HAZARDOUS MATERIALS GROUP
FACTUAL REPORT

Derailment of CSXT Train Q38831 with Subsequent Hazardous Materials Release Hyndman, Pennsylvania, August 2, 2017

DCA17FR011

Report Date: December 6, 2017

Accident Identification

Carrier: CSXT
Train No.: Q38831
Location: Hyndman, Pennsylvania
Date/Time: August 2, 2017 at 05:01 a.m.
NTSB No.: DCA17FR011

A. Hazardous Materials Group Members

Paul L. Stancil, CHMM
Hazardous Materials Group Chairman
National Transportation Safety Board
490 L'Enfant Plaza East, SW
Washington, DC 20594

Shawn Currie
Accident Investigator
National Transportation Safety Board
490 L'Enfant Plaza East, SW
Washington DC 20594

Erik Strickland
Transportation Safety Specialist
National Transportation Safety Board
490 L'Enfant Plaza East, SW
Washington, DC 20594

Robert James
HazMat Manager / Special Agent
CSXT
2700 Bennett Yard,
Charleston, SC

Randy Keltz
Manager, Tank Car Safety Programs
Federal Railroad Administration
Mail Stop 25, Office W38-101
Washington, DC 20590

John Embree
Director – Fleet Operations
TrinityRail
16822 NE 117th Street
Kearney, MO 64060

B. Accident Summary

For a summary describing the circumstances of this accident, refer to the *Accident Summary Report* in the docket for this investigation.

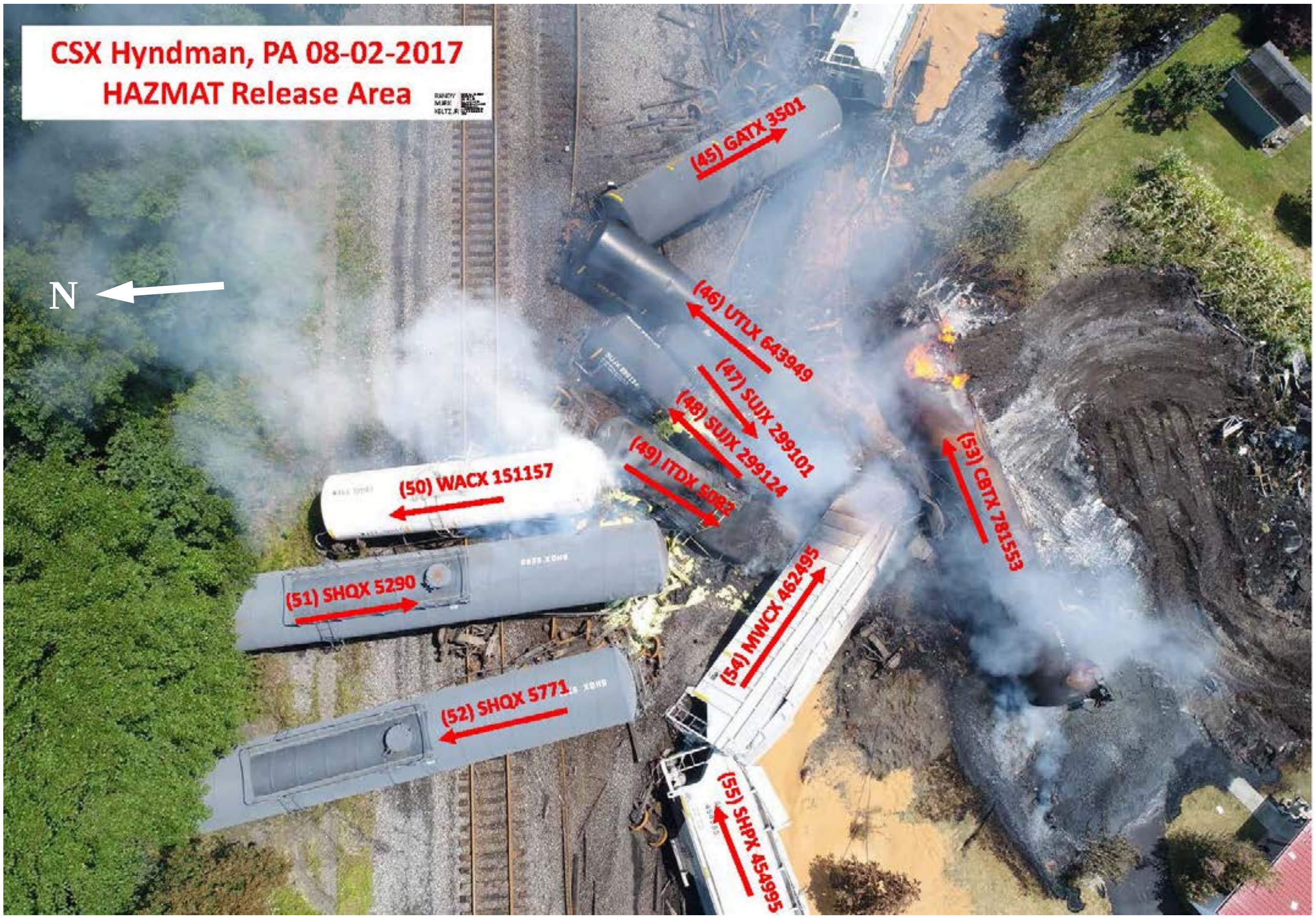

Figure 1: Accident scene hazardous materials release area, showing rail car direction of travel (arrows).

C. CSXT Train Q38831

Train Q38831 was a Key Train, carrying 70 loads of hazardous materials (Table 1).[1] The conductor's train consist matched the physical placement of the derailed cars in the train with no exceptions. The

[1] AAR Circular OT-55-P (CPC-1321) defines a key train as transporting any of the following: 1or more car loads of spent nuclear fuel or certain types of high-level radioactive waste; 1or more loaded tank cars of poison or toxic inhalation hazard material, anhydrous ammonia, or ammonia solutions; 20 or more car loads (including intermodal portable tank loads) of any combination of hazardous material. Key trains are subject to speed restrictions and other operating criteria.

consist order for the derailed cars was confirmed by AEI consist information from Station BG 58 Newcastle PA, August 1, 2017, 3:10 p.m.

Table 1: Hazardous Materials on Train Q38831 (derailed cars are highlighted)

Commodity	Description	Hazard Class	Position in Train
UN3257 Elevated Temperature Liquid	Liquid Asphalt	9	9, 10, 45, 46
UN1075 Isobutane	Non-odorized isobutane	2.1	12, 13, 14
NA2448 Molten Sulfur	Domestic shipment	9	47, 48, 49, 61, 62, 63, 64, 65, 66, 84, 85, 148, 149, 150, 151
UN2448 Molten Sulfur	Shipped from Canada	4.1	114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 157
UN1805 Phosphoric Acid Solution	Residue	8	50, 58, 88, 112
UN1075 Liquefied Petroleum Gas	Odorized propane	2.1	51, 52, 53, 89
UN1075 Liquefied Petroleum Gas	Non-odorized LPG	2.1	90, 91, 92
UN1987 Alcohols, N.O.S.	Denatured ethanol	3	75, 76, 77, 78, 79, 80, 81, 99, 100, 101, 102, 103, 104, 105, 106
UN1170 Ethyl Alcohol	Undenatured ethanol	3	107, 108
UN1495 Sodium Chlorate	Hopper car	5.1	131
UN1206 Heptanes	Marine pollutant	3	168

Attachment 1: CSXT Train Consist Q38831HAZM
Attachment 2: AEI Event Details

D. Hazardous Materials Released

Thirty-three freight cars derailed in this accident, including 15 tank cars transporting hazardous materials (Table 2). Hazardous materials released from the following three tank cars that sustained accident damage:

1. Line 46, UTLX643949, asphalt released from an open bottom outlet valve;
2. Line 49, ITDX5082, molten sulfur released from two shell tears;
3. Line 53, CBTX781553, propane (liquefied petroleum gas) released from a shell puncture.

Table 2. Derailed freight cars (15 hazardous materials highlighted in red)

Line Number	Car Number	Commodity	Hazmat	Hazmat Release	Tank Car Specification
33	FWTX620067	Empty			
34	FWTX620150	Empty			
35	FWTX620111	Empty			
36	FWTX620064	Empty			
37	FWTX620104	Empty			
38	FWTX620047	Empty			
39	FWTX 620121	Empty			
40	FWTX 620094	Empty			
41	FWTX620086	Empty			
42	FWTX620015	Empty			
43	TILX55375	Soymeal			
44	AGPX11729	Soymeal			
45	GATX3501	Asphalt	UN3257 Class 9		111A100W1
46	UTLX643949	Asphalt	UN3257 Class 9	YES	111A100W1
47	SUJX299101	Molten Sulfur	NA2448 Class 9		111A100W1
48	SUJX299124	Molten Sulfur	NA2448 Class 9		111A100W1
49	ITDX5082	Molten Sulfur	NA2448 Class 9	YES	111A100W1
50	WACX151157	Phosphoric Acid Solution residue	UN1805 Class 8		111A100W1
51	SHQX5290	Liquefied Petroleum Gas (propane)	UN1075 Class 2.1		112J340W
52	SHQX5771	Liquefied Petroleum Gas (propane)	UN1075 Class 2.1		112J340W
53	CBTX781553	Liquefied Petroleum Gas (propane)	UN1075 Class 2.1	YES	112J340W
54	MWCX462495	DICAL			
55	SHPX454995	Soymeal			
56	TILX55378	Soymeal			
57	SHPX454969	Soymeal			
58	TILX140006	Phosphoric Acid Solution Residue	UN1805 Class 8		111A100W1
59	TILX54773	Soymeal			
60	TILX291055	Methyl esters (methyl)			
61	TILX135361	Molten Sulfur	NA2448 Class 9		111A100W1

Line Number	Car Number	Commodity	Hazmat	Hazmat Release	Tank Car Specification
62	SHLX383	Molten Sulfur	NA2448 Class 9		111A100W1
63	FHRX136000	Molten Sulfur	NA2448 Class 9		111A100W1
64	KLRX136143	Molten Sulfur	NA2448 Class 9		111A100W1
65	FHRX135930	Molten Sulfur	NA2448 Class 9		111A100W1

E. Line 46: UTLX643949, Asphalt (Elevated Temperature Liquid)

On July 28, 2017, Canal Terminal Company, I-55 and Arsenal Road, Rockdale, Illinois 60436 originated an elevated temperature asphalt shipment in tank car UTLX643949. The consignee was Ergon Asphalt and Emulsions, Inc., Wilson, North Carolina.

Elevated Temperature Liquid Hazardous Materials Information

The emergency response information provided in the train consist indicates that elevated temperature material is shipped at a temperature above 212°F. Once released, the molten material will cool rapidly and solidify. In its molten state, direct contact may result in thermal burns. The temperature of the molten material is sufficiently high that rubber or plastic may melt and lose its strength. Protective equipment designed for chemical exposure protection is not effective against direct contact with molten material. The molten material is easily ignited by heat, sparks, or flames. Vapors may form explosive mixtures with air.

The recommended initial downwind evacuation in the event of a large spill is 1,000 feet. If a rail car is involved in fire, the guidance recommends ½ mile evacuation in all directions.

The DOT shipping description for UTLX643949 was UN3257, Elevated Temperature Liquid, N.O.S., Class 9, Packing Group III.

Tank Car Specifications

Line 46, UTLX643949 was a specification DOT-111A100W1 tank car that was built in October 2013 and owned by Union Tank Car. The load limit was 191,000 pounds, and the tank capacity was 23,467 gallons. The tank heads and shell were constructed of 0.4375-inch A-516-70 non-normalized steel. The tank was equipped with steam coils and covered with 4-inches of fiberglass insulation and an 11-gauge jacket. The tank car did not have head shields or a thermal protection system.

Post-accident Observations

The bottom outlet valve nozzle was missing, the operating handle was bent, and the ball valve was in the completely open position (Figure 2). The entire load of asphalt, about 23,000 gallons, released and pooled on the two residential properties north of Cleveland Street in Hyndman.

Figure 2: UTLX643949 open bottom outlet valve.

Attachment 3: UTLX643949 UMLER File
Attachment 4: UTLX643949 Damage Assessment Work Sheets

F. Line 49: ITDX5082, Molten Sulfur

On July 27, 2017, Sulcom, Inc., 1450 Lake Robbins Drive, Ste 500, The Woodlands, Texas 77380 originated a molten sulfur shipment in tank car ITDX5082. The consignee was Advansix, Inc., Hopewell, Virginia.

Molten Sulfur Hazardous Materials Information

The emergency response information provided on the train consist states that molten sulfur is elemental sulfur shipped at an elevated temperature to keep the material in a liquid state for easy loading and unloading.

Once released, molten sulfur will cool rapidly and solidify. In its molten state, direct contact may result in thermal burns to the affected area. The temperature of molten sulfur is sufficiently high that many synthetic plastic or rubber materials may melt or lose their strength. Protective equipment designed for chemical exposure is not effective against the thermal hazard of direct contact. If ignited, molten sulfur may evolve sulfur dioxide gas. Molten sulfur may be ignited by friction, heat, sparks, or flames. It may burn rapidly with flare-burning effect. Powders, dusts, shavings, borings, turnings, or cuttings may burn with explosive violence.

The recommended evacuation distance for a large spill is 330 feet. If a rail car is involved in a fire, the recommended isolation distance is ½ mile in all directions. For fire involving tanks, the container should be cooled with flooding quantities of water until well after the fire is out. The guidance recommends staying away from tanks that are engulfed in fire.

The DOT shipping description for ITDX5082 was NA2448, Molten Sulfur, Class 9 (Miscellaneous Hazardous Material), Packing Group III.

Tank Car Specifications

Line 49, ITDX5082, is a specification DOT-111A100W1 tank car, with 13,880-gallon capacity. Trinity Tank Car, Inc. constructed the tank car in February 2001. The tank car was owned and maintained by Sulcom, Inc. The load limit was 203,800 pounds, the tare weight was 59,200 pounds, GRL was 263,000 pounds. The tank head and shell were both constructed of 0.4375-inch A516-70 steel. The tank was provided with 6-inches of fiberglass insulation, steam coils, and an 11-gauge jacket. The tank did not have head shields or a thermal protection system.

Post-accident Observations

The majority of the 13,000 gallons of molten sulfur product contained in IDTX5082 released and ignited (Figure 3). The tank car sustained a 7-foot transverse shell tear in the right center of the car. The bottom of the car sustained a 32 x 18-inch puncture mid-way between the bottom outlet valve and the A-end at about 7-8 o’clock.

Figure 3: Burning molten sulfur released from tank car IDTX5082, August 4, 2017.

The Hazardous Materials Group examination found a metal-contact witness mark on the B-end left upper body bolster web structure (Figure 4). Investigators secured the upper body bolster structure for laboratory comparison to the geometry of the puncture site in propane tank car CBTX781553.

The Group traced the shape of the edge of the upper body bolster web structure onto a sheet of paper shown in Figure 4 and compared this shape to the geometry of the punctured shell in propane tank car CBTX781553 (Figure 5).

The B-L side of the tank sustained flattening and a crease. The B-L body bolster (exhibiting the above described witness mark) was deflected inboard toward the A-end with about a 90-degree bend in the upper half of the structure (Figure 6).

Figure 4: ITDX5082 upper B-L body bolster frame structure contact witness mark, August 5, 2017

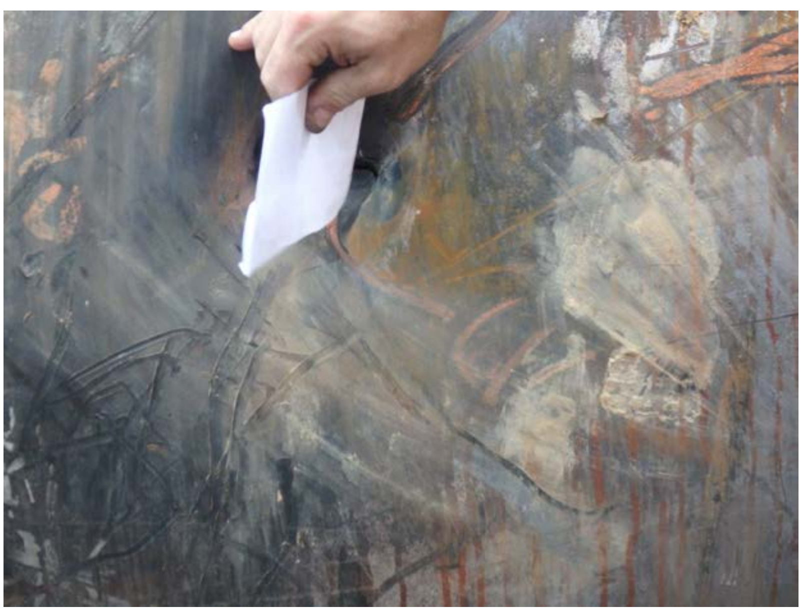

Figure 5: Hazardous Materials Group comparing the shape of the ITDX5082 B-L body bolster web structure to the CBTX781553 puncture location (August 5, 2017).

Figure 6: ITDX5082 tank shell flattening, and bolster web deflection B-L side, August 5, 2017.

Attachment 5: ITDX5082 UMLER File
Attachment 6: ITDX5082 Damage Assessment Work Sheets

G. Line 53: CBTX781553, Liquefied Petroleum Gas

On July 28, 2017, Aux Sable Liquid Products LP, 6155 E. US 6, Morris, Illinois 60450 originated a propane shipment in tank car CBTX781553. The consignee was Thompson Gas Propane Holdings, Baltimore, Maryland.

Liquefied Petroleum Gas (Propane) Hazardous Materials Information

The hazardous materials information provided in the train consist states that propane is extremely flammable and easily ignited by heat, sparks, or flames. Propane is a colorless gas that is shipped as a liquefied gas under its vapor pressure. For transportation, it is odorized with ethyl mercaptan. Its vapors are heavier than air and a flame can flash back to the source of the leak. Containers may rupture violently and rocket under prolonged exposure to fire or heat.

The Aux Sable safety data sheet refers to the US DOT Emergency Response Guidebook, #115. Chemical and physical properties of propane include:

- Flash point -156 °F.
- UEL 9.5%, LEL 2.1%

- Vapor pressure 7150 mm/Hg at 25 C

Additional information about the hazards of propane are discussed in Section L of this report.

The bill of lading indicates that on July 28, 2017, CBTX781553 was loaded with HD5 odorized propane at the Aux Sable facility at 6155 E. US Route 6, Morris, Illinois 60450. The gross loaded volume was 31,614 gallons (net quantity temperature corrected volume was 29,717 gallons). The propane density was 4.230 pounds per gallon. The billing weight was 125,702 pounds. Ethyl mercaptan odorant was injected into the load at a minimum of 1.0 pounds per 10,000 gallons.

The DOT shipping description used for the shipment was UN1075 Liquefied Petroleum Gas, Class 2.1.

Tank Car Specifications

Line 53, CBTX781553 was a specification DOT-112J340W tank car. The AAR approved its construction on September 4, 2013.[2] Trinity Tank Car, Inc. constructed CBTX781553 as part of a lot of 200 identical tank cars. The tank car was owned by CIT Rail, 30 S. Wacker Drive, Suite 2900, Chicago, IL 60606. The car was leased to NGL Terminal Supply, LLC as a full-service lease in which CIT Rail retains responsibility for periodic qualification and maintenance.

The tank car had a water capacity of 33,710 gallons and was intended for the transportation of liquefied petroleum gas products. The tank had a test pressure of 340 psig, and the rated burst pressure for specification 112J340W is 850 psig.[3] The tank heads and shells were constructed of 0.608-inch TC-128 Grade B TCVN -30F steel. The semi-ellipsoidal heads were protected with full diameter 0.5-inch thick head shields constructed of ASTM A572-50 steel. The tank was equipped with one pressure relief device with a start-to-discharge setting of 280.5 psig. The tank was also equipped with a thermal protection system consisting of 0.5-inch thick 4.5 lb./ft^3 ceramic fiber thermal blanket and 11-gauge steel jacket. The tank car had not been modified from its original construction configuration.

Maintenance History

CIT Rail provided the entire billing repair card detail history for the tank car, which indicates only two maintenance events, both involving air hose support repairs in January 2016 and in January 2017.

CIT told NTSB investigators that there are no damaged and defective car tracking (DDCT) records for the subject car, open or closed. CIT further stated the tank car has not been in a contract shop, thus no alterations have been made to the certificate of construction what would have required a report

[2] AAR form 4-2.1, Certificate of Construction Number L-126090.
[3] 49 CFR 19.101-1

to the Association of American Railroads (AAR) Tank Car Integrated Database (TCID).[4] Furthermore, since the tank car was built in 2013, it had not yet been subjected to a tank qualification inspection relative to Subpart F of 49 CFR Part 180 and the AAR MSRP.

Post-accident Observations

The A-end of CBTX781553 was leading in the eastbound train consist. The car came to rest with the A-end facing east, parallel to and about 2 car lengths south of the track. The bottom of the car was in contact with a pool of burning molten sulfur released from ITDX5082. The car was punctured and released burning propane, with torch fires escaping from holes and gaps in the jacket at several locations across the length of the car. The most vigorous flame was observed at the A-R end (Figures 7 and 8). As the incident progressed, the fire became restricted to the A-end of the car. Aerial video and visual examination of the pressure relief device did not show any evidence that it had ever activated.

Figure 7: CBTX781553 A-end puncture location (circled), August 3, 2017, 10:23 a.m. (CSXT photo).

[4] The Tank Car Integrated Database allows car owners to report alterations, modifications, conversions, and tank damage formerly reported on AAR forms R-1, R-2, and SS-3.

Figure 8: CBTX781553, puncture location circled, August 3, 2017, 2:46 p.m.

During the morning of August 4, with reduction of the internal tank car pressure, CSXT contractors vented the remaining propane through a 2-inch line to a portable flare stack. Contractors had peeled some of the tank jacket away from the shell breach and placed a magnetic patch over the shell puncture. The propane fire was extinguished, and the tank car was empty on August 4, about 6:30 a.m. About 9:00 a.m. on August 4 the Hazardous Materials Group determined with infrared thermal detector that the shell temperature was about 178 °F.

Investigators inspected the tank car, finding a shell puncture about 3 o'clock on the A-R end in the first (1st) barrel section (Figures 9 and 10). The puncture measured about 3.25 inches and was oriented longitudinally. The puncture was within a dent measuring about 3.5 inches deep, with evidence of sliding contact in an upward direction. The shell fracture was isolated to the impact area and did not show any visual evidence of brittle propagation. Ultrasonic gauge thickness measurements found thinning from 0.630 inches in nearby unaffected area to 0.537 inches at the top edge of the puncture.

CSXT removed a coupon of the punctured tank shell in Ring 1, allowing the Group to examine the interior surface of the puncture as shown in Figure 10. Penetration into the shell became deeper toward the A-end side of the puncture feature. At the A-end side of the puncture, the crack turned downward about ½ inch in the circumferential direction. Investigators noticed that carbon was deposited on the interior shell surface above the breach.

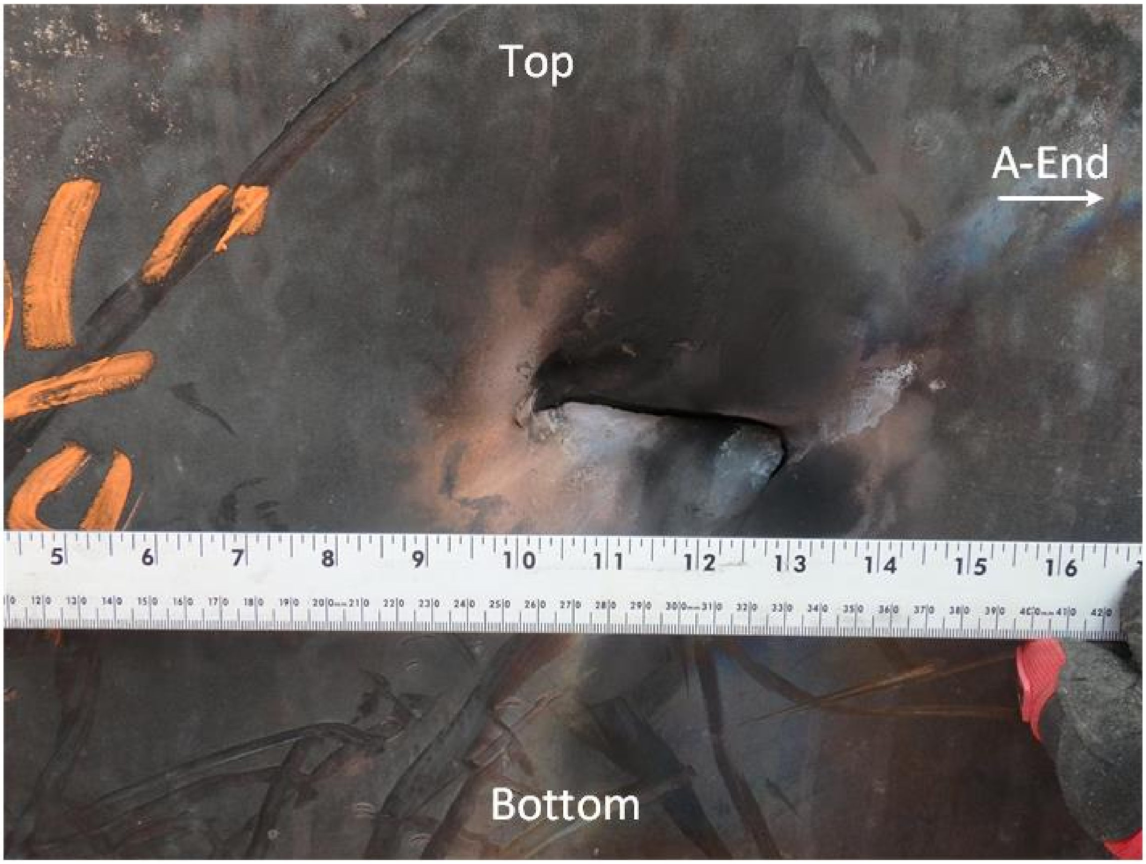

Figure 9: Tank Car CBTX781553 Puncture in Barrel Ring 1, Exterior Surface, August 4, 2017.

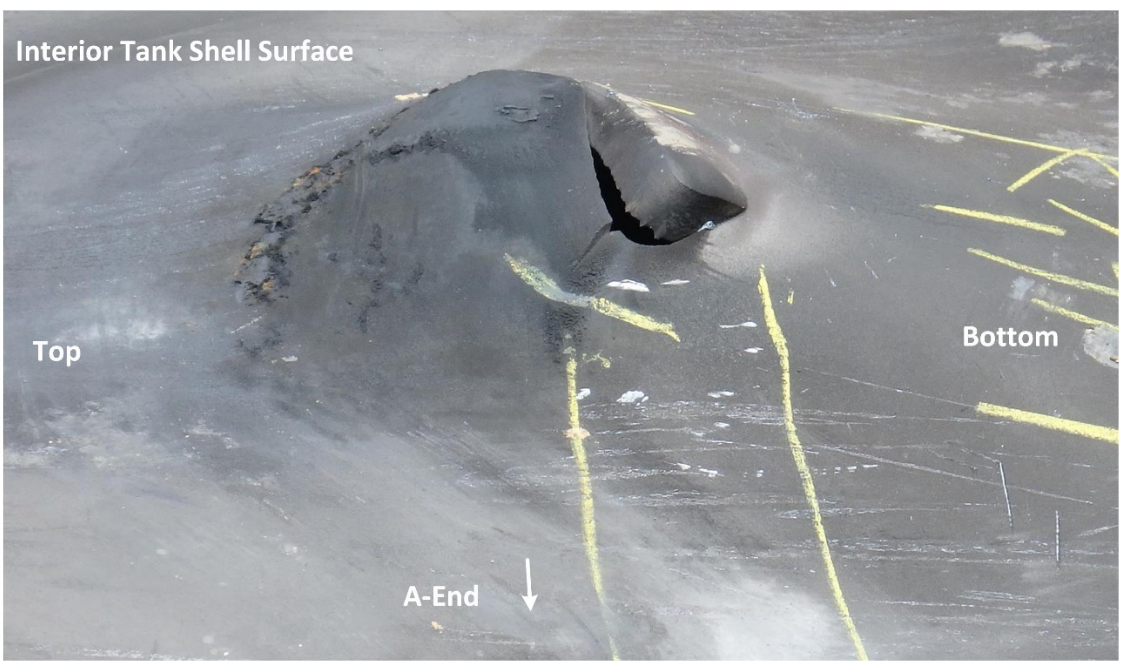

Figure 10: CTBX 781553 Interior surface of the shell puncture, August 5, 2017.

A shell bulge was observed closer to the A-end above the A-R bolster web in Ring 1 of the tank shell. The bulge measured 27 inches in the longitudinal direction and 56 inches in the circumferential direction and protruded outward about 6-inches. Ultrasonic thickness measurements found that the shell thinned from 0.630 inches in nearby unaffected area, to 0.436 inches at the thinnest location near the edge of the bulge (Figure 11). The Certificate of Construction reported a nominal shell thickness of 0.608-inch.

Ultrasonic thickness gauge shell thickness measurements were taken at about 2-inch intervals across the center of the bulge as indicated below. The circled area represents a bulge in the tank shell.

.574
.492
.436
.478
.533
.536
.476
.448
.436
.612
.630

Figure 11: CBTX781553 tank shell coupon showing the bulge profile, August 5, 2017.

Trinity Tank Car provided NTSB investigators material test reports (MTR) for the AAR TC-128 Gr. B plates used to formulate the tank car shell. The MTR for Ring 1, which contained the bulge feature, is identified as heat – 357P06990; slab – S931999. The material was produced by ArcelorMittal Burns Harbor Plate and was shipped to Trinity in September 2013. The MTR indicates the original plate thickness was 0.623 inches; the plate was normalized at 1,650 °F for 32 minutes; its tensile strength was 84,500 psi; and Charpy impact energies were 66, 69, and 63 ft./lb. at -30°F.

Attachment 7: Propane Safety Data Sheet
Attachment 8: UMLER File CBTX781553
Attachment 9: CBTX781553 Damage Assessment Work Sheets
Attachment 10: Maintenance Record CBTX781553
Attachment 11: Material Test Reports CBTX781553

H. <u>Inspection of Other Derailed Tank Cars</u>

The Hazardous Materials Group also examined the remaining tank cars that were involved in the derailment, but which did not release hazardous materials following the accident.

Line 45: GATX3501, Asphalt (Elevated Temperature Liquid)

The tank car was a jacketed specification DOT-111A100W1, built in February 1991, 23,629 gallons capacity, 0.4375-inch-thick A516-70 heads and shell. The tank and service equipment were last inspected and qualified in 2012.

The tank car sustained jacket damage to both A and B-end heads, as well as the right and left sides of the car. The bottom outlet valve nozzle was sheared off and the valve remained closed. No breaching damage was observed.

Line 47: SUJX299101, Molten Sulfur

The tank car was a jacketed specification DOT-111A100W1, built in May 1999, 13,818 gallons capacity, 0.4375-inch-thick A516-70 heads and shell. The tank and service equipment were last inspected and qualified in 2010.

The surface area of all sides of the tank jacket were bent and buckled. A 6-foot tear in the jacket material occurred on the left-center side. Both sides of the tank shell sustained compression damage. No breaching damage was observed.

Line 50: WACX151157, Phosphoric Acid Solution (residue)

The tank car was a jacketed and insulated specification AAR-211A100W1, built in May 1995, 14,298 gallons capacity, 0.4375-inch-thick A516-70 heads and shell, and rubber lining. The car was provided with 6-inches of urethane foam insulation. The tank and service equipment were last inspected and qualified in 2011, and the tank lining was inspected in 2017.

The left side of the car sustained bent and torn jacket material. A large section of jacket and insulation was missing from the lower A-R side, with longitudinal scoring to tank shell beneath. The A-end head sustained cut and bent jacket material. No breaching damage was observed.

Line 51: SHQX5290, Liquefied Petroleum Gas (propane)

The tank car was a jacketed specification DOT-112J340W, built in October 2012, 33,700 gallons capacity, 0.6250-inch-thick TC128, Gr. B heads and shell, full head shields, 2 ½ - inch fiberglass insulation and ½-inch ceramic fiber thermal protection. The tank and service equipment were last inspected and qualified in 2012.

The A-end head (head shield) sustained a 48-inch diameter rounded dent, 6 inches deep, centered about 5 o'clock. The B-end head shield was compressed with jacket buckling at the B-end. No breaching damage was observed.

Line 52: SHQX5771, Liquefied Petroleum Gas (propane)

The tank car was a jacketed specification DOT-112J340W, built in December 2013, 33,710 gallons capacity, 0.6250-inch-thick TC128, Gr. B heads and shell, full head shields, 2 ½ - inch fiberglass insulation and ½-inch ceramic fiber thermal protection. The tank and service equipment were last inspected and qualified in 2013.

The A-end head sustained a centered 36-inch by 36-inch dent, 8-inches deep. Within this dent, the A-end head shield sustained a deep 16-inch long horizontal angular gouge in the center of the dent that penetrated the ½-inch-thick head shield (Figure 12). Beneath this penetrated headshield, no evidence of damage to the tank head itself was observed. The jacket adjacent to the head at the B-R side was buckled. The jacket was torn about 5-inches by 18-inches at the lower right center of the car, however, no damage was transmitted to the tank shell. The tank car sustained no breaching damage.

Figure 12: Propane tank car SHQX5771, gouge sustained by A-end head shield, August 5, 2017.

Line 58: TILX140006, Phosphoric Acid Solution (residue)

The tank car was a jacketed specification DOT-111A100W1, built in September 1992, 14,283 gallons capacity, 0.4375-inch-thick A516-70 heads and shell, rubber tank lining. The tank was provided with 6 inches of urethane insulation. The tank, lining, and service equipment were last inspected and qualified in 2013.

The tank sustained a scrape from ground contact along the upper left side of the car. The jacket was buckled near the left side of the B-end head. The right-side B-end handrail was pushed into the head and creased the jacket in that area. No breaching damage was observed.

Line 62: SHLX383, Molten Sulfur

The tank car was a jacketed specification AAR-211A100W1, built in January 2000, 15,059 gallons capacity, 0.4375-inch-thick A516-70 heads and shell. The tank was provided with a phenolic epoxy lining. The tank and service equipment were last inspected and qualified in 2008.

The tank car sustained deep jacket buckling on all sides. The jacket at the B-end was compressed against the head and torn. No breaching damage was observed.

Attachment 12: Damage Assessment Work Sheets for Non-Breached Tank Cars

I. Retained Parts for Metallurgical Examination and Testing

CSXT retained temporary custody of the retained tank car parts at Specialized Professional Services, Inc. (SPSI), 300 commercial Drive, Washington, PA 15301. On August 8, 2017, CSXT shipped the following retained tank parts to the NTSB laboratory for examination.:

1. CBTX781553 shell plate coupon from A-R side with puncture (Ring 2)
2. CBTX781553 bulged shell plate coupon above A-R bolster (Ring 1)
3. CBTX781553 reference shell coupon
4. ITDX5082 B-L upper bolster structure coupon

See the NTSB Materials Laboratory factual report for further information about the material properties in the vicinity of the tank bulge and a comparison of the CBTX781553 shell puncture geometry with the B-L upper bolster structure of ITDX5082.

Attachment 13: Request for NTSB Materials Laboratory Examination

J. Liquefied Petroleum Gas (propane) Shipper Information

Aux Sable Liquid Products, LP is a midstream gas processing business with facilities and pipelines for storing and transporting natural gas and natural gas liquids. The company headquarters is located in Morris, Illinois. Aux Sable began rail loading operations in December 2000 and maintains a fleet of about 300 leased tank cars. Aux Sable originates an average of over 6,000 LPG tank car shipments annually.

Except as otherwise provided in 49 CFR 173.24b, liquefied gases must be loaded to provide an outage of at least 1% for materials not poisonous by inhalation, such as liquefied petroleum gas or propane. The reference temperature must be 110 °F (LPG summer schedule) for a tank car having a thermal protection system, such as CBTX781553.

The tank car filling limit and filling density calculation for the load contained in CBTX781553 indicated that Aux Sable did not overload the car with HD5 odorized propane based on a specific gravity of 0.462 at a reference temperature of 110 °F. According to the calculation, the tank car was loaded short of a maximum allowable load by about 600 gallons (Figure 13).

Tank Car Filling Limit & Filling Density Calculations								
Tank Number	CBTX 781553	Commodity Name						
Tank Specification	DOT 112	Liquid Petroleum Gas						
Tank Capacity (gals)	33,640							
Load Limit (lbs)	164,200	Hazard Class	2.1	ID No.	1075	PG		
Light Weight (lbs)	98,800							
Scale Weight (lbs)	224,485	Scale Type :		Motion	X	Static		
Use this section for Filling Density Calculations !								
Is the product Chlorine, Hydrogen sulfide, Nitrosyl chloride, Sulfur dioxide or Sulfuryl fluoride? If yes, then enter an "X" to the right of the product name below; otherwise, go to the Filling Limit calculation section (green).								
Chlorine		Hydrogen sulfide		Nitrosyl chloride		Sulfur dioxide		Sulfuryl fluoride
Use this section for Filling Limit Calculations !								
Step 1 :	Determine the appropriate Reference Temp. °F, enter an "X" in one of the six applicable boxes below:							
	For Liquefied Petroleum Gas & Anhydrous Ammonia (Nov. → March) ONLY !							
	Insulated Tank	85 °F						
	Quasi-Insulated Tank (DOT 112J or 114J)	90 °F						
	Non-Insulated Tank	100 °F						
	For LPG & Anhydrous Ammonia (April → Oct) & All other products year round !							
	Insulated Tank	105 °F						
	Quasi-Insulated Tank (DOT 112J or 114J)	110 °F	X					
	Non-Insulated Tank	115 °F						
Step 2 :	Enter an "X" in one of the applicable three boxes below:							
	Toxic Inhalation Hazard							
	Anhydrous Ammonia or Ammonia > 50%							
	All Other Materials	X						
Step 3 :	Enter Specific Gravity @ Reference Temperature of	110	°F	0.462				
"Optional" for Filling Limit or Filling Density Calculations								
Enter product loading temperature in °F	90							
Enter specific gravity @ loading temperature	0.4814							
Click HERE for Results								
Does the product weight of	125,685	lbs. exceed the LD LMT of	164,200	lbs.	NO			
Number of lbs. exceeding the Load Limit (LD LMT)	0							
Max. allowable weight using Filling Limit (FL) calculations (lbs.) or,	128,141							
Max. allowable weight using Filling Density (FD) calculations (lbs.)								
Number of lbs. exceeding the Filling Limit or Filling Density requirement	0							
FL: Is the tank overfilled by volume @ reference temp.	110	°F	NO					
FL: Calculated volume in gals @ reference temp.	110	°F	32,665					
FL & FD: Max. gallons allowed @ loading temp.	90	°F	31,961					
FL & FD: Number of gallons filled @ loading temp.	90	°F	31,349					
FL & FD: Number of gallons overfilled @ loading temp.	90	°F	0					
FL & FD: Number of gallons required to reduce the volume to meet §173.24b(a)	0							

Figure 13: Tank car CBTX781553 filling density calculation.

Attachment 14: Bill of Lading, Aux Sable Liquid Products LP, July 28, 2017

K. CSXT Emergency Response Actions

The manager of hazardous materials for CSXT who served as the CSXT operations section chief for the emergency response told NTSB investigators that on August 2, 2017, the CSXT Public Safety Coordination Center (PSCC) notified him of the accident at about 5:06 a.m. The PSCC operator said he received multiple reports of fires and an explosion in connection with a derailment in Hyndman, Pennsylvania. The operations section chief contacted and periodically updated the CSXT director of hazardous materials, who also served as the CSXT incident commander. He also contacted the CSXT primary emergency response contractor Specialized Professional Services, Inc. (SPSI) and requested they respond to Hyndman, Pennsylvania "prepared for the worst." As he was traveling to the accident scene, the PSCC informed the operations section chief of the train standing order and reviewed the hazardous materials in the train, which consisted mainly of flammable gas, flammable liquids, and molten sulfur. He also learned there was one load of sodium chlorate in the train. The PSCC operator also stated there did not appear to be any toxic inhalation hazard materials in the train. Meanwhile, the CSXT incident commander initiated the company's emergency response plan to notify other CSXT hazmat managers and contractors to respond to the accident.

At about 6:01 a.m., the operations section chief was the first CSXT official to arrive at the derailment scene. He contacted the Hyndman Fire Department first responders who were laying out firehose and establishing a water supply. As he approached closer, the operations section chief observed firefighters conducting door-to-door evacuations. He assisted evacuees while at the same time attempting to contact the fire department incident commander. At first, he heard what seemed like the sound of a large volume of firefighting water striking a building or a tank car, but he later realized it was the sound of burning gas venting from the tank car.

The operations section chief located a deputy fire chief and verbally conveyed the identity of the hazardous materials on the train. He inquired about the safety of the train crew and the deputy fire chief confirmed the crew was safe and had given a paper copy of the train consist to another fire department chief within 5 minutes of his arrival on the opposite (north) side of the tracks. The operations section chief instructed the Hyndman fire chief to contact the PSCC for an electronic copy of the train consist as well.

At about 6:10 a.m., the operations section chief entered the incident scene to assess the situation with the burning tank car. He was accompanied by two firefighters as backup. He approached two houses that were impacted by derailed freight cars and checked to verify the occupants had evacuated. At that point he was able to observe a large volume of flame and pressurized gas coming out of one tank car, but the fire was so large he could not determine the specific source of the release. At that time, the fire department confirmed that the impacted residents had all been accounted for. He then telephoned the CSXT incident commander who was enroute and reported that a pressure car was venting and was on fire, but the source of the release was still unknown. The CSXT incident commander, who could hear the sound of venting gas over the telephone, directed the operations section chief to make sure that everyone, including fire department responders, are evacuated from the area. The operations section chief recommended to the fire department to move everyone as far back as possible from the accident site.

At about 7:00 a.m., the operations section chief entered the incident scene from a different direction and was able to confirm the burning tank car was CBTX781553 and that the car had rotated such that the top fittings protective housing was oriented at about 90 degrees with the pressure relief device in communication with the liquid phase of the liquefied compressed propane. He was alarmed that the flame was venting from the end of the car some distance from the protective housing where the pressure relief device was located. He also noted a ground fire with a blue flame characteristic of molten sulfur in the area surrounding CBTX781553. He was concerned that heat from the burning molten sulfur would add to increasing pressure within the propane car. He added:

> “I didn’t know what kind of damage that we had here because the jacket was still intact at that point. So I didn’t know if I had a puncture, a crack, a run-away crack. I didn’t know what we had. But we had the noise coming from the car that was changing in volume and intensity, and then it would go down a little bit, and then it would come back up, and the height of the flames.”

Based on these observations, the CSXT operations section chief recommended to the fire chief and several of his officers that the fire department evacuate to a minimum of one-half mile. Because he expressed uncertainty of how the pressure tank car was going to behave in the fire, the fire chief agreed to evacuate all emergency response personnel and stage operations from the Hyndman fire house.

At about 7:35 a.m., the CSXT operations section chief contacted the CSXT incident commander, who was still enroute, and reported that the pressure car was venting from a breach in the tank shell and that there was no release from its pressure relief device. Afterwards, the operations section chief focused on assisting the fire department with completing the evacuation of remaining citizens.

About 9:50 a.m., the CSXT operations section chief participated in a state police helicopter overflight of the incident scene and could confirm that molten sulfur and asphalt had been released from the derailed tank cars, as well as soy meal.[5] From these observations, he was able to pinpoint the segment of the train involved in the derailment. Fire was seen issuing from several locations on the propane tank car, giving the appearance of multiple punctures.

The incident command post (ICP) was temporarily established about ½ mile from the accident site at the Hope for Hyndman Charter School. About 10:00 a.m., the CSXT incident commander reported to the charter school ICP and conferred with the CSXT operations section chief and trainmaster.

The CSXT operations section chief briefed the Pennsylvania State Police commander on his observations and discussed possible outcomes and the risks associated with the burning propane pressure tank car. He suggested that should the tank car breach further, the risks included occurrence of a larger shell tear or tank fragmentation.

In an effort to better assess the situation and tank car damages, at about 12:00 p.m. another site entry was made by the CSXT incident commander, operations section chief, alternate operations section chief, and the emergency response contractor SPSI. When they arrived close to the accident scene at the Schellsburg Road bridge over Willis Creek, they noticed a significant increase in volume, type of sound, and intensity of the flame compared with their earlier observations.

[5] Overflight operations were provided with mutual aid by the Maryland State Police Aviation Division.

The CSXT incident commander stated:

> "The moment we stepped out of the fire truck onto the bridge, Joe looked at me and just… -- kind of pulled me aside and said, this is twice as loud than what it was 3 hours ago. And you could literally see the blowtorch fire shooting up from behind the houses."

The CSXT operations section chief stated:

> "But when we got to the height of the bridge, something changed, and it was louder and the flame was clearly above all the houses now, and that signified to us that something was imminent, something was – there was a potential for something imminent happening. Was this car getting ready to come apart? We didn't know."

The CSXT incident commander decided that it was necessary to assess the situation from a safer distance, however the entry team could not get a good view of the burning tank car. During this time the sound of the escaping gas continued to become noticeably louder and the flame grew higher, suggesting to the group that conditions were changing, and the integrity of the tank car was in question. They departed the scene and reconvened at the incident command post.

The CSXT responders joined a unified command with police, fire, and emergency management officials. The unified command staff consisted of the Pennsylvania State Police, Hyndman Fire Department, Pennsylvania Department of Environmental Protection, Pennsylvania Emergency Management Agency (PEMA), and CSXT. The unified command decided the safest course of action was to allow the tank car to continue venting and burning on its own pace and to allow events to take their course without sending personnel downrange to attempt mitigating actions. Meanwhile, responders concentrated on establishing an appropriate evacuation zone and monitoring the situation from a distance as best they could. Based on CSXT' recommendation, the evacuation zone was ultimately increased to a 1-mile radius of the accident scene, which resulted in relocating the incident command post from the charter school to the Tri-State Ministry Center, about 7 miles south of town.

About 4:30 p.m. on the day of the accident the CSXT incident commander, operations section chief, alternate operations section chief, and deputy operations section chief again entered the accident site and approached the derailment from Cleveland Street such that they were immediately adjacent to the derailed tank cars, being careful not to expose themselves to the tank ends. The CSXT incident commander described what he saw:

> "Lot of heat. I mean, even now at that point it was still a lot of heat. Fire was just, I mean, an absolute inferno. You could see what appeared to be -- we weren't sure if it was a tear, but it turned out to be the bulge in the tank. You could see that part. Several fires. We made ourselves to the top of the hill up onto the actual track structure to look down. Same mindset. At this point in time that car was not in a condition for us to mess with. Best thing at that point in time was just let the car do what it was going to do."

The CSXT incident commander said that he eventually became convinced that the CBTX781553 was not going to have a catastrophic release. The next meeting of the unified command resulted in a decision to continue letting the car burn while responders focused on air monitoring and restricting access to the area (Figure 14).

Figure 14: Accident scene August 2, 2017, 7:45 p.m. (courtesy CSXT).

By the evening of August 3, the pressure in the car decreased as evidence by diminishing flame size. A Hazmat team consisting of CSXT and contractor personnel gauged CBTX781553 finding about 28 psig, confirming that the pressure had reduced considerably, and was considerably lower than the vapor pressure of propane under normal transportation conditions of 138 psi at 77°F. The shell puncture became evident when CSXT peeled the jacket back to determine the nature of any shell damage and to search for a frost line suggestive of any remaining liquid level. The frost line ranged from about 6-inches to 15-inches high, indicating an estimated 2,000 to 3,000 gallons of liquid was still inside the tank. The most significant finding to the CSXT team was the lack of a shell crack or buckled material that would have been indicative of compromised structural integrity. The CSXT operations section chief commented:

> "One of those entries when I went up to inspect to see if I could see as close as I could on that, I noticed that there was a sizeable what appeared to be a bubble in the metal adjacent to the puncture. I have no idea when that started. But I know the first time I noticed it was

> when we had the jacket all finally peeled back, and I was able to get up -- the car was still on fire."

The CSXT operations section chief said that by the time the shell bubble was discovered, there was almost no pressure or product left in the car (Figures 15 and 16). He said by then, CSXT was in the process of purging vapor from the tank car and they were confident the situation was under control. He emphasized:

> "But we – when we noticed it, we were, wow, that was something that it was very difficult to see it with the jacket still on."

Figure 15: Tank car CBTX781553 showing the area where a bulge formed under the jacket (circled), August 3, 2017, 9:58 a.m. (courtesy CSXT).

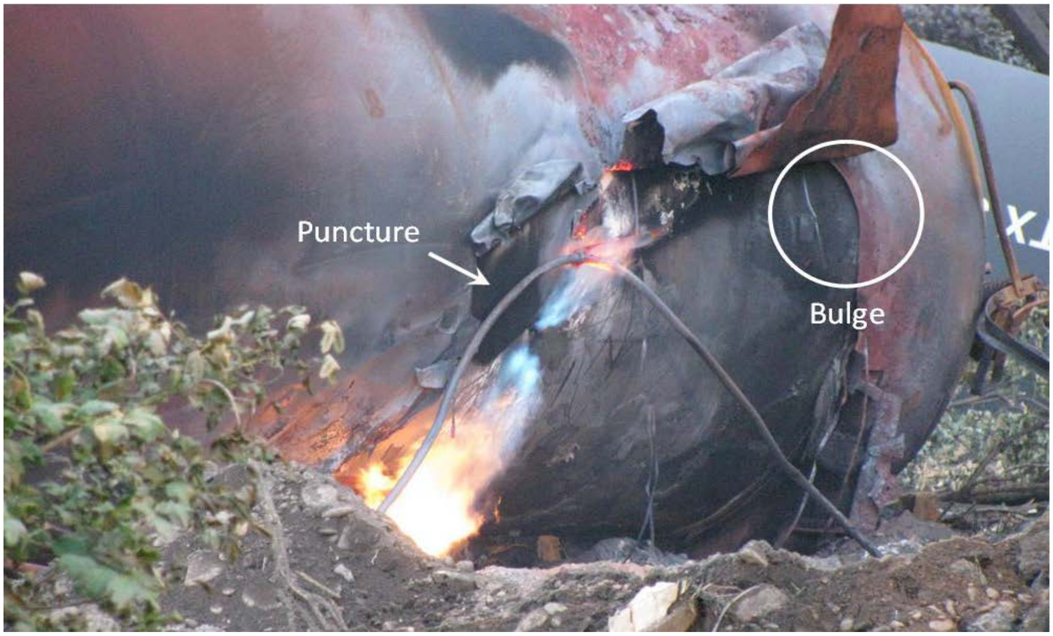

Figure 16: Tank car CBTX781553 after the jacket was peeled from the puncture area, August 4, 2017, 6:36 a.m. The edge of the shell bulge is visible under exposed jacket (circled). The puncture is covered with square of magnetic patching material (Courtesy CSXT).

When the propane tank car pressure reduced to about 8 psig CSXT responders felt confident they could manage any risks associated with moving the tank car. The CSXT incident commander explained that the unified command was uncomfortable allowing the car to burn at a diminished rate for several days while keeping evacuated residents from their homes for a prolonged period. They therefore decided to roll the car upright such that the eduction line would be situated in liquid and the vapor line was communicating only with vapor space. A pit was excavated next to the tank car to catch any liquid that might spill from the shell puncture when rolling the car. When the car was rolled upright, no liquid released from the shell puncture. Crews erected a flare stack nearby the tank car and burned off remaining propane transferred from the liquid valve over a period of about 12 hours. Following that, crews inerted the car with nitrogen. The propane fire was extinguished at 6:23 a.m. on Friday, August 4. Once the fire extinguished, crews removed the protective housing and pressure plate from the car to ensure it was completely empty of gas.

Smoke and high sulfur dioxide levels from smoldering molten sulfur fires continued to hamper access to the derailment scene for some time on August 4. Crews placed a water stream over the breached molten sulfur car to cause a crust to form over the material. They then flooded the car with nitrogen until the sulfur fire was out.

Contractors conducted air monitoring until levels of sulfur dioxide were sufficiently low in accordance with appropriate Pennsylvania Department of Health standards to allow residents to return to the area. Transporting samples for the greater precision offered by off-site laboratory testing created some delay in confirming air quality levels in the derailment area. At about 11:30 a.m. on Saturday, August 5, the unified command and state health officials agreed the air quality was sufficient for the evacuation to be lifted and residents were allowed to return at noon.

Describing the railroad's interaction with local first responders, the CSXT incident commander and operations section chief said the first responder's strengths were the basics of evacuation, incident stabilization, and their decision to take a defensive posture until the arrival of specialized resources. Although earlier hazardous materials training CSXT scheduled with the Hyndman Fire Department had to be postponed due to inclement weather, they yet were still knowledgeable enough to locate the train crew and obtain the hazardous materials shipping papers.

Questioned about the most significant challenges faced by the emergency response effort, the CSXT incident commander and operations section chief mentioned that communications were particularly difficult given the lack of cell phone service in the area. This was finally remedied when CSXT requested Verizon Wireless to establish a cell service tower in the valley. Additionally, their inability to get close enough to the propane tank car to gather data during the early phases of the incident made it difficult to know if they were making correct decisions for responder and public safety.

The CSXT incident commander pointed out a significant lesson he learned was that the lack of cell phone service also disabled the AskRail I-Phone application, which the emergency response community is becoming reliant upon for determining the identity and location of hazardous materials on a train. He said that paper train consists carried by train crews are therefore still necessary and are most the accurate form of hazard communication for first responders.

Attachment 15: CSXT Emergency Response Timeline of Events

L. Emergency Response Guidance for Railroad Accidents Involving LPG/Propane

This section describes available guidance for emergency responders to accidents involving railroad pressure tank cars, such as DOT-112 tank car CBTX781553 that released propane in this accident. Some of the highlighted literature excerpts pertain to assessment guidance for damage that may be hidden from view during emergency response or wreckage clearing operations because of the presence of tank jackets or the orientation of tank cars in a derailment pileup.

FRA Research

In 2002 and 2005 the Federal Railroad Administration (FRA) published reports on tank car damage assessment to evaluate the validity of recommended practices and to revise guidelines used to assess the severity of derailment damage to pressure tank cars. These guidelines are intended to avoid exposing personnel to the phenomenon of delayed tank fracture.[6, 7] The FRA noted that although mechanisms of delayed fracture in pressure tank cars are not well documented or understood, delayed failures have occurred and can place emergency response and wreckage clearing personnel at risk of death or injury. The FRA study reviewed literature that discusses the relevance of certain tank damage such as cracks, dents, gouges, and scores to decisions whether to move or to immediately offload damaged tank cars.

The FRA noted that tank car damage assessment is inherently dangerous because of conditions such as pre-existing cracks not visible to responders, defects in material or workmanship of the tank or its welds, and jackets covering pre-existing or accident-caused damage such that it is not visible to the responders. The FRA stated that it is therefore always prudent to limit access to an accident site involving damaged compressed gas cars until a thorough damage assessment has been made.

The FRA report contains revised damage assessment guidelines for interpreting the seriousness of various types of damage, and states that accurate damage assessment of jacketed tank cars can only be done when the jacket and insulation or thermal protection is removed. The guidelines state that although damage to a jacket itself is of little consequence, serious jacket damage may be an indication of tank damage behind the jacket. The FRA guidelines concerning assessment of various tank shell damage and deformations are limited only to those damages caused by mechanical impact.

Association of American Railroads Field Guide to Tank Cars

The *Field Guide to Tank Cars* is intended to be used by emergency responders and others involved with handling railroad tank cars. Among other things, the guide provides information about the safety systems employed on tank cars, guidelines for initial emergency response, and tank car damage assessment.[8] The tank car damage assessment guidelines provide first responders information relevant for making an initial appraisal to determine what action should be taken until expert assistance is available.

Among other things, the *Field Guide* states the following:

- The most serious damage that can occur to tanks and other containers transporting compressed gases is caused by bending, denting, scoring, or gouging without resultant leaks. Time, pressure, and handling can result in delayed rupture.
- Virtually all liquefied compressed gases are shipped in tank cars that are equipped with jackets and that tank damage refers to damage to the tank itself -- not the surrounding jacket. The guide

[6] *Damage Assessment of Railroad Tank Cars Involved in Accidents: Phase 1 Literature Search and Evaluation*. Report number DOT/FRA/ORD-06/12 (Washington, D.C. Federal Railroad Administration, 2005).

[7] *Revised Railroad Tank Car Damage Assessment Guidelines for Pressure Tank Cars*. Report number DOT/FRA/ORD-03/22 (Washington, D.C. Federal Railroad Administration, 2002).

[8] *Field Guide to Tank Cars,* Third Edition. Association of American Railroads / Bureau of Explosives (Washington, D.C. 2017).

cautions that removing a jacket to access the tank for damage assessment should only be done under the supervision of railroad personnel.

- Each visible dent, score, or gouge must be examined. Newly exposed surfaces must be examined as adjacent cars or surrounding materials are removed, or as the tank car itself is moved.
- Dents in combination with scores, gouges, or cracks, and dents which cross a weld seam, are the most dangerous and the tighter or smaller the radius or curve of the dent, the more dangerous it is.
- When fire, especially a torch-like flame, impinges on a tank, a high-volume hose stream directed at the point of flame contact may prevent dangerous heat and pressure buildup in the tank.
- Torch fires occur when a tank has been punctured or the pressure relief valve functions as well as other sources where flammable gas is burning out of the opening with strongly projecting flame. With this kind of fire, a large standoff distance is required, and unmanned monitor nozzles provide greater protection for responders than hand lines.
- A water attack is almost never the first thing that emergency responders should attempt. The guidance suggests that before laying, charging, and using hoses, responders should collect data about the hazardous material and survey the involved tank cars to interpret the damage and associated hazards.

Emergency Response Guidebook

The *Emergency Response Guidebook* (ERG) is a reference resource intended for use by first responders during the initial phase of a transportation incident involving hazardous materials.[9] The ERG is primarily a guide to aid first responders in quickly identifying the hazards of the material involved in the incident, and in protecting themselves and the general public during the initial incident response activities.

ERG Guide No. 115 provides emergency response guidance for UN1075 propane and other liquefied petroleum gases. The ERG states if a rail car is involved in a fire, isolate and evacuate for 1 mile in all directions. The guide recommends not to attempt to extinguish a leaking gas fire unless the leak can be stopped. For fire involving tanks, fight fires from maximum distance or use unmanned hose holders or monitor nozzles. The guide recommends that personnel withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. The guide states: “ALWAYS stay away from tanks engulfed in fire.”

Furthermore, the ERG contains a special section with safety precautions for boiling liquid expanding vapor explosions (BLEVEs). This section of the guide provides in two-page format background

[9] 2016 *Emergency Response Guidebook*. 11th edition. Washington, DC: DOT.

information on BLEVEs and includes a chart that provides important safety-related information to consider when confronted with situations involving liquefied petroleum gases. The ERG states that the main hazards from a propane or LPG BLEVE are fire, thermal radiation from the fire, blast, and projectiles.

For a tank car sized tank, the BLEVE safety precautions provide estimated minimum time to failure in as little as 9 minutes based on severe torch fire impingement on the vapor space of a tank in good condition. The guidance cautions that tanks may fail earlier if they are damaged or corroded or may fail minutes or hours later than the minimum times provided depending on conditions. For a tank car sized tank, the BLEVE safety precautions also suggest a minimum emergency response distance of about 1,500 feet, and a preferred evacuation distance of about 7,200 feet.[10]

The guide also references a video produced for Transport Canada (TC) and available from the TC website.[11] The topics covered in the video include BLEVE hazards and recommended safe distances for emergency responders when a fire is close to a pressure tank or tank car.

Other Hazard Communications

Additional emergency response information is appended to the hazardous materials shipping paper as required under 49 CFR 172.602. The shipping paper contained a description of hazards associated with each of the hazardous materials carried on the train, including Propane Division 2.1 flammable gas. These hazard communications included the following statements:

> EVACUATION: LARGE SPILL CONSIDER INITIAL DOWNWIND EVACUATION FOR AT LEAST 800 METERS (1/2 MILE). FIRE IF TANK, RAIL CAR OR TANK TRUCK IS INVOLVED IN A FIRE, ISOLATE FOR 1600 METERS (1 MILE) IN ALL DIRECTIONS; ALSO, CONSIDER INITIAL EVACUATION FOR 1600 METERS (1 MILE) IN ALL DIRECTIONS. IN FIRES INVOLVING LIQUEFIED PETROLEUM GASES (LPG) (UN1075); BUTANE, (UN1011); BUTYLENE, (UN1012); ISOBUTYLENE, (UN1055); PROPYLENE, (UN1077); ISOBUTANE, (UN1969); AND PROPANE, (UN1978), ALSO REFER TO BLEVE - SAFETY PRECAUTIONS (PAGE 368).

> EMERGENCY RESPONSE… FIRE INVOLVING TANKS FIGHT FIRE FROM MAXIMUM DISTANCE OR USE UNMANNED HOSE HOLDERS OR MONITOR NOZZLES. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER

[10] ERG, pages 368-369.

[11] The information contained in the Transport Canada BLEVE Response and Prevention video was prepared for Transport Canada, the Canadian Association of Fire Chiefs and the Propane Gas Association of Canada Inc. by Dr. A. M. Birk, Queen’s University, Kingston (Ontario) Canada. The video is provided on the Transport Canada website at http://www.tc.gc.ca/eng/tdg/publications-menu-1238.html (accessed on November 3, 2017).

UNTIL WELL AFTER FIRE IS OUT. DO NOT DIRECT WATER AT SOURCE OF LEAK OR SAFETY DEVICES; ICING MAY OCCUR. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICES OR DISCOLORATION OF TANK. ALWAYS STAY AWAY FROM TANKS ENGULFED IN FIRE. FOR MASSIVE FIRE, USE UNMANNED HOSE HOLDERS OR MONITOR NOZZLES; IF THIS IS IMPOSSIBLE, WITHDRAW FROM AREA AND LET FIRE BURN.

M. Remediation Actions

Air Monitoring

CSXT contracted GHD, Inc. to conduct air monitoring in the derailment area between August 2 and August 6. Real-time air monitoring was used as a screening tool to identify airborne concentrations of pollutants of interest. Roving and stationary data collected with photoionization detectors was used for monitoring volatile organic compounds (VOCs), hydrogen sulfide, and sulfur dioxide. GHD did not detect any VOC or hydrogen sulfide readings above the established action level in the derailment area during the monitoring period. There were sulfur dioxide readings at or above the community and work area action level of 0.2 and 5 ppm, respectively. According to GHD, these elevated sulfur dioxide readings were taken while the propane tank car was burning.

Solid Waste Disposal

Between August 4, and August 5, 2017, CSXT contractors disposed of 54 truckloads (about 1,300 cubic yards) of non-hazardous waste "asphalt, grain, soil and rock" at the Southern Alleghenies Landfill in Davidsonville, Pennsylvania.

Attachment 16: Air Monitoring Data Summary
Attachment 17: Solid Waste Disposal Summary

N. Previous NTSB Investigation of LPG Tank Car Delayed Rupture

Waverley, Tennessee Accident, February 22, 1978

On February 22, 1978, 23 tank cars of a Louisville and Nashville Railroad Company train derailed in Waverly, Tennessee. A derailed tank car containing liquefied petroleum gas ruptured, releasing the product which ignited with explosive force.[12] The specification DOT 112A400W tank car was not

[12] *Derailment of Louisville & Nashville Railroad Company's Train No. 584 and Subsequent Rupture of Tank Car Containing Liquefied Petroleum Gas, Waverly, Tennessee, February 22, 1978,* NTSB-RAR-79-1 (National Transportation Safety Board, Washington, DC, 1979).

equipped with a jacket, insulation, thermal protection, or head shields. During the derailment the tank car received a gouge and indentation that extended from the leading tank head to the center of the tank. The gouge had visibly altered the exterior bead of a weld between two of the tank barrel sections.

On February 24, about 40 hours after the accident, crews raised one end of the loaded tank car, using the opposite end as a pivot to move the car from the track. As the tank car was moved, a fracture originated in the gouged girth weld and propagated in each direction from the gouge causing the tank to separate into four large pieces. Large tank fragments were propelled as far as 350 feet when the product ignited. The tank car rupture and resulting fires killed 16 persons and injured 43 others. The majority of on-scene Waverly Fire Department personnel and their firefighting equipment was disabled.

The NTSB determined that the probable cause of the loss of life and substantial property damage was the release and ignition of liquefied petroleum gas from a tank car rupture. The rupture resulted from stress propagation of a crack, which may have developed during movement of the car for transfer of product or from increased pressure within the tank. The original crack was caused by mechanical damage during a derailment, which resulted from a broken high-carbon wheel on the 17th car which had overheated.

The NTSB accident report pointed out the need for training of all persons involved with hazardous materials accidents. The NTSB also stated that the inability of anyone at the scene to properly assess the mechanical damage sustained by the tank cars also indicated a need for additional knowledge.

Subsequent Tank Car Safety Improvements

Since the accident in Waverly Tennessee and several other fiery accidents that occurred in the 1960s and 1970s involving uninsulated pressure tank cars transporting hazardous materials, the Department of Transportation mandated that specification 112 and 114 tank cars carrying liquefied compressed flammable gases be equipped with shelf couplers, tank head puncture resistance systems, and thermal protection systems.[13] Modern tank cars, such as accident tank car CBTX781553, typically have thermal protection systems that consist of a ½-inch-thick ceramic fiber blanket shell covering, over which is an 11 gauge steel jacket.

Paul L. Stancil, CHMM
Senior Hazmat Accident Investigator

[13] 43 FR 30057, July 12, 1978

Attachments

Attachment 1: CSXT Train Consist Q38831HAZM
Attachment 2: AEI Event Details
Attachment 3: UTLX643949 UMLER File
Attachment 4: UTLX643949 Damage Assessment Work Sheets
Attachment 5: ITDX5082 UMLER File
Attachment 6: ITDX5082 Damage Assessment Work Sheets
Attachment 7: Propane Safety Data Sheet
Attachment 8: UMLER File CBTX781553
Attachment 9: CBTX781553 Damage Assessment Work Sheets
Attachment 10: Maintenance Record CBTX781553
Attachment 11: Material Test Reports CBTX781553
Attachment 12: Damage Assessment Work Sheets for Non-Breached Tank Cars
Attachment 13: Request for NTSB Materials Laboratory Examination
Attachment 14: Bill of Lading, Aux Sable Liquid Products LP, July 28, 2017
Attachment 15: CSXT Emergency Response Timeline of Events
Attachment 16: Air Monitoring Data Summary
Attachment 17: Solid Waste Disposal Summary