Federal Railroad Administration

Office of Railroad Safety

Summary Report

BNSF Railway Company (BNSF) Derailment
FRA Accident No. HQ-2020-1401
Custer, Washington
December 22, 2020

Synopsis

On December 22, 2020, at 11:40 a.m. PST, a westbound BNSF Railway (BNSF) loaded petroleum crude oil train, U-TNDFEP0-36T (Train 1), derailed 10 loaded crude oil tank cars on yard track 4002 at BNSF Milepost (MP) 111.7 at Custer, Washington. The derailment resulted in three of the 10 derailed cars catching fire. During the fire, Whatcom County Sheriff's Deputies evacuated approximately 120 persons from homes and businesses within a ½-mile radius of the derailment site, and closed Interstate 5 in both directions between Exit 270 and Exit 266 for four hours. Opening Interstate 5 north and south bound lanes allowed residents to return to their homes early that same evening. No members of the crew from Train 1 were injured and no civilian injuries were reported.

BNSF Derailment, Custer, WA December 22, 2020

The 10 derailed tank cars were located at positions 59 through 68 from the head-end of the train. Train 1 had separated in two parts and derailed when the rear end section of the train (lines 63-108 plus two Distributed Power Unit [DPU] locomotives) traveling at a recorded speed of 21 miles per hour (mph) collided with the head-end section (lines 1-62 plus two head end locomotives) of the train traveling at a recorded speed of 7 mph. The derailment site is located on BNSF's Bellingham Subdivision approximately 104 miles north of Seattle, Washington, and nine miles south of the Canadian Border.

The method of operation at the accident site is other than main track, movement at restricted speed. Train 1 had been secured on BNSF's Bellingham Subdivision main track one at Control Point (CP) Custer, MP 111.2. The loaded petroleum crude oil train was re-crewed with a BNSF local switch crew, R-NWE8011-22I, who operated the train from its secured location onto Custer yard track 4002. This movement routed the train onto BNSF's Cherry Point Subdivision and toward the train's destination of Phillips 66 Refinery in Ferndale, Washington.

Train 1's power configuration consisted of two locomotives located on the head-end of the train and two DPU locomotives on the rear of the train. The train consist contained 108 loaded rail cars (106 loaded petroleum crude oil tank cars and 2 buffer cars) and was 6,669 feet in total train length with 15,279 trailing tons.

While the Bellingham Subdivision is an Amtrak route, due to the COVID-19 border closure with Canada, no Amtrak trains were running on the Bellingham Subdivision at the time of the derailment. This accident was not Positive Train Control (PTC) preventable. The railroad reported $751,880 in equipment damage and $100,000 in track damage. The derailment caused approximately 225,612 liquid-pounds of petroleum crude oil to be released from three loaded tank cars.

At the time of the derailment, it was daylight and foggy with no wind recorded and a slight snow cover on the ground. The temperature was 30°F.

The Federal Railroad Administration determined that the contributing causes listed below likely led to the derailment of Train 1 because the unlocked coupler pins caused the train to separate, and the closed or partially closed angle cocks prevented the train from experiencing an emergency application of the air brakes upon movement.

Contributing causes:

- BNSF management's failure to notify employees about vandalism events to heighten their crews' situational awareness.
- BNSF's failure to comply with Federal requirements regarding the securement of key trains.
- Crews did not perform "train check" function.
- Possible vandalism.

Circumstances Prior to Accident

On December 18, 2020, at 7:20 a.m. CST, Train 1 was released for shipment to BNSF from the Phillips 66 petroleum crude oil loading facility in Trenton, North Dakota, with a destination of the Phillips 66 Refinery in Ferndale on BNSF's Cherry Point Subdivision. Train 1, from head end to rear end, was configured 2 x 2, consisting of two head end locomotives, BNSF 5215 and BNSF 5949, 108 loads, 0 empties, 6,669 feet in total train length with 15,279 trailing tons and two rear DPU locomotives, BNSF 4723 and BNSF 7866. The 108 loads consisted of 106 petroleum crude oil tank carloads and two hopper loads of sand placed as buffer cars.

Train 1 was listed as one of BNSF's extended haul trains traversing between Trenton and Ferndale. The Phillips 66 loading facility in Trenton is configured with a loop track (the train is never separated), while the receiving Phillips 66 location in Ferndale is configured with several separate unloading tracks. The train is broken up at the Ferndale facility receiving its initial terminal Class I air brake test at this location prior to departing east to Trenton, for reloading. All extended haul air brake tests are conducted by qualified mechanical employees at the intermediate point at the BNSF Havre Yard located in Havre, Montana. In accordance with BNSF's extended haul plan for the train, Train 1's extended haul air brake inspection, with no exceptions noted, was conducted at 2:39 a.m. MST, on December 19, 2020, at BNSF's Havre Yard. Train 1 continued west with no equipment restrictions and no scheduled setouts or pickups enroute, and arrived at BNSF's Balmer Yard in Seattle, Washington, on December 21, 2020, where it was secured due to increased traffic scheduling on the Bellingham and Cherry Point Subdivisions.

The original crew called to take the train from Balmer Yard to the destination at Phillips 66 Refinery consisted of an engineer and a conductor from Everett, WA. The crew reported for duty at their home terminal at BNSF's Delta Yard in Everett, at 9:45 p.m. PST, on December 21, 2020, after completing the required statutory off-duty period. Once they collected the necessary paperwork, including the train profile and general track bulletins, the crew was transported via BNSF transport van to the secured train at Balmer Yard. The Everett train crew, with the engineer seated at the locomotive controls and the conductor seated in the conductor's seat of the lead locomotive, departed Balmer Yard at 12:59 a.m. PST, on December 22, 2020, with no setouts or pickups scheduled or performed enroute.

The crew was assigned to operate the train northward approximately 142 track miles from Balmer Yard on BNSF's Scenic Subdivision onto BNSF Bellingham Subdivision, and terminate at the Phillips 66 Refinery on BNSF's Cherry Point Subdivision in Ferndale. The portion of the Scenic and Bellingham Subdivision the crew traversed operates geographically north and south, while the Cherry Point Subdivision operates geographically east and west. Scenic and Cherry Point Timetable directions are listed east and west, with the Bellingham Subdivision listed as north and south.[1] A traffic control system (TCS) is the method of operation on the Scenic and Bellingham Subdivisions. The maximum authorized speed on the Scenic Subdivision is 55 mph, and 60 mph for the Bellingham Subdivision. The Cherry Point Subdivision movements are governed by Track Warrant Control (TWC) and other than main track movement (General Code Operating Rule [GCOR] 6.28), with a maximum authorized speed of 25 mph and restricted speed.

The Everett crew told FRA during interviews that the trip was uneventful from the departure at Balmer Yard to securement of the train at Control Point (CP) Custer at MP 111.2 on the Bellingham Subdivision, and they took no exception to the head end locomotives, the DPU consist, the train consist, or how the train handled. They explained that the only delays they incurred during the trip were getting through Bayside Yard in Everett, waiting for two south bound trains to clear at Delta Junction, and making a few rolling meets along the route. The Everett engineer stated that, once Train 1 cleared the 10-mph speed restriction on Bridge 38, he engaged Train 1's Trip Optimizer (TO), which ran the train until they received a "medium"

[1] Timetable direction will be used throughout this report.

signal indication at CP Aldergrove at MP 108.1 followed by an "approach" signal indication at intermediate signal MP 109.7. The Everett engineer stated he set his distance counter at the Grandview Road crossing at MP 109.3 and, once clear of the crossing, he brought Train 1 to a stop with the head end between intermediate signal 109.7 and CP Custer on main track one.[2]

The Everett crew explained that the dispatcher had radioed them about a stalled oil train ahead of them on the Cherry Point Subdivision that was getting relieved by a local road switcher crew, and that it would be awhile before he could move them. Everett crewmembers remember the dispatcher radioing them later to instruct them to secure Train 1 because they were getting relieved due to the stalled train ahead limiting them on their hours of service. Everett crew members stated they had to move Train 1 north approximately 700 feet to a carman's crossing at approximately MP 110.94, where the BNSF transport van could access them. Everett crew members moved Train 1 to the carman's crossing, applied hand brakes on the head end locomotives and railcars, verified the hand brakes would hold by releasing the train's automatic brake, briefed the key train securement requirements to the dispatcher, locked the locomotive, got in the van, and returned to Everett Yard to tie up.[3]

The track approaching the derailment site traveling north at Train 1's location from CP Custer on main track one into Custer Siding/track 4002 is straight, traversing one public crossing at MP 111.77 and has no curves or obstructions to limit visibility. From MP 110.8 to MP 111.3, the grade descends -.8 percent, then levels out for 0.4 miles to MP 111.7. The track then slightly descends -.24 percent to MP 112. The track ascends +.5 percent from MP 112 onto the south leg of Custer Wye on the Cherry Point Subdivision.

At approximately 11:10 a.m. PST on December 22, 2020, BNSF local switch crew R-NWE8011-22I (relief crew), instructed by BNSF local management to deliver Train 1 to the Phillips 66 Refinery before starting their own work on the Cherry Point Subdivision, arrived at Train 1 at CP Custer. Train 1 had been stopped at CP Custer, MP 111.2, on BNSF's Bellingham Subdivision main track one on the morning of December 22, 2020, for 5 hours, 1 minute, and 17 seconds. Train 1 had been attended by the Everett crew for 2 hours, 2 minutes, and 24 seconds, and was then left secured unattended for 2 hours, 58 minutes, and 53 seconds, prior to the relief crew's arrival.[4]

The relief crew consisted of an engineer, a conductor, and a brakeman. All members of the relief crew reported for duty at BNSF's Swift Yard office in Blaine, Washington. The relief crew conductor was called off the Bellingham extra board, went on duty at 7:00 a.m. PST, December 22, 2020, with a reporting time of 7:30 a.m. at Swift Yard. The conductor call time included the 30-minute deadhead from Bellingham to Swift. The relief crew engineer who was also called off the Bellingham extra board and was placed on duty in Bellingham at 9:50 a.m. PST, December 22, 2020, with instruction to report to Swift Yard. The relief crew brakeman was a regular on

[2] The locomotive event recorder confirms this stop occurred December 22, 2020, at 06:19:44 a.m. PST.
[3] The locomotive event recorder confirms this occurred December 22, 2020, at 08:22:08 a.m. PST.
[4] The locomotive event recorder confirms the first stop at CP Custer by the Everett crew at 6:19:44 a.m. PST. The locomotive download confirms the second stop occurred after the Everett crew pulled down 700 feet to be relieved at 8:22:08 a.m. PST. The locomotive download confirms the final stop at CP Custer by the Everett crew at 8:22:08 a.m. PST, and the relief crew releasing the automatic brakes at 11:21:01 a.m. PST.

job R-NWE801-1, with a no-call regular report for duty at Swift Yard at 7:30 a.m. PST, December 22, 2020.

All members of the relief crew participated in a job briefing prior to departing Swift Yard. A BNSF transport van delivered the relief crew to the head end of Train 1, where the engineer and conductor unlocked the lead locomotive cab and boarded the train. The brakeman, per the job briefing, stayed with the BNSF transport van to protect the shove of the train should it stall out on the Cherry Point Subdivision grade heading to Phillips 66 Refinery. This usually occurs when there is moisture on the rail.

As the relief crew engineer and conductor readied the train for movement by releasing handbrakes on the secured oil cars and head end locomotives, the brakeman positioned himself at Valley View Yard and waited in the transport van to observe Train 1.

Once ready to depart, the relief crew radioed the BNSF dispatcher via channel 76 advising they were ready to proceed towards the Cherry Point Subdivision and the Phillips 66 Refinery. Dispatcher 76 informed them he was running the M-EVECUS1-21T around them first and would then give them a signal indication into track 4002/Custer siding. The M-EVECUS1-21T traveled northbound from main track two through the CP Custer crossovers into track 4002/Custer siding, eventually stopping between switches of the Custer Wye. They repositioned the south leg of the Custer Wye switch for Train 1's movement onto the Cherry Point Subdivision. Shortly after the M-EVECUS1-21T ran around Train 1 into the Custer siding, the relief crew received a restricting signal indication for Train 1 to proceed.

The Accident:

At 11:29 a.m. PST, the relief crew began their northbound move into track 4002/Custer siding. At approximately 11:40 a.m. PST, eleven minutes later, and only 0.5 miles down the track, Train 1 derailed 10 cars. FRA inspectors obtained security camera footage from the Bonneville Power Administration (BPA), Custer Substation complex, showing Train 1's arrival and departure at CP Custer. During the train's departure from CP Custer, the train was clearly seen separating into two sections, with approximately 17 seconds of spacing between the head end and rear end sections of the train. After viewing the BPA camera footage, locomotive event reorder downloads and evidence at the accident scene, FRA determined the leading A-end of rail car TILX 360655 from the rear section of Train 1, impacted the trailing A-end of rail car PPRX 172745 and caused the train to derail and the subsequent fire. At impact, the front section of Train 1 was traveling 7 mph and the rear section was travelling 21 mph.

FRA's investigation and evaluation of the evidence, including track charts and geography, concluded that the initial 17 second separation in the train could have been due to differences in train make-up between the two separated sections; slack in the train; and slight time delays in communications between the head end locomotive and DPU. Further, the difference in speed between the front section and rear section was due to the action of the engineer using dynamic braking and throttle adjustments for the front section while the rear section was increasing speed due to gravity. At the point of derailment (POD), there was a "bowl" effect where the front section was on an ascending grade and the rear section was on a descending grade.

A summary of engineer actions controlling the train:

1. Started with throttle in synchronous mode (sync), both head end and DPU's working power.
2. Approximately 2 minutes later came out of sync mode and put the "fence" up between the head end and DPU's. With the "fence" up, there was power only on the head end with the DPU's in idle (head end moving 7.5 mph, DPU moving 7.3 mph).
3. Approximately 30 seconds later, with the "fence" up, went into dynamic braking on the head end and DPU's still in idle (head end moving 10 mph, DPU moving 8.3 mph).
4. Approximately 3 minutes later, drops the "fence" and went back into sync mode working dynamic braking on the head end and DPU's (head end moving 12.8 mph, DPU moving 9.5 mph).
5. Approximately 3 ½ minutes later, still in sync mode, goes back into throttle until the train goes into emergency after the rear section impacted the front section.

Upon impact, the train experienced an undesired emergency application of the train brake system and came to a stop. Complying with railroad rules, crew members called out "emergency" over the radio. *See* GCOR 2.10. The brakeman, who was waiting in the van at Valley View Yard, heard this and radioed back that he would come pick up the conductor to investigate the reason Train 1 went into emergency. At the same time, crew members of the M-EVECUS1-21T, who were stopped between switches of the Custer Wye, heard the impact and observed the rail car explosions and plumes of smoke. They radioed the crew of Train 1 to verify they were okay and informed them their train was on fire.

The brakeman assigned to Train 1 radioed the engineer again reminding him to go back to BNSF Dispatcher channel 76 for the emergency call out as they had job briefed before switching channels for the Cherry Point Subdivision. As the Train 1 engineer radioed the dispatcher about the derailment, explosions, and smoke plumes, the brakeman picked up the conductor and they were working their way back to the derailment site.

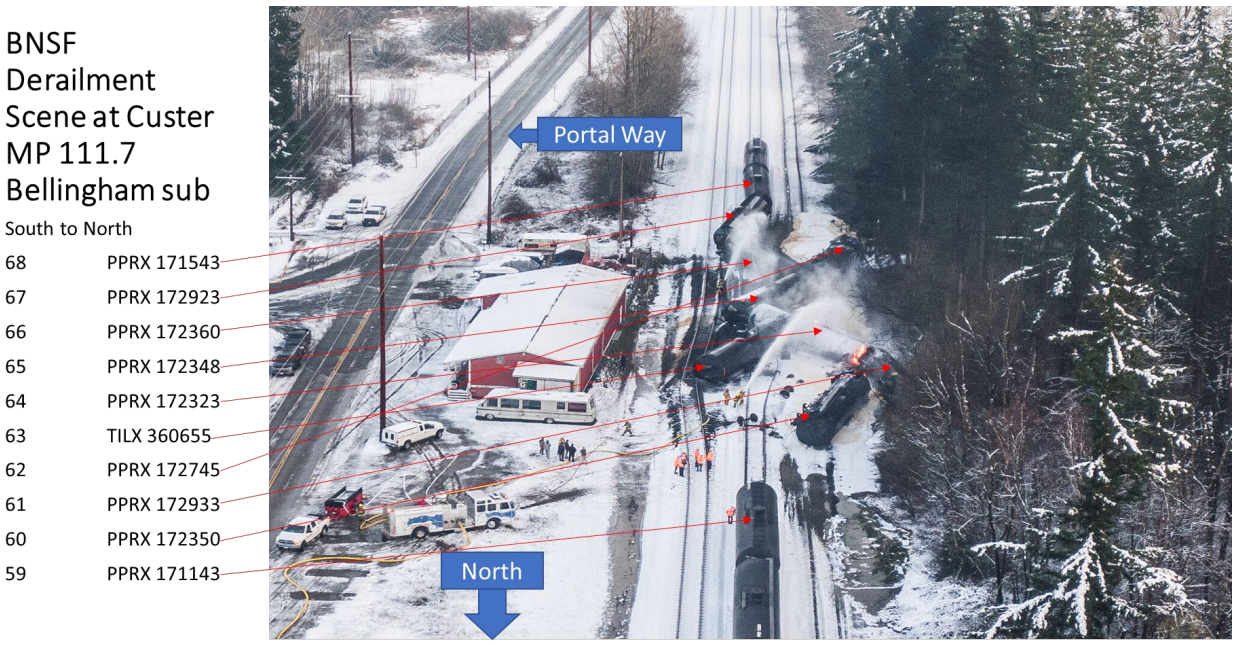
By the time the train conductor and brakeman reached the POD, Whatcom County Sheriff's Department and Fire Department were on scene. After the train crew briefed with a local fireman, it was decided they would secure handbrakes on the three railcars (lines 58-56) north of the northernmost derailed car, which was PPRX 171143. PPRX 171143 derailed standing upright with the rear truck on the ground. After securing the handbrakes, Train 1's conductor made a cut between the fourth (line 56) and fifth (line 55) cars north of derailed car PPRX 171143, instructing the engineer to take the head end section of the train ahead to Valley View Yard. The train's brakeman stayed at the derailment site while the conductor and engineer secured the head end section of Train 1 at Valley View Yard.

Train 1's conductor and engineer then traveled by BNSF transport van to the rear DPU's and set the consist up as head end power. With the train's brakeman already in position at the derailment site, the brakeman secured the handbrake on the car south of the southernmost derailed car, which was PPRX 171543. PPRX 171543 was standing upright with one set of trucks on the ground. Train 1's brakeman made a cut on the rear section of the train. The conductor and

engineer pulled the train's rear section south to Ferndale, at MP 106.4, on BNSF's Bellingham Subdivision and secured it. All crew members were taken to BNSF's Swift Yard office in Blaine, where they waited about 30 minutes for a BNSF manager to arrive and take them to get drug and alcohol tested.

The investigation revealed a total of 10 tank cars derailed, running from position 59 through 68 measured from the head of the train. As three of the derailed petroleum crude oil tank cars caught fire, Whatcom County Sheriff's Deputies ordered a partial evacuation of the local population, removing approximately 120 persons from homes and businesses within a ½-mile radius of the derailment site. The Deputies also closed Interstate 5 in both directions between Exit 270 and Exit 266 for four hours. Opening Interstate 5 northbound and southbound lanes allowed residents to return to their homes early that same evening. No members of the crew from the train were injured and no civilian injuries were reported.

The point of derailment (POD) was determined to be at MP 111.7 (GPS Coordinates 48°54'59.4"N 122°38'22.9"W and latitude +48.916498, longitude -122.639699), with the general pile-up occurring on track 4002/Custer siding.



Angle cock found on B end (north) of line 60, PPRX 172350. Its coupler was broken and still attached to line 59, PPRX 171143. Train separation as seen by BPA video was between line 62, PPRX 172745 and line 63, TILX 360655.

Hazardous Materials

Due to the derailment, three of the 10 derailed cars released 225,612 liquid-pounds of petroleum crude oil labeled with a Hazardous Material UN Code of 1267, Class 3, Packing Group I. Nine of the tank cars in the train were general purpose specification DOT-117R100W, with one tank car specification as DOT-117J100W. The nine DOT-117R100W tank cars were retrofitted

DOT-111A100W1 tank cars equipped with full-height head shields, metal jackets with insulation, and a thermal protection system to include a reclosing pressure relief device and thermal protection blanket. Each tank car has the capacity of holding approximately 29,200 gallons of petroleum crude oil.

Of the 10 derailed cars, two came to rest upside down, four on their side, and four remained upright, with three releasing product and catching fire. Below is a list of the 10-petroleum crude oil rail cars that derailed, and the amount of product released from each car:

Position in Train	Car Number	Comments	Volume Released
59	PPRX 171143	Upright	N/A
60	PPRX 172350	Upside Down	N/A
61	PPRX 172933	On left side, fire damage	68,334 Liquid Pounds
62	PPRX 172745	Upside Down, fire damage	142,991 Liquid Pounds
63	TILX 360655	Upright	N/A
64	PPRX 172323	On left side, fire damage	14,287 Liquid Pounds
65	PPRX 172348	Leaning on right side	N/A
66	PPRX 172360	On right side	N/A
67	PPRX 172923	Upright	N/A
68	PPRX 171543	Upright	N/A

There were no fatalities or injuries resulting from the release of petroleum crude oil.

Emergency Response

The Whatcom County Fire and Whatcom County Sheriff's Departments responded quickly to the train derailment on December 22, 2020. The Whatcom County Fire Chief assumed the role of the local incident commander while working with the Whatcom County Sheriff's Office and nearby oil refinery response teams from BP Cherry Point and Phillips 66. The Whatcom County Sheriff's Office began evacuating residents and businesses located in a 1/2-mile radius around the derailment area. Later in the day, a formal Unified Command structure was established at the

Custer Elementary School located near the derailment site. There was no evacuation necessary for the school as COVID-19 precautions had schools shut down for attendance. BNSF personnel, local fire and police departments, state of Washington Utilities and Transportation (UTC) rail personnel, Department of Ecology, the SERP[5] HAZMAT Team, several local oil refinery response teams, and environmental contractors responded to the derailment. Due to recent vandalism and tampering incidents along the BNSF Bellingham Subdivision, a Federal Bureau of Investigation (FBI) task force had been assigned and the FBI also responded. At the time of FRA's report, the FBI investigation is still open.

Three fire departments worked together to lay the ground water lines from fire hydrants to initialize the cooling process. Two teams attacked the fire simultaneously at its midpoint while the third team concentrated their efforts on the south end of the derailment. The SERP HAZMAT team arrived, becoming the liaison between Whatcom County Fire Districts and the Incident Command. Shortly after, BP Cherry Point and Phillips 66 Refinery response teams arrived and, after receiving instruction from SERP, began applying foam to the fires around the derailed tank cars. At approximately 1:54 p.m. PST, December 22, 2020, once the foam operation was in full force, the three main fires were extinguished. It was decided amongst the group to leave the three small controlled fires burning at each car, due to ease of letting the fires burn rather than remove the product, until the remaining product could be trans loaded out of the tank cars. The trans loading and final extinguishment of all fires occurred around 7:00 p.m. PST, on December 22, 2020.

Once the fires were out, before anyone could access the derailment site, the FBI closed the area to conduct their investigation. All parties were allowed access to the derailment site at 8:00 a.m. PST on December 23, 2020. The cleanup and restoration phase began at that time.

Post-Accident/Incident Investigation

On December 22, 2020, FRA began an investigation of the accident, including conducting crew interviews and beginning document recovery. FRA's onsite investigation began on December 23, 2020, after the FBI released the accident scene. FRA investigators requested and received all records, forms, and other documentation necessary to conduct their final analysis and draw conclusions concerning the pertinent facts of the accident. The following analysis and conclusions, as well as the probable cause and any possible contributing factors represent the findings of FRA's investigation.

Analysis and Conclusions

Analysis - FRA Post Accident-Toxicological Testing: The accident/incident met the criteria for FRA Post-Accident Toxicological Testing, as required under Title 49 Code of Federal Regulations (CFR) part 219, subpart C.

Conclusion: Test results were negative for the engineer, conductor, and brakeman on Train

[5] S.E.R.P Specialized Emergency Response Program - SERP/Hazmat is an all hazards response team which includes a hazardous device unit staffed by members of the Bellingham Police Department.

1. FRA determined drugs and alcohol did not contribute to the cause or severity of the accident.

Analysis - Crew Fatigue: FRA obtained fatigue-related information for the members of the train crew for the 10-day period preceding the derailment.

Conclusion: Upon analysis of this fatigue-related information with FRA's Fatigue Analysis Scheduling Tool (FAID), FRA concluded that excessive fatigue was not present, and that fatigue did not contribute to the cause or severity of the accident.

Analysis - Locomotive Camera: The outward-facing camera video from leading locomotive BNSF 5315 was not viewed by FRA.

Conclusion: The evidence led the investigation efforts to focus on the train separation and manipulated angle cocks. The outward-facing camera video records in front of the locomotive and would not likely contribute additional information.

Analysis - Weather Conditions: At the time of the derailment, it was daylight and foggy, with no wind recorded and a slight snow cover on the ground. The temperature was 30°F.

Conclusion: There was no indication of track surface conditions or rail misalignment caused by weather conditions. FRA determined weather did not contribute to the cause or severity of the accident.

Analysis - Motive Power and Equipment: *Equipment Inspection* - The entire train was inspected for mechanical defects in three different locations at three different times. The separate inspections are listed below:

Train consist lines 70-108 and BNSF DPU Locomotives 4723 and 7866: The rear section of the train, which had been pulled back south to Ferndale at MP 106.4, was inspected for mechanical defects on December 29, 2020. BNSF representatives were unable to attend the inspection; therefore, no air brake test was performed. A total of six mechanical defects were noted during this inspection:

PPRX 172082 – L3 and L4 brake shoes worn out;
PPRX 172601 – R2 truck side wear plate fastener loose;
PPRX 171308 – L4 truck side wear plate fastener loose;
PPRX 170039 – R2 wheel has an AAR 15/16-inch thin flange;
PPRX 170030 – R4 wheel has an AAR 15/16-inch thin flange; and
PPRX 170186 – R1 wheel has an AAR 15/16-inch thin flange.

Train consist lines 56-69: On December 23, 2020, starting at 8:00 a.m. PST, a complete inspection was performed on all railcars at the derailment site. Rail car PPRX 171143 was found with part of a broken coupler from the B-end of PPRX 172350 still attached to the B-end of PPRX 171143. It was determined that the broken coupler was caused by the action of the derailment and not a contributing factor of the derailment. This determination was based on the

"new" condition of the break in the coupler as there was no prior rust or corrosion showing on the exposed metal. On the B-end of rail car PPRX 172350, a partly closed train line end angle cock was found, and it did not appear that the angle cock became partly closed from the action of the derailment. This partially closed angle cock on PPRX 172350 together with another found on scene but not attached to a car (refer to Analysis and Conclusions – Train Separation and Angle Cocks) were analyzed as contributing factors of the derailment. No other defects were noted during the investigation on the remaining pieces of equipment at the derailment site.

Broken coupler from car PPRX172350 attached to PPRX 171143.

Train consist lines 1-55 and BNSF Locomotives 5315 and 5949: Once the head end section of the train arrived at Phillips 66 Refinery, a mechanical inspection and air test was performed on the 55 cars. The inspection occurred on December 23, 2020. The head end section of the train contained 54 tank cars and one covered hopper car acting as a buffer car between the locomotives and the loaded tank cars during transit. During the air brake test, all rail cars were observed with operative brakes except for tank car PPRX 171168. Watco Company (Watco) representatives attempted twice to get the brakes to function on this car via a 20-lb brake pipe reduction, but the car's air brakes failed to respond. A third attempt was made via an emergency application initiated from the locomotive controls, but again the car's brakes failed to respond. Watco managers noted the car and stated Union Tank Car Company (UTLX) representatives would trouble shoot and repair the tank car before it left the facility. No additional mechanical defects were noted on any of the 55 cars from the head end section of the train.

Document inspection request - Air brake test records, locomotive daily inspection reports, car and locomotive repair records, and defective conditions prior to the date of this derailment were requested.

Air test records - BNSF provided records listing Train 1 as an extended haul oil train from Trenton, ND to Cherry Point, WA. The train was loaded at the Phillips 66 petroleum crude oil loading facility in Trenton, which is configured with a loop track (train never gets uncoupled)

and unloads at the Phillips 66 Refinery in Cherry Point. At the Cherry Point refinery, the train gets uncoupled and spotted on several different unloading tracks. Once the cars are unloaded, the train is coupled together and an initial terminal Class I air brake test and safety appliance inspection is performed by the contract company, Watco. BNSF also provided the extended haul air brake test record that occurred on this train at Havre, Montana, on December 19, 2020, at 2:39 a.m. MST.

Locomotive Daily Inspection reports – The physical daily inspection cards located on each locomotive were not retrieved during the onsite investigation. However, BNSF did provide electronic copies of these reports. The last record of inspection provided by BNSF and reviewed during the investigation was performed on Train 1's locomotives on December 20, 2020, at 8:00 a.m. PST, in Pasco, Washington.

Car and locomotive repair records – BNSF provided repair records for calendar year 2020 on the 10 cars involved in the derailment. The records show 18 total repairs between the 10 cars, including: coupler knuckle pin, air hose support, wheel check, cotter/split key, Automated Equipment Identification (AEI) tags, body mount cylinder, and brake shoe comp hi-friction. Locomotive repair records identified issues including external water leak, no heat output, past due calibration on the Air Flow Meter, dirty cab, and no communication with DPU.

Conclusion: *Equipment inspection* - FRA noted the broken coupler and partially turned train line air angle cock on equipment at the derailment site. FRA observed tank car PPRX 171168 with inoperative brakes, found six defects on the rear section of the train, and reviewed the repair records for 18 cars and 10 locomotives. FRA determined Motive Power and Equipment issues on Train 1 prior to the circumstances of this accident did not contribute to the cause or severity of the accident.

Analysis - Hazardous Materials: An FRA Hazardous Materials Inspector reviewed the paperwork and handling of the cars from both the shipper and the railroad. Train 1 was a unit "key train" with a total of 106 tank cars containing petroleum crude oil, which is designated by the U.S. Department of Transportation (USDOT) as hazardous for commercial transportation purposes. Commercial transport of petroleum crude oil is subject to the regulatory requirements of the Hazardous Materials Regulations (HMR) in Title 49 CFR parts 100–185. The train was transporting a shipment of Bakken crude oil from Trenton, ND to Phillips 66 Refinery in Cherry Point, WA.

Conclusion: FRA determined there were no exceptions to BNSF's hazardous material paperwork and hazardous materials did not contribute to the cause of the accident.

Analysis - Signal: BNSF provided the field data log from the CP Custer signal box located at MP 111.2. An FRA review of the CP Custer data log revealed switch 1A and 2A on main track one were lined for normal movement at 11:28:33 a.m. PST, on December 22, 2020, and absolute signal CP Custer indicated a proceed indication (more favorable than stop) from main track one onto other than main track 4002 at 11:28:42 a.m. PST.

Conclusion: FRA determined signal conditions did not contribute to the cause or severity of the accident.

Analysis - Track: On December 23, 2020, at 8:00 a.m. PST, FRA and UTC track inspectors walked the entire area of the derailment site taking measurements for irregularities. FRA also requested BNSF hi-rail inspections for the month prior to the derailment, and detector car inspections for calendar year 2020 for analysis. BNSF references track inspections by line segment, track, milepost, and date range. Line segment 50 covers between MP 106.404 and MP 119.594, encompassing the section of track where the derailment occurred.

FRA and UTC track inspectors did not locate any visible track defects on the undisturbed portions of track surrounding the derailment. The POD was identified at MP 111.7 on track 4002 (other than main track), however, the train had traversed the Bellingham Subdivision on main track one from Ferndale, MP 106.4. BNSF performed four detector car inspections, with no defects noted, on line segment 50, M1 (main track one), with the last inspection dated November 4, 2020:

02/26/2020, line segment 50, M1 106.404-111.358;
04/30/2020, line segment 50, M1 106.404-111.358;
07/20/2020, line segment 50, M1 106.404-111.357;
11/04/2020, line segment 50, M1 106.400-111.400.

Nine hi-rail and walking inspections were conducted between November 25, 2020, and December 21, 2020, on line segment 50. No defects were noted on switches or main track one from Ferndale at MP 106.4 to the POD at MP 111.7.

Conclusion: FRA determined track conditions did not contribute to the cause or severity of the accident.

Analysis - Key Train Securement: On August 2, 2013, FRA issued Emergency Order 28 (EO28, key train securement), with an implementation date of September 1, 2013, which required railroads carrying certain quantities and classes of hazardous materials to adopt and comply with a plan identifying specific locations or circumstances when the equipment may be left unattended. EO28 was incorporated into Title 49 CFR § 232.103(n)(7)(i)-(ii)[6] on August 6, 2015.

BNSF entered an EO28 Plan on August 30, 2013, in Management Instruction No. 191. BNSF later placed their Key Train and Key Train Commodity Securement Requirements within their System Special Instructions, Item 37. BNSF's current Key Train Securement requirements, which are listed in BNSF System Special Instructions No. 1 dated April 2020, does not identify

[6] 49 CFR 232.203(n)(7)(i) provides that:

> No equipment described in paragraph (n)(6) of this section shall be left unattended on a main track or siding (except when that main track or siding runs through, or is directly adjacent to a yard) until the railroad has adopted and is complying with a plan identifying specific locations or circumstances when the equipment may be left unattended. The plan shall contain sufficient safety justification for determining when equipment may be left unattended. The railroad must notify FRA when the railroad develops and has in place a plan, or modifies an existing plan, under this provision prior to operating pursuant to the plan. The plan shall be made available to FRA upon request. FRA reserves the right to require modifications to any plan should it determine the plan is not sufficient.

specific circumstances when the equipment may be left unattended,[7] nor does the plan contain sufficient safety justification for determining when equipment may be left unattended.[8] As BNSF did not have a key train securement plan in place to identify specific locations where equipment could be left unattended, they failed to meet Federal requirements when they instructed the Everett crew to secure Train 1 and leave it unattended on main track one at CP Custer on the Bellingham Subdivision.

Conclusion: FRA took exception to BNSF's lack of compliance with Federal Regulation 49 CFR § 232.103(n)(7)(i)-(ii), establishing the foundation for this derailment.

Analysis –Train Separation and Angle Cocks: Due to the unexplained train separation and fully or partially closed angle cocks discovered at the scene, FRA investigated whether vandalism was a potential cause or contributing factor of the derailment.

FRA reviewed the BPA camera footage. The camera footage shows the stationary train starting to pull forward at time stamp 11:29:28 of the video. At 11:33:02, the rear car of the front section of the train comes into view and then exits the screen at 11:33:08. Seventeen seconds later, at 11:33:25 of the video, the second half of the train comes into view. From timestamp 11:33:25 until 11:36:56, forty-six rail cars and two locomotives are seen passing by the camera, making the leading end of the separated rear section of the train line number 63 of the consist, car number TILX 360655. The train's front section (lines 1-62) moved separate and apart from the separated rear section (lines 63-108).

BPA's video footage allowed investigators to identify the train was separated between railcars PPRX 172745, train consist number 62 and TILX 360655, train consist number 63 when leaving CP Custer. Once a freight trains railcar draft gear is coupled to another railcar these couplers must be manually manipulated to uncouple and separate from each other. Today's standard freight-car coupler is the Type E, a "clasped-hand" device that couples automatically when one or both knuckles of the coupler are open, and cars are pushed together. Upon impact, the coupler knuckle swings into the closed position and a lock drops in place, securing the coupling. Cars are uncoupled by lifting the coupler cutting lever that reaches from the coupler to the side of the car in an upward motion. Lifting the lever unlocks the coupler knuckle and lets it swing open, allowing the cars to be pulled away from each other.

As identified in the Analysis and Conclusions section for Motive Power and Equipment, FRA investigators took no exception to the draft gear on either railcar PPRX 172745 or TILX 360655, leading the investigation back to the train draft gear coupler being manually manipulated to cause the train to separate.

[7] 49 CFR 232.103(n)(7)(i) provides that- "[n]o equipment described in paragraph (n)(6) of this section shall be left unattended on a main track or siding (except when that main track or siding runs through, or is directly adjacent to a yard) until the railroad has adopted and is complying with a plan identifying specific locations or circumstances when the equipment may be left unattended."

[8] 49 CFR 232.103(n)(7)(i) provides that "[t]he plan shall contain sufficient safety justification for determining when equipment may be left unattended."

A freight train is unable to move unless all brakes (hand brakes and train line air brakes) are in the release position. A conventional, non-DPU train line air brake pressure, applied or released, is monitored by gauges located on the engineer's console. An end of train device (EOT) is attached to a train's air brake line on the last car in the train and communicates the pressure at the rear of the train to the gauges on the engineer's console. The EOT also confirms train line air brake pipe continuity. Trains configured with rear DPU's monitor train line air brake pipe pressure in a similar way. Instead of an EOT communicating with the head end locomotive engineer's console, a rear DPU locomotive is radio linked to the head end locomotive and they communicate back and forth through an integrated touch screen or push-button control screen on the engineer's console.

There is a difference in how train line air brake pressure is applied and released between a conventional train and a DPU train. A conventional train can only apply and release the train line air brakes from the head end locomotive/consist. When engineers make a brake pipe reduction (applying the brakes), they do so by applying the automatic brake, which reduces the brake valve pressure; this air pressure reduction is sent through the train line air brake pipe from the front of the train towards the rear of the train. The reduction in the brake valve pressure forces the brake piston to push the brake shoe against the railcar wheel. To release the brake shoe from the wheel, the engineer releases the automatic brake, causing the brake cylinder to release air pressure to the atmosphere, releasing the brakes and recharging the system. This occurs from the front of the train towards the rear. The only signal the brake system receives on a conventional train is pressure being applied or released from the train line air brake pipe from the head-end locomotive.

Air is applied and released in the same way on a DPU train, with the engineer making a brake pipe reduction (applying the automatic brake) and releasing the brake valve to recharge the brake pipe system. However, because there is a "link" between the lead locomotive and the DPU (linked/lead) locomotive, the DPU brake system also receives a radio signal to apply and release the train line's brake pipe pressure simultaneously from the front and the rear. This simultaneous application and release of the brake pipe between front and rear locomotives is how DPU trains gain better braking abilities.

As a result of this two-way system (air pressure in the brake pipe and radio signal) to set and release brakes on a DPU train, there is also the same two-way system to verify the train line's air brake pipe continuity. DPU's are equipped with a function called "train check." When a DPU train is stopped, a brake pipe reduction (brakes applied) has already taken place simultaneously from the head and rear end. The train check function is then initiated from the lead locomotive integrated touch screen on the engineer's console, and it cuts out the automatic brake valve on the linked/DPU locomotive. This means the only automatic brake pressure being applied to the train line brake pipe is from the head end consist. When the crew is ready to move the train, before the linked/ DPU locomotive will cut its automatic brake valve back in, it needs to verify two things:

1. It needs to receive the radio signal between the linked locomotives (head end locomotive and linked DPU locomotive) that the engineer is releasing the automatic brake valve to recharge the brake system; and

2. It needs to sense 1 ½ lb. pressure increase in the train line's brake pipe.

This train check function is also how a DPU train verifies train line continuity after it has been stopped. For example, if a train stopped and initiated the required train check function, and while the train was stopped an angle cock got closed in the train, the linked DPU would not cut its automatic brake valve back in because it would not sense the 1 ½ lb. of pressure increase in the train line's brake pipe. The closed angle cock would stop the flow of air from reaching the DPU locomotives. Not only would the train check function on the integrated engineer's screen not execute, but the brakes on the cars between the closed angle cock and the linked DPU would not release, making it impossible to move the train.

The only way both sections of the train could have moved is with closed angle cocks segregating the head end section of the train line's brake pipe (air being applied/released from the head end power) from the rear end section (air being applied/releases from the DPU locomotives).

Two angle cocks that appeared to be tampered with were found during the on-site investigation, one partially closed and the other fully closed. The first angle cock was found, sheared off from a rail car and laying on the ground approximately 15 feet from the closest derailed tank car in a completely closed position. Due to the extensive damage from the forces of the derailment, FRA could not determine which rail car the sheared off angle cock came from. When the FBI opened the accident scene on December 23rd, FRA and WUTC inspectors found a second angle cock partially closed on the B end of rail car PPRX 172350.

Angle cocks are typically in an open position, even after significant forces experienced during train derailments and accidents. A train line brake pipe angle cock can easily be turned from a closed position/flow restricting (perpendicular to the train line brake pipe) to an open position/open flow (in line with the train line brake pipe) by applying pressure to push the angle cock handle in line with the train line brake pipe. However, once in the open position, the angle cock handle fits over a protruding keeper, prohibiting the angle cock to be moved from the open position. To close a train line angle cock from the open position, one must simultaneously lift the angle cock handle over the protruding keeper and pull the handle back into the closed position (perpendicular to the train line brake pipe).

The break in Train 1's train line brake pipe continuity due to closed angle cocks would have been identified if the train check function had been initiated and conducted by either the Everett crew or relief crew. The review of BNSF 5315 (lead locomotive) and BNSF 4723 (linked/lead DPU) locomotive event recorders revealed the train check function was not executed on three occasions (refer to Analysis and Conclusions of Locomotive Event Recorders/Train Handling Rules).

Prior to 2015 and BNSF's added train scheduling to include crude oil trains originating from the Bakken Basin into the Cherry Point area, vandalism and tampering incidents within the Bellingham Subdivision were rare, if nonexistent. FRA investigators gathered the weekly reports

for calendar year 2020 and identified 28 vandalism and tampering incidents that had occurred on the Bellingham Subdivision.[9]

In interviewing crew members involved in the derailment, FRA learned that BNSF failed to educate employees about the vandalism on the Bellingham subdivision. In so doing, BNSF failed to follow their own safety rules to heighten employee awareness about these recurring security threats in the Pacific Northwest.[10]

Conclusion: FRA noted the numerous vandalism and tampering events that occurred in the immediate vicinity of the incident location, the unexplained train separation and the partially and fully closed angle cocks and determined that vandalism and tampering was a possible contributing cause of the derailment.

Analysis - Locomotive Event Recorder/Train Handling Rules: FRA obtained data from all locomotives in the consist for analysis: BNSF 5315 and 5949 - head end consist, and BNSF 4723 and 7866 - rear DPU consist. BNSF 5315 was linked with BNSF 4723 for Distributed Power usage.

Data analyzed from the printout of the leading locomotive's event recorder (BNSF 5315) indicated the head end section of the train was being operated at 7 mph at the POD. Data analyzed from the printout of the lead DPU's event recorder (BNSF 4723) indicated the rear section of the train was travelling at 21 mph at the POD.

The DPU event recorder also confirmed the train check function was not initiated and executed as required by BNSF Air Brake & Train Handling (ABTH) Rule 105.5, which reads in part:

> The train check operating feature verifies that the brake pipe is open and unrestricted between the lead consist and the remote consist(s).
> Perform the train check operation in the following instances:
> · To secure a train to be left unattended,
> · Just before movement anytime the train has been stopped or the train's brake pipe may have been compromised.

To stop a train, the engineer applies the train brakes by making a brake pipe reduction of the automatic brakes. The reduction in the train line's brake pipe occurs from both locomotive consists on a DPU train. The engineer then initiates the train check function from the locomotive console on the integrated screen. Initiating the train check sends a radio signal from the head end locomotive to the linked DPU locomotive, instructing it to cut out the automatic brake valve. At this point, the train line brake pipe air pressure is only being supplied by the head end locomotive consist because the DPU locomotive's air brake valve is now "cut out." The train sits in this

[9] FRA inspectors receive weekly generic reports from the Freight Rail Sector Coordinating Committee (SCC) and the Transportation Security Administration (TSA).

[10] BNSF Employee Safety Rules - These rules are for all employees of BNSF Railway.
Rule S-1.2.4 Co-workers Warned: Warn co-workers of all unsafe practices and/or conditions.
Rule S-28.2.7 Furnishing Information: Employees must not withhold information, or fail to give all the facts to those authorized to receive information regarding unusual events, accidents, personal injuries, or rule violations.

state until it is ready to be moved, at which time the engineer would do two things:

1. Push the "Execute" button on the integrated screen, sending a radio signal from the head end locomotive to the linked DPU, telling it to "cut in" its automatic brake valve and start recharging the brake pipe system; and
2. Place the automatic brake valve handle on the head end locomotive into the release position, sending air back through the train line's brake pipe to recharge the brake pipe system.

Even though the linked DPU received the radio signal to "cut in" its automatic brake valve and start recharging the train line's brake system, it would not do this until it sensed a 1 ½ lb. increase in the train line's brake pipe pressure when the engineer released the automatic brake valve. With angle cocks closed, the release in the train line's brake pipe would only be sensed until the closed angle cock constricted/stopped the air flow to reach the linked DPU locomotive. Therefore, the train check function would never "Execute," and the linked DPU locomotive would never cut in its automatic brake valve. This is how a train crew would identify a brake pipe continuity issue with a DPU train.

There were three occasions when the train check function should have been performed on December 22, 2020:

- Everett crew first arrived at CP Custer at 6:19:44 a.m. PST.
- Everett crew pulled the train down to the carman's crossing and secured it at 8:22:08 a.m. PST.
- Relief crew prior to initializing movement at 11:29:21 a.m. PST.

If the Everett crew had initiated the train check function on their final stop at the carman's crossing when they secured the train, the relief crew would have only had to execute the train check they initialized. Since the Everett crew failed to initialize the train check, the relief crew was responsible for initializing and executing the required function. Both crews had a responsibility to ensure the train check function was initiated and executed.

BNSF AB&TH rule 105.5 Train Check was required to be performed by railroad rule and Federal Regulation.

Conclusion: On December 22, 2020, Train 1 was stopped at CP Custer for an extended amount of time on two occasions. The first extended stop, about two hours, occurred between 6:19:44 a.m. PST and 8:22:08 a.m. PST, when the Everett crew initially arrived at CP Custer and before they moved Train 1 to the carman's crossing to secure it and get relieved, with an approximate time stop of two hours. The second extended stop, about three hours, occurred between 8:22:08 a.m. PST, when the Everett crew left the secured train, and 11:21:01 a.m. PST, when the relief crew arrived. In both instances, vandals had opportunities to tamper with the couplers and brake pipe angle cocks. FRA's investigation determined that two crews failing to comply with train check requirements established the foundation for this derailment.

Overall Conclusion: After reviewing locomotive and car conditions, hazardous materials records and handling, signal systems, track surface/structure, crew fatigue and toxicology, and weather, FRA investigators did not identify evidence to suggest any cause or contributing factors related to these factors.

FRA identified the following contributing causes:

- BNSF management's failure to notify employees about vandalism events to heighten their crews' situational awareness.
- BNSF's failure to comply with Federal requirements regarding the securement of key trains.
- FRA's investigation determined the failure by two BNSF crews to perform the "train check" function on a DPU train to ensure train line brake pipe continuity resulted in angle cocks in fully or partially closed positions being undetected. If the train check function had been performed and the compromised train line brake pipe continuity detected, the crew should have walked the train to find the problem with the manipulated angle cocks and they may have discovered the unlocked locking pins on the couplers. Even if the unlocked locking pins were not discovered, when the train began movement and decoupled, the train air brake line would have disconnected and the train would have gone into an emergency air brake application at low speed and likely would have avoided the derailment.
- Possible vandalism.

Contributing Cause Codes:

- H305 - Instruction to train and yard crew improper.
- H999 - Other train operation/human factors (key train securement).
- H017 Failure to properly secure engine(s) (railroad employee) (failing to perform "train check").
- M502 - Vandalism of on-track equipment.