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December 22, 2006

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Subject: NRCan’s technical review comments on the environmental assessment of “Laurentian Sub-basin Exploration and Drilling Program in Newfoundland and Labrador” October 2006

Dear Ms. Coady:

Natural Resources Canada (NRCan) is pleased to review and provide comments on the environmental assessment of “Laurentian Sub-basin Exploration and Drilling Program in Newfoundland and Labrador” by ConocoPhillips.

NRCan’s Geological Survey of Canada has provided comments on the seismic issues and comments on the marine geology/hazards assessments of the exploration and drilling program of the project.

Both experts have raised concerns and identified deficiencies, as outlined in the detailed comments attached below.

Please do not hesitate to contact me if you have any questions.

Thank you.

Kim Mann
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Attach.

Canada

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Comments on the Laurentian Sub-basin Exploration and Drilling Program in Newfoundland and Labrador by ConocoPhillips (October 2006)

A. *Area of Expertise – seismic issues / hazards*

Background

ConocoPhillips is proposing to conduct an exploratory drilling program in the Laurentian Sub-basin area of the Newfoundland and Labrador offshore area. It will involve drilling of up to seven wells, in water depths ranging from 100 to 2,300 m. The drilling operations may start in 2007, depending on regulatory approval and rig availability and will continue through 2010, with each well requiring 40-60 days to complete.

The strategic environmental assessment (SEA) conducted for the C-NLOPB and the Canada-Nova Scotia Offshore Petroleum Board (C-NSOPB) (JWEL 2003) identified the project area as having a high potential for seismic activity. NRCan has been specifically requested to review and provide comments on seismic issues and as to how the proponent has addressed these issues in this EA.

Deficiencies

1. The material in section 3 is acceptable at a background level, but there are no specifics on the risk they pose to the project and the environment. The treatment of consequences in section 6 totally lacks mention of earthquake-initiated accidents and of the mitigation efforts from the proponent that they justify.

2. The EA should recognize that there may be strong design constraints due to the underlying earthquakes, and that the exploration drilling needs to be undertaken in the full understanding of the seismic design levels that would be required, should the drilling justify development. The EA states that there is no alternative to going ahead with the project (2.3.1). NRCan believes that the exploration project should not go ahead unless it has been demonstrated that there is a realistic chance that the necessary seismic design levels will have an acceptable engineering solution, yet neither very approximate seismic design levels are provided (a site-specific assessment will be essential to obtain these), nor are engineering statements about coping with them made in the EA.

Details

Sections examined. 3.1.1.2, 3.1.3, 3.1.3.1, 3.1.4, 5.2.1, 6

3.1.1.2 The potential for earthquake-induced slumping and turbidity currents is recognized.

3.1.3 **Seismicity**. The general description is sound, having mainly been taken from NRCan's website, as were figures 3.6 and 3.7. Figure 3.8 has been prepared by the proponent using GSC earthquake epicentres, and visually demonstrates why the occurrence of earthquakes is an issue that must be addressed. The uncertainty of the epicentres is mentioned on that figure, but the quoted values are probably too small by a factor of 2 to 3, because the determining seismographs are very distant and all on one side of the epicentres. The uncertainty merely means that the precise location of the earthquake dots is much larger than the dot size; it does not mean that all the earthquake lie much farther away from the drill sites. NRCan concurs that while reactivation of old zones of crustal weakness, such the Cobequid-Chedbucto or the Glooscap fault is possible, the evidence to date is not decisive. For completeness, what could also be mentioned here is the presence of some young neotectonic features on the shelf that might indicate either recent faulting, or more speculatively a large region of strong shaking, though given the level of historical seismic activity this additional information is unlikely to change the situation.

3.1.3.1 **Seismic hazard.** This is an acceptable, lay-person's description of the regional seismic hazard, taken almost entirely from NRCan's website. Regional values for the coordinates of the exploration area are available from the same website. Note: these are not site-specific seismic hazard values.

3.1.4 **Slope stability & Liquefaction.** This is a general description of the slumping and liquefaction that might be caused by a strong earthquake.

5.2.1 **Physical Environment** (Effects of the Environment on the Project). Although geohazards are mentioned and Figure 3.8 shows that earthquakes occur in the immediate vicinity of the exploration area and drill sites planned, their effects are not mentioned. The comment about "a floating rig would be relatively immune to a major slumping event such as the 1929 event" neglects the environmental risk to any bottom-founded equipment (and indeed to the rig itself), if the sea bottom were to slump immediately after an earthquake.

Section 6 Earthquake "Accidents" are not mentioned in this section.

B. *Area of Expertise – marine geology*

General comments

There are two drilling sites, one at between 500 m and 1000 m on the upper slope off the Laurentian Channel and one at about 1600 m on the flanks of the submarine canyon south of Halibut Channel. Thus the seabed environmental issues are those of the deep-water continental slope. There has been considerable experience in drilling in such environments over the past five years on the Scotian Slope, where the overall geological setting is rather similar. NRCan would particularly flag the Newburn, Weymouth, Balvenie, Annapolis and Crimson wells (plus the older Acadia, Shelburne, Tantallon and Narwhal wells) as being in geologically analogous settings.

The Assessment is quite inadequate in its treatment of potential environmental impacts resulting from the geological conditions in the Assessment area. Almost all of the review of the geology concerns the shelf: this may be important as the substrate for distant wild life that could be affected by the project, but is virtually irrelevant to seabed geohazard issues. There is more published information on the deep water area than is cited and there is substantial literature on related areas of relevance, including the Scotian Slope, the SW Grand Banks slope, Salar basin, and perhaps Flemish Pass.

In contrast, the assessment of storm waves, currents, ice and icebergs appears to be generally sound, and NRCan has only comments of detail.

NRCan's understanding of the key environmental risks related to the deep-water setting of the area are:

1. The triggering of a submarine landslide by drilling operations. The risk of this is low, but this low risk needs to be justified (by known geotechnical properties, plus experience to date of drilling wells elsewhere on the east coast Canadian and Norwegian slopes). NRCan's understanding from the work in the Ormen Lange field in a rather similar geological setting off Norway was that the only serious induced landslide risk that they identified was from a gas blowout lasting more than 2 weeks leading to massive increase in pore pressure of potential failure horizons. Such a risk should be assessed. Natural failure in 1929 in the Assessment area, and at Ormen Lange 8000 years ago, resulted in large tsunamis, leading in the case of 1929 to severe loss of life.

2. Shallow water flows, which are a risk in the Gulf of Mexico slope conditions, but have not been encountered on the eastern Canadian margin. These may result in local environmental impacts on benthic communities. They may also cause hole control problems, with the resulting increase in time at the well site or increased use of particular drilling muds.

3. Risk of a natural earthquake and associated slope failures during drilling operations. The proponents need to address this issue in a more thorough manner (see comments above by NRCan reviewer A), though the risk is small. NRCan has published quite a lot of work on the recurrence interval of natural slope failures on the eastern Canadian margin, most of which are probably earthquake triggered. What is the triggering mechanism is probably a moot point: the issue is what is the risk of a natural slope failure during drilling operations. NRCan's published data suggests that a small failure may occur every few thousand years, but that the return interval of large failures like that in 1929 is measured in tens of thousands of years or more.

4. The long-term or cumulative impact on deep-water benthos of dense discharges during drilling operations. There is the potential for discharges denser than seawater (including seawater with suspended sediment and pollutants) at the well head or from the rig to flow as a density current on steep slopes (more than a few degrees) and thus move pollutants down the channel systems in the area and out onto the Sohm Abyssal Plain, where they could be further entrained into the Western Boundary Undercurrent system. The citing of recovery times for deep-water benthos from shallow water studies is inadequate. The far-field risk to deep-water benthos needs to be evaluated (similar risks existed for the Annapolis and Crimson wells, and may never have been properly evaluated; there are also similar risks from deep-water drilling elsewhere in the world). This risk is not present on the shelf, nor on low gradients such as in Orphan Basin.

Detailed comments – referenced to section number of the EA report

2.4. NRCan does not believe that most geophysical techniques will identify munitions dump hazards particularly if small and scattered over a large area of sea floor. Deep-towed or AUV sidescan sonar might work, but NRCan notes that no other deep-water site surveys on the east coast offshore have used such equipment. A deep-water ROV may be needed to confirm the lack of hazardous materials at the drill site.

3.1.1. This material is poorly focused on issues of importance to the planned well sites. It is a rather elementary overview of the geology and inadequate for environmental assessment purposes.

3.1.2. It would be more relevant to describe the deep water Quaternary sediments. Similar sediments are reviewed by Mosher et al. (2004) on the central Scotian Slope and information more specific to the drill sites can be gleaned from Piper and MacDonald (2002), Bonifay and Piper (1988) and Piper and Brunt (2006).

3.1.3.1. This section is very weak in terms of the specifics of the planned wells. The 1929 earthquake showed what a major earthquake could do, in terms of sediment failure on the slope, a devastating tsunami with substantial loss of life, and some likely some deformation on the shelf (*also see reviewer A comment 3.1.3*).

The basis of the 2006 seismic hazard map of Canada is historically recorded earthquakes. A much lower risk is predicted by studies of the geological record of failures on the slope (see, for example, Jenner et al. 2007; Piper et al. 2003, Piper 2005, and Piper et al. 2005 for older assessments). This lower risk is to the benefit of the proponent, but needs to be properly addressed.

3.1.4 This section is very weak. There have been major NRCan programs focusing on this issue on the east coast offshore since 1990. There does not seem to be a clear understanding of the manner in which sediment failure could impact an exploratory drilling operation, nor the consequences in terms of tsunami, nor the potential for drilling inducing failure. The proponent should be able to make the case from deep-water drilling elsewhere in the world that the risk of induced failure is low. There is sufficient geological data available to argue that in most settings, the risk of a liquefaction type local failure, such as has happened in the Gulf of Mexico, is very low (but it might occur in the few environments where thick fine sands are present). The issue needs to be discussed as to whether shallow gas is present and whether it is likely to make sediments more susceptible to failure. The experience with the Ormen Lange field in Norway needs to be briefly reviewed, particularly the assessment of their geohazard team with regard to a prolonged uncontrolled blowout of gas. Are conditions on the Laurentian Slope different from those at Ormen Lange, thus making this scenario more or less likely to cause slope failure?

3.4.2 In NRCan's judgement, the 1975 current meter data should be a reasonable proxy for conditions at the eastern deep-water drilling site.

3.4.3. There is a low risk of turbidity current flow down major slope valleys in the east Laurentian area. (Such events are discussed briefly elsewhere by Mosher et al. 2004, Baltzer et al. 1994, and Savoye et al. (1990). This risk should be acknowledged and would need to be considered if an exploratory well were drilled on a channel floor.

4.5.1. There was a study of reasonable scope of the benthos on the central Scotian Slope for Marathon prior to drilling of the Annapolis well. This covered water depths and topography more appropriate for the proposed drilling sites (the HEBBLE area is in 4800 m water depth and thus not very appropriate). The work was done by JWEL – is the proponent aware or not aware of those results?

4.5.2. Valued ecosystem components. NRCan is not convinced that the White Rose experience is particularly useful. White Rose was a shelf environment; the proposed drill sites are on the deep-water slope. As NRCan argued when reviewing a previous Orphan Basin EA, the deep-water benthos should be considered a valued ecosystem component because of scientific uncertainty over its stability and its response to cumulative pollution impacts far from the drill site, and also its potential importance because of its biodiversity for pharmaceuticals etc.

5.2.4.4. See 2.4 above. To be effective, the seabed site survey will have to be an expensive deep-towed survey to get adequate resolution. It may be that a ROV survey alone will be sufficient.

5.2.5 (last para on p. 242). NRCan agrees that geohazard assessment will be carried out from a specific site survey. Nevertheless, the scope of the problems (see comments on 3.1.4) should be identified in advance.

5.3.1.1 Bullet 5 on p. 245. Most of these citations deal with shallow water benthos. The recovery times for deep-water benthos (decades) and the evidence for full recovery should be justified. (see also 5.4.2, where there is some mention of the JWEL deep-water work).

5.3.1.2. This modeling must consider the possibility that the discharged mud and cuttings will flow down steep slopes as a density current and thus extend much further into deep water than as a result of simple advection by ambient ocean currents. This risk depends on the precise well site chosen and the rate of discharge of mud and cuttings.

5.4.2. p. 254 middle paragraph. This is misleading. Other than Narwhal F-99, all these wells were on the shelf, not in deep water. The dispersal mechanisms and nature of the benthos is quite different in < 100 m of water and in 1700 m of water.

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