



Sahtu Land and Water Board

Staff Report

Division: Water Program	Report No.: 1
Date Prepared: November 26, 2003	File No.: S03L1-015 S03L1-016
Meeting Date: December 9, 2003	
Subject: Distillate 822, a Hydrocarbon Based Drilling Fluid, and the Possibility of Apache Canada 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 Distillate 822, a hydrocarbon based drilling fluid, in comparison to employing salt-based drilling fluids that often require the use of sumps. 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 Distillate 822 can be utilized for drilling activities that accompany oil and gas exploration in the Sahtu Settlement Area.

2. Background

A Water Licence Application was received from Apache Canada Ltd. for the Lac Maunoir exploratory drilling project approximately 35 Km northeast of the community of Colville Lake on October 20th, 2003. A second application from Apache was received on October 21st, 2003 for the Nogha/ Tunago Lake exploratory drilling project, on the Nogha and Tunago Lake Settlement Lands located between 54 km and 73 km south of Colville Lake.

In Sections 4.7.1, of both applications, a clear preference is indicated regarding the utilization of mineral based drilling fluid, (Distillate 822), for drilling operations. In Sections 4.7.1.2 and 4.7.1.3 it delineates the environmental benefits of using a hydrocarbon based drilling fluid as opposed to a salt-based drilling fluid. While Apache has a clear preference for using Distillate 822, they are prepared to use a salt-based drilling fluid should the Board not approve the use of Distillate 822 for this drilling season.

Apache's preference for this method of drilling was first apparent in a face-to-face meeting of SLWB staff and representatives of Apache in Fort Good Hope on September 15, 2003. A sample of the distillate was presented at the meeting, and the preference for using this fluid was made clear to Staff. As per current practices, Staff made it quite

clear that hydrocarbon based drilling fluids are not allowed in the Sahtu Settlement Area at this juncture in time.

Apache has included a brief explanation of the use of Distillate 822 during drilling operations in its consultations in Norman Wells, Fort Good Hope and Colville Lake. The Hydrologist attended the consultation for the projects in Fort Good Hope on September 25, 2003 and the proponent did explain the benefits of a mineral-based drilling fluid as opposed to a salt-based drilling fluid. The Hydrologist made it abundantly clear that while it may be possible to use the fluid, pending Board approval, it was very possible that the fluid might not be approved for use. Apache representatives acknowledged that possibility and stated they were prepared for this contingency, either using Distillate 822 or salt-based muds.

A commitment was made by the Hydrologist to research Distillate 822 to determine if, in fact, it was more environmentally friendly than salt-based muds. It was further indicated by the Hydrologist that if there was to be any chance of using this hydrocarbon-based fluid that it would be prudent for Apache to supply pertinent research materials to the Board. Apache responded to this request on October 8th, 2003, by supplying the document "*Apache Canada Ltd. Base Oil Review for Northwest Territories Drilling 2003, 2004*". The document was quite comprehensive, and it provides good information such as a: Drilling Fluid Review, Product Data, Product and Additive bulletins, Material Safety Data Sheets, and an in-depth document named, "*Non-Water Based Drilling and Completion Fluids, Industry Recommended Practice (IRP), Volume 14-2002-2005*". The Canadian Petroleum Safety Council and the Drilling and Completion Committee endorse the document. This document and revisions is available from: The Petroleum Industry Training Service (PITS).

The research performed by the Water Program staff concentrated on three very important points relating to the usage of a hydrocarbon-based drilling fluid:

- a.) Firstly, in the context of Legislation and Regulation, is the use of such a substance for drilling operations prohibited?
- b.) Secondly, what are the environmental costs and benefits?
- c.) Finally, can the Board cite any precedent experience in approving the use of a hydrocarbon-based drilling fluid?

2.1 Definitions

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. (See attached diagram-Circulating system)

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

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).

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.

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 Alberta loading criteria for hydrocarbons in a sump is < 0.1%. This criteria has limited the use of oil-based drilling fluids in the NWT 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.

The *Guide 50- Drilling Waste Management* loading criteria for chlorides (salts) is < 2000 mg/kg in the subsoil and waste mix with a total limit of 1600kg per disposal site.

Due to the ability of proponents to place larger quantities of chlorides into a sump than hydrocarbons, most wells that were required to drill through salt formations have utilized a saltwater based drilling fluid in the past. In conversation with Steve Deschene, DIAND Land Use Inspector, he stated that there has only been one well drilled within the Sahtu, which 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.

2.3 Attachments

- “Drilling Fluid Discussion” an excerpt from the *Base Oil Review for Northwest Territories Drilling 2003-2004*, Baker Hughes Inteq.
- Apache Canada Ltd. Land Use Permit and Water Licence Application for EL399, Lac Maunoir. Pages 6- 8, inclusive.

- 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.
- Circulating System Diagram, *Our Petroleum Challenge – Exploring Canada's Oil & Gas Industry*, Petroleum Communication Foundation, 1999.

3. Comments

3.1 Consultations

Consultations were held in Colville Lake on August 6th, 2003, in Fort Good Hope on September 25th, 2003 and in Norman Wells on July 29th, 2003. The topic of Distillate 822 was brought forward during their presentation to the communities.

3.2 Potential Environmental and Resource Impacts

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

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

Wastes associated with the use of oil-based drilling fluids include, mineral oil, formation salt, and rock cuttings contaminated with oil and salt. Distillate 822 is a low toxicity mineral oil hydrocarbon. The Material Safety Data Sheet (MSDS) lists it as "Practically Non-Toxic for ingestion and skin contact" and "Moderately Toxic for inhalation". The short carbon chain length of the Distillate (C 11- C 18) enables any spilled distillate or contaminated drill cuttings and soils to be bio-remediated. As there is no need for a sump there is little physical disturbance to the land.

The major environmental concern with using a saltwater based drilling fluid is that salt is persistent and cannot be bio-remediated. If salt waste is spilled it is very hard for it to be remediated. There is also the issue of the possibility of the drill waste exceeding the loading limits for chlorides in a sump. There have been recurring issues related to salt soil contamination and sumps that exceed the loading limit set for chlorides.

The major concern in the Sahtu is a major subterranean salt formation called the Saline River Formation. This formation is found at depths ranging from 700m to 2000m. The thickness of the layer can exceed 650m. In the area around Colville Lake the formation varies from 100m to over 400m. Due to the thickness of the salt layer likely to be found during this winter's drilling it is possible that the logistics of tanking and shipping the quantities of saltwater based drilling fluid waste is unrealistic. If they were to deposit the salt contaminated waste into a sump it is likely that chloride levels will exceed the loading limits for a sump.

There is increasing concern over the deposit of chlorides into sumps as the major source of containment in sumps in the north is through freezing of waste fluids into the surrounding permafrost. Due to the fact that saltwater has a freezing point below 0°C some research has found that sump fluid has not frozen completely by the time that they have been backfilled and this has contributed to subsidence of the sump cap, leading to ponding and erosion. During the warmer summer months, previously frozen sump fluid that contains high levels of chlorides has melted out even though the surrounding ground temperature remains below 0°C.

3.3 Mitigation Measures/Restoration Plans

Oil Based Drilling Fluid

- The proponent plans on storing all oil based drilling fluids in double walled tanks, which are directly tied into the rig to reduce the chance of any spills. Drip pans will be used at all valves.
- Due to the frozen ground and snow cover, spills of any oil based drilling fluid or waste is easily visible and easier to contain allowing clean up to occur prior to ground infiltration.
- There will be no direct deposit of oil based drilling waste, as all reusable drilling fluid will be tanked and re-used at an alternate wellsite. Any oil based drilling waste and oil contaminated cuttings will be tanked and stabilized prior to shipment to a Class II Waste Disposal Facility in Alberta.

Saltwater Based Drilling Fluid

- All salt contaminated waste will be tanked and shipped to a Class II Waste Disposal Facility in Alberta.
- Due to the large volume of waste likely to be involved, it is unlikely that it is logistically feasible to manage, store and ship this volume of waste.
- Any spills will require costly clean-up and long term monitoring due to the persistence of salt and its long term effects on soil, groundwater and vegetation.

3.4 Traditional Environmental Knowledge

3.5 Preliminary Screening

Section 124(1) of the Mackenzie Valley Resource Management Act requires the Sahtu Land & Water Board to undertake a Preliminary Screening of any proposed development prior to the issuance of a licence, permit, or authorization. The report concludes that the environmental impact of the proposed project can be mitigated with known technologies and that no significant public concerns have been raised.

3.6 Conformity with Land Use Plan

3.7 Attachments

- Figure 1: Extent & Thickness of Saline River Formation Salt Member In Northern Interior Plains, *N.W.T. Monitoring a Sump Containing Drilling Mud with a High Salt Content*. Nenninger Engineering Inc., 1997.

4. Other Agency Comments

The application was circulated to 27 organizations requesting a reply by November 24, 2003. Organizations were contacted on November 24, 2003. To date 13 written responses have been received. Only one organization commented directly concerning the use of Distillate 822. The Sahtu Renewable Resources Board states that they would prefer the use of a mineral based drilling fluid over a saltwater based drilling fluid.

4.1 Attachments

See Staff Report for S03L1-015/S03A-007 or S03L1-016/S03A-008

5. Conclusion

- Mineral oil based drilling fluids do not expose shales directly to water, which severely limits the reaction of shale and preserves shale stability.
- Mineral oil base drilling fluids provide better lubricating properties than water based drilling fluids, which enables wells to be drilled faster and with less wear and tear on the machinery.
- Chemical contamination by formation fluids and gasses can seriously affect water based drilling fluid performance. Oil based drilling fluids are not reactive with these fluids and gasses.
- Mineral 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.
- Mineral oil based drilling fluids can tolerate much larger levels of solids, this allows less dilution and a smaller waste stream.
- Distillate 822 accommodates a low dispersion of solids, which enables the drilling fluid to be recycled from well to well.
- Distillate 822 meets or exceeds all IRP 14 criteria, except Aniline Point, which is a determinant to rubber damage. Baker Hughes states that with over 150 000 m³ of Distillate 822 already in use, there has been no significant damage to rubber in comparison to other base oils.
- There are negligible amounts of BTEX present within distillate 822. 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.
- The persistent nature of salt contamination in the environment and the associated problems with high levels of chloride in sumps makes the use of saltwater based drilling fluids less desirable in comparison to Distillate 822.
- The logistics of managing the likely large waste stream from saltwater based drilling fluid makes it less desirable than using a mineral based drilling fluid.

- There is no legislation or regulations inhibiting the use of Distillate 822 under a Type B Water Licence.

6. Recommendation

It is recommended to the Board that for this winter drilling season, Apache Canada Ltd. be allowed to utilize Distillate 822 as its base liquid phase of drilling fluid for drilling through the suspected salt formation that is to be encountered. The following conditions should be implemented under,

PART D: CONDITIONS APPLYING TO WASTE DISPOSAL.

1. All oil based drilling muds and cuttings produced during the use of this mud must be 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 waste shall be stabilized with an appropriate material prior to shipment.
4. The Licensee shall not at any time deposit oil based drilling waste into a sump.

7. Reference Material Attached

- "Drilling Fluid Discussion" an excerpt from the *Base Oil Review for Northwest Territories Drilling 2003-2004*, Baker Hughes Inteq.
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- 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.
- Circulating System Diagram, *Our Petroleum Challenge – Exploring Canada's Oil & Gas Industry*, Petroleum Communication Foundation, 1999.
- Figure 1: Extent & Thickness of Saline River Formation Salt Member In Northern Interior Plains, *N.W.T. Monitoring a Sump Containing Drilling Mud with a High Salt Content*. Nenninger Engineering Inc., 1997.

FOR M.C.P.



Mark Cliffe-Phillips
Water Technician

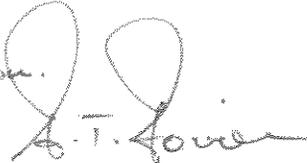
Respectfully submitted,



Patrick Clancy
Hydrologist

Executive Director Comments:

Agree with Conclusion & Recommendation.



G.T. Govier
Executive Director