National Energy Board

Office national de l'énergie

MVEIRB File: EA0506-007
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Mr. Patrick Duxbury
Environmental Assessment Officer
Mackenzie Valley Environmental Impact Review Board
200 Scotia Centre
Box 938, 5102-50th Ave
Yellowknife, NT X1A 2N7
Email pduxbury@mveirb.nt.ca
Facsimile (867) 766-7074

Paramount Resources Limited SDL8 Environmental Assessment EA0506-007
Information Request Dated 6 April 2006, IR # 13 and # 14

Please note that the National Energy Board response follows each information request.

IR Number: **IR0506-007-13**
Source: **MVEIRB**
To: **NEB**
Scoping Hearing Report: Page 7

Preamble: During the Hay River Community Scoping Hearing, Paramount noted that the SDL8 area is situated in a region where extensive, massive glacial gravel deposits exist. It was suggested that the presence of such gravel deposits may inhibit the quality of data produced from a dynamite-based seismic exploration program and would likely make vibroseis the default option for acquiring seismic data.

Request:

1. Based upon the NEB's experience and expertise of regulating seismic exploration in other areas, could it comment on the potential effects that the presence of large gravel deposits would have on the acquisition of dynamite-based seismic data? Could the NEB comment upon situations where it has encountered these concerns and if so, what were the outcomes?
2. Would a program undertaken when ground conditions are frozen, as proposed by Paramount, have an effect on the acquisition on either dynamite- or vibroseis-based seismic data compared to similar activities occurring when conditions are thawed?
3. How would the magnitude, depth from surface and average aggregate size of the gravel deposits influence the acquisition of dynamite- or vibroseis-based seismic data?

4. Is the NEB aware of, or in possession of any information regarding the gravel deposits that are present in the SDL8 area? If so, could it provide this information to the Review Board?

NEB: Response: Surface deposits of glacial gravel can have two significant affects on seismic data acquisition. These types of deposits can cause the creation of strong surface waves, commonly referred to as ground roll, which interfere with or even overwhelm the reflections returning from subsurface horizons. The deposits can also limit the amount of energy, both high and low frequencies, being transmitted downwards into the earth, thus limiting the strength and bandwidth of the signal returning from subsurface events. Both effects can significantly influence the quality of the seismic data acquired. The scale of the problem varies considerably with the content, distribution and water saturation of the deposits.

If the near surface deposits are evenly distributed over the entire area, both horizontally and vertically, and the deposits have negligible water content, seasonal considerations would be minimal, however such deposits are typically quite variable so frozen ground may be preferable.

Studies have shown in some cases vibroseis is the preferable method of data acquisition in areas with significant glacial gravel deposits. Since it is easier to control the frequency content and repeatability of the seismic source with vibrators, it is easier to minimize ground roll while maximizing the transmitted signal strength. Ground roll is typically stronger for low frequency sources and dynamite can generate strong low frequencies.

As a rule it requires testing various source and receiver options in order to determine the combination that is most effective in an area covered or partially covered by glacial deposits. The tests will show which source/receiver pair will give the best results in imaging target formations.

The NEB does not routinely require companies to submit seismic source/receiver test data nor do we require companies to submit data on surface deposits encountered while acquiring seismic data so we are unable to supply detailed information on surface glacial deposits over SDL 8. However, Rod Smith with Natural Resources Canada (Geologic Survey of Canada) has been compiling data on surface deposits from Northwest Territories shot hole data supplied by the companies. Mr. Smith may provide more information on the location and extent of surficial deposits in the southern NWT upon request (pers. comm.[1]).

It is the NEB's experience that there is a potential hazard when drilling seismic shot holes for dynamite charges into some sand and gravel deposits. These shot

[1] NEB staff personal communication with Rod Smith, Research Scientist, Natural Resources Canada, Terrain Sciences, located at 3303 - 33 Street North West, Calgary, AB T2L 2A7. Mr. Smith can be contacted at: (403) 292-7132, or fax: (403) 292-5377.

holes can be difficult to drill and their stability can be difficult to maintain potentially resulting in hole cave-ins and subsequent shallow charge placements. Detonating charges that have been set too shallow can result in an environmental impact in the form of cratering. This potential problem can exist in both summer and winter conditions, but can be minimized through good practices.

IR Number: **IR0506-007-14**
Source: **MVEIRB**
To: **NEB**

Preamble: The evaluation of alternatives to carry out a development is an integral part of environmental impact assessment practice. In reviewing Paramount's proposed SDL8 project, it is important for the Review Board to be aware of various ways that seismic exploration in the SDL8 area could be conducted. Of particular interest to the Review Board are those activities that are the most effective technologies and practices that are proven to minimize environmental impacts.

Request: Based upon the NEB's experience and expertise in seismic exploration, please comment upon the availability and applicability of best practices and alternative means for seismic exploration in the SDL8 area. In particularly, please ensure the following components are considered:

1. Windrowing material, including frequency of window breaks;
2. Options for reducing width of cutlines in vibroseis-based seismic exploration;
3. Low-impact clearing techniques;
4. Helicopter-based seismic;
5. Hand-cut seismic;
6. Any other techniques or technologies that the NEB may believe are relevant.

NEB: Response NEB's staff feel that best practicable seismic exploration practices are being employed in the Northwest Territories. Guidance provided by Indian and Northern Affairs Canada[2] for clearing of lines has been followed and noticeably improved upon by the industry and by the Land and Water Boards through Permit conditions. For instance, Chapter 5 of INAC's 1988 *Environmental Guidelines*, notes that, "Normally, a 10-metre wide right-of-way will be required... [and] adjustments are made to the width of the right-of-way based on: (1) Type of seismic survey and equipment used... [and], (2) Environmental conditions...". However, as identified in the CAPP and CAGC abstract[3] for the *Geophysical Exploration Practices*[4] document, "The environmental impact of the industry has shown some remarkable improvements over the last few years with average

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[2] INAC, 1988. *Environmental Guidelines, Northern Seismic Operations*. Catalogue No. R72-205/1988E, ISBN 0-662-16370-2.
[3] Canadian Association of Petroleum Producers web site http://www.capp.ca/default.asp?V_DOC_ID=763&PubID=81307.
[4] Canadian Association of Petroleum Producers and Canadian Association of Geophysical Contractors, 2004. *Geophysical Exploration Practices*, pp 4.

seismic line widths falling by 50%". In its Land Use Permit application[5], Paramount commits to line widths of about 6 m for the proposed seismic program.

Many of the best practices identified or recommended by the Pembina Institute in its "*Seismic Exploration: A Primer*[6]" are implemented by industry in the North. Practices such as:

- carrying out environmental impact assessments to help companies decide on ways to improve their projects and lessen environmental impacts,
- maximizing the use of existing cut lines, trails, roads, clearings and other areas that are free from trees and large scrub,
- scouting the area by helicopter to identify potential problem areas,
- not damaging the vegetative cover in permafrost areas,
- avoiding placement of [dynamite] shot holes near a water body to prevent the risk of killing or injuring fish,
- conducting seismic exploration in winter months when the ground is fully frozen to minimize surface impacts,
- using low ground pressure equipment such as tracked or balloon-tire vehicles, and
- using low-impact techniques such as Global Positioning System (GPS) surveying, smaller equipment, hand-cutting or mechanical mulching, enviro-drills, and limbing of trees and shrubs.

To date, NEB staff are satisfied that authorized geophysical operations in the Northwest Territories have protected the environment when the company's proposed mitigation measures, operating practices, and Permit conditions have been fully implemented.

Most recently, there have been three land-based seismic data acquisition methods used in the southern Northwest Territories:

1. Vibroseis;
2. Low impact (dynamite) seismic (LIS); and
3. Heli-portable (dynamite) seismic.

Vibroseis

The vibroseis technique uses large truck-mounted, or buggy-mounted vibrators, in tandem, to generate an acoustic energy source. In the NEB's experience, this is the companies' preferred method for winter operations in relatively flat terrain, i.e., where there are no steep inclines.

The technique requires the clearing of trees and brush to create lines wide enough to allow:

- global positioning system (GPS) surveying of the line,
- the placement of inter-connected geophones (recording equipment) on one side of the line,
- the passage of the vibroseis units along the other side of the line, and

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[5] Paramount Resources Limited, Land Use Permit application MV2005B0021 to the Mackenzie Valley Land and Water Board for Significant Discovery Licence 8, 2-D Geophysical Program.

[6] The Pembina Institute web site http://www.pembina.org/pdf/publications/nps_Seismic.pdf.

- in areas with more tree and brush growth, additional line width for windrowing the cut tree and brush material and setting it back from standing timber.

Lines are typically cut using a Caterpillar bulldozer. For example, in its Land Use Permit application MV2004B0040, EnCana Corporation proposed to cat-cut vibroseis lines to 5.5 m wide to provide, "3 m for the vibrators, 1.5 m for the recording equipment, and 1 m for a slash pile [windrow]."[7]

The NEB does not include land use or windrow-related conditions in its Geophysical Operations Authorizations. Placement requirements for windrows are typically included as Land Use Permit conditions by the Land and Water Board. For instance, for the Fort Liard area (Anadarko Canada Corporation) and for the Cameron Hills area (Paramount Resources Limited) the Land and Water Board conditioned the company to, "dispose of all debris and brush by making breaks in the windrow of at least seven (7) metres wide at intervals of not more than three hundred and thirty (330) metres"[8] and that the "windrows are separated from standing timber"[9].

In its Developers Assessment Report for the Paramount Cameron Hills Extension development, Paramount committed to 10 m wide breaks every 500 m and at known game trails for wildlife[10]. In its 2001 Land Use Permit application[11], Anadarko submitted that, "The windrows created by clearing and snow removal on the lines will alternate every 500 m to provide gaps for wildlife movement".

One option to reduce the width of vibroseis seismic acquisition lines could be the use of mechanical mulchers to grind the vegetation into chips and then spread the mulch on the line. When used with avoidance cutting of larger diameter trees, this would eliminate the need for windrows and associated set-back, and produce a narrower line. Also, the use of avoidance cutting, a low impact seismic (LIS) technique, would create a non-linear disturbance and reduce predator lines of sight. Paramount Resources Limited, in its Land Use Permit application[12] to the Mackenzie Valley Land and Water Board, committed to use existing lines and undertake avoidance cutting where possible. Another option to reduce line widths could be to use wider, existing cut-line corridors and undertake the above mentioned techniques. This would limit the number of new disturbance corridors.

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[7] Mackenzie Valley Land and Water Board Permit # MV2004B0040, EnCana Corporation Land Use Permit application dated 21 September 2004 for 2-D seismic program in the Muskeg South area east of Fort Liard, NT. EnCana subsequently withdrew its application and did not undertake the program.

[8] Mackenzie Valley Land and Water Board Permits # MV2001B0091 (Anadarko), Condition 44 and Permit # MV2002B057 (Paramount), Condition 43.

[9] Mackenzie Valley Land and Water Board Permit # MV2001B0091 (Anadarko), Condition 46.

[10] Mackenzie Valley Environmental Impact Review Board, EA 03-005, Paramount 1 September 2003 Developers Assessment Report, page 45.

[11] Anadarko Canada Corporation, November 2001, Land Use Permit application # MV2001B0091, Environmental Impact Assessment, page 8.

[12] Paramount Resources Limited, August 2005, Land Use Permit application # MV2005B0021, Appendix 2, Environmental Impact Assessment, page 11.

Low Impact (dynamite) Seismic – LIS

The low impact seismic (LIS) technique uses either mechanical-cutting or hand-cutting of brush and smaller diameter trees. LIS may include avoidance cutting of larger diameter trees to create a cleared, non-linear, sometimes meandering line. In NEB's experience, this line-cutting method is used in winter or summer when vibroseis is not an option or a dynamite energy source is preferred and ground conditions allow for overland movement of vehicles, shot-hole drilling equipment and personnel. LIS can be used in firm, flat to hilly terrain, but not in very steep mountainous terrain or in muskeg.

Unlike vibroseis, dynamite energy sources (in shot holes) may be emplaced before geophone recording equipment is strung along the line. If windrows are not required, the line width may be narrowed to a width that allows for GPS surveying and safe movement of vehicles, equipment and personnel. Upon application for a Geophysical Operations Authorization, the NEB will review the application to ensure that lines are wide enough for safe operation and potential emergency medical extraction.

Heli-portable (dynamite) Seismic

Helicopters may be used to transport surveying, drilling and recording equipment and personnel in areas where the terrain is overly soft (muskeg or bog) or overly steep (mountainous), and vehicles and conventional shot-hole drilling equipment cannot be used. Since vehicles and equipment would not be moved along the cut lines in a heli-portable seismic survey, the lines would only need to be wide enough for GPS surveying, laying out and pickup of the geophone recording equipment, and potential emergency medical extraction.

Operational safety is a major consideration for seismic explorers and the NEB. For this reason, heli-portable seismic is mostly restricted to the summer when there is sufficient daylight to safely operate helicopters. As well, in the absence of natural or existing clearings, some additional helipads may need to be cut to shorten the distance that stretchers would be carried. At a minimum, a 1.75 m to 2.0 m wide line should be sufficient for emergency medical extraction, e.g., if stretcher carriers need to get an injured worker to a helicopter medivac site up to a kilometre away.

Other Techniques or Technologies

Two additional technologies, Navpac and HeliStaker, were proposed by Explor Data[13] and Arcis Partnership[14], respectively, to be used in conjunction with the heli-portable portions of their seismic programs. These technologies would be used in place of conventional surveying that requires an open forest canopy to access overhead satellites. Mike Doyle, Canadian Association of Geophysical Contractors (pers. comm.[15]) says that both HeliStaker and NavPac are no longer used. Mr. Doyle however points out that the industry has a number of Global Positioning System (GPS) survey tools that can accomplish similar results.

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[13] Explor Data Ltd., June 2001, Land Use Permit application # MV2001B0043.

[14] Arcis Partnership, April 2001, Land Use Permit application # MV2001B0033.

[15] NEB staff personal communication with Mike Doyle, President, Canadian Association of Geophysical Contractors, 26 April 2006.

Navpac
In its June 2001 Fort Liard-Nahanni Butte area Land Use Permit application[13], Explor Data stated that, "Avoidance cutting using Navpac will minimize timber reduction and reduce the line of site down the lines for wildlife protection". In the documentation of a follow-up conference call with Explor Data, the Land and Water Board[16] noted that, "This technique uses a portable inertial navigation system which takes a path of least resistance through bush for accurate placement of the 4m x 4m drill locations every 100 metres along the seismic line. Clearing requirements along the seismic line between the drill points would be limbing and brushing - essentially to allow the survey crew to walk through the bush between the drill points, and to allow for laying out of the seismic receivers[geophone recording equipment]. No motorized machines would be able to navigate this type of seismic line."

HeliStaker
In its Nahanni Butte area Land Use Permit application[14], Arcis Partnership committed to using HeliStaker Navigation Technology or equivalent methodology for the survey portion of its program, eliminating the necessity of cutting standing timber and further reducing the environmental impact. On its web site, Arcis Corporation provides the following description[17]:

> *HeliStaker™ is a heli-portable Global Positioning System ("GPS") solution for applications such as seismic, pipeline and boundary, and utility surveys. The technology allows any project to be staked and surveyed from the air, thus significantly reducing the need to cut standing timber, and improves survey efficiency on any given project. The reduced environmental impact significantly lowers the cost of timber damage and can dramatically lower environmental impact for a multitude of companies in such industries as oil & gas, pipeline, utilities, and communications.*

Light Detection And Ranging (LiDAR)
Mike Doyle (pers. comm.[15]) notes that the planning tool, LiDAR (Light Detection and Ranging) allows great advantage in minimizing footprint. LiDAR is a technology that determines distance to an object or surface using laser pulses. It can provide detailed information about the surface topography (elevations and slopes), forestry information and vegetation heights for areas where extensive siesmic surveying is planned, allowing a company to better select line cutting techniques and seismic acquisition methods. LiDAR is considered to be a Low Impact Seismic technique that can be used to help minimize line widths.

Sincerely,

Bharat Dixit
Chief Conservation Officer

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[16] Mackenzie Valley Land and Water Board, Follow-up to Conference Call Regarding SWM-5. Philip Gregory, Explor Data Ltd., Public Record item #52, September 13, 2000.
[17] Arcis Corporation web site, http://www.arcis.com/news_detail.asp?id=31 News Release dated 22 August 2000.