National Transportation Safety Board

Washington, DC 20594

Railroad Accident Brief

Collision of Two Arkansas & Missouri Railroad Trains
Brentwood, Arkansas

The Accident

On Thursday, October 16, 2014, at 10:25 a.m. central daylight time, a northbound Arkansas & Missouri Railroad Company (A&M) work train locomotive (work train) collided with a stopped southbound A&M excursion train at milepost (MP) 368.25 in Brentwood, Arkansas.[1] The excursion train stopped because it had lost track adhesion and was not able to move up the 1.1 percent grade. The work train traveled north to rescue the stopped excursion train and collided with the excursion train. The work train's speed at impact was about 24 mph. Thirty-nine passengers and four A&M employees were transported to local hospitals and medical centers with non-life-threatening injuries. One of the damaged passenger cars released about 40 gallons of diesel fuel from a generator fuel tank, but the fuel did not ignite. The A&M estimated the damages at $178,500. At the time of the collision the wind was calm with scattered clouds, and the temperature was 66°F.

Arkansas & Missouri Railroad Company

The A&M was established in 1986 as a Class III railroad. It operates a 150-mile route of single main track from Monett, Missouri, to Fort Smith, Arkansas.[2] The A&M corporate headquarters is in Springdale, Arkansas. The A&M operates about six freight trains per day. During the fall, the A&M operates weekly scenic excursion trains to the top of the Boston Mountains and into the Arkansas River Basin between Springdale and Fort Smith, Arkansas. (See figure 1.)

The A&M operates through varying grades between flat and 2.68 percent with curves up to 7 degrees 1 minute. A&M trains operate in nonsignaled territory; an A&M train dispatcher in Springdale, Arkansas, controls the trains using track warrants.

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[1] All times in this brief are central standard time.

[2] Class III railroads are defined at 49 *Code of Federal Regulations* (*CFR*) Part 1201.

Figure 1. A&M excursion train.
(Photo: A&M Railroad Company Website [http://www.amrailroad.com/excursions])

Accident Narrative

Excursion Train

The A&M excursion train had one locomotive and four historic passenger cars. On October 16, 2014, the day of the accident, the lead locomotive of the train received its daily inspection at 5:10 a.m. The crewmembers went on duty at Springdale, Arkansas, at 7:00 a.m. and conducted a Federal Railroad Administration (FRA) Class I air brake test, which was completed at 7:30 a.m. The A&M provided records of the excursion train to National Transportation Safety Board (NTSB) investigators, but those records did not include identifying information such as train ID number or locomotive number. The conductor provided the test paperwork to NTSB investigators and confirmed that it was the record of the air brake test. Investigators reviewed the records of the preaccident mechanical inspections of the A&M excursion train and did not identify any areas of concern.

The crew of the A&M excursion train was a locomotive engineer, a conductor, and two show conductors.[3] The excursion train departed Springdale, Arkansas, about 8:00 a.m. to travel to Van Buren, Arkansas.

[3] *Show conductors* were volunteers who served as tour guides, riding in the passenger cars and explaining the history of the railroad. They also served as hosts/hostesses and were trained in safety and first aid.

The trip proceeded without problems until the excursion train encountered slippery rail conditions about MP 366, where the train first stalled because of a reduction in adhesion. The excursion train regained traction and resumed movement, but it stalled again about MP 368.25. During interviews with investigators, the crew stated that the train had encountered slippery rail but had no other problems. The event recorder data confirm these statements.

After the train stalled the second time, the engineer contacted the A&M maintenance-of-way supervisor by radio and then called the train dispatcher on a cell phone and requested assistance.

At the time of the collision, 38 passengers and 1 show conductor occupied the last two cars of the train. One passenger and a show conductor were in the second car, and the lead passenger car was unoccupied. The engineer and the conductor occupied the cab of the locomotive.

Work Train

The work train crew, consisting of an engineer and a conductor, went on duty in Springdale, Arkansas, at 6:00 a.m. on the day of the accident. The crew then traveled by car to the train, which was located on a siding at MP 374.7 near Winslow, Arkansas. The work train crew was at Winslow when they received a cell phone call from the excursion train engineer.[4]

The A&M train dispatcher on duty on the day of the accident told investigators that she was controlling about six trains at the time of the collision, including the excursion train and the work train. When investigators asked whether she had communicated with either of the train crews before the accident, the train dispatcher said she had communicated with the excursion train earlier in the morning to issue a track warrant for movement on the main track. She said that the excursion train crew picked up the warrant in person. To the best of her recollection, both trains operated normally until she received a cell phone call from the excursion train engineer who said that the excursion train had stopped.

The dispatcher communicated with the crews of both trains by cell phone to determine a way to get help to the stopped excursion train. Subsequently, both crews called the A&M dispatcher on their company cell phones and arranged for an out-of-service track work authority to allow the work train to approach the stopped excursion train. The excursion train had authority to operate south all the way to Fort Smith, so the train dispatcher needed to rescind that movement authority before allowing any other train movement to the stopped excursion train. The dispatcher decided to take the main track out of service from the Winslow siding (the location of the work train) to the location of the stopped excursion train.[5] The dispatcher told NTSB investigators that both engineers had discussed the situation, and the work train engineer had suggested that the dispatcher remove the track from service and allow the work train to approach the stopped excursion train. The dispatcher told investigators she did not like to issue an out-of-service track

[4] Because of unreliable railroad radio communications, A&M employees were allowed to use company-approved cell phones for communication on this area of the railroad.

[5] Main Track Authorization, Rule 6.3 in *General Code of Operating Rules, 6th Edition* (April 2010) (https://web.archive.org/web/20130904121049/http:/www.transchool.lee.army.mil/rail-safety/documents/GCOR_6th_ed.pdf.)

authority so that one train could assist another, but because both engineers had discussed the situation, the dispatcher agreed to use the out-of-service authority. The dispatcher further stated that issuing an out-of-service track authority was not a normal practice and that she would rather see all trains working under track warrants.

The dispatcher gave the conductor of the work train the authority to operate on the out-of-service track. A&M operating rule 15.4, Protection When Tracks Removed from Service, which mirrors the rule with the same number and name in the *General Code of Operating Rules* (*GCOR*), covers this type of track authority. Rule 15.4 requires that a track must be protected before it is removed from service.[6] In most cases the dispatcher uses track bulletins to designate the limits of the tracks removed from service, and the bulletins indicate who is responsible for directing all movements. In addition, *GCOR* 15.4 (and A&M operating rule 15.4) required the work train to be operated at restricted speed.[7] A&M managers told investigators that the authority given to the train crew also was recorded on an A&M-specific Form D.[8]

The work train locomotive left Winslow siding and traveled north toward the stopped excursion train, which the engineer believed to be at MP 368.25. When the work train approached MP 366, it encountered a long descending grade. The data from the locomotive event recorder showed that the engineer had attempted to slow the speed of the locomotive. Because of the grade and the slippery residue from leaves on the tops of the rails between MPs 366 and 368, the engineer had difficulty controlling the speed of the locomotive.

About 46 minutes after it left Winslow, the work train, moving at 24 mph, struck the excursion train locomotive head on. Event recorder data show that just before the collision the independent air brakes of the work train locomotive were fully applied when the locomotive was about 230 feet from the excursion train. However, the work train could not stop in 230 feet, and it struck the excursion train. (See figure 2.)

The engineer and the conductor of the excursion train, who were in the cab of the locomotive, sustained minor injuries. The work train conductor jumped from the locomotive just before impact and sustained back and ankle injuries requiring admittance to a hospital. The work train engineer remained in the locomotive during the collision and sustained minor injuries. Thirty-nine passengers and four A&M employees were transported to local hospitals and medical centers with non-life threatening injuries.

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[6] *GCOR* (April 2010).

[7] (a) A&M operating rule 15.4 is also found in the *GCOR* under the same rule number. (b) *GCOR* rule 6.27 defines *restricted speed* as a speed that allows stopping within half the range of vision short of any train, engine, railroad car, people or equipment fouling the track, stop signal, or derail or switch lined improperly, and the crew must keep a lookout for broken rail and not exceed 20 mph.

[8] The A&M paper Form D was used under previous A&M operating rules, which were North American Railroad Operating Committee (NORAC) rules. The paper Form D was still in use at the time of the accident.

Figure 2. Locomotives of work train (left) and excursion train (right) after collision.

The collision caused the lead trucks of both locomotives to derail and all four cars of the excursion train to separate from the locomotive. The passenger cars rolled about 67 feet north. The train line air brake hose connections also pulled apart when the cars separated from the locomotive. The air brake control valves on the passenger cars sensed the rapid reduction of train line pressure, triggering an emergency brake application that stopped the movement of the cars.

Operations

A&M operating rule 15.4 and *GCOR* rule 15.4 require that all train movements on out-of-service maintenance-of-way track are made at restricted speed. The data from the work train locomotive event recorder show that the locomotive reached a speed of 35 mph during the move from Winslow siding toward MP 368. This speed violates Title 49 *Code of Federal Regulations* (*CFR*) 240.117(e). Under 49 *CFR* 240.117(c), "a certified engineer who has demonstrated a failure to comply, as described in paragraph (e) of this section, with railroad rules and practices for the safe operation of trains shall have certification revoked."

The train dispatcher directed the movement of trains and, when necessary, issued appropriate track warrants and track bulletins following the A&M *Dispatchers Rules* that govern the safe movement of trains over A&M tracks.[9] Specifically, Rule 23.8, Protection of Trains,

[9] Arkansas and Missouri Railroad, *Dispatchers Rules* (Springdale, Arkansas: Arkansas and Missouri Railroad).

describes procedures and contains instructions for using track warrants to allow two trains to work between specific points with overlapping limits. *GCOR* rule 14.4, Occupying Same Track Warrant Limits, also outlines this rule:

> A track warrant must not be issued to a train within the same or overlapping limits with another train unless …
>
> 1. In signaled territory, all trains are authorized to proceed in the same direction.
>
> 2. In non-signaled territory, all trains are authorized to proceed in the same direction and are instructed to move at restricted speed.
>
> 3. Two or more trains are authorized to "WORK BETWEEN" two specific points at restricted speed within the overlapping limits.
>
> 4. Trains are authorized to proceed through the limits of another train authoriz+*ed to "WORK BETWEEN" two specific points, and track warrants instruct all trains to move at restricted speed within the overlapping limits….

Also, A&M Dispatchers Rule 23.8 states, "If a cabooseless train becomes disabled and a relief train must be operated, authorize both trains to "WORK BETWEEN" specific points which are outlined in Rule 14.4."

Based on her conversations with both engineers, the train dispatcher removed the main track from service. The operating rules provide for removing tracks from service, but all movements within the limits of the out-of-service track must be made at restricted speed. The dispatcher removed from service the track from MP 374 to MP 366, and the work train entered the out-of-service track at MP 374.

The A&M training for train crews and train dispatchers neither specified clearly nor required issuing a joint track warrant authority, instead of an out-of-service track warrant, in a situation in which an out-of-service track warrant would commonly be issued. The dispatcher told investigators that out-of-service track warrants were used previously, but she preferred using joint track authority. This situation, in which the engineers of the two trains convinced the A&M train dispatcher to use an out-of-service track warrant instead of the more commonly used joint track warrant authority, shows that a minimum training standard for railroad train dispatchers should be established and dispatchers should periodically demonstrate that they meet the standard.

Communications

The A&M radio communications system consisted of base and portable radios. The railroad used four assigned radio channels for rail operations. Base radios were in Springdale, Arkansas, and Ft. Smith, Arkansas. A&M locomotives had cab-mounted radios, and most A&M highway vehicles had permanently mounted radios. A&M employees had hand-held radios. All A&M radios transmitted on the four railroad channels assigned to A&M operations. Employees used the radio channels designated for their job responsibilities.

The A&M base station radios had the best capability to contact other radios across the A&M system. The A&M train dispatcher used the base station radio in Springdale to conduct train operations. However, certain areas of the railroad had unreliable radio communications because of mountainous terrain in those areas. Therefore, A&M employees in jobs that required reliable communications in the areas with unreliable radio coverage used company-provided cell phones instead of radios for railroad operations. These phones were to be used as needed and only for company business in areas with unreliable radio communications.

Using cell phones as the only form of communication directly affected the operation of the work train locomotive. Cell phone records show that although the two locomotive engineers made calls to each other on the day of the accident, they did not call each other in the minutes before the impact. Had there been better radio communication, the work train and excursion train engineers and the dispatcher could have confirmed the location of the stopped excursion train. In addition, other A&M employees may have been able to hear the conversations and could have provided important information to both engineers, such as track conditions and visibility approaching the excursion train.

During postaccident interviews, the engineers recalled their cell phone conversations. Both engineers remembered referencing specific locations on the territory and their associated mileposts. During the conversation, the excursion train engineer needed to be sure the work train engineer knew where the stopped excursion train was. After the engineers talked, the work train engineer believed that he knew the location of the excursion train; he thought that it was stopped at the beginning of Clarey siding. However, the excursion train was 2 miles farther south than the beginning of Clarey siding; thus, the work train was closer to the stopped train than the work train engineer thought.

The engineers' recollections of their conversations contained discrepancies in their description and understanding of the location of the excursion train relative to Clarey siding, which was between MP 366 and MP 376. The work train engineer recalled that the excursion train engineer said his train was stopped at Clarey siding, but the excursion train engineer remembered saying that his train was south of Clarey siding. The work train engineer also remembered that the excursion train engineer confirmed that he was between Clarey siding and Woolsey crossing, which would have placed the train north of Clarey siding. However, in his interview, the excursion train engineer mentioned Woolsey only once and not when he described his location. He said that when he reached "the Woolsey area, which is about [MP] 365 … [he] received a lot more wheel slippage."[10] The excursion train engineer also recalled that he had told the work train engineer to contact him when he exited the tunnel at Winslow, near MP 375, but the work train engineer did not recall this instruction. During their two cell phone conversations, the engineers attempted to clarify what was being said, but they did not use formal communication procedures, such as repeating the important parts of the message to ensure that the location information was understood. Neither of the engineers used formal communication procedures during their two cell phone conversations.

[10] *Wheel slip* means that the wheel rotates on its axis at the point of contact with the rail. Wheel slip occurs when the total horsepower of the locomotive results in force output that is higher than the maximum tractive effort that the adhesion between rail and wheel can provide. *Tractive effort* is the force (at the wheel/rail interface) at a given speed that the locomotive exerts to move itself and any coupled cars.

The NTSB is concerned that when the engineers exchanged the critical information of the location of the excursion train their informal communications did not follow generally accepted best practices for communicating critical information and orders. Examples of these best practices include a repeat procedure in which the person who receives a radio transmission repeats it to the sender and the use of standard radio terms such as "over" and "out" to help eliminate confusion over the information content of the transmission and the end of the transmission. Train dispatchers use these practices regularly, and 49 *CFR* Part 220 requires dispatchers to use these practices when a communication contains any information, instruction, or advice that could affect the safety of a railroad.[11] These best practices help make communications more efficient and effective and reduce the number of errors.

The NTSB notes that in this accident the train dispatcher was not involved in the discussion of the location of the stopped excursion train. It is unclear whether including the train dispatcher in the conversations would have facilitated a more accurate exchange of information. Nonetheless, train crews often use a train dispatcher as an effective intermediary when exchanging critical information.

Management Oversight

As previously discussed, the investigation of this accident uncovered inadequate practices at the A&M. On the day of the accident, the work train engineer did not operate his train at restricted speed when the track had been taken out of service. When investigators interviewed the engineer, they learned that he had done this on other occasions. Additionally, the work train engineer, who had been operating trains while performing maintenance-of-way operations, had recently been on duty far longer than the time limits allowed under 49 *CFR* Part 228. Moreover, before he operated a train on the main track, he had been off duty for fewer hours than required by federal regulations. When they discussed the location of the stopped excursion train, the engineers of both the work train and the excursion train used informal radio and cell phone communications. The NTSB is concerned that these practices that occurred on the day of the accident had also occurred on previous occasions. It is management's responsibility to ensure that employees understand operating rules and regularly perform operations safely. Management must also identify procedures, rules, or regulations that are not followed or that are incorrectly implemented. A&M management did not take appropriate action to ensure that incorrect operating practices were stopped and corrected, which resulted in the poor operating practices on the day of the accident.

Mechanical

Equipment

The work train locomotive was moving at about 24 mph when it struck the stopped excursion train locomotive. The excursion train was about 375 feet long, and it weighed 400 tons. During the head-on collision, the stopped southbound excursion train was pushed to the north about 10 feet, and the leading truck of the locomotive derailed. The accident damaged the

[11] See 49 *CFR* Part 220, Subpart B, "Radio and Wireless Communication Procedures."

excursion train locomotive's rear plate, end sill, and rear truck assembly, and it damaged the work train's end sill and front plate.

The passenger cars in the excursion train uncoupled from the locomotive during the collision and travelled 67 feet north before the emergency brakes stopped the cars. All but one passenger and one show conductor were seated in the last two cars of the train—cars 108 and 105.

Car 108. The seating in the upper level dome area of car 108 remained intact, but several bench seats became detached from their anchors. Several tables separated from their mounting brackets during the collision. The seating in the lower level of the car included various types of lounge chairs that were not affixed to the floor and tables that were cantilevered off the side wall of the car. Several of these tables separated from the side wall of the car during the collision.

Car 105. The last car in the excursion train, car 105, had forward- and backward-facing steel-framed plush velvet bench seats anchored to the floor with steel fixtures. The seat backs could be moved to change the direction the seat was facing. The force of the collision moved the seat back direction on several seats, and some seats partially separated from their frames.

Sanding System and Adhesion

The excursion train locomotive had an automatic sanding system to improve traction during periods of reduced adhesion. The sanders were located on the front axle (axle 1) and the rear axle (axle 4) of the locomotive. Investigators confirmed that all the sand reservoirs on the train contained sand.

The maximum force that a locomotive can generate to pull a train is limited by the weight of the locomotive and the amount of adhesion it can maintain without wheel slip. Once a wheel starts to slip, a locomotive's pulling force is greatly reduced and can stall a train. When wheel slip occurs, the sanders drop sand onto the rail in front of the leading wheels of the locomotive. Sanding systems provide a higher adhesion coefficient, mitigating wheel slip by improving tractive effort.[12]

The excursion train engineer said that during his trip he began to experience reduced adhesion as he was entering the West Fork subdivision. He reported that the sanders came on automatically, and he backed the throttle off. He again experienced reduced adhesion, the sanders came on, and he backed off the throttle. He said that this occurred once more between MPs 367 and 368. At MP 368, he noticed that the rail was black and covered with crushed leafy organic material. This condition, known as black rail, reduces adhesion.

The excursion train engineer said that after the train stopped, at MP 368.25, he stepped off the locomotive to inspect the sanding system on axle 4 (the leading axle). He said that he heard air moving, but no sand was dropping onto the rail.

[12] The *adhesion coefficient* is the percentage of the total weight on the driving wheels of a locomotive that is available for traction. It is largely dependent on the condition of the rail, and can vary from a low of 10 percent on wet rail to a high of 40 percent on dry, sanded rail. The average coefficient of adhesion is about 25 percent.

Postaccident testing of the sanding system showed that the equipment on axle 1 operated as designed. The equipment on axle 4, which was the lead axle during the excursion trip, did not function. The sanding equipment on the excursion train locomotive was unable to provide the amount of sand necessary to mitigate the reduced adhesion the southbound excursion train was experiencing.

The work train locomotive also had an automatic sanding system to assist with traction. NTSB investigators verified that the locomotive reservoirs contained sand and then examined the system, discovering that axle 1, the leading axle during the rescue move, was cut out, or bypassed. In this condition, the sanding system could not function. Once the system was restored and axle 1 was no longer cut out, the sanders functioned as designed. However, the amount of sand distributed was not the same for all the wheels and varied from light to moderate.

Postaccident Action

Since the accident, the A&M has taken the following actions:

- Specified the employee qualifications required for working on A&M locomotives: Maintenance-of-way employees no longer operate A&M locomotives. Only Transportation Division employees currently qualified as engineers and conductors subject to federal hours-of-service regulations work in those assignments on A&M locomotives.

- Instituted a new hours-of-service record-keeping system with assistance from the FRA.

- Rewrote the A&M *Dispatchers Rules* with assistance from the FRA. An outside contractor now performs dispatching responsibilities on the A&M.

- Stopped using the Form D bulletin for reporting tracks that are out of service. If an excursion train emergency occurs, the dispatcher will protect the area where the train is stopped from other train movements, using appropriate operating rules. The dispatcher will coordinate this with the superintendent of transportation and railroad police.

- Retrained all employees (except administrative employees) in the new *GCOR* (*GCOR* 7), Hazmat, Airbrake and Train Handling rules, and Hours of Service rules.

- Updated maintenance and inspection processes, which now include using higher quality sand. In addition, the A&M installed a new sand tower to further minimize possible environmental contamination of sand being stored for use on A&M locomotives.

- Added a second locomotive to the consists of all excursion trains to increase total horsepower and minimize performance decrements caused by reduced adhesion.

After the accident, the FRA inspected the A&M locomotives and took no exception to the operation of any of the sanders since the A&M had made postaccident changes. The inspectors verified that the higher quality sand is adequate to prevent clogging from moisture in the sand, and they confirmed that the sanding systems on the A&M locomotives operated with improved reliability.

The A&M is upgrading and modernizing its radio communications system with a new tower, VHF repeaters, links to the dispatch system, upgraded portable and mobile radio units, new and upgraded locomotive radios, and links to wayside equipment systems. The A&M expects the modernization will be complete in early September 2017, including employee training and subsequent efficiency testing.

Previous NTSB Investigations

The NTSB has investigated other railroad accidents where informal radio communications contributed to the probable cause of an accident.

- In the August 30, 1991, collision of two freight trains near Ledger, Montana, the NTSB determined that the dispatcher and the train crew used "poor radio procedure practices."[13] Company management knew such practices existed, and those practices fostered an environment in which misunderstanding of radio communications could occur.

- In the January 17, 1999, collision of three freight trains near Bryan, Ohio, the NTSB found that "in some cases, [operating] crews used the radio to alert other crews to their speeds and locations, but … such communication can be inconsistent, and the quality of the transmissions cannot be ensured."[14] The NTSB further stated that "radio communication between trains, because it is *ad hoc*, can itself lead to misunderstandings that could compromise safety."

- In the May 19, 2004, train collision near Gunter, Texas, the NTSB concluded that "informal communications between the dispatcher and train crews regarding authority limits, train names, and meeting or stopping points led to misunderstandings and errors."[15]

[13] See National Transportation Safety Board, *Head-On Collision between Burlington Northern Railroad Freight Trains 602 and 603 near Ledger, Montana*, *August 30, 1991*, RAR-93/01 (Washington, DC: National Transportation Safety Board, 1991) at the NTSB home page (http://www.ntsb.gov).

[14] See National Transportation Safety Board, *Collision Involving Three Consolidated Rail Corporation Freight Trains Operating in Fog on a Double Main Track near Bryan, Ohio, January 17, 1999*. RAR-01/01 (Washington, DC: National Transportation Safety Board, 2001) at the NTSB home page.

[15] See National Transportation Safety Board, *Collision Between Two BNSF Railway Company Freight Trains Near Gunter, Texas, May 19, 2004,* RAR-06/02 (Washington, DC: National Transportation Safety Board, 2006) at NTSB home page.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the work train crew to comply with the restricted speed requirement that limited train speed to no more than 20 mph and their failure to be prepared to stop within one-half the range of vision when approaching the stopped excursion train. Contributing to the accident were the informal communications of the train dispatcher and both train crews.

Adopted: May 25, 2017

For more details about this accident, visit the NTSB Docket (https://dms.ntsb.gov/pubdms/) and search for NTSB accident identification number DCA15MR002.
