



Sahtu Land and Water Board

Staff Report

Division: Water Program	Report No.: 1
Date Prepared: October 22, 2004	File No.: S04L1-006
Meeting Date: November 12, 2004	
Subject: An Amendment involving the use of Amodrill 1500, a hydrocarbon based drilling fluid, and the possibility of Northrock Resources Ltd. employing this substance during gas and oil exploration.	

1. Purpose/Report Summary

To present to the Board facts that relate to the environmental implications involved in using Amodrill 1500, a hydrocarbon-based drilling fluid, in comparison to using Distillate 822, a hydrocarbon-based drilling fluid previously approved for use by the SLWB. The main purpose of the report is to provide the Board with sufficient information to allow a decision to be made as to whether or not Amodrill 1500 can be utilized for drilling activities that accompany oil and gas exploration in the Sahtu Settlement Area.

2. Background

A Water Licence and Land Use Permit was approved by the Board on September 8, 2004 for the Northrock Resources Ltd. Summit Creek 2004-05 drilling program on lands currently under lease to the proponent or on EL-387. The program area is located approximately 60 km SSW of Tulita.

Northrock has, in its faxed letter of October 7, 2004, submitted a "Request for Permit Amendments to Land Use Permit S04A-006 and Water Licence S04L1-006 to Utilize a Mineral Oil Based Drilling Fluid System".

In the original application S04L1-006, Northrock indicated that the drilling program would utilize a fresh water gel-chem drilling fluid during drilling operations. The request for amendment, however, indicates that the proponent has reviewed the drilling program and wishes to amend the Permit and Licence to reflect the additional use of a mineral oil-based drilling fluid that will be employed while drilling certain sections of the well.

As indicated in the request for amendment, mineral oil-based drilling fluids such as Amodrill 1500, have been used successfully in Alberta and British Columbia in controlling sloughing of shale in the well bore. When employing water-based gel-chem drilling fluids water is absorbed by shale formations causing swelling of the shale, which ultimately fractures the shale causing it to slough into the wellbore. This kind of event can cause significant delays in reaching target depths during drilling. In replacing water in gel-chem drilling fluids with the mineral oil (Amodrill 1500) water uptake by shale is

Saltwater Gel-Chem Drilling Fluid (Mud) - means a drilling fluid system whose continuous liquid phase is comprised of varying levels of salt or salt saturated water. The primary use of saltwater mud is to drill salt formations that are prone to dissolution when exposed to freshwater gel-chem drilling fluid. Saltwater mud may also be utilized to limit thermal degradation of permafrost as the freezing point of saltwater is below 0° C.

Freshwater Gel-Chem Drilling Fluid (Mud) - means a drilling fluid system whose continuous liquid phase is comprised of freshwater. This type of drilling fluid system is used for drilling shallow wells (<2000m) and in formations where salt formations will not likely be encountered. This system is susceptible to dissolution of chlorides (salts).

Oil Based Drilling Fluid (Mud) - means a drilling fluid system whose continuous liquid phase is oil.

Drilling Fluids (Muds) - A suspension, usually in water (freshwater or saltwater) but sometimes in oil (diesel, mineral or synthetic), used in rotary drilling, consisting of various substances in a finely divided state (commonly bentonite clays and chemical additives), introduced continuously down the drill pipe under pressure, out through openings in the drill bit, and back up in the annular space between the pipe and the walls of the hole and to a surface pit or tank where it is conditioned and reintroduced into the wellbore. It is used to lubricate and cool the bit, to carry the cuttings up from the bottom, and to prevent blowouts and cave-ins. A drilling fluid system is comprised of three phases: Liquid, Solids and Chemical.

2.1 Definitions

- a.) Firstly, in the context of Legislation and Regulation, is the use of such a substance for drilling operations prohibited?
- b.) Secondly, can any precedent experience be cited in approving the use of a hydrocarbon-based drilling fluid?
- c.) Thirdly, how does Amodrill 1500 Synthetic Olefin compare to Distillate 822 in regards to environmental costs and benefits?

According to research materials and MSDS Sheets Amodrill 1500 is a very low toxicity hydrocarbon-based drilling fluid. The research performed by the Water Program staff concentrated on three very important points relating to the usage of a hydrocarbon-based drilling fluid:

During a teleconference Board Meeting on December 9, 2003, the Board approved the use of another, similar, hydrocarbon-based drilling fluid designated as Distillate 822. Distillate 822 was used successfully in the Apache Canada Ltd. Lac Maunoir 2003-04 Winter Drilling Program and their Nogha Tunago 2003-04 Winter Drilling Program. The proper use of Distillate 822 resulted in no significant negative environmental effects.

significantly reduced resulting in more stability in the walls of the wellbore. This generally results in a more efficient drilling program.

2.2 Regulations

Currently in the Northwest Territories there are few regulations or guidelines that pertain to the use and disposal of drilling waste. The *Northwest Territories Waters Regulations*, Schedule IV, solely states that any "deposit of drill waste to a sump" requires a Type B Water Licence and that the "deposit of drill waste in a manner other than to a sump" will require a Type A Water Licence. The lack of any specific guidelines in the NWT has led regulatory agencies to adapt criteria from the Alberta Energy and Utilities Board's (EUB) *Guide 50- Drilling Waste Management*.

The SLWB loading criteria for hydrocarbons in a sump is $< 0.1\%$. This criterion has limited the use of oil-based drilling fluids in the Sahtu Settlement Area because a Type B Water Licence stipulates that all waste must be deposited into a sump and that any other disposal method requires a Type A Water Licence.

Steve Deschene, DIAND Land Use Inspector cited a precedent to the staff of the Water Program in that there has only been one well drilled within the Sahtu Settlement Area that utilized an oil-based drilling fluid. The well in question was Ranger Oil's Notta Creek C-17, NWT Water Board Licence N3L1-1697. The fluid used in this operation was a much more toxic diesel based fluid and Ranger Oil used a pit to store fluids before transport. Recyclable drilling fluid was tanked and shipped to Alberta while any contaminated soil associated with the pit was to be shipped to Norman Wells for bioremediation. Unfortunately not all contaminated soils from the site of the oil based fluid (invert) pit were removed and the site still waits further clean up.

The Board itself set a new precedent in the Sahtu Settlement Area when on December 9, 2003, at a teleconference Board meeting it approved the use of the hydrocarbon-based drilling fluid identified as Distillate 822.

2.3 Attachments

- Faxed letter dated October 7, 2004 to the SLWB from Northrock Resources Ltd.
- Appendix 2 Table 1 "Summary of Loading Criteria for Disposal Methods", Alberta Energy and Utilities Board's (EUB) *Guide 50-Drilling Waste Management*, October 1996 Edition.

3. Comments

3.1 Consultations

Amodrill 1500 was not mentioned in community consultations for Land Use Permit and Water Licence applications S04A-006/S04L1-006. No additional consultations have been submitted by the proponent relating to the Amendment request.

3.2 Potential Environmental and Resource Impacts

There are two major environmental concerns related to the handling of drilling fluid wastes. These are:

The function of the table below is to provide a comparison between Amodrill 1500 and the previously approved oil-based drilling fluid Distillate 822. The table rates volatiles (Aromatic Content and PAH), physical properties (Pour Point and Flash Point, Toxicity, Oral LD50, Dermal LD50 and BTEX) and relative biodegradability.

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Oil Based Drilling Fluid

3.3 Mitigation Measures/Restoration Plans

Wastes associated with the use of oil-based drilling fluids may include, mineral oil, formation salt, and drill waste cuttings contaminated with oil. Amodrill 1500 is a synthetic, low toxicity olefin oil hydrocarbon. The Material Safety Data Sheet (MSDS) and Health and Safety Information lists this Fluid as "having a low level of acute toxicity with an oral and dermal LD50 of not greater than (10) grams per kilogram. The synthetic chemical properties of Amodrill 1500 enables any spilled fluids or contaminated drill cuttings and soils to be bio-remediated. Bioremediation results are superior in comparison to Distillate 822. As there is no need for a sump, and all oil contaminated drill waste and separated oil will be tanked and shipped to Alberta, there is little physical disturbance to the land.

- The contamination of ground water, surface water and soils. Contamination may cause damage to vegetation, both land and aquatic species, and to wildlife and fish. Contamination may also cause negative effects to human health and safety.
- Physical disturbance of land, both on and adjacent to the wellsite, may result from sump construction, sump failure or reclamation procedures.

Table Comparing Amodrill 1500 and Distillate 822 in Various Categories Relating to Toxicity, Safety and Biodegradability

Category	Amodrill 1500	Amodrill Rating	Distillate 822	Distillate Rating
Aromatic Content	0%	1	<.1%	0
PAH	<0.001%	1	<0.1%	0
Viscosity (40°C)	1.46	1	3.78	0
Pour Point	-30°C	1	-21°C	0
Flash Point	116°C	1	94°C	0
Oral LD50	>10g/kg	1	>5g/kg	0
Dermal LD50	>10g/kg	1	>2g/kg	0
Biodegradability in Biopiles	<0.1% 32 months	1	0.5% 32 months	0
BTex	Negligible	1	Negligible	1
	Total	8	Total	1

*Note: Rating of 1 = superior in that category
Rating of 0 = inferior in that category

The results of the table clearly demonstrate the superiority of Amodrill 1500 over Distillate 822 in regards to employee safety, much lower toxicity, less negative environmental effects and superior biodegradability in the environment. Amodrill is rated as superior to Distillate 822 in every category except Btex as both fluids have negligible effects in that regard.

The absence of aromatic content and extremely low levels of polyaromatic hydrocarbons (PAH's) means Amodrill 1500 is superior in regards to escaping volatiles and fugitive emissions that have negative effects on the health and safety of workers and on the environment (i.e. global warming). The low viscosity and pour point makes for better performance and ease of handling in cold weather conditions. The high flash point makes Amodrill 1500 safer for use on the rigs and during storage (less likelihood of fires or explosions). The oral and dermal lethal dose of Amodrill 1500 required to kill 50% of a test populations is at least twice that of Distillate 822, making it much safer for personnel working on the rigs and involved in the transport of the fluid, and it is much safer for wildlife that might be inadvertently exposed to Amodrill 1500 through spills or accidental exposure.

Amodrill has been used in offshore drilling for more than ten years in sensitive marine environments. The reasons for this are low ecotoxicity and an extremely low biological oxygen demand when release into water. This has very interesting and positive environmental implications when considering a spill into a waterbody. Fish and aquatic life are less likely to be affected by a spill of Amodrill 1500 than a spill of Distillate 822.

A research document titled "Bioremediation Study of Olefins, Mineral Oils, Iso-Paraffin Fluids and Diesel Oils Used for Land-based Drilling" (attached) and released by the society of Petroleum Engineers, in conjunction with the University of Calgary and the BP Amoco Chemical Company clearly indicates that linear olefins (Amodrill 1500) is superior in every respect compared to mineral oil-based drilling fluids (Distillate 822).

A referral comment in a faxed letter was received from John Korec of the NEB on October 22, 2004. In his comments, he indicated that Northrock has not yet applied for an "Approval to Drill a Well" (ADW). It was also stated that an operator must provide a "Drilling Fluid Program" in its application for an ADW, and that the Drilling Fluid Program will be reviewed as per the Canada Oil and Gas Operations Act.

The request for amendment and the supplied MSDS Sheets and research documents relating to Amodrill 1500 were forwarded to John Korec of the National Energy Board (NEB) for his review and commentary.

4. Other Agency Comments

- Research document titled "Bioremediation Study of Olefins, Mineral Oils, Iso-Paraffin Fluids and Diesel Oils Used for Land-based Drilling" released by SPE International.

3.7 Attachments

3.6 Conformity with Land Use Plan

3.5 Preliminary Screening

3.4 Traditional Environmental Knowledge

1. Bioremediation of olefins (Amodrill 1500) result in almost complete biodegradation of the fluid. They are not only highly biodegradable but are also non-toxic after remediation and breakdown based on plant, earthworm and Microtox bioassays.
2. Degradation of mineral oils (Distillate 822) is 50% of that of olefins, only 39-45% mass loss compared to 91-96% mass loss for olefins. Distillate 822 is relatively non-toxic when applied to soils, but very toxic in soils after breakdown and bioremediation. Amodrill 1500 is non-toxic in the environment after breakdown and bioremediation.
3. Based on the research, laboratory analysis olefins (Amodrill 1500) is ranked as the most biodegradable of all fluids in the study.
4. Short term ecotoxicity testing indicate that only isomerized olefin is less ecotoxic than linear olefins (Amodrill 1500). Mineral oil-based fluid (Distillate 822) is the second most ecotoxic, surpassed in toxicity only by diesel fuel.
5. Olefins (Amodrill 1500) is highly recommended in the study as a land-based drilling fluid because of their inherent biodegradability, ease of remediation, low toxicity and because they are environmentally friendly. Amodrill 1500 offers the same biodegradability advantages under terrestrial conditions as they offer in marine or freshwater habitats.

The following are the conclusions of the previously mentioned research document:

fluid additive, we believe that, when treated or disposed properly as per SLWB Water Mr. Korec further stated that " If the NEB permits the use of Amodrill 1500 as a drilling

Licence requirements and Northrock's proposed recovery procedures, it should pose no adverse environmental effects".

4.1 Attachments

- Faxed letter dated October 19, 2004 to John Korec, NEB from the SLWB.
- Faxed letter dated October 22, 2004 to SLWB from John Korec, NEB.
- Research document named "Amodrill 1500 Synthetic Olefin".
- Material Safety Data Sheet for Amodrill 1500 Synthetic Olefin.
- News release named "New Research Shows BP's Amodrill Olefin Drilling Fluid Degrades in Co-Compost Piles to Significantly Lower Hydrocarbon Release Levels Than Diesel and Mineral Oils".
- Research document named "Newpark Drilling Fluids, New100 Invert".

5. Conclusion

- Based on research and a comparison of Amodrill 1500 and Distillate 822, it is readily apparent that Amodrill 1500 is superior in every respect for land based and water-based drilling programs.
- Amodrill 1500 is almost totally biodegradable in the environment with less treatment required.
- Amodrill 1500 is practically non-toxic after biodegradation.
- Amodrill 1500 is much less toxic if released into marine and freshwater environments.
- Amodrill 1500 has fewer fugitive emissions and is safer for workers exposed to it.
- Amodrill 1500 drilling fluids does not expose shale directly to water, which severely limits the reaction of shale and preserves shale stability and wellbore integrity.
- Amodrill 1500 oil-based drilling fluids provide better lubricating properties than water based drilling fluids, which enables wells to be drilled more efficiently and with less wear and tear on the machinery.
- Amodrill 1500 oil-based drilling fluid is superior to saltwater based drilling fluids to drill through thick salt beds due to its ability to drill through salt without hole enlargement.
- Amodrill 1500 oil-based drilling fluids can tolerate much larger levels of solids, this allows less dilution and a smaller waste stream.
- Amodrill 1500 accommodates a low dispersion of solids, which enables the drilling fluid to be recycled from well to well.
- There are negligible amounts of BTEX present within Amodrill 1500. This is considered to be the greatest hazard to health of all the chemical components of a hydrocarbon based waste stream.
- All waste associated with oil-based drilling fluids are to be removed from the Northwest Territories.
- There is no legislation or regulations inhibiting the use of Amodrill 1500 under a Type B Water Licence.

It is recommended to the Board that for this winter drilling season, Northrock Resources Ltd. be allowed to utilize Amodrill 1500 as its base liquid phase of drilling fluid for drilling through the suspected shale or salt formations that may be encountered. The following conditions should be implemented into the Terms and Conditions of the Water Licence:

PART D: CONDITIONS APPLYING TO WASTE DISPOSAL

1. All Oil Based Drilling Mud(s) and cuttings produced during the use of this mud must be stabilized and removed for disposal to an approved waste disposal facility outside of the Northwest Territories.
2. The Licensee shall notify the Board and the Water Licence Inspector, in writing, (48) hours prior to the shipping of any Oil Based Drilling Mud Waste.
3. All Oil based Drilling Mud Waste shall be stabilized with an appropriate material prior to shipment.
4. The Licensee shall not at any time deposit Oil Based Drilling Mud Waste into a Sump.

7. Reference Material Attached

- Faxed letter dated October 7, 2004 to the SLWB from Northrock Resources Ltd. Appendix 2 Table 1 "Summary of Loading Criteria for Disposal Methods", Alberta Energy and Utilities Board's (EUB) *Guide 50-Drilling Waste Management*, October 1996 Edition.
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Respectfully submitted,

Patrick Clancy

Agree with Conclusion & Recommendation. Recommend to approve Amendment.

G.T. Gover
Executive Director

Executive Director Comments:

6. Recommendation