Minutes of a Meeting of the Industrial Commission of North Dakota
Held on August 6, 2014 beginning at 11:00 a.m.
Fort Totten Room, State Capitol, Bismarck, ND

Present: Governor Jack Dalrymple, Chairman
Attorney General Wayne Stenehjem
Agriculture Commissioner Doug Goehring

Also Present: Lynn Helms, Department of Mineral Resources
Bruce Hicks, DMR – Oil and Gas Division
Alison Ritter, DMR – Oil and Gas Division
Kari Cutting, ND Petroleum Council
Dennis Sutton, Turner, Mason & Company
Ron Ness, ND Petroleum Council
Kari Doan, Department of Agriculture
Hope Hogan, Attorney General's Office
Jerod Tufte, Governor's Office
Justin Kringstad, ND Pipeline Authority
John Morrison, Crowley Fleck
Jan Swenson, Badlands Conservation Alliance
Craig Smith, Crowley Fleck
Danette Welsh, ONEOK
Dick Vanderbusch, ONEOK
Steve McNally, Hess
Jeff Hume, Continental Resources
Mike Smith, QEP
Julie Fedorchak, Public Service Commission
Members of the Press

Governor Dalrymple called the Industrial Commission meeting to order at 11:00 a.m. in the Fort Totten Room and the Commission took up Department of Mineral Resources business.

Governor Dalrymple called on Kari Cutting to introduce Mr. Dennis Sutton of Turner, Mason & Company.

Ms. Kari Cutting, ND Petroleum Council, thanked the Commission for the opportunity to present and discuss the Bakken Quality & Safety Initiative Study. She said in February the Petroleum Council commissioned a study by Turner, Mason & Company which is a nationally known engineering consulting firm to delineate Bakken crude oil characteristics. After several months of sampling, analyses and comparative research, the Turner, Mason report was released on August 4. She introduced Mr. Dennis Sutton to provide a summary of the Study. She indicated that Mr. Sutton is a consultant with Turner, Mason and has over thirty years of analytical experience in crude oil quality and serves as Executive Director of the United States Crude Oil Quality Association and is a board member on the Canadian Crude Oil Quality Technical Association. She said Mr. Jeff Hume with Continental Resources, Mr. Steve McNally with Hess and Mr. Dick Vanderbusch with ONEOK representing the producers, pipelines, gas gathering and gas processing for the industry were available to answer any questions the Commission might have regarding the impact of the Turner, Mason recommendations.

Mr. Dennis Sutton presented the Turner, Mason & Company and SGS Laboratories Bakken Crude Quality Assurance Study as follows: (The entire report is available in the Commission files.) The following is a PowerPoint presentation summarizing the report.

BKN QUALITY & SAFETY INITIATIVE

NDPC Bakken Crude Characterization Task Force

Presentation to
Industrial Commission of North Dakota
Bismarck, ND – August 6, 2014

Agenda

- Overview
  - Executive Summary
  - Description of North Dakota Petroleum Council (NDPC) Study
  - Other Recent Reports and Presentations
- Details of NDPC Study
  - Comprehensive Sampling and Testing
  - Round Robin Testing – SGS vs. another major lab
  - Loading vs. Destination Testing
  - Vapor Pressure Seasonality Testing
- Conclusions
  - Recommended Action Steps
  - BKN Typical Specification Ranges

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Executive Summary

- In early 2014, the NDPC commissioned a comprehensive sampling and testing program to establish and understand Bakken crude oil quality
- This study, in conjunction with other recent work, shows:
  - Bakken is a light, sweet crude with an average API Gravity of 40-43; similar to other light crudes, e.g. WTI, Brent
  - Bakken is not materially different in vapor pressure or light ends content from other light crudes
  - The Bakken crude is extremely consistent across the entire basin and consistent from load to delivery point.
  - Bakken crude is correctly classified as a Class 3, Flammable Liquid.
    - Packing group designation can vary. Thus, the NDPC recommends all producers categorize Bakken as Packing Group I
    - Study provided basis for development of recommended action steps and typical BKN quality

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Project Overview

- NDPC commissioned a comprehensive and tightly controlled sampling and testing program to establish a quality baseline for Bakken crude oil
- Bakken (BKN) crude sampled at both well and rail sites
  - 15 well sites and 7 rail-loading terminals
  - Rail sites represent about 50% of total ND rail capacity
  - Significant geographic dispersion for both well and rail sites
- Sampling initiated on 3/25/14 and completed on 4/24/14
  - 7 samples at each site
  - Initial samples at well sites included both top and bottom of tank
- Preliminary findings presented by Jeff Hume at the Williston Basin Petroleum Conference in May
- Supplemental data provided by member companies and from other studies

Project Contractors

- Turner, Mason & Company – Overall Project Coordinator
  - Internationally recognized refining consultants
  - 43 years in business
  - Project Lead - John Auers, P.E., Executive Vice President
  - TM&C staff supplemented by outside expertise
    - Dennis Sutton –over 40 years crude quality experience
- SGS - Sampling and Testing Contractor
  - World leading testing and inspection company
  - Over 135 years in business
  - Utilized both local (Williston, ND) and U.S. Gulf Coast laboratories

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Testing Protocol

- Testing focused on parameters relevant to DOT hazardous material compliance
- The test slate included:
  - API Gravity
  - Flash Point by ASTM D3278
  - Initial Boiling Point (IBP) by ASTM D86
  - Vapor Pressure by ASTM D6377 at 37.8°C (100°F) *
  - Light Ends Analyses by IP344
  - High Temperature Simulated Distillation (HTSD) by ASTM D7169

* Results about 1 psi higher than if D323 RVP test method is used

Operating Data

- To develop best practices, key operating conditions were recorded during sampling
  - Ambient temperatures
  - Separator and treater temps and pressures
  - Production rates/last movements out of tank
  - Tank heights
  - Vapor capture status

Other Recent Related Work

- AFPM Survey of Bakken Crude Oil Characteristics- published May 14, 2014
  - A compilation of available data from a variety of sources
- Bakken Light Ends Brief - presentation by Randy Segato, Suncor to the Crude Oil Quality Association, February 2014
- Transportation Safety Board of Canada Laboratory Report LP 148/2013
- DOT PHMSA reports issued July 23, 2014 including *Operation Safe Delivery Update*

NDPC Report vs. PHMSA Report

- Both reports agree Bakken is not a flammable gas, corrosive liquid, or toxic material.
- Both reports agree well on the vapor pressure and light ends content.

	NDPC Rail Avg.	PHMSA Report
Vapor Pressure, psi	11.5	12.3
Light Ends (C2-C4s), vol %	4.95	4.65

Note: For comparison, winter grade gasoline can have up to an RVP of 15 and >10% C4.

- The PHMSA report states it is more volatile than most other types of crude but provides no supporting evidence for this claim.

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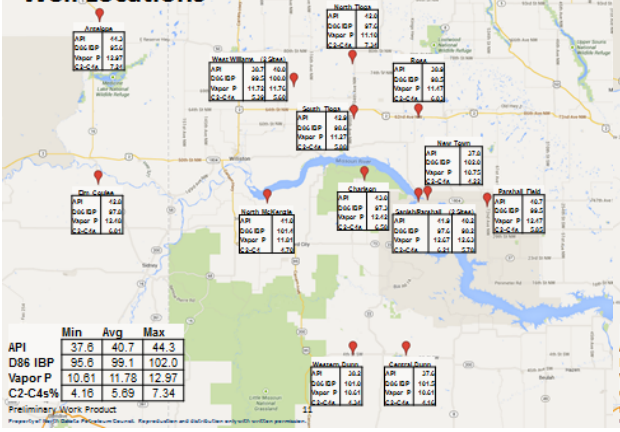
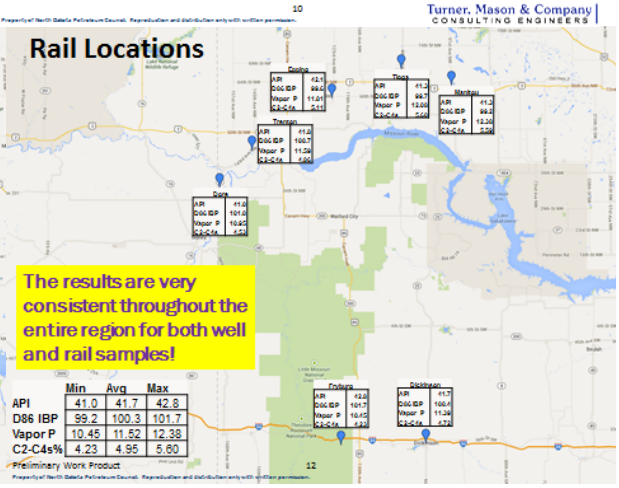
Well Locations



	Min	Avg	Max
API	37.6	40.7	44.3
D86 IBP	95.6	99.1	102.0
Vapor P	10.61	11.78	12.97
C2-C4s%	4.16	5.69	7.34

Preliminary Work Product

Rail Locations



The results are very consistent throughout the entire region for both well and rail samples!

	Min	Avg	Max
API	41.0	41.7	42.8
D86 IBP	99.2	100.3	101.7
Vapor P	10.45	11.52	12.38
C2-C4s%	4.23	4.95	5.60

Preliminary Work Product

Consistent Quality – Rail vs. Well

- Quality is consistent between well and rail
- Indicates there is no spiking of crudes before shipment

	Well	Rail
API Gravity	40.6	41.7
D86 IBP (°F)	99.1	100
VPCR D6377 (psi)	11.8	11.5
Light Ends %		
Ethane	0.24	0.23
Propane	1.63	1.39
Isobutane	0.65	0.58
n-Butane	3.16	2.75
Isopentane	1.52	1.42
n-Pentane	2.90	2.72
C2-C4s	5.69	4.95
C2-C5s (excluding Cyclopentane)	10.12	9.10

SimDist (°F)	Well	Rail
IBP	<97	<97
5%	106	113
10%	153	165
20%	231	238
30%	310	316
40%	394	396
50%	481	482
60%	572	572
70%	671	670
80%	785	787
90%	935	939
95%	1053	1060
FBP	1305	1317

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Comparison of Light Crude Properties

Crude Grade	Origin	API Gravity	Sulfur (wt. %)
Eagle Ford	Texas, USA	30-60+	~0.1
Arabian Super Light	Saudi Arabia	50-51	~0.1
Agbami	Nigeria	48	<0.1
Saharan Blend	Algeria	45-46	0.1
Bakken	North Dakota, USA	40- 43	~0.1
WTI	Texas, USA	37- 42	~0.4
Light Louisiana Sweet (LLS)	Louisiana, USA	36-40	~0.4
Brent	North Sea, UK	37-39	~0.4
Arabian Light	Saudi Arabia	32-33	~2.0

Note: Bakken data reflects bulk of samples. Other data obtained from various sources including Capline, COQA, BP, Chevron, ExxonMobil, eni, and Energy Intelligence Research.

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In response to a question regarding if they are testing in the car after treatment or before treatment, Mr. Sutton said these are samples from the tanks at the well facility and at the rail facility where the cars are being loaded. Mr. Hume clarified that the samples were after the crude oil had gone through the field treating equipment.

Supplemental Work-Round Robin Testing

- As the work progressed, questions arose regarding lab-to-lab precision
- Thus, three different labs tested four identical Bakken crude samples
- The samples were analyzed for:
  - API Gravity by ASTM D5002
  - Vapor Pressure of Crude at 37.8°C, 4:1 V/L Ratio, by ASTM D6377
  - Initial Boiling Point (IBP) by ASTM D86 distillation

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Round Robin Testing

- Excellent agreement on API gravity and Vapor Pressure
  - Supports sample integrity and lab performance
- Poor agreement on D86 IBP
  - Results for the same sample in each case fall on either side of 95°F; Level used for PG I/PG II determination
  - Underscores shortcomings of the D86 test required by PHMSA
  - Initial boiling point determination (IBP) is also being studied by the API task force.

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In response to a question Mr. Sutton explained the differences between the Packing Group 1, 2 and 3. He stated that if you look at the hazardous material regulations, they break things down into classes and then packing groups. Those regulations determine how the material is packaged, labeled and shipped and that will cover everything from a sample sent by UPS or Federal Express to what would be transported by rail cars and trucks. A question that has come up with Bakken Crude is whether it is a Packing Group 1 or Packing Group 2 material. It hinges on this one test that everyone in the industry is finding is not a perfect test for determining this parameter at this particular level. The cutoff point is 95° and all of the samples analyzed are right around that point and the variability is such that one reputable lab might get lower than that and on the exact same sample another lab might get higher than that.

In response to a question regarding which is safer and which more dangerous, Mr. Sutton said Packing Group 1 is the most conservative – that would be the group for handling the most hazardous materials.

In response to a question Mr. Sutton said when you are referring to light crude the industry generally has established that as API gravity of 35 and above. Very heavy crude oils would be in the low 20's and intermediate crude oils would be in the high 20s/low 30s.

In a response to a question regarding the borderline classification between Packing Group 1 and 2 if there is a specific trait that is tilting it one way or the other, Mr. Sutton said it is this particular test for the initial boiling point of the material. The boiling point is significant because the initial boiling point, where that first drop of material boils, is indicative of how much of the light boiling compounds are present in the crude. So the lower initial boiling point would be indicative of more lighter material being in the crude oil. Crude oil is this wide boiling mixture from things as light as ethane, propane and butane all the way out to the heaviest most viscous molecules that get made into asphalt.

In response to a question regarding if there is a comparison of boiling points between Bakken and other light sweet crudes, Mr. Sutton said there really is not and the reason is that kind of data is not available. You can get into what's the composition of those light boiling compounds and that is why some additional testing was done.

Ms. Cutting added that the 49 CFR allows crude oil to be characterized as Packing Group 1, 2 or 3 so all crude oils are allowed to be moved by rail. Packing Group 1 and 2 are allowed to move in the same rail cars. Packing Group 1, there is a distinction on the type of trucks that are required for Packing Group 1 and that is part of the reason that Turner, Mason recommended just calling all this material Packing Group 1 until either API or PHMSA come out with recommendations on a better testing methodology because that is really the problem here. Material going to one lab would come back with a Packing Group 2 designation and if the same material went to a different lab it could come back with a Packing Group 1 designation – so the real fuzzy area is the analytical test to determine if it is Packing Group 1 or 2.

In response to a question Ms. Cutting stated that when it comes to rail cars it is the same car whether it is Packing Group 1 or 2.

In response to a question regarding the 95° temperature, Mr. Sutton said that is a different test, the vapor pressure. It is a piece of equipment that has been used for decades for measuring vapor pressure of finished gasoline, for example, because you have regulations there. You introduce a small sample to the instrument and it measures the pressure exerted by the vapor above the liquid in the sample. It is two different tests but the way the regulations are spelled out, it utilizes data from both of those tests for determining the Packing Group.

In response to a question regarding boiling point and vaporization, Mr. Hume said that is exactly what they are trying to determine--at what point do the lighter molecules, if there are trace amounts of ethane or propane or butane still in the crude oil – when do they come off, how much

is there – the initial boiling point is when the first light molecule vaporizes. That is what they are looking for in that test. Then the vapor pressure is more quantitative, if you will, how much light material is in that. It's a very fine cut there, it is not a function of flammability, it is a function of when does it turn from a liquid to a gas. What they did on the analyses – we see what our percentages show -- it's about the same as you would get from a WTI oil.

In response to a question regarding how they determine what a significant difference in vapor pressure is Mr. Sutton said he didn't think any study has ever been done to definitively answer that. Gasoline is blended up to 15 pounds vapor pressure by design and moved safely. We know that a lot of crude oils are in the 5 to 12 range; we know that a lot of the new shale crudes from the Niobrara in Colorado, Eagle Ford, Utica, Bakken are more in the 8 to 12 range; but he does not believe any research like that has been done.

Ms. Cutting said the DOT regulation lists flammable liquids up to a vapor pressure of 43.5 so by regulation itself, it is a flammable liquid. Flammable gases could have a vapor pressure above 33.5 according to the DOT. The rail car design, even for the older DOT 1-11 cars, is designed for 100 pounds of pressure – and that is not even the burst pressure which is 250 to 500 psi. So when talking about a vapor pressure that is 11 or 12, we are not anywhere near the design capacity for pressure via rail car and 4 times less than the regulatory threshold between flammable liquids and flammable gases by DOT's own definition.

Loading vs. Destination Testing

- Tested Bakken Shipped on Train from ND; April 2014
  - 5 cars sampled
  - Loading in North Dakota - Discharge at St. James, LA
  - All analyses conducted by Intertek at labs in ND and LA
- Analyses conducted included:
  - Vapor Pressure of Crude at 37.8°C and a V/L ratio of 4, utilizing ASTM D6377
  - Flash Point by ASTM D56
  - H_2S in Vapor Phase at 77°F, using ITM 3468
  - Light Ends Analysis by Modified ASTM D6730

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Summarized Results

Test	Units	Avg. ND Rail Terminal Car Samples	Avg. St. James Rail Terminal Car Samples	Avg. NDPC Data for Same Rail Terminal
VPCR 4 (37.8° C)	psi	10.47	10.61	10.45
IBP	°F	94.7	90.4	101.7
Flash Point	°F	<50	<50	<73
H_2S in Vapor Phase	ppm v/v	<1	<1	
C2-C4s	Vol %	4.00	4.08	4.23
C2-C5s (excluding cyclopentane)	Vol %	8.01	7.89	8.13

Conclusion: Excellent agreement except for IBP

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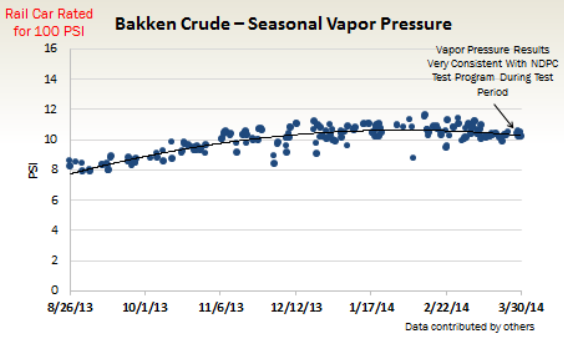
Vapor Pressure Seasonality

- One NDPC member's rail terminal has been measuring Reid Vapor Pressure (RVP) at their rail-loading facility for each unit train loaded since initiating operations in 2013
- The rail terminal receives Bakken quality crude oil from both truck deliveries and pipeline receipts
- The onsite test method is ASTM D323-B (Reid, 100°F)
- This data is summarized on the following slide

Vapor Pressure Seasonality



Vapor Pressure Seasonality

- While there is some variability to the data, it shows seasonal variation over a narrow range: 8 psi to 11 psi
- This is exactly as would be expected, with a predictable pattern of higher vapor pressure in the winter and lower vapor pressures in the hotter summer months
- Over this entire 7-month period, there are **no** unusually high values
- This study demonstrates a predictable, consistent crude oil stream

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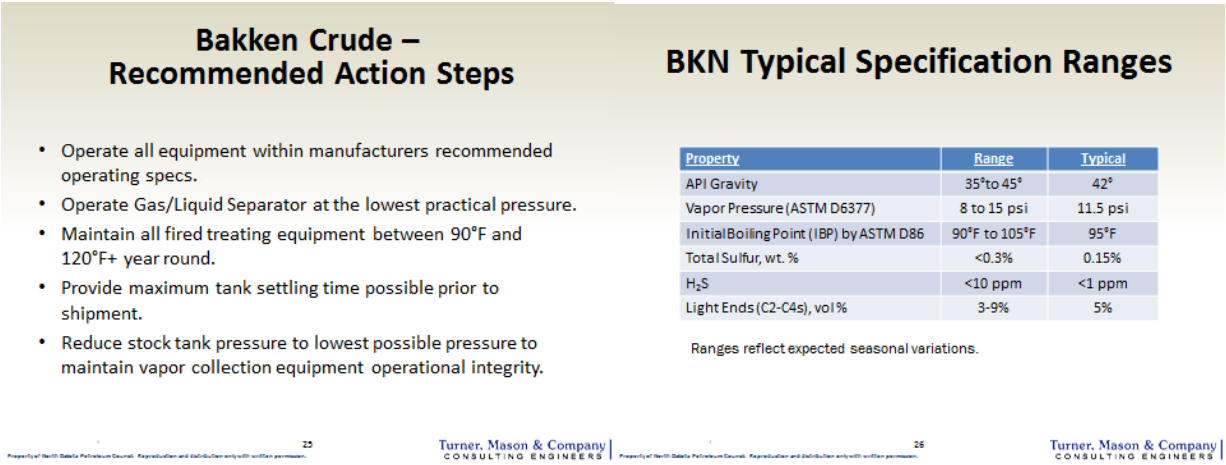
Bakken Crude - Conclusions

- BKN crude is a light sweet crude oil
  - API gravity ~40 to 43° and sulfur < 0.3 wt.%
  - Similar to other light sweet crude oils
- Quality is very consistent
  - Both well-to-well and throughout the supply chain
  - Little variation throughout entire basin
  - Shows no "spiking" with NGL's before rail shipment
  - No practical changes in quality during transit
- Classified correctly
  - As a Class 3 Flammable Liquid
  - Recommended to be categorized as Packing Group I

Bakken Crude - Conclusions

- While the companies operating in the Bakken use a variety of well site production equipment and operating conditions:
  - The data consistency shows the equipment is limited in its ability to significantly impact vapor pressure and light ends.
  - This is consistent with the design and expected capabilities of the equipment.
  - Measurable reductions in ethane and propane can be achieved by running the equipment at higher temperatures.



Bakken Crude – Recommended Action Steps

- Operate all equipment within manufacturers recommended operating specs.
- Operate Gas/Liquid Separator at the lowest practical pressure.
- Maintain all fired treating equipment between 90°F and 120°F+ year round.
- Provide maximum tank settling time possible prior to shipment.
- Reduce stock tank pressure to lowest possible pressure to maintain vapor collection equipment operational integrity.

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BKN Typical Specification Ranges

Property	Range	Typical
API Gravity	35°to 45°	42°
Vapor Pressure (ASTM D6377)	8 to 15 psi	11.5 psi
Initial Boiling Point (IBP) by ASTM D86	90°F to 105°F	95°F
Total Sulfur, wt. %	<0.3%	0.15%
H_2S	<10 ppm	<1 ppm
Light Ends (C2-C4s), vol %	3-9%	5%

Ranges reflect expected seasonal variations.

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In response to a question on how can you assure anyone that there was independence and so forth and no bias when the study was paid for by industry, Mr. Sutton said by using a company like Turner, Mason that is well regarded in the industry for doing studies, utilizing an independent third party laboratory for all of the testing, SGS Controls, and providing the detail that is contained in this report for anyone's review. How do we also know the data is good? Comparing it to other independent work, to look at what the AFPM obtained, what PHMSA obtained and their data just came out late July. He stated that he had a copy of that study and that was the first thing he did was to look at – how does it compare. PHMSA's study was funded by PHMSA and it was done by a different laboratory than was used by Turner Mason – which is encouraging when you see different organizations using different laboratories and coming up with the same analytical results. The API is working on a project that is just in the draft stages right now.

The Commission members, Mr. Sutton and the industry representatives discussed the best practices that had been recommended in the study and how they would impact field operations. They discussed in detail:

- current field operating practices;
- types of production equipment;
- the balancing that takes place in the field of capturing or flaring the gases;
- the temperature and pressure that is needed to move the materials through the pipelines;
- operating the equipment as per the manufacturers recommended operating specifications;
- impact of multi-pad drilling and the consolidation of equipment in one location in order to have a smaller footprint on the surface;
- new technology that is evolving to deal with these issues;
- operating conditions during the winter when temperatures are much lower;
- rail cars, equipment installed on rail cars and rail safety issues;
- volume of Bakken crude moving by rail compared to other crude;
- the need for clarification of the DOT proposed regulations;
- comparison of Bakken crude oil to other crude oils without scientific data; and
- the ongoing study being done by PHMSA and the API study.

In response to a question, Mr. Helms stated it would be his recommendation that the Commission hold a public hearing to obtain testimony on these issues including the recommendations outlined in the Turner Mason study and then the staff bring back a recommended order or perhaps a recommended emergency rule with the goal to make the crude oil as safe as possible with it being a Packing Group 1 DOT Class 3 flammable liquid.

It was moved by Attorney General Stenehjem and seconded by Commissioner Goehring that the Oil and Gas Division proceed with the scheduling of a public hearing to take information on action steps to improve the reduction of volatility of crude oil at North Dakota well sites. On a roll call vote, Governor Dalrymple, Attorney General Stenehjem and Agriculture Commissioner Goehring voted aye. The motion carried unanimously.

Mr. Helms indicated that there were several informational items that the Commission had requested at their last meeting that they will present at the Commission's next meeting or subsequent meetings. Governor Dalrymple stated that he would be asking the Secretary of Transportation on Friday about the proposed rules on railcars as there are a lot of questions about what is being proposed.

Being no further Department of Mineral Resources business, Governor Dalrymple adjourned this portion of the meeting at 12:11 p.m. and the Commission took up Administrative business.

INDUSTRIAL COMMISSION OF NORTH DAKOTA

Karlene Fine, Executive Director and Secretary

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Agriculture Commissioner Doug Goehring

Also Present: Lynn Helms, Department of Mineral Resources
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Steve McNally, Hess
Jeff Hume, Continental Resources
Mike Smith, QEP
Julie Fedorchak, Public Service Commission
Members of the Press

Governor Dalrymple called the Administrative portion of the Industrial Commission meeting to order at 12:11 p.m. following completion of Department of Mineral Resources business.

Ms. Karlene Fine, Industrial Commission Executive Director, presented the non-confidential and confidential July 1, 2014 meeting minutes for the Commission's consideration.

It was moved by Commissioner Goehring and seconded by Attorney General Stenehjem that the Industrial Commission approves the non-confidential and confidential July 1, 2014 meeting minutes. Governor Dalrymple, Attorney General Stenehjem and Commissioner Goehring voted aye. The motion carried unanimously.

Being no further Administrative business, Governor Dalrymple adjourned the Commission meeting at 12:12 p.m.

INDUSTRIAL COMMISSION OF NORTH DAKOTA

Karlene Fine, Executive Director and Secretary