U.S. Department of Transportation
Federal Railroad Administration

Federal Railroad Administration, Office of Railroad Safety

Accident Investigation Summary Report HQ-2023-1813

Norfolk Southern Railway Company (NS)
East Palestine, OH - Derailment
February 3, 2023

1. EXECUTIVE SUMMARY

On February 3, 2023, at 8:54 pm EST, Norfolk Southern (NS) Train 32N derailed at Milepost (MP) 49.5 on main track 1 of NS's Fort Wayne Line Subdivision of the Keystone Division in East Palestine, Ohio. The train was 9,309 feet long, configured with two head-end locomotives and one distributed-power locomotive, and was hauling 149 freight cars, including 20 tank cars containing hazardous materials.

Three crew members were on the train during the accident. Immediately prior to the derailment, the engineer was in the process of slowing the train with dynamic braking in anticipation of a red signal ahead, when a critical alarm radio transmission was broadcast to the crew. The critical alarm indicated that the train had a "hotbox axle."

Thirty-eight cars derailed, including 11 of the 20 tank cars containing hazardous materials. Three of those tank cars were breached in the derailment, fueling a fire that damaged an additional 12 cars (none of which were carrying hazardous materials). Emergency responders implemented a one mile evacuation zone surrounding the derailment site, which affected approximately 2,100 residents of East Palestine for five days (from the evening of February 3, 2023, through February 8, 2023). There were no reported fatalities or injuries as a direct result of the derailment, but as of the date of this report, NS has reported to FRA 24 minor injuries (18 civilian and six remediation contractors) due to inhalation hazards as a result of the fire that resulted from the derailment and subsequent hazardous materials remediation activities. Both the Federal Railroad Administration (FRA) and the National Transportation Safety Board (NTSB) responded to the accident site to investigate, as did the Pipeline and Hazardous Materials Safety Administration (PHMSA). FRA's first safety inspector arrived at the accident site at approximately 2:00 am on February 4, 2024. Both PHMSA and FRA worked to support NTSB's investigation, and FRA conducted an investigation of the accident under its independent statutory authority at 49 U.S.C. §§ 20107 and 20902. This report documents the results of FRA's investigation.

FRA's investigation and analysis found that the probable cause of this accident was a failed

Date Report Issued: July 19, 2024

journal bearing (roller bearing)[1] on the 23rd car in the consist. FRA determined that NS's Advanced Train Control (ATC) desk procedures (which governed how information from hot box detectors (HBDs) was used and communicated to train crews) and the on-duty staffing levels for that desk may have been contributing factors to the cause of the accident. Additionally, FRA found that the use of a general-purpose DOT 111 specification tank car to transport butyl acrylate (a flammable liquid) contributed to the severity of the accident.

2. CIRCUMSTANCES PRIOR TO THE ACCIDENT AND NS'S HOT BEARING DETECTOR SYSTEM AND PROCESSES

Having departed Toledo, Ohio, at approximately 2:15 pm EST on February 3, 2023, Train 32N was traveling East on NS's main track 1 of the railroad's Fort Wayne Subdivision destined for Conway, Pennsylvania. The train was configured with two head-end locomotives, 149 rail cars, and one distributed power locomotive (located in the 112th position in the consist). The train was 9,309 feet long with a trailing tonnage of 17,977 tons. Train 32N's consist included 20 placarded hazardous materials tank cars (17 loads and 3 residues) and was traveling at 42 mph when the derailment occurred (which was under the maximum authorized speed of 50 mph).

The 20 hazardous materials tank cars in Train 32N's consist included flammable gasses and flammable and combustible liquids.[2] Because the train's consist contained fewer than 20 tank car loads of a Class 3 flammable liquid, it was not considered a "high-hazard flammable train" (HHFT) under the Federal hazardous materials transportation regulations (49 CFR Parts 171-180; HMR) and was not subject to the HMR's additional restrictions and information sharing requirements applicable to HHFTs.[3] Although Train 32N was not an HHFT, the train was traveling over a route HHFTs commonly traversed.

As train 32N traveled East on NS's main track 1 through LaCarne, Ohio, it passed 10 HBDs before reaching East Palestine, Ohio. As discussed in more detail below, HBDs are one type of wayside detector that railroads use to detect defective roller bearings of wheelsets that are mounted to on-track equipment. The first 9 HBD readings recorded the temperature of the left number 1 (L1) roller bearing on covered hopper car GPLX 75465 (the 23rd car in the train) as being between 21°F over the ambient air temperature to 44°F over the ambient temperature.[4] The 10th HBD at Salem, OH (approximately 19 miles before the HBD at East Palestine, Ohio) recorded a significant spike in the temperature of that roller bearing; that HBD recorded a

---

[1] The roller bearings of on-track equipment are the components of the equipment's wheelset that support the trucks (also called bogies) and allow the axles to rotate freely.

[2] *See* 49 CFR §§ 172.101 (hazardous materials table), 173.115 (defining Division 2.1 flammable gasses), and 173.120 (defining Class 3 flammable and combustible liquids). 49 CFR § 171.8 (defining "high-hazard flammable train" as a "single train transporting 20 or more loaded tank cars of a Class 3 flammable liquid in a continuous block or a single train carrying 35 or more loaded tank cars of a Class 3 flammable liquid throughout the train consist

[3] *See* 49 CFR 174.310 (operational restrictions for HHFTs) and 174.312 (HHFT information sharing notification for emergency response planning).

[4] The temperature of a properly functioning bearing will typically measure 20-25° above the ambient air temperature. The bearing temperature is compared to the ambient air temperature as a measure of the bearing's internal heat. An elevated internal bearing temperature indicates a defect developing within the bearing.

temperature of 103°F over ambient. 19 miles later at East Palestine, Ohio, the 11th HBD recorded a temperature of 253°F over ambient and an absolute alert for a hot bearing was immediately transmitted via radio to the crew. At the time of the absolute alert, the engineer was already in the process of slowing the train with dynamic braking in anticipation of a red signal ahead.

Hot Bearing Detectors, Generally

As noted above, HBDs are one type of wayside detector that railroads use to detect defective roller bearings of wheelsets that are mounted to on-track equipment. HBDs measure the temperature of wheel bearings on both ends of each axle (i.e., on both sides of a rail car) using infrared thermal detection systems.[5]

Generally, HBDs are designed to provide an alert when certain anomalies are detected, including:

- The difference between the temperature of a roller bearing surface and the ambient temperature exceeds a predetermined threshold (a "warm alarm" or "hot alarm");

- The temperature difference between a roller bearing and the mate bearing on the same axle exceeds a predetermined threshold (a "differential alarm"); or

- When other methods of calculating excessive roller bearing temperatures indicate a problem (e.g., when the readings of several HBDs indicate a trend of temperature increases).

An overheated bearing, if not addressed, will result in the bearing failing (commonly referred to as the bearing being "burnt off"). Overheated bearings result when the interior components of the bearing begin to rub together. The rubbing results in friction, which causes heat, which in turn degrades the bearing's lubrication. At some point the friction-generated heat causes the bearing's moving components to seize, and the bearing can no longer roll freely. When this happens, the axle begins to overheat, and ultimately the portion of the axle within the bearing fails and the truck is no longer supported, leading to the equipment's derailment.

NS HBD System Configuration and Processes

At the time of the derailment, NS's system of HBDs was configured to provide two types of alerts: (1) absolute alerts,[6] and (2) non-critical alerts. NS's system was designed to trigger an "absolute alert" if a roller bearing temperature was measured as being more than 200 °F over ambient temperature (a "hot alarm"), and to trigger a "non-critical alert" if a roller bearing's temperature was measured as:

[5]Another type of wayside detector used to detect defective roller bearings is acoustic bearing detectors (ABDs). ABDs are designed to automatically detect flaws in roller bearings by evaluating the acoustic signature of the noise created by a bearing flaw. ABDs are a newer technology and are only in limited locations across the U.S. FRA does not regulate wayside detectors, whether HBDs or ABDs.

[6] Although NS's Standard Operating Procedures governing its Wayside Help Desk at the time of derailment referred to "absolute" alerts, within the railroad industry, "absolute" alerts are often referred to as "critical" alerts.

(1) being more than 170 °F over ambient temperature (but not more than 200 °F over ambient temperature) (a "warm alarm");

(2) having a temperature of 115 °F more than its mate bearing on the same axle (a "differential alarm"); or

(3) as "trending" warm (e.g., when the readings of several HBDs indicate a trend of a certain level of temperature increases or a spike in a bearing's detected temperature between HBDs).

NS's HBD system was further designed to communicate absolute alerts and non-critical alerts differently. Absolute alerts were directly communicated to both NS's ATC desk and to the crew operating the train in which the equipment triggering the alert was located. Specifically, for absolute alerts, an electronic message would be sent to the ATC desk, and an audible "talker" alert would also be immediately transmitted via radio to the train crew. Non-critical alerts, however, were only communicated to NS's ATC desk via an electronic message. A train crew would be made aware of a non-critical alert only if the ATC desk analyst or some other party (e.g., a dispatcher once notified of the alert by the ATC desk analyst) contacted the crew directly.

At the time of the derailment, NS's ATC desk was staffed 24/7, in 12-hour shifts, with one analyst on duty each shift. That analyst, who worked remotely from their residence, was required to use NS's Wayside Diagnostic System (WDS) to monitor alerts from the entire NS system at any given time and to determine what action, if any, to take in response to the alert.

At the time of the accident, NS's WDS assigned three-digit codes to each type of alert. Two of the non-critical alerts included the "853" alert (Condemnable Bearing) and the "953" alert (Bearing Temperature Spike). The "853" alert was intended to indicate a roller bearing that was trending hot based off multiple readings from several HBDs. An 853 alert triggered the requirement for the equipment to be inspected, and NS's processes further required the ATC desk analyst to do the following: (1) talk to the train crew; and (2) e-mail the NS Network Operations Center (NOC). NS's processes did not provide any timeframe for completing these actions. The "953" alert was intended to indicate a single instance of a roller bearing starting to run at an elevated temperature. A 953 alert did not trigger a requirement for the equipment to be inspected. NS's processes only required the ATC desk analyst to do the following in the event of a 953 alert: (1) monitor; (2) talk to the train crew; and (3) e-mail the NOC. NS's processes did not establish any timeframe for completing these actions. The NS processes also had no specified process for alert escalation if the on-duty analyst did not respond to any active alerts nor did they specify what NOC personnel should do with the information about the 953 alert.

3. The Accident

On February 3, 2023, at 7:47 pm EST, Train 32N passed an HBD located in Sebring, Ohio, at MP PC79.8, and the HBD recorded the temperature of the left number 1 (L1) bearing on covered hopper car GPLX 75465 (the 23rd car in the train) as 38 °F over the ambient temperature.

Twenty-six minutes later (at 8:13 pm EST) Train 32N passed an HBD in Salem, Ohio, at MP PC69, and the HBD recorded the temperature of the same L1 bearing on GPLX 75465 as 103 °F over the ambient temperature. The HBD system sent a 953 alert to the ATC desk. Additionally, as the train passed the Salem HBD, a security camera mounted on a building near the track captured video of the same bearing emitting visible fire and sparks as it passed.

Thirty-three minutes later (at 8:46 pm EST), Train 32N, passed a security camera mounted on a building near the track at MP PC54.1 in New Waterford, Ohio. This video footage showed the L1 bearing on GPLX 75465 glowing as it passed.

Six minutes later (at approximately 8:52 pm EST), Train 32N passed an HBD in East Palestine, Ohio at MP PC49.8, and the HBD recorded the temperature of the same L1 bearing on GPLX 75465 as 253 °F over the ambient temperature. At approximately 8:53 pm EST, the HBD system sent an absolute alarm for a hot bearing to the crew of Train 32N, and an electronic alert to the ATC desk. Approximately 1 minute later, at 8:54 pm EST, the L1 bearing on GPLX 75465 failed completely, and GLPX 75465 derailed. The train came to a stop at the North Pleasant Drive public highway-rail grade crossing at MP PC 49.2 and an accordion style pile-up of derailed cars centered near MP PC 49.

The crew then radioed the dispatcher and the conductor went to inspect the train on foot. After observing the fire, the conductor returned to the cab and the crew radioed the dispatcher again and asked to cut their locomotives away from the train. The dispatcher approved the crew's request and the crew cut the locomotives away from the train and operated the locomotives to a location about one mile east of the derailment site. As trained, the crew then remained in the cab with a copy of the train's consist until instructed otherwise.

Thirty-eight cars derailed, beginning with GPLX 75465.[7] A fire ignited as a result of the overheated, failed journal bearing on GPLX 75465 and damaged an additional 12 cars (the cars in position 63 through 74 of the consist).

4. INVESTIGATION AND ANALYSIS

FRA conducted a comprehensive investigation and analysis of this accident. FRA's investigation included evaluation of each crew member's qualification, certification, and testing records, as well as the crew's actions. FRA took no exception to the crew's training, qualification, and testing records or to the crew's hours of service records. FRA also conducted a fatigue analysis of each crew member's relevant work/rest schedule and found no excessive fatigue risk. In addition, the results of each crew member's FRA Post-Accident Toxicological Testing were negative, indicating that neither drugs nor alcohol contributed to the cause or severity of the accident.

Similarly, FRA evaluated and took no exception to all aspects of the relevant signal and train control system; the track over which the train was traveling at the time of derailment; and the

[7] The cars in position 25 through 62 of the train's consist derailed.

various brake tests, equipment inspections, and repairs performed on the equipment in the train's consist prior to the derailment.

FRA notes that during inspection of the involved locomotives on February 5, 2023, NS removed the event recorder and provided the recorder data and video to the NTSB. On February 15, 2023, NTSB requested additional video – covering the operation of Train 32N past the last four HBDs. Because the locomotives had been placed back into service, the requested video had been written over. Although overriding this data did not violate FRA's regulations, FRA notes the importance of ensuring all video and data relevant to the facts and circumstances of an accident is preserved for the duration of an accident investigation. FRA issued a letter to the Class I industry on July 20, 2023, stating that FRA expects that the data on any locomotive recording device active at the time of an accident or incident will remain intact until FRA, and any other Federal agency, such as NTSB, has had an opportunity to review the data.

FRA's investigation identified that the point of derailment (POD) was at MP PC 49.5, but the train traveled another 1,368 feet, to the North Pleasant Drive public highway-rail grade crossing at MP PC 49.2, before coming to a stop due to an undesired emergency brake application.[8]

Based on the analysis below, FRA determined that the probable cause of the accident was the failure of a journal bearing on the 23rd car in the consist (GPLX 75465), which failed as result of overheating. FRA additionally found that NS's ATC desk procedures (which governed how information from HBDs was used and communicated to train crews) and the permitted on-duty staffing levels for that desk may have been contributing factors to the cause of the accident. Additionally, FRA found that the use of a general-purpose DOT 111 specification tank car, without a jacket or tank head puncture resistance system, to carry butyl acrylate contributed to the severity of the accident.

Train 32N's HBD Data Prior to Derailment

From its origination to the time of the derailment, Train 32N passed 39 HBDs. In the approximately 120 miles prior to the derailment, Train 32N passed 11 HBDs. Of those 11 HBDs, only the final detector triggered an absolute alarm to the train crew. That alarm alerted the train crew and ATC desk that the temperature of the L1 roller bearing on GPLX 75465 was 253 °F above ambient temperature. That absolute alarm sounded approximately one minute before the train derailed. However, in the hour before the train derailed, the HBD system sent one non-critical 953 alert to the ATC desk, and two different security camera videos captured evidence of the bearing on fire and emanating sparks and then glowing. FRA notes that NS neither owned the security cameras nor had access to their footage prior to the derailment.

Table 1 below details the time, location, train speed, and HBD readings for the L1 roller bearing on GPLX 75465 for the last 11 HBDs, along with the noted video evidence from the non-NS security cameras.

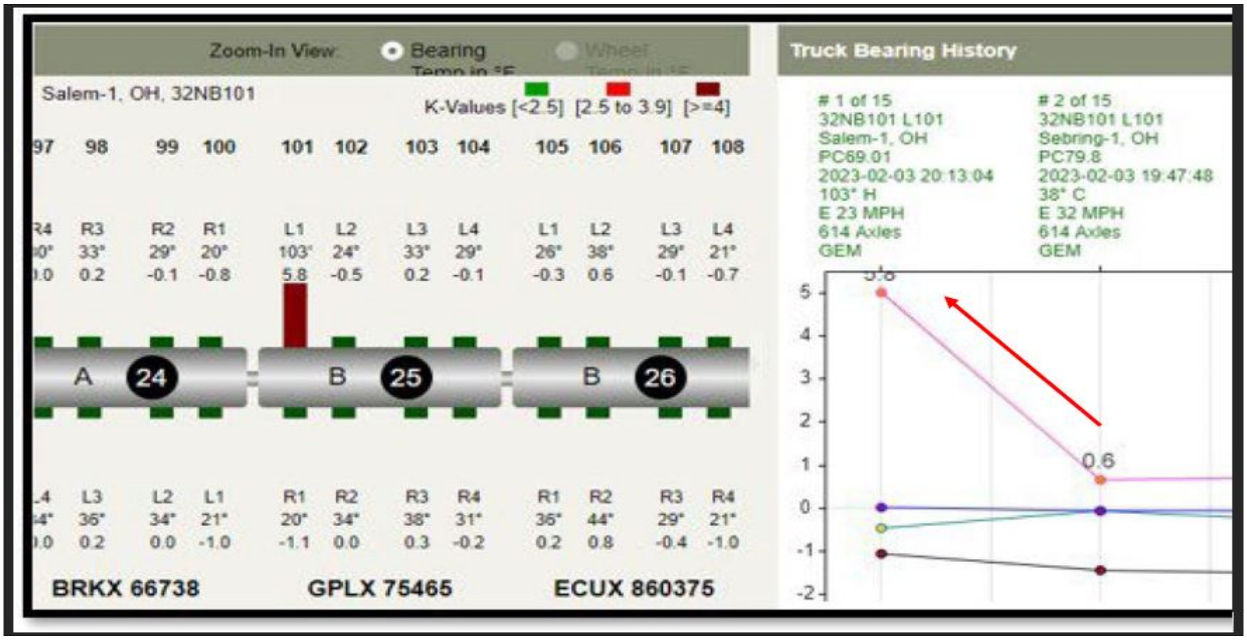
[8] An "undesired emergency brake application" means an unintentional and irretrievable brake application resulting in the maximum braking force available from a train's brake system. An undesired emergency brake application is not intentionally initiated by the crew and occurs when there is a separation in a train's air line and air pressure is released from the system (e.g., when a derailment occurs).

Table 1: Summary of HBD readings and surveillance video of February 3, 2023.

Time (EST)	City/State	MP	Train Speed (mph)	Alert Type	HBD reading of L1 roller bearing on GPLX 75465 (degrees over ambient temperature) / video summary
2:45 PM	LaCarne, OH	CD260.9	44	N/A	44 °F
3:19 PM	Sandusky, OH	CD239.3	44	N/A	41 °F
3:44 PM	Vermilion, OH	CD220.9	43	N/A	40 °F
4:16 PM	Olmstead Falls, OH	CD199.75	26	N/A	43 °F
5:14 PM	Cleveland, OH	CD187.4	20	N/A	25 °F
5:54 PM	Cleveland, OH	RD116.5	19	N/A	21 °F
6:38 PM	Twinsburg, OH	RD101.6	34	N/A	27 °F
7:13 PM	Rootstown, OH	RD81.0	30	N/A	43 °F
7:47 PM	Sebring, OH	PC79.8	32	N/A	38 °F
8:13 PM	Salem, OH	PC69.01	32	953	103 °F At the same time, security camera recorded visible fire and sparks emanating from bearing.
8:46 PM	New Waterford, OH	PC54.1	N/A	N/A	Security camera recorded bearing glowing as train passed.
8:52 PM	East Palestine, OH	PC49.8	44	ABSOLUTE ALERT	253 °F
8:54 PM	East Palestine, OH	PC49.2	38 CARS DERAILED		

Figure 1 below is a screen shot of the HBD information the WDS system provided to the ATC desk after Train 32N passed the HBD in Salem, Ohio.

Figure 1: HBD temperature data provided to ATC Desk.



NS's Handling of the HBD Data

Both an absolute alert and a non-critical 953 alert were issued leading up to the derailment. Table 2 shows the sequence of events immediately prior to and following the absolute alert transmitted after the train passed the HBD in East Palestine. At the time of the absolute alert, the train crew was already in the process of bringing Train 32N to a stop because of a red signal ahead.

Table 2: Sequence of events following Train 32Npassing HBD in East Palestine.

Time	Location	Description
8:52 (seconds unknown)	East Palestine HBD	Head end of Train passed HBD.
8:52:45	Car 23 of the consist (GPLX 75465 passes the HBD)	Absolute alarm condition recorded by HBD.
8:53:19	Milepost PC 49.8	Audible "talker" alert broadcasted to crew. (At this point the train was already in dynamic braking as engineer prepared to stop the train in response to a red signal.)
8:53 (after 8:53:19)	Milepost PC 49.5	L1 bearing on GPLX 75465 failed catastrophically.
8:54:23	Milepost PC 49.2	Train reached a highway-rail grade crossing. The train derailed and an undesired emergency brake application was recorded.

FRA interviewed the ATC desk analyst on duty during the time leading up to the derailment. Regarding the non-critical alert that was transmitted to the ATC desk after the train passed the

HBD Salem, the ATC analyst indicated that at around 8:13 p.m. EST, their attention was split between three absolute alerts on other trains. Due to their attention being focused on the three other trains, the analyst did not notice the non-critical 953 alert the Salem HBD generated.

Per the NS ATC SOP that was in effect on February 3, 2023, there was no specified timeframe in which the analyst was required to initiate any follow-up action to the 953 alert. Furthermore, even if the 953 alert had been noticed by the analyst, there was no requirement for the train to be stopped and inspected in response. An inspection would not have been required by NS policy unless an 853 alert had been logged.

FRA reviewed data downloads from the 11 HBD locations and reviewed the NS "MS-404 – Hot Bearing / Wheel Temperature Detector Systems" document, which governs the maintenance of HBDs and Hot Wheel Detectors (HWD). The calibration dates contained in the downloaded data indicated calibration procedures were performed within the required time intervals.

FRA, NS, and the HBD manufacturer conducted multiple field visits to the HBDs at Sebring, Salem, and East Palestine, Ohio, locations where they observed calibration tests. These tests indicated that the HBDs were working as intended. Accordingly, FRA's investigation concluded that while the HBD equipment relevant to this accident was working as designed and did not contribute to the accident, NS's ATC desk procedures in effect on February 3, 2023, may have contributed to the cause of the accident. Had there been a requirement for the train crew to stop and inspect the train following the issuance of the 953 alert, the crew may have identified the failing L1 roller bearing on GPLX 75465 before the derailment occurred. Additionally, NS's policy of staffing the ATC desk with only one analyst each 12-hour shift may have contributed to the 953 alert going unnoticed. Staffing the ATC desk with adequate personnel commensurate with the normal workload may have allowed proper attention to be paid to all incoming alerts.

Hazardous Materials

FRA's investigation found that NS and the offeror of the hazardous materials being transported in the train (Oxychem) had complied with all required hazardous materials documentation, package marking, labeling, and emergency response information requirements. Additionally, FRA found that Oxychem had selected the regulatorily approved packages and performed its pre-transportation functions in compliance with all applicable regulations.

Train 32N's consist included 20 tank cars containing hazardous materials. Eleven of those tank cars derailed when the L1 roller bearing on covered hopper GPLX 75465 failed. Table 3 details the position in the train of each derailed hazardous materials tank car, the DOT specification of that car, the hazardous material each car was transporting, as well as the damage to the cars that resulted from the derailment and/or resulting fire, and the estimated amount of product lost from each tank car.

Table 3: Tank cars transporting hazardous materials involved in the derailment.

Train Position	Car Number	Car Specification	Product	Hazard	Car Damage Summary/ Product Loss

				Class No.[9]	
28	TILX 402025	DOT105J300W	Vinyl Chloride, Stabilized	2.1	No Leak
29	OCPX 80235	DOT105J300W	Vinyl Chloride, Stabilized	2.1	No Leak, Melted aluminum housing cover
30	OCPX 80179	DOT105J300W	Vinyl Chloride, Stabilized	2.1	No Leak, Melted aluminum housing cover
31	GATX 95098	DOT105J300W	Vinyl Chloride, Stabilized	2.1	No Leak, Melted aluminum housing cover
36	SHPX 211226	DOT111S100W 1	Combustible Liquid, N.O.S. (Ethylene Glycol Monobutyl Ether)	3, PG III	Entire Load, B-end head cracked, open bottom outlet valve
38	DOWX 73168	DOT111S100W 1	Combustible Liquid N.O.S. (2-Ethyl Hexyl Acrylate)	3, PG III	Partial Load; B-end head cracked, A-end head puncture
49	NATX 35844	DOT105J300W	Isobutylene	2.1	No Leak, fire damage only
50	UTLX 205907	DOT111A100W 1	Butyl Acrylates, Stabilized	3, PG III	Entire load, A/B-end head punctures; manway gasket burned
55	OCPX 80370	DOT105J300W	Vinyl Chloride, Stabilized	2.1	No Leak
59	DPRX 259013	DOT111A100W 1	Benzene (Residue)	3, PG II	No Leak, Fire damage only
60	DPRX 258671	DOT111A100W 1	Benzene (Residue)	3, PG II	No Leak, Fire damage only

Notably, three specification DOT 111 tank cars were breached in the derailment resulting in the release of product upon impact (i.e., the cars in positions 36, 38, and 50 noted in Table 3 above). In particular, the DOT 111 tank car in position 50 in the consist (containing butyl acrylates, a flammable liquid) was punctured and, as a result, released its contents which ignited and formed a pool fire. Notably, that tank car was a general-purpose DOT 111 tank car that was not equipped with a jacket, tank head puncture resistance system, or thermal protection system. In addition, an adjacent hopper car containing non-hazardous plastic pellets was also breached, with the plastic pellets igniting and helping to sustain the pool fire. The long burning pool fire then impinged on the DOT 105 tank cars containing vinyl chloride, another flammable gas.

On February 6, 2024, as the pool fire continued to burn, engulfing additional tank cars, NS and its contractors recommended the Incident Commander approve the execution of a vent and burn operation on the five DOT-105 tank cars carrying vinyl chloride (the cars in positions 28, 29, 30, 31, and 55 of the consist).[10] Notably, these DOT 105 tank cars were not breached in the

[9] A hazardous material's hazard class defines the nature of the physical or health hazard the material presents. A Class 2.1 hazardous material is a flammable gas, while a Class 3 material is a flammable or combustible liquid. *See* 49 CFR § 172.102.

[10] Vent and burn operations are rare and such operations are generally undertaken to (1) mitigate the risk of an explosive release of hazardous materials in the event of a runaway polymerization of the material due to prolonged exposure to the pool fire; and (2) to prevent the catastrophic failure of the tank cars during reclamation activities. A vent and burn operation involves the strategic placement of small explosive charges on each tank car. One charge is placed on the tank over the vapor space. The second charge is placed at the lowest location on the tank. Once detonated, the top charge provides venting so the liquid can flow from the tank. The bottom charge opens the

derailment, but they were severely damaged due to the pool fire. FRA neither made, directed, nor participated in the decision to conduct vent and burn operations,.

5. CONCLUSION

FRA's investigation and analysis of this accident determined that the probable cause of the accident was the failure of the L1 roller bearing on covered hopper car GPLX 75465. The bearing failed as a result of overheating. Potential contributing causes leading to this derailment include NS's ATC desk processes and procedures and on-duty staffing levels in effect on February 3, 2023. Additionally, FRA determined that the use of a general-purpose DOT 111 specification tank car to carry butyl acrylate, a flammable liquid, contributed to the severity of the accident, because it was not equipped with a jacket, tank head puncture resistance system, or thermal protection system. This tank car was breached, and the subsequent release and ignition of the flammable liquid initiated a pool fire that ignited other derailment debris (i.e., plastic pellets from an adjacent breached car). The debris then sustained the pool fire that impinged the tank cars containing vinyl chloride.

bottom of the tank, allowing the liquid to flow and igniting the liquid as is drains into a pit for a controlled burn.