatchers and he had missed the basic railroading review, which was primarily designed for apprentice train dispatchers lacking a background in railroading. He then had 1 month of training in dispatcher duties using a simulator to become familiar with the computer-aided dispatching (CAD) system.[7] In July, he started 1-month on-the-job training (OJT), during which he observed an experienced dispatcher operate the line and later operated the line while being observed by the OJT dispatcher trainer. Afterwards, as part of the qualifying period, the manager of train dispatchers observed him as a trainee performing dispatch duties during a shift. He became a qualified dispatcher on August 17, 1996, and since then had worked on the Austin subdivision. Before June 22, 1997, he had not been cited for any dispatching rules violations.

After the Devine accident, the third-shift dispatcher stated that he believed that he had been adequately trained to operate as a dispatcher. He added that the simulator and OJT were not equal to handling the dispatching demands and said, “How can training be equal

[6]Opened in 1989, the dispatch center houses the entire UP main track operations system and the dispatchers who oversee train operations.

[7]Supports the track warrant system that is unique to the UP.

to . . . a dozen radios going off and 10 people yelling at you at the same time. . . . I guess the main thing that would be missing from all of that would be really interaction with somebody out in the field . . . especially when you're new. . . . Having to deal with that sort of thing is hard."

The third-shift dispatcher reported that he was in good health, and, according to his medical records, he had normal vision, with no color-vision problems, and normal hearing. His last UP physical was in 1989. He reported that he was not taking any prescription or over-the-counter medications at the time of the accident. He stated that he did not smoke tobacco or drink alcohol.

The third-shift dispatcher had not worked on Friday, June 20, 1997. On Saturday, June 21, he woke about 9 a.m., remained at home performing chores, left for work about 9:40 p.m., and arrived there at 10:15 p.m. He started his shift about 10:20 p.m. and worked until 6:20 a.m. on Sunday, June 22. After returning home, he retired at 7 a.m. and slept until about 12:30 p.m. He remained at home during the day, left for work about 9:40 p.m., arrived about 10:15 p.m., and started his shift.

5981 North Traincrew -- The UP records indicated that the crew of train 5981 North met the requirements as prescribed in the Hours-of-Service Act.

The 27-year-old engineer was hired in July 1989 by the UP as a trainman at San Antonio. In June 1993, he transferred to engine service and worked as a fireman while participating in the training program to become a locomotive engineer. In December 1993, he was promoted to locomotive engineer. He had passed his most recent physical examination in March 1995. His vision and hearing were normal. He reported being well-rested before the accident. The engineer had worked the previous 3 days before the accident. He was a certified locomotive engineer under the regulations found in 49 Code of Federal Regulations (CFR) Part 240, was current on the UP operating rules, and had passed his last rules examination in January 1995.

The 48-year-old conductor was hired in May 1973 by the UP as a trainman at San Antonio. In May 1975, he was promoted to conductor. He passed his last physical examination in May 1996. According to the guidelines established by UP, the conductor was qualified to perform the duties of a conductor on the Austin subdivision. He was current on the UP operating rules and had passed his last rules examination in April 1995. The conductor had worked the previous 2 days before the accident.

9186 South Traincrew -- The UP records indicated that the crew of train 9186 South met the requirements as prescribed in the Hours-of-Service Act.

The 39-year-old engineer was hired in August 1976 by the UP as a laborer at San Marcos. In May 1985, he transferred to a clerical position; moving to Omaha in July 1989, he worked in a crew dispatching position. He transferred to San Antonio in May 1993 as a trainman and in October 1994 was promoted to conductor. In March 1995, he transferred to the position of student engineer to learn the craft of locomotive engineer; on May 12, 1995, he was promoted to locomotive engineer. He passed his last physical examination on September 12, 1996. According to the UP guidelines, the engineer was qualified to perform the duties of a locomotive engineer on the Austin subdivision. He was a certified locomotive engineer under the regulations found in 49 CFR Part 240, was current on the UP operating rules, and had passed his last rules examination on June 10, 1997. The engineer had worked the previous 2 days before the accident.

The 37-year-old conductor was hired in June 1996 by the UP as a brakeman at San Antonio. Within 3 weeks, he received formal training, with examinations, that would later qualify him as a conductor. In February 1997, he was qualified as and promoted to conductor; during the previous 6 months, he had worked primarily in yard service. In April 1997, he was assigned to work as a freight conductor. For the 60 days before the collision at Devine, he worked as a freight conductor, alternating his duty cycles with yard service positions. He passed his last physical examination in December 1996. According to the UP guidelines, the conductor was qualified to perform the duties of a conductor on the Austin subdivision. He was current on the UP operating rules and had passed his last rules examination on

June 27, 1996. The conductor had worked the previous 2 days before the accident.

Train Information

Train 5981 North -- The train consisted of locomotive units UP5981 (a 3,800-horsepower EMD[8] SD60), UP4211 (a 3,000-horsepower EMD SD-40-2), and UP5084 (a 3,500-horsepower EMD SD50M) and 83 loaded and 11 empty freight cars. On June 22, 1997, at 7,200 feet long and drafting 8,200 tons, train 5981 North originated at Laredo, where it was inspected at 12:20 p.m. An initial terminal air brake test was successfully completed at 2:20 p.m., and the train departed at 3 p.m. Eight loaded ballast cars were added at Derby.

Train 9186 South -- The train consisted of locomotive units UP9186 (a 4,000-horsepower General Electric C40-8) and UP6143 (a 3,800-horsepower EMD SD60-M) and 62 loaded freight cars. At 4,071 feet long and drafting 3,284 tons, train 9186 South originated at the UP Yard Center near Chicago, Illinois, on June 21, 1997. Two carmen inspected the train and then assisted in performing a successful initial terminal air brake test, and the train departed at 6:03 a.m. On June 22 at 2:40 a.m., the train was given an intermediate (1,000-mile) air brake test at Texarkana. The air brake test was successfully completed, and 9186 South departed at 4:09 a.m.

Train 9186 South arrived at 8:48 p.m. at San Antonio, where it was to receive another air brake test. The outbound traincrew reported that the radio was defective on the lead locomotive unit, and the radio was subsequently replaced. The air brake test was successfully completed by the traincrew, and 9186 South departed at 10:10 p.m.

Postcollision Train Information

The three-unit locomotive consist of train 5981 North remained on the bridge, but the two-unit locomotive consist of train 9186 South toppled from the bridge onto the road below. A number of trailing freight cars in each train piled up on and around the locomotive wreckage on the bridge and in the street below. Diesel fuel spilled, and a fire ensued, extensively damaging most of the equipment in the immediate proximity of the overpass. (See figure 5.)

Train 5981 North -- The lead locomotive unit UP5981 exhibited massive catastrophic structural damage; the short-hood structure, cab assembly, and electrical cabinet were effectively sheared off horizontally at the top of the frame assembly deck plate surface. The diesel engine was found to have been displaced aft about 8 feet, and the main generator had separated from the engine. The frame had bowed downward, displaying a bend estimated at 1 foot. The remaining car body (sheet metal) was heavily deformed, and the entire unit had been consumed by the fire.

The trailing locomotive unit UP4211 also exhibited massive damage; the cab assembly and electrical cabinet were found to be sheared off level with the top deck of the short-hood structure, which remained relatively structurally undamaged. The car body (sheet metal) and internal machinery on the aft-end of the unit were compressed in a forward direction, having been contacted by the third locomotive in the consist, which overrode this unit. Approximately one-third of the front of the unit exhibited fire damage.

The trailing locomotive unit UP5084 overrode the aft-end of the succeeding unit and came to rest with its lead-end resting on top of the frame of the locomotive in the number two position. The leading truck assembly had detached from its mounting and was wedged between the two locomotive structures. The trailing truck remained attached. The fuel tank was detached from its normal mounting position and came to rest on the ballast beneath the unit. The locomotive, which exhibited fire damage on its exterior surfaces, was the least damaged of the units involved.

[8]Electro-Motive Division of General Motors.

Figure 5 - Photograph of trains 5981 North and 9186 South after impact.

Train 9186 South -- The lead locomotive unit UP9186 traveled down the northwest embankment slope and landed upright on the road, approximately parallel to the bridge, with the aft-end of the unit resting on the northwest embankment slope. The unit lost its front truck assembly, exhibited inward deformation to its front pilot plate and short-hood structure, and was consumed by the fire. The cab structure remained intact and was not crushed by the impact.

The trailing locomotive unit UP6143 fell toward the pavement on the east side of the bridge, landed cab-end down, and oriented slightly on its right side on top of derailed freight car wreckage, with the aft-end raised up and the left side resting on wreckage that remained on the bridge. The front truck assembly had separated, and the fuel tank showed massive deformation damage. The front pilot plate and short-hood structure were substantially deformed inward; the cab remained structurally intact. The remainder of the unit exhibited extensive car body panel (sheet metal) deformation, and the entire unit was consumed by the fire.

Track and Signal Information

The track in the area of the collision was constructed with 112-pound rail, which was manufactured and laid in 1943, and later restructured into continuous-welded-rail. The rail rested in double shoulder tie-plates secured to 9-foot timber cross ties with 5/8- by 6-inch cut track spikes. The ties were supported in 2-inch crushed rock ballast and maintained with 12-inch shoulders to restrain lateral movement. Longitudinal movement was restricted with channel lock rail anchors base-applied to every cross tie in a box pattern.

The southbound alignment for the undulating track was tangent at the point of impact (POI). Train 9186 South negotiated a 1° 23′ left-hand curve at MP 289.5, ascended a 0.51-percent grade before cresting the hill at MP 290, and was descending the 0.82-percent grade leading to the POI. At MP 290.4, 5981 North negotiated the 3° 11′ right-hand curve at MP 293 before entering the long tangent approach to the POI.

The track is maintained to meet or exceed the Federal Railroad Administration (FRA) standards for a class 4 track.[9] The UP track personnel inspect the track 7 days a week. The weekly inspection records between May 1 and June 3, 1997, indicate no FRA track defects were found. An inspection of the track was conducted on the day of the accident, and no FRA defects were discovered.

The 140-foot concrete ballast deck bridge at the POI consisted of two 30-foot approach spans and an 80-foot main span extending over the highway. The bridge had extensive damage as a result of the collision and was replaced with a similar structure on the approach spans. The main span was changed from built-up beam sections over the highway to welded beams over the highway. The concrete deck was replaced with a steel deck to hold the ballast and ties.

The accident territory did not employ a block signal system (wayside signals) to govern train movements and was called dark (nonsignalized) territory; the movement of trains was controlled by a track warrant system.

Operations Information

According to the UP, 12 or 13 trains in both directions pass through the Devine area daily. The movement of trains over the territory is governed by the UP operating rules, timetable instructions, and general orders. The operating rules were provided by the *Third Edition of the General Code of Operating Rules*, dated April 10, 1994. Any rule modifications or revisions to the operating rules were part of the UP *Timetable No. 2*, effective October 29, 1995, that included the "System Special Instructions," which provided general revisions, and the "Service Unit San Antonio, Austin Subdivision," which contained information specific to operating trains through the territory where this accident occurred. The

[9]Maintained to accommodate passenger and freight trains at maximum allowable speeds of 80 and 60 mph, respectively.

permanent track speeds for the trains were designated in the timetable, and temporary speed restrictions were issued through the train dispatcher by track bulletin.[10]

The train movements were controlled by the train dispatcher, who issued instructions in the form of track warrants. Track warrants evolved from train orders and are not addressed in the CFR. Each train received its original movement instructions at the initial station of the train. Subsequently, the train dispatcher issued additional track warrants by radio to the traincrews at intermediate locations. The receiving crewmember was required to write down the track warrants, as received over the radio, on a standard UP form and to read them back to the train dispatcher. This method of operation allowed the train dispatcher to establish or change the meeting locations of trains and add movements on the territory.

To establish a meeting point between opposing trains, the train dispatcher issued a track warrant (see figure 3) to one train that included, at a minimum, a box 2 that stated the "proceed from" and "to" limits being granted and a box 10 that instructed "clear main track at last named point" as prescribed in box 2. The train traveling in the opposite direction was issued a track warrant that included, at a minimum, a box 2 that stated the "proceed from" and "to" limits being granted and a box 8 that instructed "hold main track at last named point" (the "to" limit granted in box 2). The train instructed to clear the main track at the station where the meet was to take place was not authorized to proceed on the main track beyond the initial switch of the siding without additional track warrant authority. The train instructed to hold the main track was not authorized to proceed beyond the switch at the end of the last named point for the "to" station until additional track warrant authority was issued. This system protected the two opposing trains, and the physical passing of the trains was accomplished.

When one train arrived at a station earlier than the other train, the dispatcher had two options for giving the first train further instructions. The dispatcher could either wait until the meet had taken place and then authorize both trains to proceed beyond this station in the opposite directions or authorize the train that had arrived at the station early to proceed to the next station but not leave that station until "after the arrival" (after-arrival) of the opposing train. The dispatcher gave movement instructions to trains, but the trains could not act on these instructions until a prescribed event occurred, such as the arrival of another train. This method (conditional track warrant control authority)[11] allowed the train dispatchers to prepare the train movements in advance and pace their workloads.

All track warrants that were issued by the train dispatcher were created on a computer screen using the CAD system. The dispatcher requested a track warrant by entering the train's ID (mainframe computer symbol) and the subdivision on the computer screen menu. The CAD system then generated a track warrant screen displaying a box 1 (to void a previously issued track warrant), a box 2 (to establish directional authority limits), and a box 4 (to establish "work between" or nondirectional limits). Should the train dispatcher choose to establish directional authority, the dispatcher would place an "x" in box 2 and type the "proceed from" and "to" locations (specifying the limits the train was being granted). (See figure 3 for the blank UP track warrant form.) Trains were authorized from station to station, moving through the territory in short segments, which gave the dispatcher flexibility in establishing a meeting location between opposing trains.

A conflict resolution logic had been developed for the CAD system to prevent two trains from receiving nonconditional authorization onto the same segment of track at the same time. For example, if a train dispatcher authorized a southbound train from station A to station B, the computer accepted this as a valid track warrant. If the train dispatcher subsequently issued a track warrant authorizing a northbound

[10] Track bulletins are addressed to trains that operate through the dispatcher's assigned territories and contain temporary speed restrictions, locations of personnel and equipment working, and possible safety hazards.

[11] Although authority for the train movement has been issued, a specific condition must be met before the authority is acted on.

train from station B to station A, the CAD system detected the conflict, and the screen immediately displayed the required conditional authority instruction (box 7) that the northbound train not leave station B until after-arrival of the southbound train. At the same time, a third screen displayed a conflict between the two trains. After interviews with several dispatchers, the Safety Board found that dispatchers were aware that this protection was available in the system.

During an interview with the third-shift train dispatcher, he recalled mentioning to the 9186 South traincrew that he intended to issue an after-arrival authority. During the formal transmission of track warrant 8289, the dispatcher failed to orally communicate the box 7 requirement (not in effect until after the arrival of 5981 North at Gessner) even though the CAD system had generated the box 7 after-arrival instruction on the screen. When the train dispatcher was later asked how he had determined that the track warrant would be an after-arrival, he stated that he had logically come to that conclusion because of the train movements in the territory and, specifically, the conflict with the northbound train.

Dispatching Information

Responsibilities and Duties -- Train dispatchers at the HDC are responsible for scheduling the movement of trains over a specified segment of railroad. Their duties include arranging train meets and passes with minimum delays, managing unexpected delays and emergency situations, and issuing track warrants to traincrews. The track warrant information is conveyed by using various types of signaling equipment and radios to communicate with maintenance-of-way employees or operating personnel. Dispatchers formulate and transmit track warrants by typing information into their computer terminals and then orally issuing the track warrants to traincrews.

Both dispatchers and traincrews are instructed to follow proper radio procedures when communicating track warrants to ensure that train movement information is accurately exchanged. The dispatcher's primary task is to read the track warrant data as they are presented on the computer screen. After receiving and recording the data, a train crewmember is required to read them back to the dispatcher for verification. During the repeat for verification, the dispatcher compares the oral information being received with the data on the computer screen. The dispatchers also record information on paper, such as the train ID and the conductor's name.

Several dispatchers reported that the most difficult time for a dispatcher was during the first 30 minutes of the shift, when a dispatcher was "trying to assimilate everything" and mentally planning the operation of the territory during that shift. At this time, the relieving dispatcher has to process the information just received from the briefing of the departing dispatcher, prioritize the tasks that are to be performed during the current shift, and respond to radio transmissions received from traincrews that could not be responded to during the shift changeover. In addition, supervisors often called the dispatchers during the first 10 to 15 minutes to be apprised of operations on the territory.

Dispatchers at the HDC operate inside a station with waist-high walls partitioning one dispatcher from another. Several dispatchers, including the third-shift dispatcher, stated that radio conversations between other dispatchers and operating crews can be overheard, that adjacent dispatchers also converse with each other about train movements and other operational matters, and that conversations and other noise are greatest during shift changeover. Intercoms are available for communications but are generally not used. Many dispatchers reported that they find the noise distracting and believed that glass barriers to muffle sounds would decrease the noise and provide a better working environment.

Workload -- The UP told the Safety Board that a workload study team began assessing the dispatcher workload in the third quarter of 1997 with the intent to conduct ongoing studies of positions with high workload issues. The UP management indicated that the dispatcher workload was determined, first, by the time dispatchers spend in communication with train and maintenance-of-way employees and, second, by the number of CAD functions performed by a dispatcher in a given period of time. According to the UP management, "there

is no specific information available which would determine what constitutes high workload, as a rule of thumb, . . . a position [is considered] to be a possible high workload if the data indicates a consistent pattern of quantifiable activity in excess of six hours."

The Safety Board reviewed data, provided by the UP, on the Austin subdivision. The average number of trains each day from January to June 1997 was 12.5. During the same time in 1996 and 1991, respectively, the average number of trains each day was 10.8 and 6.47.

The third-shift dispatcher reported that he usually directs between 15 and 20 trains on the three subdivisions in his territory. The UP indicated that, on average, dispatchers deal with 21 telephone and radio calls each hour, talking to traincrews, track maintenance workers, and dispatch center supervisors. It added that when discussing track warrant information, dispatcher and traincrew conversations typically take about 2 minutes. According to the FRA, one dispatcher stated that he spends about 6 hours of his shift on the telephone and radio.

According to dispatchers interviewed at the HDC, because of the high workload on several territories, some dispatchers issuing track warrants may be mentally or physically attending to their next task and not concentrating on the read-back communication from the traincrew. The dispatchers also stated that newly qualified dispatchers were involved in territories of high-operating demands. Several dispatchers reported experiencing increased stress while on duty and specifically cited the following as contributing factors to the elevated stress levels: increased workload due to increased train volume and congestion, the lack of support from management in recognizing the dispatching challenges, the management requirement that they work on scheduled off-days, and the frustrated attitude of the traincrews.

The UP management reported that some of the recent concerns expressed by the dispatchers were volume-related issues. Dispatchers stated that the workload continued to increase after the Devine accident due to increased train volume. Their duties focused on moving trains in and out of sidings, dispatching vans to pick up crewmembers who had reached the maximum hours-of-service time, dispatching relief crewmembers, and responding to increased numbers of phone calls from the field personnel.

Apprentice Program -- The UP management indicated that it tries to select people to become train dispatchers who have been associated with the railroad industry, such as those working in the maintenance-of-way, signal, and communications departments; in the customer service center; and in crew management placement. Some dispatchers expressed concern that apprentice dispatchers are being selected without having a railroad background. The UP management reported that because of technological changes, they have had to expand the applicant pool to include engine crew employees and college-educated people from outside the rail industry.

The UP management stated that it uses a screening method to select apprentice (trainee) dispatchers. Prospects from outside the industry are required to take and pass a series of tests that include a learning abilities test, as well as math, typing, and psychological profile tests. Applicants who pass these tests then undergo an interview process before being considered for training.

The apprentice dispatchers receive training in the fundamental workings of the UP, the operating rules, and the CAD system; they also receive a training manual and OJT with a dispatcher trainer. (Safety Board investigators found that the training manual lacked organizational structure, a class syllabus or outline, student objectives, a focus for major points, and summaries for reviewing important areas.) Apprentice dispatchers are placed on a territory, where they will later dispatch full time, and observe one or more qualified dispatchers during each of the three shifts. As apprentice dispatchers become more familiar with the operations, they perform OJT dispatcher duties under the supervision of an OJT dispatcher trainer. At the time of the Devine collision, the training process to become a qualified dispatcher took about 3 months to complete. Since March 1998, the UP has extended this program to 6 months, increasing the rules part of the training from 2 to 3 weeks

and requiring more on-the-job and simulator training.

Like many other railroads, the UP has no formal training or procedures for the dispatcher trainers who oversee the apprentice dispatchers during OJT. As reported in the FRA 1995 *Train Dispatchers Follow-up Review*,[12] the FRA detected inconsistencies in many railroads in the area of OJT and found that

> OJT, in some instances, has been delegated to subordinates without adequate direction, control or evaluation methodology. Additionally, some management officials did not have definitive opinions, nor did they provide direct guidance, regarding necessary components of dispatcher training programs. This leads to unstructured training and inconsistent training.

The FRA found no evidence during its 1987-88 and 1993 train dispatcher reviews that inadequate dispatcher training directly resulted in train accidents. Nevertheless, the FRA noted that training directly impacts train dispatcher efficiency and productivity, which have the potential to impact safety, and that the failure to provide well-defined training may also contribute to train dispatcher stress, fatigue, and work overload.

The FRA advised that within 36 months of its 1995 dispatchers review, it would

> [p]ublish an ANPRM [advanced notice of proposed rulemaking] proposing minimum training standards for train dispatchers, to include initial, periodic, refresher, and physical characteristic training; and minimum operating rule training and testing standards. These standards will be based upon data developed through the partnership between FRA, BN[SF], ATSF [Atchison, Topeka and Santa Fe Railway] and Amtrak. As part of the review, FRA will examine railroad operating rules to assess consistency, standardization, and applicability to today's railroad environment.

The FRA also reported that it established a Railroad Safety Advisory Committee (RSAC), consisting of representatives from government, industry, and unions, to address issues of train dispatching. The FRA noted that dispatcher training standards have been developed and published, that it anticipated the formal presentation of those standards at an RSAC meeting in 1998, and that it expected the standards to be voluntarily adopted by the railroads.

The UP management stated that before the Devine accident, OJT dispatcher trainers had at least 5 years of experience working as dispatchers. The UP reported that since the Devine accident, OJT dispatcher trainers with between 15 and 20 years of experience are preferred, although some UP dispatchers have reported that on several occasions dispatchers with less than 5 years of experience have served as OJT dispatcher trainers. Several OJT dispatcher trainers have been reported to have less than 2 years of experience, and some dispatcher trainers occasionally performed OJT duties only a few months after becoming qualified dispatchers themselves. Several dispatchers told Safety Board investigators that they believed OJT dispatcher trainers should have a minimum 5 years of dispatching experience before assuming training duties.

Apprentice dispatchers take direction from qualified dispatchers who are directly supervised by corridor managers. According to the UP, a train dispatching background and field experience are the two attributes that make better supervisory corridor managers. However, corridor managers are not required to have been qualified dispatchers.

Those involved in the UP training process are the director of train dispatching personnel and hiring, two rules instructors at the HDC, a rules instructor from Salt Lake City, the manager of train dispatching, the corridor manager, the region director of the apprentice

[12]This report responds to the congressional mandate to assess corrective actions taken by the rail industry in addressing concerns identified in the FRA *National Train Dispatcher Safety Assessment of 1987-88.*

area, and the dispatcher trainer. The UP management stated that all of these individuals must generally agree that a dispatcher trainee has qualified as a dispatcher. The UP reported that in April 1997, it incorporated changes requiring a formal qualification process that takes place over a 4-day period. According to the UP management, this 4-day qualification process is performed only after an apprentice train dispatcher has demonstrated the knowledge and ability to qualify. During those 4 days, the apprentice dispatcher is evaluated in 16 dispatching-specific areas and is not allowed to perform solo train dispatching service until acceptable proficiency has been demonstrated in all areas. The UP stated that this evaluation process "will be followed in all instances."

Several UP dispatchers reported that on occasion management had determined an apprentice dispatcher was qualified for a specific territory despite the OJT dispatcher trainer's conclusion that the apprentice needed additional supervision. Moreover, one dispatcher stated that management pressured him to start dispatching duties despite his own belief that he was not yet fully trained. The UP management has stated that when a qualified dispatcher fills a new position, "the person is provided training until she or he feels ready to work the position."

Following the Devine accident, the UP management scheduled daily safety and production meetings for dispatchers before the start of each shift. The guidelines for these meetings, according to the UP, require the "meetings to focus on 'safety issues, rules and the state of the railroad'." The UP management stated that meetings, which last up to 15 minutes, are supervised by a corridor manager or the region director or both. The manager of train dispatching publishes a monthly outline for the corridor managers to review, which includes suggested subject matter, such as recent rules, issues, and general operating concerns. The UP dispatchers reported that initially during these meetings, management discussed the Devine accident and emphasized safe dispatching operations. Several UP dispatchers have since reported that the subsequent meetings focused more on operations and less on safety and that because management often did not attend, the meetings were cancelled. According to the UP management on March 30, 1998, the requirement to conduct these meetings remains in effect.

Violations -- The UP management reviews the dispatching tapes and produces a rules violation report[13] when a dispatching error has occurred. According to the UP, before June 22, 1997, it had no formal process to monitor the issuance of track warrants containing a box 7 after-arrival order. Safety Board investigators examined the UP violation reports for the 6 months before and 1 month after the Devine accident. Four different dispatchers on five occasions, including the Devine accident, failed to read all or parts of the box 7 instruction of the track warrant. Three of these four dispatchers, including the third-shift dispatcher, had been trained in the last year before the Devine accident**.** The UP management reported that each of the box 7 rule violations was handled independently over a period of time and "each of these incidents was looked at from a global perspective" by the UP management. According to the UP, it noted that a possible common thread between these incidents was the experience level of the dispatchers involved and, as a result, it reviewed and expanded the section of its apprentice dispatcher program that focused on track warrant control authorities.

The FRA review of the UP violation incidents occurring at the HDC from January through August 1997 indicated that 52 percent of all rule violations were by 7 of the 43 dispatching positions. The FRA reported that these seven dispatching positions typically had multiple authority territories or an unusually high number of track warrants, or both. The UP violation data also indicated that about 30 percent of the violations occurred within the first hour of an 8-hour shift.

The UP reported that in July 1997, it implemented a track warrant audit process that involves the daily retrieval of printed copies of recent track warrants to compare with the issuing dispatcher's audio recording. According to the UP, five track warrant issuances for each of three different train dispatchers are audited to determine whether the track warrant is issued

[13]Document generated by the UP for its use only.

and repeated exactly as it appears on the printed copy. The UP stated that it defined 13 categories of potential errors and that each track warrant is checked for compliance with these failure categories. Three failure categories were defined as "cardinal rules" that, if not met, require the immediate notification of the regional director for train handling with the involved train dispatcher.

Meteorological Information

At 10:51 p.m., the weather station at Hondo, which is 19 nautical miles northwest of Devine, reported clear skies with 10-mile visibility, 78°-F temperature, 71°-F dew point, and 11-knot winds.

Medical, Pathological, and Toxicological Information

Third-Shift Dispatcher -- Following the accident, the third-shift dispatcher was removed from service. Consistent with FRA regulations, he took a breath test and provided blood and urine specimens for postaccident alcohol and drug testing. About 2 a.m. on June 23, a breath test was administered to the dispatcher, who was then taken to a local hospital, where at 3:45 a.m., he provided blood and urine specimens, which were sent to and analyzed by Northwest Toxicology, Incorporated. The results of the urine analysis and the blood and breath test analyses were negative for drugs and for alcohol.

5981 North Traincrew -- The engineer was transported to an area hospital for treatment of superficial abrasions and released the same day. His postaccident toxicological testing was negative for drugs and alcohol.

The body of the conductor of 5981 North was found adjacent to the track beneath wreckage debris. The autopsy report indicated that he had received severe chest and abdominal injuries, that he had sustained severe burn trauma, and that his right arm had been severed. The postaccident toxicological testing indicated the presence of ethyl alcohol in his blood (0.011 w/v%) and urine (0.024 w/v%). Northwest Toxicology, Incorporated, concluded,

> Based upon the information provided by the FRA regarding the putrefaction of the body and the low concentration of ethyl alcohol found, it cannot be determined whether the ethyl alcohol present in the blood and urine is due to antemortem consumption or postmortem production.[14]

The severely burned and mangled bodies of two unidentified people, believed to have been the individuals who may have been riding on one of the 5981 North locomotive units, were found beneath wreckage debris on the pavement under the bridge near the POI.

9186 South Traincrew -- The body of the 9186 South engineer was found adjacent to the track about 126 feet north of the north bridge abutment. The autopsy report indicated that he had sustained severe chest injuries and blunt force trauma to the head. His postaccident toxicological testing was negative for drugs and alcohol.

Within minutes after the collision, a firefighter found the conductor of 9186 South standing on the road on the east side of the overpass near the burning wreckage. He had sustained first and second degree burns to the face, torso, and leg, and was helicoptered to the U.S. Army Hospital in San Antonio for treatment. His postaccident toxicological testing was negative for alcohol but indicated the presence of morphine in both the urine (107,929 ng/ml) and blood (45 ng/ml). Morphine was administered to the conductor at the medical facility to which he was admitted.

Emergency Response

Shortly before 11 p.m. on June 22, 1997, a Devine Police Department (DPD) officer, on routine motor patrol near the UP track south of the railroad bridge at MP 290.4, reported that he observed a passing northbound train, heard a loud explosion sound, and noted that the passing train was rapidly decelerating. Seeing flames and black smoke at the railroad overpass in his

[14] The postmortem production of alcohol can occur during the decomposition process with no prior alcohol consumption.

rear view mirror, he radioed the DPD dispatch desk, which received the transmission at 10:52 p.m. and notified the Devine Volunteer Fire Department (DVFD) and the DPD with an "all-hands" respond request. Numerous 911 phone calls were also received from concerned residents reporting a loud explosion sound.

While driving to the accident scene, the officer who had witnessed the event encountered the engineer of 5981 North, who had been injured after jumping from the northbound train; the engineer indicated that the other train possibly contained hazardous materials. Other police officers and an emergency medical service (EMS) ambulance and staff soon arrived at that location, which later functioned as the medical staging area for the accident. The EMS ambulance staff determined that the engineer of 5981 North did not have life-threatening injuries, and he was later transported by ambulance to a local hospital. The chief of the DVFD activated the Incident Command System and assumed control as the incident commander. A temporary command post was established on the west side of the overpass.

Because the 5981 North engineer had indicated that hazardous materials may have been on board a train, the community disaster plan was implemented, and the Devine Emergency Management Coordinator was dispatched. The Chemical Transportation Emergency Center[15] was contacted about 11:06 p.m. by the DPD, which also contacted the railroad to request hazardous materials consist information. The UP responded by phone and fax that no hazardous materials products were on board either train. Because of the concern about a toxic materials release, the DVFD chief had directed an evacuation of all residences within a 1/4-mile radius of the fire. The DPD had closed roads around the fire scene to all traffic but emergency vehicles. Between 75 and 100 residents were sheltered at the local high school and were permitted to return to their residences when the UP confirmed that no hazardous materials products were involved in the fire.

The firefighting suppression effort continued to focus on the blaze, which reportedly flared several hundred feet high and was seen up to 30 miles away. About 1 a.m. on June 23, the fire had been substantially suppressed, and the DVFD chief directed that all water lines be shut down. About 1:37 a.m., the fire was declared under control.

Survival Aspects

Locomotive Cab Survivability -- On the northbound train, the operating cab had separated from the lead unit (UP5981) and was found crushed beneath the wreckage debris. The cab had been fully consumed by fire, and no survival space remained. On the southbound train, the operating cab of the lead unit (UP9186) had not been significantly crushed during the collision, but the cab and the entire unit were fully consumed by the fire.

Fire and Rescue Services -- The 29-member DVFD provides exclusive firefighting support to Devine, a rural community of about 4,000 people. Supplementary firefighting support is available through mutual aid requests to neighboring communities. The DVFD is commanded by the chief (he works professionally for and in the city of San Antonio as a trained, full-time firefighter) and is supported by three assistant chiefs. At the time of the accident, the DVFD fire suppression equipment consisted of two conventional pump trucks (750 gpm and 1000 gpm) and three small support trucks. The DVFD's support apparatus included ladders, nozzles and hoses, lights, self-contained breathing equipment, and a small stock of fire suppression foam.

Municipal Disaster Plan -- The city of Devine has a comprehensive, documented plan (issued in 1990 and revised in August 1996), based on the State model, which is coordinated by the Emergency Management Coordinator and an assistant staffer of the Devine Emergency Management Agency. Under the plan, Devine conducts an annual simulated live-disaster exercise and a semiannual table-top drill. All the Devine municipal agencies (fire, police, emergency management, and public works)

[15] The center, operated by the Chemical Manufacturers Association, was established to provide initial and immediate information about handling hazardous materials and other chemicals.

participated in the most recent simulation exercise, which occurred about 6 months before the train accident. The exercise involved a hazardous materials truck fire in a congested residential neighborhood and the hazardous materials cleanup. The most recent table-top drill occurred about 1 year before the train accident.

Tests and Research

Sight Distance -- Sight distance tests, conducted from 10:15 p.m. on June 24 until 12:10 a.m. on June 25, 1997, indicated that given the topography of the area, visibility from the POI was unrestricted for a minimum of 4,000 feet for train 5981 North and of 6,400 feet for train 9186 South.

Train Brake Controls -- Because of the accident damage to the lead locomotive unit on 5981 North, the control positions could not be determined. On the lead locomotive unit of 9186 South, the observed control positions were: automatic brake valve, handle in emergency; independent brake, applied; reverser, forward; throttle, idle; and dynamic brakes, off.

Locomotive Event Recorders -- On August 11, 1997, the Safety Board laboratory received the Pulse Data Pack event recorder, the Pulse Data Pack DP-400 event recorder cartridge, and the speed indicator from locomotive UP4211 of train 5981 North; the Q-Tron event recorder, the UP event recorder download diskette, and the speed indicator from locomotive UP5084 of train 5981 North; and the burned remains of the event recorder from locomotive UP9186 of train 9186 South.

The Pulse Data Pack event recorder from locomotive UP4211 was designed to record the time, distance traveled (miles), speed (mph), traction motor current (load amps), automatic brake setting, throttle position, independent brake pressure (psi), and reverser position. These digitally encoded parameters were sampled every 5 3/4 seconds. The data were then written to the magnetic tape in two consecutive and identical records of 2 7/8 seconds in length during the 5 3/4-second period between the samples.

The data from the cartridge of the Pulse Data Pack event recorder from locomotive UP4211 were found to be anomalous when read out using equipment in the Safety Board laboratory. The recorder and its magnetic tape were taken to the manufacturer[16] for analysis. The manufacturer indicated that the event recorder appeared to be operating properly and the magnetic tape could be read, but no input signals concerning traction motor current or brake reduction levels could be found.

Locomotive UP5084 was equipped with a Q-Tron Datacord 5000 solid-state recording system that was designed to record the time, date, unit number, distance traveled (miles), speed (mph), traction motor current (load amps), brake pipe pressure (psi), throttle position, and brake cylinder pressure (psi). The parameter values were recorded whenever a parameter changed. The magnitude of the change necessary to trigger a parameter recording is preprogrammed into the recording system. The manufacturer of the Q-Tron recorder indicated that the maximum recording resolution of the recorder was 1/10 second, with the exception of speed, which was recorded at 1-second intervals.

The collision log report from the locomotive UP5084 Q-Tron recorder read-out at the Safety Board laboratory follows:

Recorder Time	Train Speed	Action
10:49:44 p.m.	43.6 mph	Throttle position changed from 8 to 4. Traction motor current decreased steadily from 416 to 205 amps during the following 6 seconds.
10:49:50 p.m.	42.5 mph	Throttle position changed from 4 to 0 and remained at 0 thereafter. Traction motor current decreased from 205 to 99 amps about 1 second later and gradually decreased to 0 amps during the following 4 seconds.

[16]Pulse Electronics, Incorporated, Rockville, Maryland.

10:49:52 p.m. 42.2 mph Brake cylinder pressure changed from 0 to 6 psi and increased to 76 psi during the following 10 seconds.

10:49:53 p.m. 41.7 mph Brake pipe pressure changed from 89 to 59 psi and decreased to 0 psi within 1 second.

10:50:23 p.m. 18.7 mph Brake cylinder pressure changed from 77 to 7 psi and decreased to 0 psi during the following 3 seconds.

10:50:25p.m.[17] 0 mph

The type of event recorder equipment from locomotive UP4211 of train 5981 North and from locomotives UP9186 and UP6143 of train 9186 South was customarily carried in the nose section of the controlling end of the locomotive. The event recorder equipment from locomotive units UP5981 and UP5084 of train 5981 North was most likely located in the locomotive alcove either immediately on the right, attached to the sidewall, or on the left, attached to the bulkhead wall. No standards have been developed for the location of event recorder equipment.

The event recorder from locomotive UP5981 of train 5981 North was destroyed by crushing force, and the event recorders on locomotives UP9186 and UP6143 of train 9186 South were destroyed by the fire. The Safety Board is working with the FRA, class 1 railroads, railroad employee union representatives, and locomotive event recorder and locomotive manufacturers to develop and implement an FRA rule detailing specific survivability standards that locomotive event recorders must adhere to. The Safety Board has encouraged the FRA to address the survivability of event recorders in all known or anticipated accident scenarios, considering the experience with other modal standards of event recorder crashworthiness. At the time of this report, the FRA had no anticipated date of issuance for the standards.

[17]The railroad recording time was not synchronized with the time of the police report.

Other Information

Nonsignalized Territory Accident Risk -- The Safety Board investigated an earlier accident having similar circumstances as those that occurred in the June 1997 Devine accident. On August 30, 1991, near Ledger, Montana,[18] a Burlington Northern Railroad Company (BNSF)[19] train was operating in dark (nonsignalized) territory, and the radio transmission for authority to the main track was improperly delivered. The train dispatcher failed to detect an improper read-back from the crew in the field. In the Ledger accident, the train dispatcher did not detect the crew's misreading of a train station when the crew read the track warrant back to the train dispatcher. Thus, two trains had authority to proceed to the same block of track from opposite directions at the same time. The trains collided head-on and three crewmembers were fatally injured.

After the Ledger collision, the BNSF determined that if the train dispatcher had to perform a physical or mechanical task during the repeat process, the failure to detect an incorrect read-back would be less likely to occur. The computerized system that BNSF uses was reprogrammed, and, during the read-back by the crews, the dispatcher must now perform specific tasks. The track warrant that the dispatcher originally issued is displayed on the computer screen, but the variable fields that are unique to this track warrant are not filled. As the crew reads the original track warrant to the train dispatcher, the train dispatcher follows along on the computer screen and a pull-down selection menu appears at each variable field. Within the pull-down menu are randomly generated numbers or station names. Only one of the choices corresponds to that in the original track warrant. The train dispatcher must select the correct "fill-in," hit the enter key before the cursor will move on the screen, and fill all the

[18]For more information, see Railroad Accident Report--*Head-On Collision between Burlington Northern Railroad Freight Trains 602 and 603 near Ledger, Montana, on August 30, 1991* (NTSB/RAR-93/01).

[19]The Burlington Northern Railroad Company and the Atchison, Topeka and Santa Fe Railway Company merged on October 1, 1995, and formed the Burlington Northern and Santa Fe Railway Company. The carrier is referred to as the BNSF throughout this report.

fields correctly before the screen will clear and allow the next task to be performed on the computer. In addition, the BNSF traincrews in the field are required to identify a specific train before using authority to the main track and must write the train ID, time passed, location passed, or current time and location on the track warrant form; they can be disciplined for not performing this activity.

After the accident at Devine on June 22, 1997, the BNSF further modified its track warrant system to include a "total number of lines issued" statement at the end of the track warrant. If a train dispatcher is issuing a track warrant that has a box 7 after-arrival restriction, a total of nine lines for the track warrant may be created. If the train dispatcher fails to transmit the box 7 after-arrival restriction, yet informs the crew that they have been given a total of nine lines, the crew in the field should challenge the train dispatcher's original transmission.

Federal Railroad Administration -- The FRA began a review of the UP operations on August 23, 1997. Following this 14-day comprehensive safety inspection of the UP by Federal and State inspectors, the FRA announced on September 10, 1997, that the "findings of widespread safety deficiencies in the areas of training, dispatching, and employee fatigue are of great concern to the FRA, and we strongly encourage that our recommendations be implemented." Based on the findings by the inspection team, the FRA recommended mandatory classes and job briefings for dispatchers, dispatcher supervisors, and other operating officials; management identification of the safety officer on duty; adequate training for all employees on all equipment they use; and adequate crew transportation for traincrews whose hours-of-service have expired.

Between November 3 and 7, 1997, the FRA conducted another safety audit of the HDC and reported that it "observed inefficient and unsafe practices by supervisors and dispatchers at the HDC, which can be attributed to lack of training and extreme work overload."

Union Pacific Railroad Postaccident Actions -- According to the UP, since the Devine accident on June 22, 1977, it has developed a safety action plan for the HDC covering communication, dispatching training and staffing, and track warrant control. The plan is reviewed regularly within the HDC and with the FRA.

A dispatching safety hot line has been established for employees to express their concerns and make suggestions regarding dispatching safety and rules issues. The UP is setting up focus teams of managers and dispatchers to develop policies and procedures for rules compliance, two-way communications, and dispatcher skill levels.

The UP identified several corridor managers who had no experience as train dispatchers and has scheduled training for them in dispatching system procedures. An annual dispatcher retraining program has been initiated to include a complete review of safety rules. A mentor program has been established in which dispatchers with more than 5 years of experience coach one or more train dispatchers with less experience. The UP has also modified the train dispatcher selection, training, and qualification program. It has revised the dispatcher track warrant training module to include current process changes and suggestions from the FRA February 1998 *Safety Assurance and Compliance Report* and also revised its training manual. The UP has a staff of 15 dispatcher training personnel, in addition to the 8 positions that continue to support and develop train dispatching systems, and has hired 9 former train dispatchers and 39 apprentice train dispatchers during the 6 months since the Devine accident. In September 1997, the UP added to its staff a director of efficiency testing for the HDC and all UP centers with dispatching operations. Finally, the Austin subdivision was split in January 1998 to reduce the dispatcher workload.

The UP stated that the visibility of the box 7 after-arrival instruction on the track warrant control and track warrant form has been enhanced and heightened on its computers. Dispatcher acknowledgment procedures have been implemented for box 7, as well as an interactive read-back feature. The UP has instituted an oral summary requirement for the box numbers and the total boxes checked in the

sending and receiving of every track warrant. According to the UP, it has discontinued the use of box 7 after-arrival authority in nonsignalized track warrant control territory and is signalizing the Austin subdivision from San Antonio to Laredo, which should be completed by December 31, 1998. Also, the UP is upgrading its digital dispatcher recording system to allow both sides of the train dispatcher conversation to be monitored.

Safety Board Public Hearing -- In March 1998, the Safety Board conducted a 3-day public hearing in Springfield, Virginia, that concerned the safety oversight of the UP. The results of this hearing, "The Special Investigation of the Effectiveness of Safety Oversight on the Union Pacific Railroad," will be addressed in future Safety Board reports.

ANALYSIS

General Factors

The weather at the time of the collision was reported to be clear, with visibility of 10 miles, and did not adversely affect train operations. No mechanical problems or equipment failure were noted. During the pre- and postaccident inspections, no defects or deviations were found in the track or equipment.

No evidence of dispatching computer equipment malfunction was found. A print-out of the track warrant information from the dispatcher's computer confirmed the accuracy of track warrant 8289 for train 9186 South as presented on the computer screen. The previous and subsequent issuance of track warrants contained accurate information for other traincrews.

A review of the UP records indicated that all crewmembers met the requirements as prescribed in the Hours-of-Service Act. Information obtained during the postaccident interview with the dispatcher did not indicate that he was fatigued. The data retrieved from the event recorders confirm that train 5981 North was handled in accordance with accepted train handling practices while operating on a track warrant as prescribed by the UP operating rules. Because event recorder data from train 9186 South were destroyed in the fire and no testimony could be obtained from the traincrew, the Safety Board could not retrieve information about the train's functions and operations.

Postaccident toxicological tests were negative for drugs and alcohol for the train dispatcher and the engineers of trains 5981 North and 9186 South. In the case of the deceased conductor of 5981 North, the alcohol levels detected were consistent with expected postmortem microbial production of ethanol. No evidence was found that alcohol had been consumed by the 5981 North conductor immediately before or during the trip, and his medical and personnel records contained no information relating to alcohol-related incidents or problems. The level of drugs found in the blood and urine specimens of the conductor of 9186 South was apparently due to drug administration after the accident.

The Safety Board therefore concludes that neither the weather nor the train equipment or track caused or contributed to the collision. The computer-generated track warrant 8289 information was correct. Both operating traincrews were in compliance with the requirements specified in the Hours-of-Service Act and were qualified to perform their duties; no crewmember or dispatcher fatigue was indicated. Neither alcohol nor drug use appears to have been a factor in the accident.

Accident Narrative

During the issuance of track warrant 8289 to train 9186 South, the third-shift dispatcher failed to accurately communicate the track warrant information in its entirety to the traincrew from his computer screen as it was apparently displayed. He omitted the after-arrival instructions (hold the main track at Gessner until the arrival of train 5981 North) when formally issuing authorization to train 9186 South to proceed from Gessner to Melon. The recorded radio transcripts of the transmission between the dispatcher and the 9186 South traincrew substantiated that the dispatcher did not include the after-arrival instructions of track warrant 8289 to the crew. When the train 9186 South conductor repeated the track warrant back to the dispatcher, the third-shift dispatcher failed to confirm the accuracy of the read-back information from the crew with the display on the computer screen. Had the third-shift dispatcher done so, he would have noted the discrepancy between the track warrant that was displayed on his computer screen and the read-back information and could have corrected the inconsistency and provided the after-arrival instruction (hold the main track at Gessner until the northbound train had

passed). Because train 9186 South was not notified to wait for the northbound train to pass at Gessner, it proceeded from Gessner toward the northbound train, which was earlier authorized to proceed and occupy the block of track from Melon to Gessner. Therefore, the Safety Board concludes that the third-shift dispatcher's failure to accurately issue track warrant 8289 to train 9186 South and his failure to detect and correct the 9186 South conductor's repeat of the track warrant authority limit resulted in the crew receiving an incorrect track warrant that allowed the opposing trains 5981 North and 9186 South to operate on the same track in opposite directions through Devine on June 22, 1997.

Dispatcher Performance and Workload

The third-shift dispatcher had been operating as a qualified dispatcher since August 1996. Most of his experience had been dispatching trains in dark (nonsignalized) territories, such as the one in which this accident occurred. He had no previous dispatching violations before June 22, 1997. During the 10 months before the Devine accident, the third-shift dispatcher had demonstrated sufficient knowledge of dispatching duties. He had accurately communicated track warrant information to other traincrews during previous and subsequent issuance of track warrants. However, he failed to accurately communicate the track warrant 8289 information to train 9186 South and to validate the line repeat-back from the conductor of that train.

At the time of the Devine accident, the UP verification process of track warrants relied on the train dispatcher to detect an inaccurate read-back message and to ensure that a complete and accurate transmission was received from the traincrew. This verification process, in which the train dispatcher just followed the oral repeat-back received from the crew, did not provide a redundancy feature that would confirm whether an accurate repeat-back of the original transmission had registered with and been noted by the train dispatcher.

On the day of the accident at Devine, the third-shift dispatcher understood that when communicating a track warrant to a traincrew, his primary tasks were to read the information as presented on the screen and verify its accuracy, comparing the oral read-back from the traincrew with the information on the screen; he believed that he had been following the established UP track warrant communication procedures. Track warrants have not been addressed in the CFR and, therefore, their use as a method of operation for train movement has not been federally directed. The Safety Board concludes that the third-shift dispatcher did not communicate the accurate information in track warrant 8289 to the crew of train 9186 South. Therefore, the Safety Board believes that the UP should evaluate its dispatcher training program and make necessary revisions to place greater emphasis on all safety critical activities including procedures used to issue and confirm track warrants. In addition, the Safety Board believes that the FRA should revise 49 CFR 220 to address track warrants and other current railroad operating practices.

The third-shift dispatcher stated that on the night of the accident, his workload was "probably an average night for that position" and that from the start of his shift, he had received several radio calls and "it was busy." Immediately after the shift changeover, he had to process the information just received from the departing dispatcher and prioritize the tasks that he was to perform during the shift. That night the dispatcher's first task was the radio transmission with the delayed Amtrak train still on his territory, which was a rare occurrence for the beginning of this shift. Immediately after this, he turned his attention toward dispatching the UP trains and spent the majority of his initial time on the radio.

The third-shift dispatcher issued the incomplete track warrant information to the crew of train 9186 South within the first 10 minutes of his shift. Veteran dispatchers at the HDC reported that the most difficult time of a shift is the first 30 minutes, when a dispatcher is "trying to assimilate everything" and mentally planning the operation of the territory. The Safety Board examined the UP dispatcher rule violations data and found that approximately 30 percent of the violations occurred within the first hour after the start of a new, 8-hour shift, particularly on territories of high-operating demands. The Safety Board concludes that the UP dispatchers' elevated workload at the

beginning of shifts may contribute to the disproportionately greater number of dispatching violations occurring during this time. Therefore, the Safety Board believes that the UP should conduct an audit of its train dispatching operations to identify specific factors that can lead to dispatching errors and include in the audit an assessment of dispatching errors that occur during or shortly after shift changes or because of improper radio procedures.

The Safety Board is concerned that an error similar to the one committed by the third-shift dispatcher was also committed by two other dispatchers, all of whom were trained in the year before the June 22, 1997, accident. The third-shift dispatcher, although reporting that he believed his training was adequate, stated, "How can training be equal to . . . a dozen radios going off and ten people yelling at you at the same time. . . . Having to deal with that sort of thing is hard." The Safety Board therefore examined the challenges faced by less experienced dispatchers operating in territories of high-operating demands.

Many of the territories to which less experienced dispatchers are initially assigned, such as the Austin subdivision, have nearly doubled in train volume since the early 1990s, when they may have been more easily dispatched because of the fewer trains operating. Such territories often pose operational challenges to even the most experienced dispatchers. Veteran dispatchers reported that under conditions of high-operating demands, less experienced dispatchers may issue track warrants while mentally or physically attending to their next task and not concentrating on the read-back communication from the train crewmembers. The FRA noted during its safety audit of the HDC that dispatchers working under high-workload conditions were not consistently monitoring the computer screens during read-backs of track warrants because of other task demands, which included answering the telephone, communicating with other dispatchers, and reading lineups and performing transfers with their relief shift dispatchers. Some dispatchers, as a result, may forgo safe dispatching practices in an attempt to manage the high-operating demands.

The Safety Board is concerned that newly qualified dispatchers initially assigned to territories of high-operating demands may not have the opportunity to refine their skills to increase their dispatching efficiency. Rudimentary skills taught to apprentice dispatchers in the initial training program can be further developed as they operate in territories of moderate-operating demands. Those assigned to territories of high-operating demands who have not developed critical skills and strategies to operate efficiently may relinquish safe procedures to manage the high-operating demands. The box 7 after-arrival errors committed by the newly qualified dispatchers were the result of their omitting track warrant verification procedures, perhaps as a means to manage their dispatching duties. The Safety Board concludes that some UP apprentice dispatchers may not have been adequately prepared to be placed and operate safely in territories of high-operating demands immediately after completing the training program.

The majority of all HDC dispatching errors for dispatchers occur in territories of high-operating demands. As train volume increases, the workload demands on the dispatcher likewise increase. The Safety Board is thus concerned that for both veteran and newly qualified dispatchers, the need to manage the steady increase in train traffic may jeopardize their ability to attend to all critical tasks and to dispatch trains safely.

The UP has a study under way to determine which territories on its system pose the highest operating demands on its dispatchers. Several operational factors are being assessed, including the train volume, the number of track warrants issued, and the amount of time spent issuing track warrants. The Safety Board notes that this assessment is a critical step in determining where the greatest challenges are for the UP dispatchers but advises that a comprehensive evaluation of operational demands in a given territory needs to consider both the task and the knowledge, skill, and ability of the dispatchers, including the level of task demands, the operator's mental and physical capacity, the

work strategy, and the skill level.[20] For instance, one UP dispatcher with many years of experience indicated that handling 18 trains on his territory was not difficult for him; however, a less-experienced dispatcher working the same territory felt overloaded by the dispatching demands. The Devine accident demonstrates that not all qualified dispatchers are equally prepared to manage similar operating demands. The errors committed by qualified, but less experienced, dispatchers strongly indicate a need for careful consideration of the placement of dispatchers in territories of high-operating demands. The Safety Board believes that the UP should conduct an audit of its train dispatchers' activities to evaluate the current workload and should make necessary changes to dispatcher operations to distribute workload based on the individual dispatcher's qualifications, ability, and experience.

Management Oversight

Dispatcher Apprentice Program -- Although the UP had a policy that an apprentice dispatcher became a qualified dispatcher only with the full agreement of several officials involved in the training process and would be provided training until ready to work the position, the Safety Board found some instances in which these standards were not being upheld by management. Dispatchers indicated that management has qualified apprentice dispatchers despite opposition from some OJT dispatcher trainers involved in the training process, and dispatchers believed that the qualifying process has been compromised to expedite the placement of new dispatchers in the dispatching operations. The Safety Board concludes that the UP may have jeopardized safe dispatching operations by qualifying unprepared apprentice dispatchers and assigning less experienced dispatchers to territories of high-operating demands.

Another area in which the UP did not adhere to its policies was in upholding the experience level of OJT dispatcher trainers for apprentice dispatchers. The UP management reported that qualified dispatchers responsible for conducting the OJT for apprentice dispatchers must have at least 5 years of dispatching experience. According to UP dispatchers, however, dispatchers with less than 5 years of experience were training apprentice dispatchers. Some veteran dispatchers believed that 5 years should be the minimum experience level for an OJT dispatcher trainer. Since the accident at Devine, the UP has increased to 10 years the minimum experience level for the OJT dispatcher trainers. The Safety Board has learned from the UP dispatcher data that fewer than half of the UP dispatchers have attained this experience level and concludes that because the UP did not meet its 5-year experience standard for OJT dispatcher trainers, complying with the higher standard of a minimum 10-year experience level for OJT dispatcher trainers may not be achieved. Therefore, the Safety Board believes that the UP should examine the circumstances in which its policy to require a minimum 5 years of experience to qualify as an OJT dispatcher trainer was not followed and take action to ensure that the UP qualification policies are followed.

Like many other railroads, the UP had no formal training or procedures for the dispatcher trainers who oversee the apprentice dispatchers during OJT. The FRA reported that in many railroads the OJT had been delegated to subordinates without adequate direction, control, or evaluation methods, which led to unstructured and inconsistent training. Although the FRA found no evidence during its reviews that inadequate dispatcher training directly resulted in train accidents, it noted that training directly impacts train dispatcher efficiency and productivity, which can impact safety. Additionally, the lack of well-defined training may contribute to train dispatcher stress and fatigue, as well as work overload. The Safety Board concurs with the FRA's position. Therefore, the Safety Board believes that the UP should develop and implement a comprehensive program to select and train experienced dispatchers to serve as dispatcher trainers.

The FRA report in 1995 stated that the FRA would publish in 1998 an ANPRM proposing minimum training standards for train dispatchers that include initial, periodic, refresher, and physical characteristic training and minimum

[20]Welford, A.T., "Mental Workload as a Function of Demand, Capacity, and Skill," *Ergonomics*, 21, 1978, pp. 151-167.

operating rule training and testing standards. The Safety Board urges the FRA to encourage the timely adoption and implementation of these standards.

Dispatching Operations -- The safety of the system is directly dependent on the appropriate actions of those operating in safety-sensitive areas. Management has a responsibility to establish an operating environment most conducive to safe operations. The Safety Board examined the UP management efforts to ensure a safe and efficient operating environment for the dispatchers. Although the UP policies do address many critical safety-sensitive areas, the Safety Board has identified areas in which actual company practice has fallen short of company standards. The Safety Board understands that apprentice dispatchers have become qualified dispatchers without the concurrence of OJT dispatcher trainers or the apprentice dispatcher trainee. Newly qualified dispatchers have been placed in territories of high-operating demands without the benefit of developing skills through experience. By failing to accommodate the needs of less experienced dispatchers and by not adhering to its own standards, the UP failed to create an environment conducive to safe dispatching operations. Consequently, the Safety Board concludes that the third-shift dispatcher's failure to communicate the information in track warrant 8289 accurately to the 9186 South traincrew and to verify the accuracy of the read-back information resulted from operational shortcomings at the HDC.

The UP company policy did not require that corridor managers have previous dispatching experience, and some did not. Although during normal operations this typically does not pose a problem, dispatchers expressed frustration with what they perceived as poor decisions by some corridor managers during more complex operating situations. Dispatchers reported that during the daily safety and production meetings, some corridor managers lent support to the dispatchers' workload challenges on their territories, and other corridor managers were not interested in discussing the problems experienced by the dispatchers. As a result, dispatchers sought advice from other sources, such as upper management officials, when confronting certain complex situations. The Safety Board concludes that some UP corridor managers did not consistently provide appropriate technical support to the train dispatchers. Therefore, the Safety Board believes that the UP should evaluate and determine the technical expertise required of corridor managers and make the necessary changes to ensure that corridor managers are qualified to provide proper dispatching assistance to the train dispatchers.

The UP train dispatchers also expressed concern about the noise level originating from adjacent dispatching stations at the HDC. The noise level is highest during the shift changeover when the dispatchers brief their replacements about the status of their territories. Waist-high barriers separate dispatchers from each other, but do not block out distracting conversations. Higher partitions, used at some dispatch centers, serve better as sound barriers and provide a quieter working environment. The Safety Board has investigated accidents in which distractions hindered the performance of a safety-critical operator. The Safety Board concludes that although no evidence was found that adjacent noises in the dispatching area contributed to the third-shift dispatcher's inattention to the track warrant 8289 information in the Devine accident, a dispatcher's performance may be affected by unnecessary, avoidable sound distractions. Therefore, the Safety Board believes that the UP should identify all distractions, evaluate their effects on dispatchers, and take action to establish a working environment conducive to safe dispatching operations.

After-Arrival Conditional Authority -- The use of after-arrival instructions creates an inherent danger by giving a traincrew conditional authority, under which, if a condition is met, their train is allowed to proceed into a block of track even though that track is occupied by an opposing train. (In the Devine accident, the condition was the physical passing of another train.) Should a failure occur in the transmission or comprehension of a track warrant that results in the omission or inaccurate communication of the condition, two opposing trains may occupy the same block of track at the same time, as they did in the Devine accident. Once an error has occurred in dark

(nonsignalized) territory and two trains are on the same track at the same time, no wayside signals are available to warn one train of the presence of the other.

After the 1991 Ledger train collision, the BNSF dispatching system was reprogrammed to add another protection barrier against the occurrence of a train dispatcher error. If the train dispatcher does not correctly apply the read-back information from the traincrew, the computer screen does not clear, and the next computer screen display will not appear. This redundancy feature increases protection against dispatcher error in the BNSF dispatching system. The UP attempted to mitigate the risk of a dispatcher error by adding a warning system that required the train dispatcher to acknowledge a message on the computer screen. In the UP dispatching system, the UP elected to display its track warrant box 7 ("not in effect until after arrival of") on the computer screen to reduce the risk of a dispatcher error and a train collision.

The Safety Board has investigated other railroad accidents in which the avoidance of a collision depended on the use of a rule or standard operating practice that proved to be insufficient to prevent an accident. In the Devine accident, the third-shift dispatcher failed to adhere to procedural policy and to follow verbatim the read-back message from the traincrew. The system employed by the UP at the time of the Devine accident allowed for such a failure to occur and permitted the third-shift dispatcher to overlook a critical element during the issuance of track warrant 8289. Hence, the UP method used for dark (nonsignalized) territory operations needs to be revised to ensure that an oversight by a dispatcher cannot occur. The Safety Board concludes that had the UP after-arrival system in dark (nonsignalized) territory operations not been used in the Devine accident area, the opposing trains 5981 North and 9186 South would not have been occupying the same block of track. Therefore, the Safety Board believes that the UP should discontinue permanently the use of after-arrival orders in dark (nonsignalized) territory The Safety Board also believes that the FRA should require railroads to discontinue permanently the use of after-arrival orders in dark (nonsignalized) territory.

Federal Railroad Administration Train Dispatching Oversight

The Safety Board has previously examined the FRA oversight of train dispatching. After the Safety Board investigated the derailment of an Amtrak train at Fall River, Wisconsin,[21] in October 1986, it urged the FRA to:

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

In 1990, the FRA reported to the U.S. Congress that the imposition of Federal training standards for train dispatchers was not necessary. The FRA based its judgment on a number of factors that it found during the FRA nationwide review of train dispatching.

In a September 1991 letter to the Safety Board, the FRA wrote of its intent to implement a formal research and development study of dispatcher training programs, workload measurement models, occupational stresses, and fatigue effects. The FRA stated in January 1995 that it had found that train dispatchers continue to provide safe, efficient service to the industry; however, it believed that several dispatching areas, particularly training and testing, had shortcomings. In February 1995, the Safety Board advised the FRA that it was disappointed that many of the study's findings and concerns were not adequately addressed in the published recommendations for action. For example, the study identified several major safety-related problems in the occupational stress, workload, and environmental policies affecting dispatchers, but the FRA still has not completed satisfactory regulatory activity to establish

[21]For more information, see Railroad Accident Report--*Derailment of Amtrak Passenger Train 8 Operating on the Soo Line Railroad, Fall River, Wisconsin, on October 9, 1986* (NTSB/RAR-87/06).

dispatcher standards. Therefore, the Safety Board concludes that the FRA has failed to develop dispatcher standards and needs to accelerate the establishment of regulatory standards for train dispatchers.

Because the FRA has only partially met the intent of Safety Recommendation R-87-66 by conducting a study of the selection process, training, duties, and responsibilities of train dispatchers, the Safety Board is classifying Safety Recommendation R-87-66 "Closed--Unacceptable Action/Superseded" and issuing a new safety recommendation to the FRA. The Safety Board believes that the FRA should develop and establish dispatcher selection and training standards, dispatcher trainer standards, and workload limits for dispatchers by January 1, 2000.

During its investigation of a train collision that occurred on July 30, 1988, near Altoona, Iowa,[22] the Safety Board examined the FRA's surveillance and enforcement of compliance with Federal regulations. The Safety Board cited the FRA as contributing to the cause of the Altoona accident because of the inadequate FRA surveillance and enforcement of compliance with Federal regulations.

After its investigation of the August 1991 Ledger head-on collision between two BNSF freight trains, the Safety Board found that several procedural dispatching errors occurred during the train radio transmissions that precipitated the accident. Three years before the Ledger accident, the FRA, in its *National Train Dispatcher Safety Assessment of 1987-88*, had recommended that the BNSF immediately implement a program for dispatchers to teach and enforce radio procedures that comply with all applicable Federal and carrier radio rules. The Safety Board found that had either the FRA or the BNSF adequately followed up on the recommendations to the BNSF, the Ledger accident would not have happened.

Following the Devine accident in June 1997, the FRA documented significant dispatcher procedural deficiencies at the HDC that had preexisted that accident. Although the FRA had in place a routine operating practices oversight program for the HDC, the FRA has no record that its previous routine inspections had cited these dispatcher procedural deficiencies. The Safety Board concludes that the FRA surveillance and enforcement of compliance with Federal regulations at the HDC before the Devine accident were inadequate and ineffective. Therefore, the Safety Board believes that the FRA should evaluate its surveillance and enforcement activities at dispatching centers and take appropriate corrective actions to ensure that Federal oversight is adequate and effective.

Emergency Response and Disaster Preparedness

Within minutes of the collision, a DPD officer, as well as the first fire, rescue, and EMS personnel, had arrived on scene. The chief of the DVFD activated the Incident Command System and assumed control as incident commander. He acted effectively and managed the incident successfully to completion without serious injury to responders, local residents, or officials at the accident site. However, the DVFD did not have access to an adequate amount of fire suppression foam equipment that would have further aided its efforts to mitigate the massive fire that ensued after the collision. Such equipment is not readily available for rural fire departments, although hazardous materials are routinely transported through their jurisdictions. The increase in rail traffic on the San Antonio to Laredo railroad corridor indicates a need for such readily available firefighting equipment to mitigate a fire event such as the one that occurred in the Devine accident. Therefore, the Safety Board concludes that although the local emergency response was timely and adequate, the lack of readily available fire suppression foam equipment shows a need for additional firefighting equipment to mitigate significant fire events. Consequently, the Safety Board believes that the Texas Railroad Commission should develop a system that would make fire suppression foam equipment readily available to emergency management agencies and local rural fire departments for the fighting of hazardous materials fires.

[22]For more information, see Railroad Accident Report -- *Head-On Collision between Iowa Interstate Railroad Extra 470 West and Extra 406 East with Release of Hazardous Materials near Altoona, Iowa, July 30, 1988* (NTSB/RAR-89/04).

Crashworthiness

Locomotives -- The operating cab of the lead locomotive of train 5981 North had separated from the unit, was found crushed beneath the pile of wreckage debris, and was fully consumed by the fire. Based upon the engineer's statement, he was able to successfully jump from the unit several hundred feet before impact and landed on the ground immediately adjacent to the railroad right-of-way. The body of the conductor was found adjacent to the track beneath wreckage debris north of the north bridge abutment. Given the injuries sustained, massive crush, and severe burn trauma, his death resulted from being crushed near the POI beneath wreckage debris, which was further engulfed in the fire. Based on the available evidence, the conductor may not have jumped before impact but may have been on or near the left front corner of the locomotive at the time of impact. Upon collision, the impact momentum may have resulted in his body being thrown and then crushed by wreckage debris of the derailing equipment, which then caught afire. Fragments of two unidentified, severely traumatized and burned bodies, suspected to be transients, were found beneath wreckage debris near the POI. The likely location of the two people before the collision was either in the cab of the second locomotive, which was crushed and overridden by wreckage, or beneath the floorboards of the lead locomotive, which was fully crushed by wreckage.

The operating cab of the lead locomotive of train 9186 South was not significantly crushed on impact, but the unit derailed and was then fully consumed by the massive fire. Based on the evidence, the two crewmembers apparently exited the locomotive with the intention of jumping clear before impact. The body of the engineer was found adjacent to the track. Given the location of the body and the injuries sustained, he died as a result of his impact with the ground. The conductor was found standing on the road beneath the bridge near the burning wreckage. Given his severe burn injuries and the lack of ground-impact type injuries, he probably was subjected to the heat of the massive fire after jumping clear of the locomotive very close to the POI.

Based upon the estimated speeds of the locomotives at impact, the loss of survival space in the locomotives, and the severity of the massive fire, the Safety Board concludes that the collision in Devine was not survivable for crewmembers or anyone occupying the locomotive equipment at the time of the impact.

Event Recorders -- In its investigations, the Safety Board relies on data recovered from the event recorders to determine train speed, direction of travel, distance, throttle position, brake application, and cab signal aspects, when applicable, before and during an accident. As was demonstrated in the Safety Board's investigation of the February 1996 freight train derailment near Cajon Junction, California,[23] certain critical data are retrieved only in the event recorder of the lead locomotive unit and not in the event recorders of the trailing units. In the Devine accident, the event recorder data for train 9186 South and the lead locomotive of train 5981 North were destroyed by impact forces or fire, or both, and critical event recorder data were lost that could not be retrieved from the other event recorders.

The Safety Board has investigated other accidents in which the event recorder data were compromised due to impact forces or water or fire exposure. In its Corona, California,[24] Knox, Indiana,[25] and Mobile, Alabama,[26] accident investigations, the Safety Board found that critical operational data were lost because the

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[23]For more information, see Railroad Accident Report--*Derailment of Freight Train H-BALT1-31 Atchison, Topeka and Santa Fe Railway Company near Cajon Junction, California, on February 1, 1996* (NTSB/RAR-96/05).

[24]For more information, see Railroad Accident Report--*Atchison, Topeka and Santa Fe Railway Company (ATSF) Freight Trains ATSF 818 and ATSF 891 on the ASTF Railway in Corona, California, on November 7, 1990* (NTSB/RAR-91/03).

[25]For more information, see Railroad Accident/Incident Summary Report -- *Knox, Indiana -- September 17, 1991* (NTSB/RAR-92/02/SUM).

[26]For more information, see Railroad Accident Report--*Derailment of Amtrak Train No. 2 on the CSXT Big Bayou Canot Bridge near Mobile, Alabama, on September 22, 1993* (NTSB/RAR-94/01).

event recorders were not crashworthy. Since 1993, when the FRA required the use of locomotive event recorders, the Safety Board has advocated the development of standards for the crashworthiness of these devices.

Three of the five event recorders in the Devine accident were destroyed either from crash forces or fire exposure. The event recorder on the lead locomotive of 5981 North was destroyed by damage incurred in the accident. Data were recovered from the event recorders on the two trailing locomotives of 5981 North. The event recorders on the lead locomotive and the trailing locomotive of 9186 South were destroyed in the postaccident fire. From a fire resistance standpoint, the type of encasement employed by the manufacturer did not protect the event recorders from thermal destruction. None of the event recorders on the locomotives were designed to meet crash forces or fire exposure standards. The Safety Board concludes that had the event recorders been designed to withstand crash forces and fire exposure, the three destroyed event recorders would have survived and could have provided data for the investigation.

The Safety Board is familiar with the crashworthiness standards in the aviation industry that require the ability to withstand impact shock forces of 3,500 g[27] and fire exposure at 1,100° F for 1 hour, which allow the retrieval of event recorder data after a catastrophic event occurs to the aircraft. Similar standards are not available in the railroad industry. Although the FRA assured the Safety Board in August 1997 that actions have been taken to develop standards for crashworthiness, no standards have been established. Therefore, the Safety Board believes that the FRA, working with the railroad industry, should develop and implement event recorder crashworthiness standards for all new or rebuilt locomotives by January 1, 2000.

[27]An acceleration equal to the acceleration of gravity, about 32 feet per second per second.

Positive Train Separation Control Systems

A positive train separation (PTS) control system can prevent trains from colliding by automatically intervening in the operation of a train when an engineer does not comply with the requirements of a signal indication or operating rules. The Safety Board has long advocated a PTS control system and since 1970[28] has issued safety recommendations calling for this prevention measure. Since most train collisions result from human error, a highly effective train control system is needed as a preventive measure. Greater security is provided by a train control system capable of intervening should a failure to observe signals and operating rules occur for whatever reason.

Following its investigation of the head-on collision between two BNSF freight trains near Ledger, the Safety Board urged the FRA in July 1993 to:

> Establish a firm timetable that includes at a minimum, dates for final development of required advanced train control system hardware, dates for an implementation of a fully developed advanced train control system, and a commitment to a date for having the advanced train control system ready for installation on the general railroad system. (R-93-12)

The Safety Board classified Safety Recommendation R-93-12 "Open--Acceptable Response" on July 8, 1994, after the FRA took action to seek the "final system definition, migration path, and timetable" for a PTS control system by December 1994.

The Safety Board has investigated numerous train collisions in which the probable cause or contributing cause was the inattention of the traincrew to wayside signals. After its investigation of the Thedford, Nebraska,[29]

[28]For more information, see Railroad Accident Report--*Head-on Collision Between Penn Central Trains N-48 and N-49 at Darien, Connecticut, August 20, 1969* (NTSB/RAR-70/03).

[29]For more information, see Railroad Accident Report--*Collision and Derailment Involving Three*

accident, the Safety Board stated that had a PTS control system been in place, it could have detected that the engineer was not responding appropriately to the signal indications and could have slowed and stopped the train, thus preventing the collision.

The Silver Spring, Maryland, accident[30] in February 1996 was the latest in a series of collisions that could have been prevented if a PTS control system had been in place. The Safety Board determined that the probable cause of the accident was the apparent failure of the engineer and the traincrew because of multiple distractions to operate their train according to signal indications and the failure of the FRA, the Federal Transit Administration, the Maryland Mass Transit Administration, and the CSX Transportation Inc. . . . to provide a redundant safety system that could compensate for human error. As a result of the Silver Spring accident investigation, the Safety Board reiterated Safety Recommendation R-87-16, which asked the FRA to promulgate Federal standards to require the installation and operation of a train control system on main line tracks that will provide for positive separation of all trains,[31] and Safety Recommendation R-93-12.

The FRA and the railroad industry share responsibility for the development and implementation of a PTS control system. Under its regulatory authority, the FRA can order a railroad to install a PTS control system. In the Devine accident, a PTS control system could have detected that the 9186 South engineer was not responding appropriately to the track warrant and then have slowed and stopped the train, thus preventing the head-on collision. The Safety Board concludes that had a PTS control system been installed and working in the Devine accident area, the two trains would not have been allowed to enter the same block of track traveling in opposite directions and, as a result, the head-on collision on June 22, 1997, would not have occurred. Therefore, the Safety Board reiterates Safety Recommendation R-87-16 to the FRA.

Burlington Northern Freight Trains near Thedford, Nebraska, on June 8, 1994 (NTSB/RAR-95/03).

[30]For more information, see Railroad Accident Report--*Collision and Derailment of Maryland Rail Commuter MARC Train 286 and National Railroad Passenger Corporation Amtrak Train 29 near Silver Spring, Maryland, on February 16, 1996* (NTSB/RAR-97/02).

[31]Issued to the FRA in May 1987 after the review of accident investigations since 1967 in which the accidents could have been prevented had a mandated train separation system been in effect.

CONCLUSIONS

Findings

1. Neither the weather nor the train equipment or track caused or contributed to the collision. The computer-generated track warrant 8289 information was correct. Both operating traincrews were in compliance with the requirements specified in the Hours-of-Service Act and were qualified to perform their duties; no crewmember or dispatcher fatigue was indicated. Neither alcohol nor drug use appears to have been a factor in the accident.

2. The third-shift dispatcher's failure to accurately issue track warrant 8289 to train 9186 South and his failure to detect and correct the 9186 South conductor's repeat of the track warrant authority limit resulted in the crew receiving an incorrect track warrant that allowed the opposing trains 5981 North and 9186 South to operate on the same track in opposite directions through Devine on June 22, 1997.

3. The third-shift dispatcher did not communicate the accurate information in track warrant 8289 to the crew of train 9186 South.

4. The Union Pacific Railroad dispatchers' elevated workload at the beginning of shifts may contribute to the disproportionately greater number of dispatching violations occurring during this time.

5. Some Union Pacific Railroad apprentice dispatchers may not have been adequately prepared to be placed and operate safely in territories of high-operating demands immediately after completing the training program.

6. The Union Pacific Railroad may have jeopardized safe dispatching operations by qualifying unprepared apprentice dispatchers and assigning less experienced dispatchers to territories of high-operating demands.

7. Because the Union Pacific Railroad did not meet its 5-year experience standard for OJT dispatcher trainers, complying with the higher standard of a minimum 10-year experience level for OJT dispatcher trainers may not be achieved.

8. The third-shift dispatcher's failure to communicate the information in track warrant 8289 accurately to the 9186 South traincrew and to verify the accuracy of the read-back information resulted from operational shortcomings at the Harriman Dispatch Center.

9. Some Union Pacific Railroad corridor managers did not consistently provide appropriate technical support to the train dispatchers.

10. Although no evidence was found that adjacent noises in the dispatching area contributed to the third-shift dispatcher's inattention to the track warrant 8289 information in the Devine accident, a dispatcher's performance may be affected by unnecessary, avoidable sound distractions.

11. Had the Union Pacific Railroad after-arrival system in dark (nonsignalized) territory operations not been used in the Devine accident area, the opposing trains 5981 North and 9186 South would not have been occupying the same block of track.

12. The Federal Railroad Administration has failed to develop dispatcher standards and needs to accelerate the establishment of regulatory standards for train dispatchers.

13. The Federal Railroad Administration surveillance and enforcement of compliance with Federal regulations at the Harriman Dispatch Center before the Devine accident were inadequate and ineffective.

14. Although the local emergency response was timely and adequate, the lack of readily available fire suppression foam equipment shows a need for additional firefighting equipment to mitigate such significant fire events.

15. Based upon the estimated speeds of the locomotives at impact, the loss of survival space in the locomotives, and the severity of the massive fire, the collision in Devine was not survivable for crewmembers or anyone occupying the locomotive equipment at the time of the impact.

16. Had the event recorders been designed to withstand crash forces and fire exposure, the three destroyed event recorders would have survived and could have provided data for the investigation.

17. Had a positive train separation control system been installed and working in the Devine accident area, the two trains would not have been allowed to enter the same block of track traveling in opposite directions and, as a result, the head-on collision on June 22, 1997, would not have occurred.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the third-shift dispatcher to communicate the correct track warrant information to the traincrew and to verify the accuracy of the read-back information because the Union Pacific Railroad management had not established and implemented workload policies and operational procedures to ensure a safe dispatching system and the Federal Railroad Administration had failed to provide standards and oversight in all aspects of train dispatching operations. Contributing to the accident was the lack of an installed positive train separation control system that would have prevented the trains from colliding by automatically intervening in their operation because of inappropriate actions being taken.

RECOMMENDATIONS

As a result of its investigation, the National Transportation Safety Board makes the following recommendations:

-- to the Union Pacific Railroad:

Evaluate your dispatcher training program and make necessary revisions to place greater emphasis on all safety critical activities including procedures used to issue and confirm track warrants. (R-98-18)

Conduct an audit of your train dispatching operations to identify specific factors that can lead to dispatching errors and include in the audit an assessment of dispatching errors that occur during or shortly after shift changes or because of improper radio procedures. (R-98-19)

Conduct an audit of your train dispatchers' activities to evaluate the current workload and make necessary changes to dispatcher operations to distribute workload based on the individual dispatcher's qualifications, ability, and experience. (R-98-20)

Examine the circumstances in which your policy to require a minimum 5 years of experience to qualify as an OJT dispatcher trainer was not followed and take action to ensure that your qualification policies are followed. (R-98-21)

Develop and implement a comprehensive program to select and train experienced dispatchers to serve as dispatcher trainers. (R-98-22)

Evaluate and determine the technical expertise required of corridor managers and make the necessary changes to ensure that corridor managers are qualified to provide proper dispatching assistance to the train dispatchers. (R-98-23)

Identify all distractions, evaluate their effects on dispatchers, and take action to establish a working environment conducive to safe dispatching operations. (R-98-24)

Discontinue permanently the use of after-arrival orders in dark (nonsignalized) territory. (R-98-25)

--to the Federal Railroad Administration:

Revise 49 Code of Federal Regulations 220 to address track warrants and other current railroad operating practices. (R-98-26)

Require railroads to discontinue permanently the use of after-arrival orders in dark (nonsignalized) territory. (R-98-27)

Develop and establish dispatcher selection and training standards, dispatcher trainer standards, and workload limits for dispatchers by January 1, 2000. (R-98-28)

Evaluate your surveillance and enforcement activities at dispatching centers and take appropriate corrective actions to ensure that Federal oversight is adequate and effective. (R-98-29)

Working with the railroad industry, develop and implement event recorder crashworthiness standards for all new or rebuilt locomotives by January 1, 2000. (R-98-30)

--to the Texas Railroad Commission:

Develop a system that would make fire suppression foam equipment readily available to emergency management agencies and local rural fire departments for the fighting of hazardous materials fires. (R-98-31)

Also, as a result of its investigation, the National Transportation Safety Board reiterates the following recommendation:

--to the Federal Railroad Administration:

Promulgate Federal standards to require the installation and operation of a train control system on main line tracks that will provide for positive separation of all trains. (R-87-16)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JAMES E. HALL
Chairman

ROBERT T. FRANCIS II
Vice Chairman

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Member

JOHN J. GOGLIA
Member

GEORGE W. BLACK, JR.
Member

May 19, 1998

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APPENDIX A

TRANSCRIPT OF TRACK WARRANTS 8289 AND 8290

Time Stamp	R/P/I	D/T/C/Y	Transcription
22:24:59	R	D	OK This one will be track Warrant 8288 8-2-8-8 June 22nd 97 to the UP 400 South at Gardendale X Box 2 proceed from Gardendale G-A-R-D-E-N-D-A-L-E to MP 360 3-6-0 Main Track Austin Sub · Box 15 flag protection not required against following trains on the same track Dispatcher GLB Over
22:25:25	R	T	Make it 8288 8-2-8-8 June 22nd 1997 UP 400 4-0-0 South at Gardendale Box 2 proceed from Gardendale to MP 360 3-6-0 Box 15 Flag protection not required against following trains on the same track Dispatcher GLB Over
22:25:58	R	D	?---unintelligable-----?8288 is OK at 2226 GLB over
22:26:00	R	T	8288 is OK at 2226 2-2-2-6 Hours GLB
22:26:01	R	T	Thank You Out
22:26:01	R	D	Thats correct over
22:26:03	R	D	Alright Thank You Out
22:26:04	R	D	UP Dispatcher ZYCMX Over
22:26:08	R	D	Yea, let me get you an after arrival there at Gessner while I have a minute, over
22:26:08	R	9186	ZYCMX go ahead over
22:26:15	R	9186	Alright ready
22:26:18	R	D	OK, track warrant 8289 eight two eight nine, June 22, 97 to the UP 9186 South at Gessner X box 2, proceed from Gessner G-e-s-s-n-e-r to Melon M-e-l-o-n on Main track Austin Sub. X box 8, hold main track at last named point X box 15, Flag protection not required against following trains on the same track Dispatcher GLB, over.
22:26:50	R	9186	OK track warrant 8289 eight two eight nine, dated June 22, 97 to the Union Pacific UP 9186 nine one eight six South at Gessner. X box 2, proceed from Gessner G-e-s-s-n-e-r to Melon, M-e-l-o-n, on main track Austin Sub X box eight, hold main track at last named point X box 15, flag protection not required against following trains on the same track Dispatcher GLB, over
22:27:59	R	D	OK 8289 to the UP 9186 South is OK at 2228, GLB, over
22:28:00	R	9186	Repeat the OK time please
22:28:02	R	D	2228, two two two eight, over
22:28:06	R	9186	Track warrant 8289 to the Union Pacific 9186 south OK at 2228, dispatcher GLB, over
22:28:10	R	D	That's correct, over, thank you.
22:28:14	R	D	UP dispatcher to the MLDU, over
22:28:16	R	5981	MLDU, go ahead, over
22:28:17	R	D	Yea, I can get you an after arrival there at Gessner if you'd like, over
22:28:22	R	5981	Alright, ready to copy
22:28:26	R	D	Alright, this will be track warrant number 8290, eight two nine zero, June 22, 97 to the 5981 North at Gessner. X box 2, proceed from Gessner G-e-s-s-n-e-r, to yard limit 268, YL 268 on main track Austin Sub. X box 7, not in effect until after the arrival of the UP 9186, nine one eight six, south at Gessner X box 7, X box 15, Flag protection not required against following trains on the same track. Dispatcher GLB, over.
22:29:08	R	5981	Alright, this is track warrant 8290, eight two nine zero, dated June 22, 1997 to the UP 5981 five nine eight one, north at Gessner. Box number 2, Proceed from Gessner, G-e-s-s-n-e-r to yard limit 268, YL 268 on main track Austin Sub Box number 7, not in effect until after the arrival of UP 9186, nine one eight six, south, s-o-u-t-h, at Gessner Box number 15, flag protection not required against following trains on the same track Dispr GLB, copied by Yarbrough.
22:29:58	R	D	OK, Track warrant 8290 is OK at 2230, GLB, over
22:30:00	R	5981	Track warrant 8290 to the UP 5981 north is OK'd at 2230, GLB, over
22:30:02	R	D	Thats correct, over
22:30:04	R	5981	Thank you out
22:30:05	R	D	OK thank you out.
22:30:08	R	D	UP Omaha Dispatcher Over
22:30:09	R	T	SP 9273 South Omaha Over

KEY: Under R/P/I
R=Radio
P=Phone
I=Intercom

KEY: Under D/T/C/Y
D= Dispatcher
T=Train
C=Cor Mgr
Y=Yard
?=Unknown

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APPENDIX B

ACRONYMS AND ABBREVIATIONS

Amtrak	National Railroad Passenger Corporation
ANPRM	advanced notice of proposed rulemaking
ATSF	Atchison, Topeka and Santa Fe Railway
BNSF	Burlington Northern Santa Fe Railroad
CAD	computer-aided dispatching
CFR	Code of Federal Regulations
DPD	Devine Police Department
DVFD	Devine Volunteer Fire Department
EMS	emergency medical services
FRA	Federal Railroad Administration
HDC	Harriman Dispatch Center
MP	milepost
NPRM	notice of proposed rulemaking
OJT	on-the-job training
POI	point of impact
PTS	positive train separation
RSAC	Railroad Safety Advisory Committee
UP	Union Pacific Railroad