Operation Safe Delivery Update

Executive Summary

Oil and gas production is at an historic high in the United States – a positive development for our economy and our energy independence – but the responsibilities that come along with that production are serious. More crude oil is being shipped by rail than ever before, and it is the U.S. Department of Transportation's responsibility to ensure these crude shipments travel safely.

USDOT is focused on ensuring the United States is the world leader in safely transporting energy, and we have taken more than two dozen steps to strengthen all the ways we deliver this oil, from issuing emergency orders to advancing new rail safety and tank car regulations.

On July 6, 2013, a train carrying 72 tank cars, each filled with 30,000 gallons of crude oil from the Bakken Shale Formation, derailed in a small resort village outside Quebec. A large part of the town, known as Lac-Megantic, was destroyed, and forty-seven of its people perished.

There were oil train derailments in North America before Lac-Megantic. There have been derailments since. And yet no event, as much as that one, has warned us to the dangers of transporting the continent's newfound bounty of energy.

The Lac-Megantic tragedy, along with other crude oil train derailments, made clear that we need to take steps to understand the risks associated with the transport of crude oil in growing volumes and better understand the characteristics of the product being shipped.

In August 2013, the Department embarked on Operation Classification in the Bakken Shale Formation, in the Williston Basin of North Dakota, where crude oil production has skyrocketed. Operation Classification is focused on ensuring shippers are properly classifying crude oil for transportation in accordance with federal regulations, and on better understanding the unique characteristics of mined gases and oils from this region.

We were particularly focused on the Bakken region because there was some question of whether the crude being produced there is more flammable, or more volatile, than most of the other types of crude being produced or shipped in this country. After months of unannounced inspections, testing, and analysis, Operation Classification has determined that the current classification applied to Bakken crude is accurate under the current classification system, but that the crude has a higher gas content, higher vapor pressure, lower flash point and boiling point and thus a higher degree of volatility than most other crudes in the U.S., which correlates to increased ignitability and flammability.

Importantly, our review of crude oil transportation data also confirmed that large volumes of this crude are moving at long distances across the country. At any given time, shipments of more than two million gallons are often traveling distances of more than one thousand miles. Put simply, Operation Classification determined that the U.S. is currently shipping a crude oil product with a higher gas content, lower flash point, lower boiling point and higher vapor pressure than other crude oils in large amounts and for long distances.

This report provides the Pipeline and Hazardous Materials Safety Administration's (PHMSA) and the Federal Railroad Administration's (FRA) testing results of Bakken crude oil as of May 2014.

Background

The United States is in the midst of a historic increase in energy production. One significant area of domestic oil production is in Bakken Shale Formation, which covers approximately 200,000 square miles in Montana, North Dakota and Saskatchewan, Canada. Crude oil is the primary product being mined from the Bakken region, where oil production there has nearly tripled from 2010 to 2013.

Crude oil is being transported throughout North American and Canada through various modes of transportation, including pipelines, truck, barge and, increasingly, by rail.
In the vast majority of cases, these shipments reach their final destination without incident. Rail incidents have declined by 47 percent over the past decade and incidents involving the transportation of hazardous materials have declined by 16 percent.

Despite this progress, over the last year, a number of significant incidents involving Bakken crude have demonstrated the potential devastating consequences of a crude oil train derailment:

- Lac-Megantic, Quebec involving 63 tank cars out of 72;
- Aliceville, Alabama involving 26 tank cars out of 88;
- Casselton, North Dakota involving 20 tank cars out of 106;
- Lynchburg, Virginia involving 17 tank cars out of 105.

As the nation's regulator of hazardous materials by all modes, PHMSA requires the proper classification of hazardous materials. Proper classification of hazardous materials helps ensure the proper packaging is selected to safely transport the material. It also communicates the risks associated with the material to emergency responders and others who are likely to come in contact with the product as it moves through the transportation network, and in case of an incident.

Operation Classification activities include unannounced inspections, data collection and sampling at strategic terminal and loading locations for crude oil. PHMSA investigators continue to test samples from various points along the crude oil transportation chain: from cargo tanks that deliver crude oil to rail loading facilities, from storage tanks at the facilities, and from pipelines connecting storage tanks to rail cars that would move the crude across the country.

Operation Classification is part of DOT's broader effort called Operation Safe Delivery. Launched in 2013, Operation Safe Delivery is examining the entire system of crude oil delivery, from the well head to its final destination, and applying a comprehensive approach to ensure the safe transportation of crude oil moving by rail.

Additional DOT efforts to improve the safe transport of crude oil include:

- **Safety Communications and Alerts—**Concurrent with enforcement and rulemaking actions, the Department, FRA and PHMSA continue to address safety concerns by issuing emergency orders, safety advisories, safety alerts and other announcements. On May 7, 2014, for example, DOT required railroad carriers to inform first responders about crude oil being transported through their towns.
- **Regulatory Actions—**As recent derailments have proven, the current tank car most frequently used to transport crude oil – the DOT 111 – is not an adequate container for flammable crude oil involved in an incident or derailment. PHMSA and FRA have worked to update rail safety regulations, including those that address rail tank car standards as well as operating practices that would enhance rail safety.
- **A Call to Action—** On January 16, 2014, Secretary Foxx issued a Call to Action, to the rail and petroleum industries, to identify immediate actions to improve safety in the transportation of crude oil by rail. Following the Call to Action, railroad companies agreed to a series of significant safety measures, including speed reductions, increased inspections, the implementation of new brake technology, new routing protocols, and investments in first responder training.
- **Safety Education and Awareness—**PHMSA and FRA continue to provide resources to educate industry, the public, and emergency responders about safe transportation of hazardous materials.
- **Field Inspections, Testing and Enforcement Actions—**PHMSA and FRA continue to conduct hazardous materials field inspections, crude oil testing and, when necessary, issue enforcement penalties.

The Classification of Petroleum Crude Oil

PHMSA issues the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) that prescribe requirements for the safe transportation of hazardous materials by all modes. The proper classification of any hazardous material is required prior to offering it into transportation. Packaging selection, marking, labeling, shipping papers and placarding are all dependent upon this first, critical step.

Each entity that offers hazardous materials for transportation is considered a shipper (i.e., both initial offerors and subsequent downstream offerors). It is the shipper's responsibility to properly classify and describe a hazardous material, including determining the constituents present and any multiple hazard classes present.

Each shipment of hazardous materials must be accompanied by a shipping paper that must include a statement certifying that the material is in compliance with all appropriate regulations, including classification and packaging. In summary, anyone offering a hazardous material for shipment must:

1. Properly identify all the **hazards** of the material.
2. Determine which of the **nine hazard classes** characterizes the hazards associated with the material.
3. Assign each material to a **packing group**, if applicable.

Hazard Classes: The HMR has nine hazard classes that define the type of risk a hazardous material poses. Some materials meet the definition of more than one hazard class with primary risks and subsidiary risks. Some hazard classes contain divisions in order to further group materials with similar risks and designate higher degrees of a particular hazard. [See Hazardous Materials Hazard Class/Division Table 49 CFR § 173.2]

Packing Group (PG): Once classified, some hazardous materials are assigned to one of three packing groups based upon their degree of hazard, from a great hazard (PG I) to a minor hazard (PG III) material. The quality, damage resistance, and performance standards of the package authorized in each packing group are designed for the hazards of the material transported.

The hazard class and packing group for a material meeting more than one of these hazard classes shall be determined using the precedence table in 49 CFR § 173.2a(b).

The following list illustrates the hazard classes and sub-divisions that need to be considered, at a minimum, for mined gases and liquids based on knowledge of the material.

(1) Class 2, Division 2.3 (poisonous gases) [49 CFR § 173.115]

(2) Class 2, Division 2.1 (flammable gases) [49 CFR § 173.115]

(3) Class 2, Division 2.2 (nonflammable gases) [49 CFR § 173.115]

(4) Class 6, Division 6.1 (poisonous liquids), PG I, poisonous-by-inhalation only [49 CFR § 173.132]

(5) Class 3 (flammable liquids) [49 CFR § 173.120]

(6) Class 8 (corrosive materials) [49 CFR § 173.136] or Division 6.1 (poisonous liquids or solids other than PG I, poisonous-by-inhalation) [49 CFR § 173.132]

(7) Class 3 (combustible liquids) [49 CFR § 173.120]

Provided a particular crude oil does not meet the definition of a gas or poisonous-by-inhalation liquid, and it meets the definition of a flammable liquid, it would be classified and transported as a flammable liquid.

Flammable Liquid Hazard Class: A flammable liquid (Class 3) means a liquid having a flash point of not more than 140 °F, or any material in a liquid phase with a flash point at or above 100 °F that is intentionally heated and offered for transportation or transported at or above its flash point in a bulk packaging. There are five exceptions, see (HMR §173.120 (a) (1-5)). Flash point is the lowest temperature at which it can vaporize to form an ignitable mixture in air.

For flammable liquids (Class 3), the packing groups are defined below.

Hazardous Materials Packing Groups Table

Packing Group	Flash Point	Initial Boiling Point
I (Great Danger)		≤ 95 °F
II (Medium Danger)	< 73 °F	> (95 °F
III (Minor Danger)	≥ 23 °C, ≤ 60 °C (140 °F)	> (95 °F

On March 6, 2014, DOT issued an amended Emergency Order (EO) requiring all rail shippers to test product from the Bakken region. That way, they can ensure the proper classification of crude oil in accordance with the HMR before it's transported by rail.

The Emergency Order also requires those who ship bulk quantities of petroleum crude oil – and do so by rail with tank cars – to treat petroleum crude oil as a Class 3 PG I or PG II hazardous material only, even if it tests as PG III.

Analysis and Classification

The intent of Operation Safe Delivery's sampling and analysis component is to determine if shippers are properly classifying crude oil for transportation. The intent is also to quantify the range of physical and chemical properties of crude oil.

Prior to the launch of our sampling and analysis, FRA identified that most crude oil loading facilities were basing classification solely on a generic Safety Data Sheet (SDS), formerly known as Material Safety Data Sheets (MSDS). This data can provide a wide range of material properties. SDSs provide workers and emergency personnel with procedures for handling or working with a substance in a safe manner, and include information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures. PHMSA observed that SDSs for crude oil were out-of-date with unverified information and provide ranges of chemical and physical property values instead of specific measured values. Further, these ranges may cross the threshold between PG I, II and III making it difficult to assign the proper packing group. Given the potential variability of crude oil, PHMSA and FRA believed that operators' reliance on generic information was a safety concern.

Based on the initial findings and shippers' reliance on SDS, the operation was expanded to take more samples and test for additional chemical composition and properties including vapor pressure, corrosivity and chemical components of the materials. PHMSA performed the following series of sampling and testing activities.

Legend

FP – Flash Point
BP – Initial Boiling Point
API – American Petroleum Institute Specific Gravity
ASTM – American Society for Testing of Materials
RVP – Reid Vapor Pressure
TVP – True Vapor Pressure
BTEX – Benzene/Toluene/Ethylbenzene/Xylene content
Comp – Gas/Liquid composition
W&S – Water & Sediment content
Sulfur – Sulfur content
H2S – Hydrogen Sulfide content
Corrosion – Steel/Aluminum

PHMSA Sampling and Testing Activities Summary

# Samples Tested	Period	Tests Completed	Test Lab	Mean Ambient Temps
14	August, 2013	FP	Minnesota Valley Test Lab	78 °F
21	September – October, 2013	FP, BP	Intertek	44 °F - 66 °F
12	November, 2013	FP, BP, API, RVP, Comp, W&S, Sulfur, H2S, BTEX	Intertek	24 °F
88	February-May, 2014	FP, BP, RVP, TVP, Comp, H2S, BTEX, Corrosion	Intertek	10 °F - 55 °F
Total Samples Tested: 135				

Below is a table summarizing the two phases of testing and sampling performed pursuant to Operation Safe Delivery.

Date	August – November	February - May
Summary	The initial efforts of this phase were focused on determining and verifying hazard classes and packaging group selection. Tests focused on flash point and boiling point and then expanded to address other chemical characteristics of crude oil.	The goal of Phase 2 was to gain a more complete understanding (beyond flash and boiling points) of the properties of crude oil and collect a more representative sample of the transportation population. A continuous rotation of investigators was present in the Bakken region during this phase. These investigators collected more samples from various points in the transportation stream.

Samples Taken	47 Total Samples from rail loading facilities and cargo tanks, storage tanks, pipelines used to load rail cars and several were collected from cargo tanks. All samples were collected in accordance with ASTM 4057, "Standard Practice for Manual Sampling of Petroleum and Petroleum Products.	88 Total Samples from rail loading facilities and cargo tanks, storage tanks, pipelines used to load rail cars and several were collected from cargo tanks. Samples were collected via a syringe-style cylinder in accordance with ASTM 4057, "Standard Practice for Manual Sampling of Petroleum and Petroleum Products.
ASTM Tests Conducted	Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method) (ASTM D323). Standard Test Method for Determination of Individual Components of Crude Oil (ASTM D6730 MOD). Standard Test Method for Water and Sediment in Crude Oil (ASTM D4007). Standard Test Method for Sulfur in Petroleum and Petroleum Products (ASTM D4294). Standard Test Method for Measurement of Hydrogen Sulfide in the Vapor Phase Above Residual Fuel Oils Hydrogen Sulfide Content (ASTM D5705). Standard Test Method for Density and Relative Density for Crude Oil (ASTM D5002). Standard Test Method for Flash Point by Tag Closed Cup Tester (ASTM D56). Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure (ASTM D86).	Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method) (ASTM D323). Standard Test Method for Determination of Individual Components of Crude Oil (ASTM D6730 MOD). Standard Test Method for Measurement of Hydrogen Sulfide in the Vapor Phase Above Residual Fuel Oils Hydrogen Sulfide Content (ASTM D5705). Standard Test Method for Flash Point (FP) by Tag Closed Cup Tester (ASTM D56). Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure, Initial Boiling Point (IBP) (ASTM D86). Standard Test Method for Determination of Vapor Pressure of Crude Oil: VPCRx (Expansion Method) for both Vapor/Liquid ratios of 0.02 (at 122 °F) and 4 (at 100 $°^{0}$F). U.N. Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, Chapter 37 (corrosion to aluminum and carbon steel).

Summary and Test Results

Total Samples Taken: 47 total samples (August – November, 2013)

The first set of testing began with taking samples from several locations, and with limited analysis that included flash point and boiling point to determine if petroleum crude oil was being properly classified and packaged. The effort continued through the fall of 2013 based upon observations from investigators and testing results.

During the week of August 26-30, 2013, PHMSA and FRA investigators conducted joint activities at 14 crude oil transfer locations in North Dakota. The summary of the results from these samples are provided in Table A.

Investigators observed that facility analyses only determined viscosity, solid content, and sulfur content. PHMSA acquired a total of 14 samples at these locations. Analytical results indicated that the materials had a flash point less than 73°F, indicating that, at a minimum, PG II must be assigned to the material.

Boiling point information was not determined because the lab conducting the testing did not have adequate equipment to test for boiling point. So, final determination of a packing group was not possible. The results are provided in Table A.

Table A
Crude Oil Samples (August 26-30, 2013)

Sample	Location	Flash Point (°F)	Boiling Point (°F)	Packing Group
#1	New Town, ND	<73	Not Analyzed	I or II
#2	New Town, ND	<73	Not Analyzed	I or II
#3	Berthold, ND	<73	Not Analyzed	I or II
#4	Stanley, ND	<73	Not Analyzed	I or II
#5	Fairview, ND	<73	Not Analyzed	I or II
#6	Trenton, ND	<73	Not Analyzed	I or II
#7	Dore, ND	<73	Not Analyzed	I or II
#8	Epping, ND	<73	Not Analyzed	I or II
#9	Tioga, ND	<73	Not Analyzed	I or II
#10	Ross, ND	<73	Not Analyzed	I or II
#11	Dickinson, ND	<73	Not Analyzed	I or II
#12	Dickinson, ND	<73	Not Analyzed	I or II
#13	Belfield, ND	<73	Not Analyzed	I or II
#14	Scranton, ND	<73	Not Analyzed	I or II

The week of September 9, 2013, PHMSA and FRA investigators collected samples at three additional rail loading facilities. The samples were analyzed for flash point and boiling point. Two of the samples met criteria as a PG II and one sample met criteria as a PG I. The results are provided in Table B.

Table B
Crude Oil Samples (September 9, 2013)

Sample	Location	Flash Point (°F)	Boiling Point (°F)	Packing Group
#1	Epping, ND	<40	96.5	II
#2	Ross, ND	<40	96.2	II
#3	Tioga, ND	<40	81	I

From October 8-10, 2013, PHMSA and Federal Motor Carrier Safety Administration (FMCSA) investigators collected 18 samples from cargo tank motor vehicles at roadside inspections or at loading/unloading terminals. Of the 18 samples tested, 10 samples met criteria as PG I and eight samples met criteria related to this testing as PG II. The results from these tests are provided in Table C.

Table C
Crude Oil Samples (October 8-10, 2013)

Sample	Location	Flash Point (°F)	Boiling Point (°F)	Packing Group
#1	Portal, ND	< 50	102.7	II
#2	Portal, ND	< 50	123.8	II
#3	Docado--SWSW 11-162N-98W (Divide Cty, ND)	< 50	108.1	II
#4	Zimmerman 3-13H	< 50	96.8	II
#5	Plano 1-28H	< 50	103.7	II
#6	SW/SW sec.12-7151N- Rigaw (Mckenzie Cty, ND)	< 50	118.3	II
#7	Cora Martin Battery 12345 Tank #2380	< 50	96.7	II
#8	Cora Martin Battery 12345 Tank #2395	< 50	89	I
#9	BB- State H3 (McKenzie Cty, ND)	< 50	92.1	I
#10	SW-SE Section 34 Township 152 Dir N	< 50	92.6	I
#11	HA Nelson A Facility 152-95-3427	< 50	91.9	I
#12	SW-SE Section 2 Township Dir N Tank Lact L8515	< 50	89	I
#13	AV-Wrigley-163-94-0607H-1 (Burke Cty, ND)	< 50	96.2	II
#14	SESW-8-154-93 (Mountrail, ND)	< 50	88.9	I
#15	SE-SE Section 9 Township 156 Dir N Range 93 Dir W (Mountrax Cty, ND)	< 50	87.6	I
#16	SC Ellingsberg 32-29 H-2 25697 (Williams Cty, ND)	< 50	90.9	I
#17	Cora Martin Battery 12345 Tank #2377	< 50	91.6	I
#18	Cora Martin Battery 12345 Tank #2388	< 50	92.1	I

During the week of November 5, 2013, PHMSA investigators collected 12 samples, including eight samples from the discharge of cargo tanks into bulk storage tanks at rail loading facilities. The remaining four samples were taken from bulk storage tanks at a rail loading facility. The scope of testing was expanded to determine vapor pressure, gas and liquid composition, corrosivity, and toxicity, density, flash point and boiling point.

The results from these analyses are provided in Table D.

Table D
Crude Oil Samples (Week of November 5, 2013)

Sample	Location	Reid Vapor Pressure (psia)	Methane (% Vol)	Ethane (% Vol)	Propane (% Vol)	Butane (incl. isomers) (% Vol)	Water & Sediment Content (% Vol)	Sulfur Content (% Wt)	Hydrogen Sulfide Content (ppm)	API Gravity @60^{O}F	Flash Point (^{O}F)	Initial Boiling Point (^{O}F)	Packing Group
#1	Killdeer, ND	10.4	<0.01	0.12	1.17	2.94	0.05	0.123	<5	39.9	< 32	88.2	I
#2	Beulah, ND	10.05	<0.01	0.13	1.17	2.89	0.05	0.121	<5	40.0	< 32	104.2	II
#3	Killdeer, ND	8.70	<0.01	0.05	0.81	2.70	0.10	0.117	< 5	41.4	< 32	89.1	I
#4	Beulah, ND	8.80	< 0.01	0.05	0.86	2.80	0.10	0.128	< 5	41.5	< 32	92.6	I
#5	Killdeer, ND	11.45	< 0.01	0.06	1.00	3.19	0.05	0.112	< 5	42.0	< 32	91.1	I
#6	Beulah, ND	11.75	< 0.01	0.07	1.14	2.21	0.10	0.111	< 5	42.4	< 32	84.6	I
#7	Killdeer, ND	9.20	< 0.01	0.06	0.96	2.91	0.05	0.117	< 5	41.1	< 32	95.6	II
#8	Tioga, ND	10.80	< 0.01	0.08	1.08	3.06	0.05	0.116	< 5	41.4	< 32	85.9	I
#9	New Town, ND	9.50	< 0.01	0.04	0.76	2.72	0.05	0.148	< 5	41.2	< 32	93.7	I
#10	New Town, ND	10.90	< 0.01	0.12	1.21	2.41	0.05	0.0844	< 5	43.8	< 32	85.5	I
#11	Epping, ND	7.70	< 0.01	0.03	0.61	2.42	0.10	0.114	< 5	42.0	< 32	95.6	II
#12	Dickinson, ND	8.75	< 0.01	0.06	0.82	2.68	0.10	0.0856	< 5	42.8	< 32	91.7	I

Summary and Test Results

Total Samples Taken: 88 total samples (February – May, 2014)

The second phase of testing involved additional inspectors on a continual rotation in the Bakken region to collect samples. The majority of the samples were collected at rail loading facilities from storage tanks and pipelines that were used to load rail cars. Several were collected from cargo tanks. Four of the samples collected were drawn using a closed syringe-style cylinder connected to loading pipeline to determine if there were differences from previous samples collected using the open container sampling method. The results are provided as Table E. The following tests were conducted:

Table E
Crude Oil Samples (February – May, 2014)

Company Name	City	State	Sample Date	Test Date	Flash Point (deg. F)	Initial Boiling Point (deg. F)	VPCR 0.02 @122 deg. F (psia)	VPCR 4 @ 100 deg. F (psia)	Methane (%Vol)	Ethane (% Vol)	Propane (% Vol)	Butane (% Vol)	Hydrogen Sulfide (ppm)	Corrosivity (% Weight Loss)
Bakken Oil Express LLC	Dickinson	ND	02/24/14	03/03/14	< 50	88.1	27.0	11.1	0	0.2079	1.2461	3.1643	<1	
			02/24/14	03/03/14	< 50	89.3	27.8	11.4	0	0.2256	1.2991	3.2295	<1	
			02/24/14	03/03/14	< 50	97.5	25.7	11.1	0	0.2015	1.2461	3.1735	<1	
			02/24/14	03/03/14	< 50	93.1	27.7	12.2	0	0.2586	1.4587	3.4972	<1	0**
			02/25/14	03/03/14	< 50	89.0	29.8	12.5	0	0.2206	1.3773	3.423	<1	
			02/25/14	03/03/14	< 50	93.6	28.3	12.7	0	0.2574	1.4409	3.3963	<1	
			02/25/14	03/03/14	< 50	92.1	26.9	10.8	0	0.1746	1.0088	2.8672	<1	
			02/25/14	03/03/14	< 50	89.4	26.7	10.7	0	0.1735	1.0093	2.8324	<1	
			02/25/14	03/03/14	< 50	92.3	23.4	10.5	0	0.184	1.0543	2.9483	<1	
			02/25/14	03/03/14	< 50	83.8	24.3	11.6	0	0.2233	1.3951	3.4341	<1	
			02/25/14	03/03/14	< 50	86.2	28.2	12.4	0	0.2347	1.384	3.3272	<1	
			02/25/14	03/03/14	< 50	87.2	30.2	12.5	0	0.2251	1.4192	3.4896	<1	
Dakota Plains/Strobel Starostka	New Town	ND	02/25/14	03/03/14	<50	90.5	31.2	13.1	0	0.2192	1.5254	3.735	<1	0**
			02/25/14	03/03/14	< 50	92.8	28.6	11.8	0	0.1379	1.279	3.521	<1	

			02/25/14	03/02/14	< 50	86.4	27.7	12.2	0	0.1359	1.2462	3.4476	<1	
Enbridge Rail, LLC	Beuthold	ND	02/26/14	03/03/14	< 50	93.5	26.7	11.2	0	0.1945	1.2662	3.2127	<1	
			02/26/14	03/03/14	< 50	89	26.4	11.1	0	0.1975	1.2624	3.1692	<1	
			02/26/14	03/03/14	< 50	92.5	26.8	11.2	0	0.2182	1.3064	3.2112	<1	
EOG Resources	Stanley	ND	02/25/14	03/03/14	< 50	88.4	29.3	13.3	0	0.1194	1.1389	3.3152	<1	0**
			02/25/14	03/03/14	< 50	85.7	28.5	13.3	0	0.2099	1.5419	3.7439	<1	
			02/25/14	03/03/14	< 50	86.8	29.4	13.4	0	0.2112	1.5539	3.7434	<1	
Plains Marketing, LP	Ross	ND	02/26/14	03/02/14	< 50	81.8	28.7	14.2	0	0.2005	1.7301	4.1952	<1	
			02/26/14	03/02/14	< 50	80.6	29.0	15.1	0	0.2858	1.9851	4.4043	<1	
			02/26/14	03/02/14	< 50	83.8	29.0	13.3	0	0.3158	2.0843	4.48	<1	
Inergy Crude Logistics, LP	Epping	ND	02/26/14	03/03/14	< 50	85.5	28.3	13.5	0	0.3064	1.5878	3.5817	<1	0**
			02/26/14	03/03/14	< 50	84.9	28.7	13.6	0	0.2963	1.5604	3.5526	<1	
			02/26/14	03/03/14	< 50	84.7	29.8	13.6	0	0.2965	1.606	3.6625	<1	
Great Northern Gathering & Marketing	Fryburg	ND	02/26/14	03/10/14	< 50	86.7	26.2	11.5	0	0.2635	1.399	3.3975	<1	
			02/26/14	03/10/14	< 50	87.0	27.1	11.3	0	0.3138	1.617	3.8413	<1	
			02/26/14	03/10/14	< 50	90.8	26.4	11.1	0	0.3204	1.5856	3.7071	<1	
Basin Transload/Global Stampede	Stampede	ND	02/27/14	03/10/14	<50	88.0	28.2	12.4	0	0.1719	1.2974	3.3689	<1	
			02/27/14	03/10/14	<50	88.1	25.5	12.5	0	0.2685	1.7044	3.8848	<1	
			02/27/14	03/10/14	<50	87.7	29.5	12.9	0	0.3153	1.9675	4.4686	<1	
Musket Corp.	Dickinson	ND	02/27/14	03/10/14	<50	86.7	28.5	13.4	0	0.2329	1.5192	3.6576	<1	

			02/27/14	03/10/14	<50	84.5	28.7	13.4	0	0.241	1.5076	3.6036	<1	
			02/27/14	03/10/14	<50	88.0	28.1	13.3	0	0.2711	1.6539	3.9135	<1	
Red River Supply	Williston	ND	02/27/14	03/10/14	<50	88.7	28.4	13.0	0	0.2631	1.3361	3.0534	<1	
			02/27/14	03/10/14	<50	89.0	29.1	13.3	0	0.3444	1.7621	4.0086	<1	
			02/27/14	03/10/14	<50	87.5	28.6	12.9	0	0.3953	1.9241	4.3453	<1	
Great Northern Gathering & Marketing	Fryburg	ND	02/27/14	03/10/14	<50	91.7	26.8	11.2	0	0.2265	1.4366	3.7671	<1	
Basin Transload/Global Beulah	Beulah	ND	02/28/14	03/10/14	<50	83.3	30.0	11.8	0	0.227	1.3635	3.5145	<1	
			02/28/14	03/10/14	<50	87.3	26.3	10.6	0	0.1877	1.3101	3.566	<1	
			02/28/14	03/10/14	<50	88.1	25.2	11.2	0	0.2195	1.4373	3.9621	<1	
EOG Resources	Stanley	ND	03/04/14	03/07/14	< 50	87.9	26.6	12.1	0	0.2312	1.5577	3.7271	<1	
			03/04/14	03/07/14	<50	89.3	28.3	12.6	0	0.2393	1.5617	3.6901	<1	
Enbridge Rail, LLC	Berthold	ND	03/04/14	03/07/14	<50	93.6	26.4	11.4	0	0.1743	1.1727	3.062	<1	
			03/04/14	03/07/14	<50	88.9	26.1	11.3	0	0.1645	1.1517	3.0522	<1	
Savage	Trenton	ND	03/04/14	03/07/14	<50	84.4	27.5	12.7	0	0.2583	1.5151	3.5849	<1	
			03/04/14	03/07/14	<50	87.1	28.7	13.1	0	0.248	1.4652	3.5252	<1	
			03/04/14	03/07/14	<50	88.8	30.0	13.1	0	0.2667	1.5277	3.5926	<1	
			03/04/14	03/07/14	<50	84.1	29.2	13.2	0	0.2743	1.5579	3.6289	<1	
			03/04/14	03/07/14	<50	85.0	26.1	13.1	0	0.2364	1.4313	3.4846	<1	
			03/04/14	03/07/14	<50	86.6	29.5	13.0	0	0.2251	1.4072	3.4837	<1	
Plains All	New Town	ND	03/04/14	03/11/14	<50	83.7	31.2	13.3	0	0.2538	1.6544	3.9182	<1	

American														
			03/04/14	03/11/14	<50	82.7	28.1	13.4	0	0.2456	1.6288	3.8824	<1	
			03/04/14	03/11/14	<50	87.3	30.1	13.6	0	0.2062	1.5219	3.7927	<1	
			03/04/14	03/11/14	<50	87.3	29.7	13.4	0	0.2602	1.6871	3.9719	<1	
			03/04/14	03/11/14	<50	86.9	29.0	13.5	0	0.2584	1.6681	3.9274	<1	
			03/04/14	03/11/14	<50	86.7	32.1	14.1	0	0.2649	1.6666	3.8536	<1	
Basin Transload/Global Stampede	Stampede	ND	03/10/14	03/17/14	<50	88.5	28.6	12.8	0	0.2709	1.5797	3.7126	<1	
			03/10/14	03/17/14	<50	90.8	29.2	13.2	0	0.2988	1.6097	3.6708	<1	
			03/10/14	03/17/14	<50	86.7	28.0	N/A	0	0.259	1.5127	3.6046	<1	
			03/10/14	03/17/14	<50	89.2	27.8	13.0	0	0.2869	1.6188	3.7266	<1	
			03/10/14	03/17/14	<50	89.8	29.1	13.3	0	0.2495	1.4623	3.5335	<1	
			03/10/14	03/17/14	<50	91.3	27.2	13.2	0	0.294	1.6143	3.712	<1	
Basin Transload/Global Beulah	Beulah	ND	03/11/14	03/17/14	<50	92.3	24.9	10.1	0	0.1556	0.9818	2.7378	<1	
Bakken Oil Express LLC	Dickinson	ND	03/12/14	03/17/14	<50	88.0	26.1	12.2	0	0.2476	1.3834	3.3223	< 1	
			03/12/14	03/17/14	<50	87.7	26.3	11.7	0	0.232	1.3385	3.2275	< 1	
			03/12/14	03/17/14	<50	88.9	20.3	11.6	0	0.2368	1.333	3.2269	< 1	
			03/12/14	03/17/14	<50	92.9	26.8	11.7	0	0.2235	1.3089	3.2207	< 1	
			03/12/14	03/17/14	<50	87.1	27.2	11.9	0	0.2034	1.241	3.1276	< 1	
			03/12/14	03/17/14	<50	92.1	27.0	11.8	0	0.233	1.3208	3.2072	< 1	
			03/12/14	03/17/14	<50	92.3	27.4	11.7	0	0.2211	1.2849	3.1663	< 1	
EOG Resources	Stanley	ND	03/13/14	03/18/14	<50	89.6	27.20	12.24	0	0.1845	1.4065	3.5213	<1	
			03/13/14	03/18/14	<50	86.6	27.02	12.03	0	0.1849	1.3732	3.4601	<1	

			03/13/14	03/18/14	<50	94.0	26.80	12.24	0	0.1913	1.4155	3.5186	<1	
Hess Corporation	Tioga	ND	03/11/14	03/15/14	<50	85.8	27.12	14.38	0	0.23	1.8	4.02	<1	
Inergy Crude Logistics, LP	Epping	ND	03/18/14	03/21/14	<50	86.6	28.89	13.29	0	0.1961	1.3918	3.5	<1	
			03/18/14	03/21/14	<50	94.4	28.34	13.7	0	0.2251	1.51	3.626	<1	
			03/18/14	03/21/14	<50	88.4	29.84	13.82	0	0.2484	1.5539	3.649	<1	
			03/18/14	03/21/14	<50	92.3	23.04	10.22	0	0.0571	0.8493	3.0056	<1	
Hess Corporation	Tioga	ND	03/17/14	03/20/14	<50	79.1	25.26	13.64	0	0.217	1.7327	4.1573	<1	
Enbridge Rail, LLC*	Berthold	ND	04/28/14	05/01/14	<50	88.5	39.36	11.31	<0.01	0.19	1.2	3.07	<1	
			04/26/14	05/01/14	<50	87.2	24.71	10.97	<0.01	0.21	1.32	3.31	N/A	
			04/26/14	05/01/14	<50	85.9	26.35	11.29	<0.01	0.21	1.29	3.24	N/A	
Plains Marketing, LP*	Ross	ND	04/30/14	05/02/14	<50	84.2	36.73 (0.05)	14.28	<0.01	0.29	1.95	4.44	N/A	
Great Northern Gathering & Marketing*	Fryburg	ND	05/01/14	05/05/14	<50	86.7	37.21	11.12	<0.01	0.2	1.16	3.05	N/A	
Dakota Plains/Strobel Starostka*	Newtown	ND	05/02/14	05/05/14	<50	84.1	31.12	11.47	<0.01	0.15	1.24	3.32	N/A	

Conclusion

Based upon the results obtained from sampling and testing of the 135 samples from August 2013 to May 2014, the majority of crude oil analyzed from the Bakken region displayed characteristics consistent with those of a Class 3 flammable liquid, PG I or II, with a predominance to PG I, the most dangerous class of Class 3 flammable liquids. Based on our findings, we conclude that while this product does not demonstrate the characteristics for a flammable gas, corrosive liquid or toxic material, it is more volatile than most other types of crude– which correlates to increased ignitability and flammability.

Bakken crude's high volatility level – a relative measure of a specific material's tendency to vaporize – is indicated by tests concluding that it is a "light" crude oil with a high gas content, a low flash point, a low boiling point and high vapor pressure. The high volatility of Bakken crude oil, and its identification as a "light" crude oil, is attributable to its higher concentrations of light end hydrocarbons. This distinguishes it from "heavy" crude oil mined in other parts of the United States,

Given Bakken crude oil's volatility, there is an increased risk of a significant incident involving this material due to the significant volume that is transported, the routes and the extremely long distances it is moving by rail. Trains transporting this material, referred to as unit trains, routinely contain more than 100 tank cars, constituting at least 2.5 million gallons within a single train. Unit trains only carry a single type of product, in this case flammable crude oil. These trains often travel over a thousand miles from the Bakken region to refinery locations along the coasts.

PHMSA and FRA plan to continue the sampling and analysis activities of Operation Safe Delivery through the summer and fall of 2014 and to work with the regulated community to ensure the safe transportation of crude oil across the nation. The Department will continue to keep the public, regulated entities and emergency responders informed about our efforts.

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