National Transportation Safety Board

Washington, DC 20594

Safety Recommendation

Date: January 21, 2014

In reply refer to: R-14-4 through -6

The Honorable Cynthia L. Quarterman
Administrator
Pipeline and Hazardous Materials
Safety Administration
Washington, DC 20590

The National Transportation Safety Board (NTSB) is providing the following information to urge the Pipeline and Hazardous Materials Safety Administration (PHMSA) to take action on the safety recommendations issued in this letter. These recommendations are derived from the NTSB's participation in the Transportation Safety Board of Canada's (TSB) investigation of the July 6, 2013, derailment of a Montreal, Maine & Atlantic (MMA) freight train in Lac-Mégantic, Quebec, Canada.

These recommendations address hazardous materials route analysis and selection, oil spill prevention and response plans, and identification and classification of hazardous materials in railroad freight transportation. As a result of this investigation to date, and consistent with the evidence found and the observations made, the NTSB is issuing three safety recommendations to PHMSA. Information supporting these recommendations is discussed below.

The Accident

On July 5, 2013, at 10:45 p.m. eastern daylight time, MMA freight train MMA-002 was proceeding eastbound on the MMA Sherbrooke Subdivision, en route from Montréal, Quebec, to Saint John, New Brunswick, Canada. The train was 4,700 feet long and weighed more than 10,000 tons. The train was composed of 5 head-end locomotives, a special-purpose caboose equipped to remotely control the locomotives, 1 loaded boxcar used as a buffer car, and 72 US Department of Transportation (DOT) Specification 111 general service tank cars (DOT-111) loaded with petroleum crude oil. The waybills described the product in the tank cars as Petroleum Crude Oil, UN1267, Class 3, Packing Group III. The crude oil originated from a tank truck-to-rail car transloading facility in New Town, North Dakota, and was destined for an oil refinery in Saint John, New Brunswick. The Canadian Pacific Railway transported the tank cars from New Town to Montréal, where the train was conveyed to the MMA with the same waybill information.

About 11:00 p.m., the engineer stopped the train at the designated MMA crew change point at milepost 7.40 near Nantes, Quebec. He left the lead locomotive idling and then departed the area, leaving the train unattended on the mainline track. The track had a descending grade of about 1.2 percent toward the town of Lac-Mégantic.

About 11:40 p.m., a nearby resident called the 911 emergency call center to report a fire on the idling locomotive. The local fire department responded, and the MMA dispatched an employee to assist the fire department personnel. About midnight, the responders initiated emergency shutdown procedures on the locomotive and extinguished the fire. The fire department and MMA personnel then departed the location, leaving the train unattended.

Shortly before 1:00 a.m. on July 6, 2013, the unattended train started to move, and it gathered speed, rolling uncontrolled for 7.4 miles down the descending grade into Lac-Mégantic. As the train entered the center of Lac-Mégantic, it was moving well over the authorized speed. The boxcar and 63 loaded crude oil tank cars derailed near the center of Lac-Mégantic. The locomotives separated from the train and came to rest about 1/2 mile east of the derailment.

At least 60 of the 63 derailed DOT-111 tank cars released about 1.6 million gallons of crude oil. Some of the spilled oil ignited immediately. The fire engulfed the derailed cars and the surrounding area. Forty-seven people died as a result of the fire, and nearby structures were destroyed or extensively damaged. The fire was extinguished by noon on July 7, 2013. About 2,000 people evacuated the surrounding area.

DOT Postaccident Actions

On August 2, 2013, the Federal Railroad Administration (FRA) issued Emergency Order No. 28 to address safety issues related to securement of unattended trains containing the following:

> (1) five or more tank car loads of any one or any combination of materials poisonous by inhalation as defined in Title 49 *Code of Federal Regulations* (CFR) 171.8, and including anhydrous ammonia (UN1005) and ammonia solutions (UN3318); or (2) 20 rail car loads or intermodal portable tank loads of any one or any combination of materials listed in (1) above, or, any Division 2.1 flammable gas, Class 3 flammable liquid or combustible liquid, Class 1.1 or 1.2 explosive, or hazardous substance listed in 49 CFR 173.31(f)(2).[1]

These quantities of specific hazardous materials addressed in Emergency Order No. 28 are the same as those that define a key train[2] as outlined in the Association of American Railroads (AAR) Circular No. OT-55-N, *Recommended Railroad Operating Practices for Transportation of Hazardous Materials,* effective August 5, 2013. Emergency Order No. 28 "was intended to address some of the human factors failures that may cause unattended equipment to be

[1] *Federal Register* 78, no. 152 (August 7, 2013): 48218.

[2] The Association of American Railroads revised the definition of *key train* on August 5, 2013, to mean "any train with one tank car load of Poison or Toxic Inhalation Hazard (Hazard Zone A, B, C, or D), anhydrous ammonia (UN1005), or ammonia solutions (UN3318); 20 car loads or intermodal portable tank loads of any combination of hazardous material; or one or more car loads of spent nuclear fuel or high level radioactive waste."

improperly secured and to protect against a derailment situation similar to that which occurred in Lac-Mégantic."

Emergency Order No. 28 prohibits railroads from leaving trains or vehicles transporting the specified hazardous materials unattended on mainline track or siding outside of a yard or terminal unless the railroad adopts and complies with a plan that provides sufficient justification for leaving them unattended under specific circumstances and locations. The order also requires railroads to develop specific processes for securing, communicating, and documenting the securement of applicable unattended trains and vehicles, including locking the controlling locomotive cab door or removing the reverser[3] and setting a sufficient number of hand brakes before leaving the equipment unattended. In addition, the order requires railroads to review, verify, and adjust as necessary existing requirements and instructions related to the number of hand brakes to be set on unattended trains; conduct train securement job briefings among crewmembers and employees; and develop procedures to ensure qualified employees inspect equipment for proper securement after emergency response actions that involve the equipment.

The NTSB agrees with the following safety concerns arising from the Lac-Mégantic accident the FRA identified in Emergency Order No. 28:

- Crude oil is problematic when released because it is flammable, and the risk is compounded because it is commonly shipped in large units.
- Similar dangers exist with other hazardous materials such as ethanol, which was transported via rail more than any other hazardous material in 2012.
- Although the Lac-Mégantic accident occurred in Canada, the freight railroad operating environment in Canada is similar to that in the United States.
- The MMA train in the Lac-Mégantic accident was transporting 72 carloads of petroleum crude oil in a single consist. Rail lines in the United States commonly configure trains to transport crude oil by a unit train that consists virtually entirely of tank cars containing crude oil.

On August 2, 2013, PHMSA and the FRA issued joint Safety Advisory 2013-06.[4] The advisory recommends eight additional actions that railroads and shippers should take to ensure the safe transportation of hazardous materials:

- Review the details and lessons learned from the Lac-Mégantic accident;
- Review crew staffing levels;
- Require the train reverser to be removed and secured when unattended;
- Review all railroad operating procedures, testing, and operating rules concerning train securement;

[3] The *reverser* is the directional control for the locomotive. Removing it would put the locomotive in neutral, preventing it from moving forward or backward under power of the engine.

[4] *Federal Register* 78, no. 152 (August 7, 2013): 48224.

- Review the Transport Canada[5] directives to secure and safely operate a train;
- Conduct a systemwide assessment of security risks when a train is unattended and identify mitigation efforts for those risks;
- Evaluate processes to ensure proper classification of hazardous materials for shipment; and
- Review shippers' and carriers' safety and security plans and amend the plans as necessary.

DOT-111 Tank Cars

The NTSB recognizes that rail shipments of crude oil have sharply increased in recent years as the United States experiences unprecedented growth in oil production,[6] and the Lac-Mégantic accident demonstrates that major loss of life, property damage, and environmental consequences can occur when large volumes of crude oil or other flammable materials are on a train involved in an accident. The potential destructive effects of large numbers of derailed DOT-111 tank cars containing flammable materials are further demonstrated by several recent NTSB accident investigations:

- The December 30, 2013, BNSF Railway Company crude oil unit train that derailed near Casselton, North Dakota, after striking another derailed freight train. Several of the DOT-111 tank cars ruptured and released product that ignited. The postaccident fire destroyed two locomotives and thermally damaged several additional tank cars causing violent, fiery eruptions. Dense, toxic smoke forced a temporary evacuation of the town.
- The July 11, 2012, Norfolk Southern Railway Company train derailment in a Columbus, Ohio, industrial area in which three derailed DOT-111 tank cars released about 53,000 gallons of ethanol, with energetic rupture of one tank car in a postaccident fire.
- The October 7, 2011, derailment in Tiskilwa, Illinois, of 10 DOT-111 tank cars resulting in fire, energetic rupture of several tank cars, and the release of 162,000 gallons of ethanol.[7]

[5] *Transport Canada* is the Canadian government department responsible for regulating transportation safety in Canada.

[6] Bureau of Explosives, *Annual Report of Hazardous Materials Transported by Rail,* BOE 12-1 (Washington, DC: Association of American Railroads, Bureau of Explosives, 2013).

[7] National Transportation Safety Board, *Derailment and Hazardous Materials Release and Fire, Tiskilwa, Illinois, October 7, 2011*, RAB-13/02 (Washington DC: National Transportation Safety Board, 2013).

- The June 19, 2009, Canadian National Railway derailment in Cherry Valley, Illinois, in which 13 of 19 derailed DOT-111 tank cars were breached, caught fire, and released about 324,000 gallons of ethanol. The postaccident fire resulted in one death, nine injuries, and the evacuation of 600 houses within 1/2 mile of the accident.[8]
- The October 20, 2006, derailment in New Brighton, Pennsylvania, in which 23 DOT-111 tank cars in a unit train derailed, fell from a bridge, caught fire, and released more than 485,000 gallons of ethanol.[9]

The NTSB is aware that the FRA investigated the February 6, 2011, derailment in Arcadia, Ohio, of a unit train of DOT-111 tank cars that released about 786,000 gallons of ethanol from 32 derailed tank cars. The FRA also investigated the August 5, 2012, derailment of 18 DOT-111 tank cars of ethanol in Plevna, Montana, where 5 cars caught fire, resulting in some explosions. Most recently, the FRA is investigating the November 7, 2013, derailment of 26 tank cars of a 90-car unit train of crude oil in Aliceville, Alabama, in which breached tank cars caught fire and released crude oil into a wetland.

Planning Requirements for Rail Transportation of Hazardous Materials

Title 49 CFR, Part 172, Subpart I, prescribes the requirements for the development and implementation of plans to address security risks related to the commercial transportation of hazardous materials. On November 26, 2008, PHMSA, in coordination with the FRA and the Transportation Security Administration (TSA), issued a final rule requiring, among other things, that rail carriers compile annual data on certain shipments of explosive, toxic by inhalation, and radioactive materials; use the data to analyze safety and security risks along rail routes where those materials are transported; assess alternative routing options; and make routing decisions based on those assessments. The final rule also addresses section 1551(e) of the Implementing Recommendations of the 9/11 Commission Act of 2007, Pub. L. 110-53, that requires rail carriers transporting "security sensitive materials" to select the safest and most secure route to be used in transporting those materials, based on the carrier's analysis of the safety and security risks on primary and alternative transportation routes over which the carrier has authority to operate.

Route planning and route selection requirements have been incorporated into the Hazardous Materials Regulations at 49 CFR 172.820. The regulation requires that a rail carrier that transports more than 5,000 pounds of a Division 1.1, 1.2, or 1.3 explosive in a single car load; a single bulk package of a material toxic by inhalation; or a highway route-controlled quantity of a Hazard Class 7, radioactive material, must annually compile commodity data to identify routes on which these materials are transported. The rail carrier also must annually analyze the safety and security risks for the transportation routes to include 27 risk factors, such

[8] National Transportation Safety Board, *Derailment of CN Freight Train U70691-18 With Subsequent Hazardous Materials Release and Fire, Cherry Valley, Illinois, June 19, 2009*, RAR-12/01 (Washington DC: National Transportation Safety Board, 2012).

[9] National Transportation Safety Board, *Derailment of Norfolk Southern Railway Company Train 68QB119 with Release of Hazardous Materials and Fire, New Brighton, Pennsylvania, October 20, 2006*, RAR-08/02 (Washington DC: National Transportation Safety Board, 2008).

as the volume of hazardous materials transported; track type, class, and maintenance schedule; track grade and curvature; environmentally sensitive or significant areas; population density along the route; emergency response capability along the route; and areas of high consequence along the route as defined in 49 CFR 172.820(c). The carrier also must identify alternative routes over which it has authority to operate and perform a safety and security risk assessment of those routes for comparison. The carrier must use the analysis to select the practicable route posing the least overall safety and security risk.

According to the regulations, if the FRA finds the carrier's route selection documentation and underlying analyses to be deficient, the carrier may be required to revise the analyses or make changes in the route selection. If the FRA finds that a selected route is not the safest and most secure practicable route available, in consultation with the TSA, the FRA may require the use of an alternative route.

A primary safety and security concern related to rail transportation of hazardous materials that was considered in the interim final rule issued on April 16, 2008,[10] is the prevention of catastrophic release or explosion in proximity to densely populated areas, including urban areas and events or venues with large numbers of people in attendance, iconic buildings, landmarks, or environmentally sensitive areas. The goal of the PHMSA-required routing analysis is to ensure that each route used for the transportation of the specified hazardous materials presents the fewest overall safety and security risks. PHMSA also noted that even in the absence of alternative routes, assessing the safety and security risks along the route is critical to enhancing rail transportation safety and should prompt rail carriers to address identified vulnerabilities.

With the notable exception of the Lac-Mégantic accident, in which 47 people died and the town center was destroyed, none of the accidents cited above that involved fires and explosions on blocks of tank cars and unit trains carrying flammable materials occurred in densely populated areas. However, each of these accidents exhibited the potential for severe catastrophic outcomes had they occurred in such critical areas.

PHMSA has considered suggestions that other classes of hazardous materials, such as flammable gases, flammable liquids, hydrogen peroxide, oxidizers, poisons, and corrosives, should be included in the requirements for route selection. While evaluating the final rule, PHMSA, the FRA, and the TSA assessed the safety and security vulnerabilities associated with the transportation of different types and classes of hazardous materials based on accident scenarios and on scenarios that depict how hazardous materials could be used deliberately to cause significant casualties and property damage. In the interim final rule, the DOT and the TSA concluded the following:

> The risks are not as great as those posed by the explosive, poison inhalation hazards, and radioactive materials specified in the interim final rule, and we are not persuaded that they warrant the additional precautions required by the interim final rule.

Significant changes to the regulatory landscape have occurred since the issuance of the 2008 final rule. Major growth in crude oil and ethanol transportation volumes has occurred in

[10] *Federal Register* 73, no. 74 (April 16, 2008): 20752.

recent years, yet this market did not exist when the rule was developed. According to the AAR *Annual Report of Hazardous Materials Transported by Rail* for 2012, crude oil shipments have increased 443 percent since 2005.[11] The first quarter of 2013 saw a 166 percent increase in crude oil shipment by rail over the first quarter of 2012, and growth is expected to continue for the foreseeable future.[12] Furthermore, in response to the US Environmental Protection Agency's 2005 Renewable Fuel Standard, ethanol traffic by railroad increased 441 percent between 2005 and 2011, and it was the most frequently transported hazardous material in 2012.

In the April 16, 2008, interim final rule, PHMSA stated that route planning and selection regulations were intended to protect against an event such as the one that occurred on January 6, 2005, in Graniteville, South Carolina, in which a release of chlorine, a material classified as a toxic inhalation hazard, caused 9 fatalities and 554 injuries.[13] The Lac-Mégantic accident and other recent accidents have demonstrated that the same potential for loss of life and damage to communities and the environment exists when accidents occur involving blocks of tank cars and unit trains transporting large volumes of flammable materials. Although the FRA actions under Emergency Order No. 28 acknowledge that better security is needed for unattended key trains, route planning and route selection protections currently required for explosive, toxic by inhalation, or radioactive materials are not required for trains transporting large bulk quantities of volatile flammable liquids through populated communities. The NTSB believes that at a minimum, the route assessments, alternative route analysis, and route selection requirements of 49 CFR 172.820 should be extended to key trains transporting large volumes of flammable liquid. Therefore, the NTSB recommends that PHMSA work with the FRA to expand hazardous materials route planning and selection requirements for railroads under 49 CFR 172.820 to include key trains transporting flammable liquids as defined by AAR Circular No. OT-55-N and, where technically feasible, require rerouting to avoid transportation of such hazardous materials through populated and other sensitive areas.

Oil Spill Response Plans

About 1.6 million gallons of crude oil were released from the derailed tank cars in Lac-Mégantic with initial cleanup costs estimated at more than $200 million. According to a report released by the Quebec Ministry of Sustainable Development, Environment and Parks, the released crude oil covered about 77 acres of surface area in the center of Lac-Mégantic, and petroleum related contaminants that entered the Chaudière River were transported as far as 74 miles away.[14] As devastating as the Lac-Mégantic accident was, it did not fully represent a worst-case (maximum potential) discharge, because 9 of the 72 tank cars at the rear of the train did not derail or release crude oil.

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[11] Bureau of Explosives, *Annual Report of Hazardous Materials Transported by Rail*, BOE 12-1 (Washington, DC: Association of American Railroads, Bureau of Explosives, 2013).

[12] J. Karl Alexy, "Crude Oil and Ethanol Transportation Trends" (presentation, 49th Railroad Safety Advisory Committee, Washington, DC, August 29, 2013).

[13] National Transportation Safety Board, *Collision of Norfolk Southern Freight Train 192 With Standing Norfolk Southern Local Train P22 With Subsequent Hazardous Materials Release at Graniteville, South Carolina, January 6, 2005*, RAR-05/04 (Washington, DC: National Transportation Safety Board, 2005).

[14] Quebec Ministry of Sustainable Development, Environment and Parks, *Déraillement ferroviaire raillement de Lac-Mégantic* (*Environmental Characterization, Lac-Mégantic Derailment, Preliminary Report),* (Quebec: Golder Associates, 2013).

The Lac-Mégantic accident shows that railroad accidents involving crude oil have a potential for disastrous consequences and environmental contamination equal to that of the worst on-shore pipeline accidents. The July 25, 2010, crude oil pipeline accident in Marshall, Michigan, released about 843,000 gallons of crude oil from a 30-inch-diameter ruptured transmission pipeline and was the most costly inland pipeline crude oil spill in the United States to date, with environmental remediation costs approaching $1 billion.[15] Although railroad accidents involving large numbers of crude oil tank cars can have similar outcomes, oil spill response planning requirements for rail transportation of oil/petroleum products are practically nonexistent compared with other modes of transportation. Current regulations do not require railroads transporting crude oil in multiple tank cars to develop comprehensive spill response plans and have resources on standby for response to worst-case discharges. Although simple plans must be developed, the plans are not reviewed to evaluate the capability of rail carriers to respond to and mitigate discharges.

Executive Order 12777[16] delegates to the DOT various responsibilities identified in section 311(j) of the Clean Water Act regarding discharges of oil and hazardous substances from transportation-related on-shore facilities. The PHMSA authority for on-shore transportation facilities (motor vehicles and rolling stock) is limited to promulgating regulations. Spill response plans are submitted to the Federal Motor Carrier Safety Administration and the FRA for highway carriers and railroads, respectively. Since 1996, regulations have been in place at 49 CFR Part 130 to require comprehensive response plans for oil shipments in bulk packages (cargo tank motor vehicles and railroad tank cars) in a quantity that exceeds 42,000 gallons in a single package. For smaller petroleum oil shipments—in bulk packages of 3,500 to 42,000 gallons—the regulations require a less detailed basic response plan.

A spill response plan is intended to help the transporter develop a response organization and ensure the availability of resources needed to respond to an oil release. According to 49 CFR 130.31, the plan also should demonstrate that the response resources will be available in a timely manner to reduce the severity and impact of a discharge. Federal regulations require all railroads that transport liquid petroleum oil to develop basic written response plans that describe the manner of response to discharges that may occur during transportation, take into account the maximum potential discharge, identify the private personnel and equipment available to respond to a discharge, and retain that plan on file at its principal place of business and at the dispatcher's office. A comprehensive written plan is required for carriers transporting bulk shipments that exceed the 42,000-gallon package size. Each of these carriers also is required to have a comprehensive written plan that

- is consistent with the requirements of the National Contingency Plan (40 CFR Part 300) and Area Contingency Plans;
- identifies a qualified individual having full authority to implement removal actions;

[15] National Transportation Safety Board, *Enbridge Incorporated Hazardous Liquid Pipeline Rupture and Release, Marshall, Michigan, July 25, 2010*, PAR-12/01 (Washington, DC: National Transportation Safety Board, 2012).

[16] *Federal Register* 56 (October 22, 1991): 54757.

- ensures by contract or other means the availability of private personnel and equipment necessary to remove a worst-case discharge;
- describes training, equipment testing, drills, and exercises; and
- is submitted to the FRA.

When a discharge occurs into navigable waters of the United States, the carrier is responsible for implementing the basic or comprehensive response plan.

In the preamble to the June 17, 1996, final rule,[17] the Research and Special Programs Administration (RSPA)[18] stated its belief that 42,000 gallons in a single packaging is an appropriate and reasonable liquid quantity for a finding that a release would cause substantial harm to the environment, and thus should be the threshold for comprehensive planning. However, RSPA noted that on the basis of available information, no rail carrier was transporting oil in a quantity greater than 42,000 gallons in tank cars. During 1996, when the rulemaking was being considered, there were only 67 tank cars listed in the AAR UMLER[19] file with a capacity equal to or greater than 42,000 gallons. Only six of these cars were being used to transport oil or petroleum products.

The NTSB finds that as currently written, the regulation circumvents the need for railroads to comply with spill response planning mandates of the federal Clean Water Act. Although the DOT 42,000-gallon threshold for comprehensive response plan development is equivalent to an unrelated threshold contained in a spill prevention, control, and countermeasures rule administered by the US Environmental Protection Agency for nontransportation related oil storage facilities,[20] the DOT regulation is rendered ineffective because of its lack of applicability to any real-world transportation scenario. By limiting the comprehensive planning threshold for a single tank size that is greater than any currently in use, spill-planning regulations do not take into account the potential of a derailment of large numbers of 30,000-gallon tank cars, such as in Lac-Mégantic where 60 tank cars together released about 1.6 million gallons of crude oil.

RSPA stated further that the risk to the marine environment posed by oil in transport is proportional to the quantity of oil that could be discharged in an accident, and when the rule was developed 17 years ago, it was based on the relatively few petroleum shipments by tank car that were not being assembled as unit trains. The NTSB believes that because conditions have significantly changed with the recent massive growth in crude oil transportation, the regulations are no longer sufficient to mitigate the risks of petroleum product releases in accidents. Although no one tank car meets the current threshold for comprehensive spill planning, the Lac-Mégantic accident and the well-known poor lading retention performance history of DOT-111 tank cars

[17] *Federal Register* 61, no. 117 (June 17, 1996): 30533.

[18] RSPA was abolished by act of November 30, 2004 (118 Stat. 2424-2426), and certain duties were transferred to both PHMSA and the Administrator of the Research and Innovative Technology Administration, DOT.

[19] UMLER refers to the Universal Machine Language Equipment Register, which is a file of vital statistics for each rail car in service.

[20] Under 40 CFR Part 112, if the facility transfers oil over water to or from vessels and has a total oil storage capacity greater than or equal to 42,000 gallons it could, because of its location, reasonably be expected to cause substantial harm to the environment by discharging oil on the navigable waters or adjoining shorelines.

have demonstrated that the worst-case release potential of these unit trains, in many cases greater than 2 million gallons, must be considered in the oil and hazardous materials spill planning process.

US Coast Guard regulations for marine tank vessels require spill response planning to address a worst-case discharge, which is defined as the entire cargo on the vessel. Planning to respond to maximum potential releases for trains transporting crude oil, many of which are configured in unit trains as "virtual pipelines" of tank cars, also must take into account the entire quantity of lading. Therefore, the NTSB recommends that PHMSA revise the spill response planning thresholds contained in 49 CFR Part 130 to require comprehensive response plans to effectively provide for the carriers' ability to respond to worst-case discharges resulting from accidents involving unit trains or blocks of tank cars transporting oil and petroleum products.

Hazardous Materials Packing Group Classification

The MMA train originated from a tank truck-to-rail car transloading facility in New Town, North Dakota, operated by Strobel Starostka Transfer (SST) on behalf of subsidiaries of World Fuel Services Corporation. The original bills of lading that SST provided to Canadian Pacific Railway described the hazardous material as a Hazard Class 3 flammable material, Packing Group III.

Packing groups indicate the degree of danger presented by the material as either high, medium, or low (Packing Group I, II, or III, respectively).[21] The table below shows the flash point and initial boiling point criteria for each packing group.

Table. Hazardous Liquids Class 3 Packing Group Criteria

Packing Group	Flash Point	Boiling Point
I	N/A	≤ 35°C
II	< 23°C	> 35°C
III	≥ 23°C ≤ 60°C	> 35°C

The intensity of the postaccident fire in Lac-Mégantic and the apparent low viscosity of the crude oil product prompted the TSB to collect and analyze samples of the product from nine undamaged tank cars in the train and from two tank cars in a second crude oil train stationed in Farnham, Quebec, to determine if the shipments had been properly described and the appropriate packing group assigned. Test results indicate the flash point was less than -35°C and the initial boiling point was between 43.9°C and 48.5°C, which placed this product in the lower end of the crude oil flash point range, well below the parameters for Packing Group III materials. Thus, the test results confirmed the crude oils on these trains had been incorrectly assigned to Packing Group III, and they should have been assigned to the more hazardous Packing Group II.

[21] Packing groups for Class 3 materials are defined in 49 CFR 173.121.

The crude oil on the accident train was derived from 11 different suppliers from producing wells in the Bakken Shale formation region of North Dakota, and the suppliers classified it as a Class 3 hazardous material with the packing group varying from Packing Group I to Packing Group III. Investigators determined that the hazardous materials shipping papers provided by trucking companies transporting crude oil from the wells to the tank transloading facility indicate the crude oil was Packing Group II, although these companies could not provide evidence that the oil had been tested to assign the appropriate packing group. Investigators learned that after these loads were placed into rail tank cars, the bills of lading SST provided to the Canadian Pacific Railway described the crude oil as Packing Group III. The accident train with the same incorrect Packing Group III waybill information was interchanged to the MMA in Montréal.

On September 11, 2013, the TSB issued Rail Safety Advisory Letter 13/13, which recommended that PHMSA review its procedures for suppliers and companies transporting these products to ensure the product properties are accurately determined and documented for safe transportation.

The packing group classification requirements of the Hazardous Materials Regulations include the packaging that must be used to ship the material. The packing group classification determines authorized filling densities and outage requirements, hazard communications (marking, labeling, and placards), transportation safety and operational controls, and safety and security planning. Proper identification of hazardous materials is required to ensure emergency responders understand the hazards associated with the shipped material.

The NTSB investigated several accidents involving DOT-111 general service tank cars, and identified the vulnerability of tank heads, shells, and fittings to damage and subsequent release of lading during derailments. In the most recent accident report focusing on the crashworthiness of DOT-111 tank cars as a result of the derailment of a CN freight train transporting denatured ethanol in Cherry Valley, Illinois,[22] the NTSB issued the following safety recommendation to PHMSA:

R-12-5

> Require that all newly manufactured and existing general service tank cars authorized for transportation of denatured fuel ethanol and crude oil in Packing Groups I and II have enhanced tank head and shell puncture-resistance systems and top fittings protection that exceeds existing design requirements for DOT-111 tank cars. (Currently classified "Open—Acceptable Response.")

Additionally, the AAR developed new design criteria for tank cars built for the transportation of Packing Groups I and II materials with the proper shipping names Petroleum Crude Oil, Alcohols, n.o.s., and Ethanol and Gasoline Mixture.[23] These standards published in

[22] National Transportation Safety Board, *Derailment of CN Freight Train U70691 With Subsequent Hazardous Materials Release and Fire, Cherry Valley, Illinois, June 19, 2009*, RAR-12/01 (Washington, DC: National Transportation Safety Board, 2012).

[23] *n.o.s.* means not otherwise specified.

the AAR *Manual of Standards and Recommended Practices, Specifications for Tank Cars*, M-1002, require that all such tank cars ordered after October 1, 2011, in Packing Groups I and II service must meet the following criteria:

> Class 111 tank cars used to transport Packing Group I and II materials with the proper shipping names Petroleum Crude Oil, Alcohols, n.o.s., and Ethanol and Gasoline Mixture, must have heads and shells constructed on normalized TC128 Grade B steel or normalized A516-70 steel. Tank car heads must be normalized after forming, unless approval is granted by the AAR Executive Director of Tank Car Safety on the basis that a facility has demonstrated that its equipment and controls provide an equivalent level of safety. For tanks constructed of normalized TC128 Grade B steel, non-jacketed tanks must be at least 1/2-in. thick and jacketed cars must be at least 7/16-in. thick. For tanks constructed of normalized A516-70 steel, non-jacketed cars must be at least 9/16-in. thick and jacketed cars must be at least 1/2-in. thick. In all cases the cars must be equipped with at least 1/2-in. half-head shields.

Federal regulations at 49 CFR Part 179, Subpart D, do not provide the same level of protection as the industry standard, and they allow DOT-111 tank cars to be built of nonnormalized steel to a lesser plate thickness of 7/16 inch, with no provision for a jacket or head shield.

The August 2, 2013, FRA and PHMSA joint safety advisory recommended that shippers evaluate their processes to ensure that all hazardous materials are properly classed and described in accordance with the Hazardous Materials Regulations. Although the NTSB agrees with the broad scope of this recommendation, the absence of a product testing requirement to properly classify hazardous materials may lead shippers or carriers to rely on incorrect information or refer to generic data sheets that may not accurately represent the nature of the material being shipped. Such was the case with 10 inconsistent safety data sheets for the crude oil that was loaded in the tank cars that derailed in Lac-Mégantic. Several of these data sheets were developed by companies that had no involvement in the production of crude oil in the Bakken Shale region. Two of the data sheets indicated it was necessary to "determine the flash point accurately to classify the packing group."

Although PHMSA issued an Advanced Notice of Proposed Rulemaking on September 6, 2013, to address safety improvements for DOT-111 tank cars,[24] the regulations do not require the use of currently available, improved tank cars for Packing Groups I and II crude oil or other hazardous materials.

On October 17, 2013, Transport Canada issued Protective Direction No. 31 directing any person engaged in importing or offering crude oil for transportation in Canada to provide results for packing group classification testing and a safety data sheet for the tested product to Transport Canada. Until such time as testing is completed, any person transporting crude oil in Canada must ship the oil as a Class 3 flammable liquid, Packing Group I, and meet the requirements established for this classification.

[24] *Federal Register* 78, no. 173 (September 6, 2013): 54849.

The shipper's responsibility under the Hazardous Materials Regulations at 49 CFR 173.22 mandate classifying and describing the hazardous material in accordance with Parts 172 and 173. The regulations at 49 CFR 172.204 also require the shipper to declare that the contents of a consignment are fully and accurately described and classified. In several interpretation letters issued on these regulations, PHMSA has stated it is the shipper's responsibility to properly classify and describe a hazardous material and that such determinations are not required to be verified by PHMSA. However, proper classification of hazardous materials is one of the most important responsibilities of the shipper because all other requirements for safe transportation are dependent on accurate identification.

Although the regulations prescribe test methods to assign the appropriate classification, there is an assumption that shippers have exercised the necessary due diligence and testing to ensure their shipments are properly described.[25] However, the record-keeping requirements of the Hazardous Materials Regulations do not require shippers to maintain evidence to demonstrate that the physical and chemical properties of a hazardous material have been sufficiently evaluated to justify the description and classification used for transportation. For example, for classification of a flammable material, 49 CFR 173.120 and 173.121 provide specific flash points and initial boiling points for determining if the material meets the definition of a flammable material and for classification into the appropriate packing group. The regulations are silent on whether a shipper must test the product or whether the shipper may rely on manufacturer data or even the shipper's own undocumented knowledge for determining the applicable shipping requirements.

On November 20, 2013, PHMSA and the FRA jointly issued Safety Advisory 2013-07 to reinforce the importance of proper characterization, classification, and selection of packing group for flammable materials.[26] The safety advisory emphasized specific definitions for the proper classification of petroleum crude oil and selection of shipping names and packing groups. The advisory also announced that PHMSA recently initiated the "Operation Classification" initiative, in which PHMSA and the FRA will conduct unannounced inspections and testing to verify hazardous material classifications selected and certified by shippers of petroleum crude oil. Although the NTSB applauds this enforcement initiative, product testing or other acceptable forms of proof are needed to document the decisions made by shippers of crude oil and other hazardous materials when they classify materials for transportation. Moreover, shippers should be required to maintain these records so inspectors are able to evaluate the accuracy of hazardous materials classifications.

On January 2, 2014, PHMSA issued a safety alert addressing the flammability characteristics of the crude oil produced from the Bakken Shale region in the United States.[27] When it announced the safety alert, PHMSA noted that the alert reinforces "the requirement to properly test, characterize, classify, and where appropriate sufficiently degasify hazardous

[25] Certain Class 1 explosive materials have specific testing and records retention requirements. See 49 CFR Part 173, Subpart C.

[26] *Federal Register* 78, no. 224 (November 20, 2013): 69745.

[27] Pipeline and Hazardous Materials Safety Administration, *Safety Alert, January 2, 2014: Preliminary Guidance from Operation Classification* (Washington, DC: US Department of Transportation, Pipeline and Hazardous Materials Safety Administration, 2014).

materials prior to and during transportation." It also stresses that offerors[28] "must ensure that all potential hazards of the materials are properly characterized," and assign the appropriate classification and packing group of crude oil shipments.

The NTSB believes that properly classified shipments are paramount for appropriate package selection, for assessment of risks to develop meaningful safety and security plans, and for the safety of emergency responders and other individuals who may come into contact with hazardous materials in transportation. Therefore, in support of TSB Safety Advisory Letter 13/13 the NTSB recommends that PHMSA require shippers to sufficiently test and document the physical and chemical characteristics of hazardous materials to ensure the proper classification, packaging, and record-keeping of products offered in transportation.

Investigators are still examining issues related to the Lac-Mégantic, Quebec, accident. At this time, the TSB has not made any final conclusions about this accident. Nonetheless, the NTSB has identified the safety issues described above, which should be addressed expeditiously. Therefore, the National Transportation Safety Board makes the following safety recommendations to the Pipeline and Hazardous Materials Safety Administration:

> Work with the Federal Railroad Administration to expand hazardous materials route planning and selection requirements for railroads under Title 49 *Code of Federal Regulations* 172.820 to include key trains transporting flammable liquids as defined by the Association of American Railroads Circular No. OT-55-N and, where technically feasible, require rerouting to avoid transportation of such hazardous materials through populated and other sensitive areas. (R-14-4)
>
> Revise the spill response planning thresholds contained in Title 49 *Code of Federal Regulations* Part 130 to require comprehensive response plans to effectively provide for the carriers' ability to respond to worst-case discharges resulting from accidents involving unit trains or blocks of tank cars transporting oil and petroleum products. (R-14-5)
>
> Require shippers to sufficiently test and document the physical and chemical characteristics of hazardous materials to ensure the proper classification, packaging, and record-keeping of products offered in transportation. (R-14-6)

The NTSB also issued three safety recommendations to the Federal Railroad Administration.

Chairman HERSMAN, Vice Chairman HART, and Members SUMWALT, ROSEKIND, and WEENER concurred in these recommendations.

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[28] Title 49 CFR 171.8 defines *offeror* as any person who (1) performs, or is responsible for performing, any pre-transportation function required under this subchapter for transportation of the hazardous material in commerce and/or (2) tenders or makes the hazardous material available to a carrier for transportation in commerce.

The NTSB is vitally interested in these recommendations because they are designed to prevent accidents and save lives. We would appreciate receiving a response from you within 90 days detailing the actions you have taken or intend to take to implement them. When replying, please refer to the safety recommendations by number. We encourage you to submit your response electronically to correspondence@ntsb.gov.

[Original Signed]

By: Deborah A.P. Hersman,
Chairman