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A Compendium of Spent Fuel Transportation Package Response Analyses to Severe Fire Accident Scenarios

Comment On: NRC-2015-0234-0001
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Government Agency: NRC

General Comment

Attached are the Association of American Railroads comments to Draft NUREG/CR-7209 report entitled, "A Compendium of Spent Fuel Transportation Package Response Analyses to Severe Fire Accident Scenarios."

Attachments

2016-3-28 AAR Comments on NUREG-CR-7209 PNNL-24792 NRC Fire Study Final

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BEFORE THE

NUCLEAR REGULATORY COMMISSION

COMMENTS ON A COMPENDIUM OF SPENT NUCLEAR FUEL RESPONSE ANALYSIS TO SEVERE FIRE ACCIDENT SCENARIOS NUREG/CR-7209 / PNNL-24792

NRC Docket ID NRC–2015–0234

SUBMITTED BY

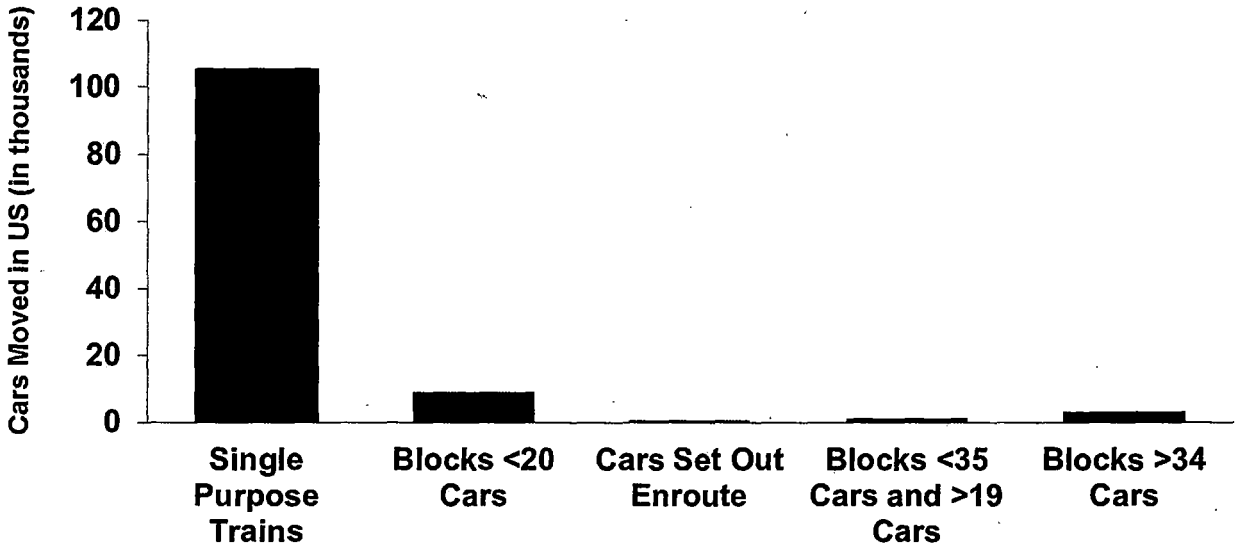
THE ASSOCIATION OF AMERICAN RAILROADS

The Association of American Railroads ("AAR"), on behalf of itself and its member railroads, submits the following comments to the Nuclear Regulatory Commission's report entitled "A Compendium of Spent Nuclear Fuel Transportation Package Response Analysis to Severe Fire Accident Scenarios" (NUREG/CR-7209).[1] The U.S. Department of Energy ("DOE") has stated that rail is the preferred mode of transportation of spent nuclear fuel ("SNF"), giving, AAR and its member railroads a major interest in its safe transportation. The conclusions reached in the report are flawed because the time period NRC used to evaluate railway accidents involving fire was limited to 1997 - 2008. By limiting the time period of railway accidents in the report, the report fails to capture several major changes in the transportation of hazardous materials in North America in the early 21st Century. The early 2000's saw a large increase in the transportation of ethanol. Additionally, there has been an even larger increase in the number of petroleum crude oil shipments starting in around 2009. In 2014, petroleum crude

[1] AAR is a trade association whose membership includes freight railroads that operate 72 percent of the line-haul mileage, employ 92 percent of the workers, and account for 95 percent of the freight revenues of all railroads in the United States; and passenger railroads that operate intercity passenger trains and provide commuter rail service.

oil became the largest and ethanol was the second largest hazardous material transported by rail. Ethanol and petroleum crude oil are transported in large blocks of tank cars and/or unit trains, which is different than the historic practice of a smaller number of shipments of flammable liquids. Figure 1 shows how petroleum crude oil moves by rail.

Figure 1 – How Petroleum Crude Oil Moves by Rail



Source: AAR, Third Quarter 2015 Data

Table 1 shows the annual number of petroleum crude oil shipments in the US from 2008 to 2014. The number of carloads of petroleum crude oil has increased by over 5,683% since 2009.

Table 1

Number of Annual Carloads of Petroleum Crude Oil Terminated in the US 2008 – 2014

Annual Totals	
2008	9,344
2009	10,966
2010	26,673
2011	67,103
2012	236,556
2013	435,560
2014	540,383

Source: AAR

Unfortunately, the number of accidents involving large quantities of ethanol and petroleum crude oil has increased, even though the train accident rate is the lowest on record, due to the large increase in the number of shipments of these commodities. Table 2 is a list of the large flammable liquids derailments since 2006.

Table 2

Large Crude Oil and Ethanol Derailments Since 2006

Incident	Date	# Tank Cars Derailed	Unit Train	Commodity	Release (gallons)	Fire
New Brighton, PA	Oct. 2006	23	Yes	Ethanol	485,278	Yes
Shepherdsville, KY	Jan. 2007	16	No	Various	69,402	Yes
Painesville, OH	Oct. 2007	6	No	Ethanol	76,153	Yes
Luther, OK	Aug. 2008	8	No	Crude Oil	80,746	Yes
Rockford, IL	Jun. 2009	19	No	Ethanol	232,963	Yes
Arcadia, OH	Feb. 2011	32	Yes	Ethanol	834,840	Yes
Tiskilwa, IL	Oct. 2011	10	No	Ethanol	143,534	Yes
Columbus, OH	Jul. 2012	5	No	Ethanol	53,347	Yes
Plevna, MT	Aug. 2012	18	No	Ethanol	245,336	Yes
Lac-Megantic	Jul. 2013	63	Yes	Crude Oil	1,500,000	Yes
Aliceville, AL	Nov .2013	26	Yes	Crude Oil	700,000	Yes
Casselton, ND	Dec. 2013	21	Yes	Crude Oil	400,000	Yes
Plaster Rock, NB	Jan. 2014	9	No	Crude Oil	tbd	Yes
Timmins, Ontario	Feb. 2015	29	Yes	Crude Oil	250,000	Yes
Mt. Carbon, WV	Feb. 2015	27	Yes	Crude Oil	378,000	Yes
Galena,IL	Mar. 2015	21	Yes	Crude Oil	TBD	Yes
Gogama, Ontario	Mar. 2015	29	Yes	Crude oil	TBD	Yes
Totals		362			5,449,599	

Sources: Federal Railroad Administration, Pipeline and Hazardous Materials Safety Administration, National Transportation Safety Board, Transportation Safety Board of Canada, railroads

Fires are likely to occur when ethanol or petroleum crude oil is released in a derailment. The U.S. Department of Transportation ("DOT")'s regulatory impact analysis on the HM-251 rulemaking stated that "the properties of the flammable liquids and handling of the cars in large blocks or unit trains presents a unique hazard in that, if released and ignited, the fire will affect adjacent cars."[2] Historically, non-jacketed DOT-111 tank cars were used for the transportation of petroleum crude oil and ethanol. Non-jacketed DOT-111 tank cars do not have a

[2] Docket No. PHMSA-2012-0082] (HM-251)- Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains; Final Rule, Office of Hazardous Material Safety, May 2015.

thermal protective blanket, which reduces the conductance of heat into the tank car. As cars heat up in pool fires started by impact caused releases, the pressure in adjacent cars increases until it reaches the pressure relief device setting, at which time the valves opens and feeds more fuel to the fire. As the level in the cars drops, the steel on the top of the cars heats up rapidly, weakening the steel at the top of the car. When the temperature reaches a crucial point, the tank car material fails. Failure occurs either by a thermal tear, which occurs at the top of the car to release pressure, or catastrophically with the car breaking into pieces. In both cases, the entire contents of the car is released and further contributes to the fire.

An estimated 1.5 million gallons of petroleum crude oil was released in the horrific July 6, 2013 accident in Lac-Mégantic, Quebec. The fire burned for over 28 hours and reached upwards of 1,800 ℉ as evidence by eye witness reports that some of the steel of the tank cars involved actually melted. The Transportation Safety Board of Canada's report on the Lac-Mégantic accident indicated that "[t]hirteen tank cars had localized loss of tank material in the form of a burn-through as a result of extreme fire damage."[3][4] The fire in the Lac- Mégantic derailment was not extinguished until 11:00 on July 7, 2013 with only minor flare-ups after that point in time.[5] The fire caused by the Lac- Mégantic accident was extremely hot and lasted for an extended time period.

NRC should have also included a number of additional accidents involving the transportation of ethanol and petroleum crude oil by rail in its analysis. Since 2008, there have been a number of high-profile derailments involving these products, including: the 2009 accident in Cherry Valley, IL; the 2011 accident in Tiskilwa, IL; the 2012 accident in Columbus, OH; the 2013 accident in Casselton, ND; the 2014 accident in Lynchburg, VA; and the 2015 accident in Mt. Carbon, WY. Please see the appendix to these comments for URLs to the National Transportation Safety Board ("NTSB") accident reports or dockets.

NRC should have included these accidents involving fires caused by the rail transportation of ethanol and petroleum crude oil because it would provide for a

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[3] A burn-through is a perforation of the tank shell caused by fire damage. http://www.tsb.gc.ca/eng/rapports-reports/rail/2013/r13d0054/r13d0054.pdf
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[4] http://www.tsb.gc.ca/eng/rapports-reports/rail/2013/r13d0054/r13d0054.pdf
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[5] http://www.tsb.gc.ca/eng/rapports-reports/rail/2013/r13d0054/r13d0054.pdf
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more accurate analysis of the inherent challenges in the transportation of these commodities.

Mitigating Factors

NRC notes that several mitigating factors make the chance of a SNF cask being involved in fire less likely. One mitigating factor is that DOE plans to ship SNF by rail in dedicated trains. A SNF train could be involved in an accident involving a release of flammable liquids and a resulting fire if it happened to be passing another train with flammable liquids that derailed. While unlikely, the derailment at Casselton, ND in December of 2013 is proof that such a scenario can occur and result in a major fire in this case involving 400,000 gallons of petroleum crude.

Another mitigating factor is DOT's final rule HM-251 - Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains ("HM-251")[6]. HM-251 requires flammable liquid tank cars to either be retrofitted to higher standards or be replaced with new tank cars meeting the new DOT-117 standard. HM-251 will reduce the conditional probability of a release ("CPR") in a derailment of a DOT-117 car significantly over a non-jacketed DOT-111 tank car by ensuring a stronger tank car to transport flammable liquids with a thicker shell, a jacket, head shields, top and bottom fitting protection and thermal protection.

Table 3 below shows the CPRs for the jacketed and non-jacketed legacy DOT-111, CPC-1232 and DOT-117 cars.[7] The CPR for releases of more than 100 gallons is shown as well as the overall CPR since minor leaks are not the concern addressed by the HM-251 rulemaking.

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[6] 80 Federal Register, No, 89, May 8, 2015.

[7] CPC-1232 issued on August 31, 2011 is an AAR interchange rule implemented by the AAR Tank Car Committee for tank cars carrying packing group I and II petroleum crude, alcohols NOS and ethanol and gasoline mixture commodities constructed after October 1, 2011 to be upgraded, prior to DOT final action in May of 2015.

Table 3.

Conditional Probability of Release Configurations[8]			
Car Category	Tank Car Features	CPR %	CPR (>100 gal) %
Legacy DOT-111	7/16" shell	26.6	19.6
Legacy DOT-111	7/16" shell, JKT	12.8	8.5
CPC-1232 DOT-111 w/o JKT	½" shell, HHS, TFP	13.2	10.3
CPC-1232 DOT-111 w JKT	7/16" shell, HHS, TFP	6.5	4.6
DOT-117	9/16" shell, FHS, TFP	4.2	2.9

JKT – jacketed; HHS – half-height head shield; FHS – full-height head shield; TFP – top-fittings protection

The 2015 FAST Act requires DOT to further mandate improved tank car survivability in accidents by delineating a prioritized phase-out schedule.[9] Non-jacketed DOT-111 tank cars carrying petroleum crude oil must be phased out/retrofitted first by January 1, 2018. Non-jacketed DOT-111's carrying ethanol have to be phased out/retrofitted by May 1, 2023. Finally, all other non-DOT-117 tank cars carrying flammable liquids have to be phased out/retrofitted by May 1, 2029. The FAST Act also requires the thermal protection requirement to be changed to a minimum ½" thermal blanket. As a result of these changes, tank cars carrying petroleum crude oil and ethanol, the products most often carried in large blocks or unit trains, will be transported in more crash resistant tank cars the soonest. In addition, the thermal blanket requirement will greatly reduce the chance these cars, when involved in a derailment and fire, will sustain a thermal tear or catastrophic failure.

In summary, NRC should update its report titled "A Compendium of Spent Nuclear Fuel Transportation Package Response Analysis to Severe Fire Accident Scenarios," to include more recent accidents reflecting the large increase in energy products by rail in the US, and NRC should take into consideration the mitigating

[8] The CPRs in this table are significantly lower than the CPRs published in the RSI-AAR Project's Report RA-05-02, "Safety Performance of Tank Cars in Accidents: Probabilities of Lading Loss," (January 2006). For example, the recalculated CPR for the current DOT-111 tank car without a jacket is 25 percent lower than was calculated in 2006. There are three reasons. One, RA-05-02 used data from accidents that occurred from 1965-1997. The CPRs in Table 3 are based on more recent data, from 1980-2010. More recent data are more likely to be representative of accidents occurring today. Two, Table 3 CPRs were calculated utilizing more factors than were used in RA-05-02, including train speed, derailment severity, tank diameter, and commodity transported. Three, the techniques used for the newer analysis allowed for better handling of some of the complexities of the data that could have masked important relationships in the RA-05-02 analysis.

[9] https://www.congress.gov/114/bills/hr22/BILLS-114hr22enr.pdf

factors associated with the reduced risk of transporting these products as required by HM-251 and supplemented by the FAST Act.

AAR and its member railroads are committed to the safe, secure and efficient transportation of hazardous materials, and look forward to NRC's response to these comments.

Respectfully submitted,

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March 28, 2016

Appendix

The NTSB Docket for each of the post-2008 accidents can be found at the following URLs:

Cherry Valley, IL - June 19, 2009 http://dms.ntsb.gov/public/48000-48499/48053/504639.pdf

Tiskilwa, IL - October 7, 2011 http://dms.ntsb.gov/public/51500-51999/51838/536056.pdf

Columbus, OH July, 2012
http://dms.ntsb.gov/pubdms/search/hitlist.cfm?docketID=53168&CurrentPage=2&EndRow=30&StartRow=16&order=1&sort=0&TXTSEARCHT=

Casselton, ND – December 30, 2013
http://dms.ntsb.gov/pubdms/search/hitlist.cfm?docketID=55926&CurrentPage=1&EndRow=15&StartRow=1&order=1&sort=0&TXTSEARCHT=

Lynchburg, VA April, 2014
http://dms.ntsb.gov/pubdms/search/hitlist.cfm?docketID=57646&CurrentPage=1&EndRow=15&StartRow=1&order=1&sort=0&TXTSEARCHT=

Mt. Carbon, WV – February, 2015
http://dms.ntsb.gov/pubdms/search/hitlist.cfm?docketID=57593&CurrentPage=1&EndRow=15&StartRow=1&order=1&sort=0&TXTSEARCHT=