4.0 Regulations for Transportation of Crude Oil and Ethanol by Rail

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The U.S. Department of Transportation (USDOT), through the Federal Railroad Administration (FRA) and Pipeline and Hazardous Materials Safety Administration (PHMSA), regulate crude oil and ethanol movements by rail. Other independent agencies also play a role in the regulation of crude oil and ethanol by rail. The National Transportation Safety Board (NTSB) investigates accidents involving rail transportation, whereas the U.S. Surface Transportation Board (STB regulates economic aspects of rail transportation. The Department of Homeland Security's Transportation Security Administration (TSA) regulates security aspects of rail transportation. Although all of these agencies have a hand in the safe transportation of crude oil and ethanol by rail, the primary agencies for safety regulation are the FRA and PHMSA.

The FRA specializes in supporting and enforcing rail regulations, while performing research and development to improve rail safety and policy. PHMSA serves to establish national policy, set and enforce standards, educate, and conduct research to prevent accidents related to hazardous materials transportation. For practical purposes, the FRA can be thought of as the agency regulating the operation of railroads and the maintenance and safety of railroad track, bridges, signals, and rolling stock; while PHMSA regulates construction and maintenance aspects of tank cars transporting crude oil and ethanol that pertain to their integrity and their resilience to impact, penetration, fire, heat, and explosion in case of a derailment or collision.[33] Synergistically, these two organizations combine to create regulation affecting the transportation of crude oil and ethanol by rail. It is important to note that the U.S. Congress and Senate are currently considering new regulations that would pertain to the safety of crude oil and ethanol transportation by rail. Provided below is a description concerning rail elements that have been or are being considered for regulation. A summary of regulation for the transportation of crude oil and ethanol by rail is found in Section 4.2.

4.1.1 Train Braking System

Freight trains utilize a braking technology originally developed in the 1930s, which has been continuously improved and is reliable and effective when operated and maintained correctly. The system is composed of a brake cylinder, brake shoes, dual air reservoir and control valve mounted on each car in the train, an air line traveling the length of the train, an air compressor and reservoir on the locomotive(s), and an engineer's control valve on the lead locomotive. The air line traveling the length of the train has a dual-purpose serving as both a supply line (to recharge the reservoirs on each car after a brake application and release cycle) and as a signaling line. As a signaling line, a drop in pressure signals the control valve on each car to apply the brakes on that car, and an increase in pressure signals the control valve on each car to release the brakes. This provides a fail-safe design; any drop in brake pressure will cause a brake application on each car (provided that the air reservoirs on each car have adequate reserve air pressure).

In addition to air brakes, many trains can also utilize dynamic braking, provided the locomotive(s) on the train is so equipped. Dynamic braking consists of using the electric traction

[33] USDOT: PHMSA, *Mission and Goals*, http://www.phmsa.dot.gov/about/mission

motors mounted on the locomotive axles that normally provide rotational force to the locomotive's axles to act instead as generators. By acting as generators, the traction motors resist turning and provide a braking force to the locomotive(s) and train.

All U.S. railroads utilize, operate, and maintain air brake systems under FRA regulations. Most locomotives utilized for over-the-road train service are equipped with dynamic brakes; however, dynamic braking is not necessarily required to be serviceable so long as the operating rules of the railroad account for inoperative dynamic brakes, and the engineer of the train is aware of the inoperable condition before departing the train's initial station. All Iowa railroads included in this study have operating rules governing use of air brakes and dynamic brakes that are similar, and maintenance practices that are similar.

A new type of air brakes, Electronically Controlled Pneumatic (ECP) braking, has been developed but has not been widely deployed on U.S. railroads. The principal feature of ECP braking is it uses an electronic signal to each car in a train to instruct it to apply or release brakes, rather than using the train line as the signaling system. ECP braking thus offers simultaneous application or release of all the brakes in the train, as opposed to the delay inherent in conventional air brakes as the air pressure signal travels on the train line. The FRA has mandated that all trains of 70 or more tank cars loaded with Class 3 flammable liquids (flammable or combustible liquids, including crude oil and ethanol) with at least one car carrying Packing Group 1 flammable liquids, must be operated with ECP braking by January 1, 2021. This requirement will effectively require all crude oil and ethanol trains operated in or through Iowa to be equipped with ECP braking.

4.1.2 Trackside Safety Technology

Trackside safety technologies, known also as wayside asset protection devices, are systems designed to remotely monitor and alert train operating crews or train dispatchers to changes in train activity and conditions that are unsafe in the field. These devices include:

- Dragging Equipment Detector (DED): This system detects derailed cars or axles, brake rigging that is dragging on the track, or any other dragging component of the train.
- Hot Box Detector (HBD): This system detects wheel bearings and wheels that have elevated temperature, typically due to failed or failing wheel bearings or brakes that have failed to release. Wheel bearings that have failed can cause derailments; hot wheels can fracture, stuck brakes can cause rapid flange wear or wheel shelling that can cause derailments.
- Wheel Impact Load Detector (WILD): This system detects excessive wheel impacts, which may be due to wheels that have flat spots or are broken, which can lead to derailments.
- Wheel Crack and Flange Integrity Detectors: This system detects wheel cracks or broken flanges, which can cause derailments.
- High-Water Detectors and Slide Detectors: These systems detect high water under or through a bridge or culvert, which can lead to failure of the railway embankment or bridge, and landslides of the track structure or of slopes above the track.

- High-Wide Detectors: These systems detect rail cars or ladings that protrude beyond the vertical and horizontal clearance gauge of a rail line. They are typically placed on the approaches to through truss bridges or tunnels.

These systems improve train and railroad safety by detecting and reporting defects or failures that may cause train derailments. Typically, these systems are installed at intervals reflecting a cost-benefit approach to derailment prevention. Because WILD and wheel-crack and flange-integrity detectors are costly, and because these conditions tend to be slow developing, their spacing is very wide, as infrequent as one every 1,000 miles. HBD and DED detectors, conversely, are often spaced more closely. Spacing of detectors is influenced by train density, local geography, the potential for risks, and other considerations. For example, because of the greater vulnerability of concrete crossties to damage caused by any derailment, such as a single axle of a car, compared to timber crossties, DEDs are often closely spaced on rail lines that are laid with concrete ties.

4.1.3 Grade Crossing Safety

Grade-crossing safety is an issue recognized by most local and state officials as well as railroad operators. A grade crossing collision occurs approximately once every three hours in the U.S. Although most grade crossings are equipped with warning signs to alert motorists that they are approaching a rail crossing, not all grade crossings have passive or active warning devices. Passive warning devices include signs, pavement markings, and crossbucks. Active warning devices typically include automatic crossing gates, flashing lights, and bells, which are maintained by the owner of the tracks. These are more effective in preventing collisions than the passive devices, which typically consist of crossbucks and/or stop signs.

Rail companies and local public safety officials work with programs like Operation Lifesaver, which is a non-profit organization providing public education programs in Iowa and all other states. Operation Lifesaver's programs work to ensure the public is aware of the rules of the road and to practice caution when using unmarked private crossings and active or passive marked crossings on public roads.

On June 29, 2015, the FRA announced a partnership with Google that integrates FRA's geographic information system data, providing the location of public and private railroad crossings into Google's navigation and mapping products.[34] This partnership provides navigational warnings to drivers and passengers when approaching a grade crossing.

4.1.4 Train Speeds

Operating at lower train speeds is a procedural safety measure, which is ultimately the responsibility of the train operator. PHMSA recently issued the final ruling, Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains (HHFT), which implements speed reduction rules in certain defined urban areas.[35] These

[34] U.S. Department of Transportation, *Google, FRA team up for safety; will add rail crossing data to maps*, June 29, 2015, http://www.transportation.gov/fastlane/fra-google-team-to-incorporate-rail-data-in-maps (accessed June 30, 2015).

[35] U.S. Department of Transportation, Pipeline Hazardous Materials Safety Administration, *Docket No. Pipeline Hazardous Materials Safety Administration-2012-0082 (HM-251), Hazardous Materials: Enhanced Tank Car Standards and Operational Controls of High Hazard Flammable Trains*,

rules limit the speed of crude oil unit trains to 40 mph in high-population areas (100,000 population or more) unless all tank cars meet or exceed the performance standards for the DOT-117 tank car. Train operators must be cognizant of their geographic locations, in relation to a high-population area, to operate the train through these areas, in a proper and safe manner. It is important to note that Class I railroad company, BNSF, is taking steps to assign even slower speeds in high-risk areas by initiating voluntary speed restrictions in high threat urban areas (HTUAs).[36]

4.1.5 Train Loads and Securement

Railroads are expected to address proper distribution of loaded and unloaded railcars in a train consist, which have varying weights, to help prevent derailments and other accidents. For example, if an empty car is placed before loaded cars in a train and the brakes are applied in an emergency application, buff forces in the train may cause the empty car to derail. The position of loaded and unloaded cars in a train consist is critical in challenging railroad operating territories, as in mountainous areas for example, which may include alignments with severe upgrades and downgrades and curvature.

Directly related to train loads is proper train securement. This involves actions for securing an unattended train containing hazardous materials, generally including the setting of an appropriate number of handbrakes on the railcars in the consist to prevent the train from rolling away, locking the locomotive cab(s) to prevent entry and train operation by unauthorized individuals, and comprehensive coordination with a train dispatcher in which a train crew member identifies the location, tonnage, and length of the train, the grade and weather conditions at the location where the train is staged, and the number and location in the train of handbrakes that are applied. One factor of the 2013 accident at Lac Mégantic, Quebec, (described earlier in this Study) was related to the improper securement of the locomotives and other train cars. Understanding that train securement was a factor that contributed to the Lac Mégantic accident, U.S. regulatory agencies examined current railroad operating practices, and issued a final rule for the securement of unattended rail equipment. While past securement regulations have thwarted risk associated with unattended movement of unattended equipment, this rule provided additional securement requirements for unattended equipment, primary trains transporting poisonous by inhalation hazardous materials or large volumes of Class 2.1 (flammable gases), Class 3 (flammable or combustible liquids, including crude oil and ethanol), and Class 1.1 or 1.2 (explosive) hazardous material. This final rule finalizes requirements set forth in FRA Emergency Order 28, Establishing Additional Requirements for Attendance and Securement of Certain Freight Trains and Vehicles on Mainline Track or Mainline Siding Outside of a Yard or Terminal.[37]

4.2 Rules and Regulations for Rail Haulage of Crude Oil and Ethanol

A summary of recently adopted rules and regulations for the rail haulage of crude oil and ethanol can be found in Appendix A.

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http://www.transportation.gov/sites/dot.gov/files/docs/final-rule-flammable-liquids-by-rail_0.pdf (accessed June 22, 2015).

[36] Ibid.

[37] FRA, *Final Rule: Securement of Unattended Equipment*, https://www.fra.dot.gov/eLib/Details/L16849

4.3 Railroad Tank Car Regulations

The section identifies current and impending regulations that affect tank car design, construction, resilience, use, and employment in crude oil and ethanol rail transportation. The most commonly used tank cars have an approximate capacity of 28,000 to 32,000 U.S. gallons, and are generally arranged in unit trains of 75 to 120 cars in length. Ethanol also commonly moves in smaller lots of between one and 50 cars in mixed freight trains. See Section 5 and Section 9.1.1 for more information regarding operating and tank car regulations.

4.3.1 Recent Rail System Improvements

A spike in crude oil transportation by rail has resulted in several significant incidents, as well as an increase in the reports of oil leaks and other releases from the tank cars. Incidents increased from 12 in 2008 to 186 in 2014, according to USDOT data. Note that an "incident" can include any event from a leak due to an improperly maintained or closed drain valve on a tank car, to a major derailment and subsequent fire. Significant incidents, such as fires and explosions after a derailment, have caused increased concern in crude oil transport by rail. In the past few years, there has been effort by the U.S. government and the railroad industry to improve the safety of transportation of crude oil by rail. According to the Railway Supply Institute, approximately $7 billion has been spent to put 57,000 of the upgraded, CPC-1232 compliant USDOT Class 111 tank cars in service. These upgraded tank cars included safety upgrades that were voluntarily adopted by the tank car industry in 2011.

4.4 Tank Car Standards

Recent changes in rail car standards are expected to decrease the risk of fire and explosion for upgraded tank cars. The new standard for cars carrying crude oil will start with cars constructed after October 1, 2015. All existing cars transporting crude oil with the Packing Group I designation will have to be retrofitted to meet the new standards. Under a new USDOT rule, railways have three years to retrofit or retire existing cars if they are to be used to haul crude oil.

The new USDOT 117 tank car, which replaces the CPC-1232 tank car, has a thicker steel shell (9/16" vs. 1/2" for CPC-1232) and a full-height 1/2" end shield, intended to increase strength and prevent puncture during a derailment or crash. It includes a thermal jacket to withstand heat and reduce the risk of tank failure by fire impingement, and it has an enhanced bottom outlet valve designed to withstand impact from a crash or derailment, reducing the risk of leaks and spills.