Hebron Project - Comprehensive Study Report ExxonMobil Canada Ltd. Response to Review Comments, Part 2

Comment on the revised spill trajectory modelling reports for the Bull Arm Nearshore Area and the Offshore Area as well as revised Sections 14.2 and 14.3 of the Comprehensive Study Report

prepared by

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Background

This review is part of a series of communications the Emergencies Science and Technology Section - ESTS (Ali Khelifa) had with the Atlantic Environmental Protection Operations Division (EPOD-Atlantic) regarding the Hebron Project - Comprehensive Study Report conducted by a group of petroleum companies, hereafter referred by the "Proponent". A brief history of these communications is given below.

1. In August 17, 2010, ESTS provided the Atlantic Region with comments on the spill modelling work presented in "Spill Trajectory Modelling for the Hebron Project", prepared by AMEC Earth & Environmental a Division of AMEC Americas limited, and summarised in Chapter 14 of the Hebron Project - Comprehensive Study Report of June 2010. A copy of the comments is in Appendix I.
2. The Proponent reviewed our comments and followed up with what we called a pre-proposal prepared by Applied Science Associates (ASA) to redo the spill trajectory modelling work. The document was submitted to ESTS in September 20, 2010 (Appendix II).
3. ESTS reviewed the document and submitted new comments in September 24, 2010 (Appendix III). Our main comment was to request a full proposal from the Proponent before starting the new modelling study. This request was reiterated to the REEC in January 18, 2011 (Appendix IV).
4. ESTS did not receive the full proposal from the EPOD-Atlantic or the Proponent. Instead, the Proponent conducted a new modelling study (Appendix V). On March 03, 2011, ESTS received four documents that relate to this study from the EPOD-Atlantic for review.

Documents reviewed

The aim of this study is to review the four documents ESTS received on March 03, 2011, from the EPOD-Atlantic. These documents are:

1. Document 1: HEBRON PROJECT – Comprehensive Study Report: Sections 14.2 and 14.3 (revised), 39 pages.
2. Document 2: HEBRON PROJECT – Comprehensive Study Report: Response to Comments, Part II, 23 pages.
3. Document 3: HEBRON PROJECT – Comprehensive Study Report: Offshore Spill Trajectory Modelling Report, 121 pages.
4. Document 4: HEBRON PROJECT – Comprehensive Study Report: Nearshore Bull Arm Spill Trajectory Modelling Report, 88 pages.

Comments

Summary comments

1. The new modelling study was conducted using SIMAP software developed by Applied Science Associates, Inc. (ASA). This model responds to the requirements of the modelling needs much better than the one used in the previous study. Some documentation about the model was provided. Results were presented using color figures and tables.
2. Both the stochastic and determinist modelling approaches were used to assess the impact, which is good and appropriate in this project.
3. Wind and current data used to conduct the modelling work were similar to the ones used in the previous study. A hydrodynamic model for the Bull Arm site was developed in this new study. However, less analysis of the data was performed than in the previous study, especially for statistical analysis of wind data.
4. The major concern of this new study relates to the duration of the simulations, particularly for offshore spills related to platform and subsea blow-outs. Results from these simulations are not adequate to assess the risk of shoreline oiling, for instance. For most of the scenarios for offshore spills, the simulations were stopped at the end of the spill period. The results of the simulations using the deterministic approach showed that 29 to 79% of the spilled oil remains on the surface at the end of the simulations. The fate of this oil should be tracked further in order to assess shoreline oiling properly. In addition to the oiling of the Newfoundland shorelines, there is a potential risk for oil to reach the European shores on the Atlantic side. Some recommendations to improve the simulations and the risk assessment study overall are proposed below. The content of the Executive Summary should be revised accordingly.
5. Two seasons, summer and winter, were selected to conduct the modelling work without any scientific justification. Wind data at both spill sites should be presented using monthly, or at least seasonal (four), wind rose. Presentation of wind data using annual wind rose is not appropriate for selecting the wind scenarios in this study. To determine the risks of various resources being oiled, modelling scenarios should be based on at least the seasonal wind rose, i.e. need to consider four seasons wind and current conditions.
6. The trajectory modelling summary is not representative of the new modelling study. Revision is necessary and recommendations are proposed below.
7. The algorithm used to model oil-ice interaction is based on simplified assumptions that were introduced about three decades ago. Significant knowledge about oil-ice interaction has been gained since then. As such, the modelling results obtained with the SIMAP model when ice is present have high degree of uncertainty. This should be stated clearly in the report.
8. For consistency with Section 14.3, a Summary Table for the modelling work for the Bull Arm site should be presented in Section 14.2 in Document 1. Both

summary tables in Document 3 and 4 require revision as discussed below. The captions of the Tables should explain what the data in the Tables represent.

9. The entire Section 14.3.4 entitled "Trajectory Modelling Summary" in Document needs substantial revision. This section does not provide a representative summary of the modelling results. The section should be revised considering the additional comments provided in this review. For consistency, similar section should be added for the Bull Arm site, section 14.2.

Specific comments

Bull Arm

1. The selection of the simulation period of 30 days is not justified. The only argument provided in page 2 of Document 4 mentioned "… a length of time sufficient to allow for all of the weathering processes to occur". This is a general statement that applies to any oil spills. It does not provide a justification based on the requirements of the study and the particularities of the spill scenarios. For proper evaluation of the environmental impact, all simulations related to the Bull Arm spill site should be run until the disappearance of the spilled oil from the sea surface.
2. The method used to correlate the Oceans Ltd wind data collected in Bull Arm to the data from the MSC50 grid node M13032 is not described. This information is needed to evaluate its validity. Also, why node M13032 was used instead of the nearest M12874 node?
3. The hydrodynamic model at Bull Arm was validated using one comparison with observed water elevation only. This is the easy part in the validation process of a hydrodynamic model. It is not sufficient for the validation of the model. The predicted currents should be compared with the existing current and circulation data for Bull Arm and Trinity Bay.
4. Tide currents and wind-driven currents in Bull Arm and Trinity Bay were modeled separately and then linearly added. This is not necessarily correct. Why wind effect was not model simultaneously with tide currents, as it commonly done in hydrodynamic modelling?
5. In the oil spill model, tide currents are constructed based on the date and time of the simulation. However, average wind speed and direction occurring at that time were used. Furthermore, the average wind speed was not used explicitly, it was used to scale the current data modeled using a constant wind speed of 8 m/s. This is big and unrealistic simplification of the problem. Average wind and linear scaling do not represent the reality. It may produces a completely different trajectory than the real wind (time dependent), especially if the averaging period is long, as is the case in the selected scenarios for the Bull Arm spill site (30 days). In addition, working with a constant (average or statistical dominant) wind direction for the entire domain and the simulation period is inacceptable. Results obtained from these simulations cannot be considered as representative when

assessing shoreline oiling for instance. Real wind data (time- and space-dependent), as collected in this study and the previous one, should be used in all simulations. As it is recognised in the first paragraph in page 7 of Document 4, the wind effects dominate the hydrodynamic circulation in Bull Arm and Trinity Bay.

6. Two seasons, summer and winter, were selected to conduct the modelling work without any scientific justification. Wind data at Bull Arm spill site should be presented using monthly, or at least seasonal (four), wind rose. Presentation such as the one shown on Figure 2.4-2 for annual wind rose cannot be used to select the wind scenarios in this study. To determine risks of various resources being oiled, modelling scenarios should be based on at least the seasonal wind rose.
7. Evaporated oil volume shown in Table 14.1 in Document 1 (Table 4.2-1 in Document 4) for IFO 180 is overestimated (15.5 to 18%), according the actual state-of-knowledge. The fact that the results showed that oil evaporation under ice conditions is equal or higher that the one obtained without ice in winter is not realistic. This is further evidence that the algorithm used to model oil-ice interaction is not appropriate. Revisions of the evaporation model used for the IFO 180 and the algorithm used for oil-ice interaction are necessary.
8. Results obtained under ice conditions are missing in Table 4.1-1 in Document 4.
9. Were the ice condition kept constant for the entire modelling period (30 days)? If yes, this not realistic. The simulations should be re-run time-dependant ice conditions as show in the data. If not, this should be mentioned in the report.
10. Table 4.1-1 in Document 4 should be added to Document 1, just before Table 14-1.
11. A column showing the length of oiled shorelines should be added in Table 14-1 in Document 1 and Table 4.2-1 in Document 4.
12. Results on time for shoreline oiling (Figure s B5-B8 in Document 4) should be included in Document 1.
13. How possible entrainment of IFO 180 into the water column under ice condition is higher than without ice during the winter (10 to 25 m3 compared to zero in Table 4.2-1/Document 4 and Table 14-1/Document 1)? This is one more evidence that the algorithm used to model oil-ice interaction in the SIMAP software is adequate.
14. Estimation of the volume of oil that contaminates the shorelines is strongly controlled by the type of shorelines. Where proper data on the types of shorelines in Bull Arm and Trinity Bay gathered and used in the model? If yes, the information should be discussed and presented in the report. If not, the results shown in Tables 14.1 and 4.2-1 about shoreline oiling are questionable and require revision. New simulations using proper information on shoreline types are required.
15. Information on how the “Decayed Oil” is calculated is missing in the report and the Annexes describing the SIMAP software. This information is needed and

should be presented in details in the report. Explanations should be presented also to clarify how ice effect is modelled in the calculations of the decayed oil. Modelling results presented in Tables 14-1 and 14-3 showed that the volume of decayed oil is significant.

16. The Summary Table in the Executive Summary in Document 4 should be revised. The data presented should be consistent with those presented in similar Table in Document 3. The percentage should be used and proper caption should be added to explain what the data in the Table represent. All process affecting the mass balance calculation should be listed. Information about the percentage of the spilled oil that remains on the surface should be mentioned. As discussed above, this percentage should be ZERO when the simulations in this study are re-run until the oil disappears from the surface.

Hebron

17. The Summary Table in the Executive Summary in Document 3 should be revised. A proper caption should be added to explain what the data in the Table represent. All process affecting the mass balance calculation should be listed. Information about oil on shorelines and the length of oiled shorelines is missing. The percentage of the spilled oil that remains on the surface should be mentioned. As discussed above, this percentage should be ZERO when the simulations in this study are re-run until the oil disappears from the surface.
18. Selection of the spill scenarios is crucial in this study. It is not clear how the 35K bpd for the platform blowout and the 20K bpd for the subsea blowout were estimated. Considering recent event of well blowout, these rates are underestimated by two to three orders of magnitude. Details about scientific estimation of the release rate should be provided. The estimate should provide a range of values. The spill scenarios include extreme and average values in this range.
19. Statistical presentation of wind is not adequate for this study (Figures 2.4-2 to 2.4-4 in Document 3). As for the Bull Arm study, wind rose should be presented for each month of the year, or at least for the four seasons. Definition of the wind conditions to consider in the study should be based on such analysis, instead of considering two seasons only (summer and winter).
20. Why wind data observed from the nearby platforms were not considered in this study? A complete comparison of the MSC50 wind data and the observed data for several years should be performed to show the accuracy of the wind data used in the simulations.
21. Values of the variables used in the calculation of the oil droplet size distribution shown in Table 3.2-1 in Document 3 should be listed in the document. Selection of these values should be justified.
22. The oil droplet size distribution shown in Table 3.2-1 in Document 3 is valid for the dynamic zone of the jet close to the exit. It is not correct to use the droplet size distribution in the SIMAP to track the fate of the spilled oil in the far-field. The

end results obtained using such assumption, as it is done in this study, may lead wrong estimation of the fate, especially estimation of oil entrainment into the water column. Above the dynamic zone of the jet, the intensity of turbulence weakens and coalescence of oil droplets takes. This leads to formation of bigger droplets. In the far-field, oil droplet size distribution is controlled by local turbulence and the state of oil weathering. So, was the oil droplet size distribution shown in Table 3.2-1 used in the SIMPA model kept constant in the entire simulation period? If yes, results from such simulations are not correct and related simulation should be re-run. If not, details about the procedure used should be discussed in Document 3.

23. Estimation of the volume of oil that contaminates the shorelines is strongly controlled by the type of shorelines. Where proper data on the types of shorelines in the affected areas gathered and used in the model? If yes, the information should be discussed and presented in the report. If not, the results shown in Tables 14.3 and 4.2-1 about shoreline oiling are questionable and require revision. New simulations using proper information on shoreline types are required.
24. For simulations with 100 and 120 days of release, it is doubtful that the 100 simulations used in the stochastic model are sufficient to assess the probability of oiling. Selection of this number should be justified with a quantitative analysis, i.e. consider different number to show convergence of the results.
25. Second paragraph in page 14.3 in Document 1. The justification proposed to focus on a 30-day platform blowout at a rate of 5,600 m^3/d, and a 100-day subsea blowout at 3,200 m^3/d is not acceptable. As discussed in this review, all simulations should be considered with longer simulations period (until the disappearance of oil from the sea surface).
26. First paragraph in page 14-10 in Document 1. The statement "… represent a worse possible outcome" is not correct. The phrase should be removed from the report or revised according to the comments provided in this review. oiling of Newfoundland shore becomes much worst if the For the 120 day simulation, results in Table 14.3 in Document 1 showed that 51% of the spilled oil remains on the surface at the end of the simulations!
27. Figures 14.10 to 14.16 in Document 1 and the corresponding figures in Document 3 should be replaced to show details of the oiled shorelines, i.e. zoom on the oiled areas, as shown in Figures 14.5 to 14.10 in Document 1.
28. One of the important outcomes from the simulations presented in this report is the need to extend the simulation domain to include the European shorelines on the Atlantic side, including Greenland and Iceland. Figures such as 14.8 and 14.9 in Document 1 (Figures 29 and 33 in Document 3) are clear illustration of the need to extend the modelling domain for proper assessment of the shoreline oiling. It should be noted that the oiled area shown in these figures is expected to extended significantly when the simulations are continued until the disappearance of the oil from the seas surface.

29. Results presented in Table and Figures in Document 3 should be reviewed once all simulations are re-run until oil disappears from the water surface, as recommended in this review.

Recommendations

1. All simulations (using stochastic and deterministic approaches) should be re-run until the disappearance of oil from the sea surface. This may require extension of the simulation periods for few months. The result should be shown in the mass balance calculations. Stopping the simulations at the end of the spill duration, as it is done in most of the simulations conducted in this study, is not adequate for assessing the environmental impact, especially shoreline oiling. This has been validated by the observation from the Deepwater Horizon oil Spill in the Gulf of Mexico and from several other oil spills. It is also obvious from some of the results of this study when the simulation duration was extended from 30 to 60 days for a 30-days spill.
2. The domain of the simulations should be extended to include the European shorelines on the Atlantic side, including Greenland and Iceland.
3. Additional scenarios should be studied for the platform and subsea blowouts considering a release period longer than 120 days. Based on past well blowout events, this is not an impossible event. In addition, the remote location of the Hebron site and the harsh weather in the area are additional justifications to increase the release during beyond the three months period.
4. Results from both the stochastic and deterministic simulations for the spill scenarios representing 50% shoreline oiling, surface oiling and oil entrained in the water column should be presented for the Bull Arm spill site, in addition to the 95% event for which the information was presented in the report.
5. The hydrodynamic model developed for the Bull Arm site should be validated using existing current and circulation data for Bull Arm and Trinity Bay water systems.
6. Wind data in both spill sites should be presented using monthly, or at least seasonal, wind roses. Seasonal wind (four) should be used in the simulations.

Appendix I

Comments on the spill modelling work presented in "Spill Trajectory Modelling for the Hebron Project", prepared by AMEC Earth & Environmental a Division of AMEC Americas limited, and summarised in Chapter 14 of the Hebron Project - Comprehensive Study Report of June 2010. ESTS's comments provided to the Atlantic Region in August 17, 2010.

HEBRON PROJET
Comprehensive Study Report

Comment on the spill modelling work presented in "Spill Trajectory Modelling for the Hebron Project", prepared by AMEC Earth & Environmental a Division of AMEC Americas limited, and summarised in Chapter 14 of the study.

The study considered two spill sites: a nearshore site in Bull Arm in Trinity Bay where the Hebron platform will be built and an offshore site where the Hebron oil exploitation will take place. The study used three oil spill models to conduct this modelling work: ADIOS, the weathering model developed by NOAA and is publicly available, AMEC model developed (and apparently used previously) by AMEC, and finally the Oilmap model developed by Applied Science Associates. ADIOS was used to address the oil weathering, AMEC model was used for stochastic modelling, and Oilmap was used for trajectory modelling at the offshore spill site using deterministic approach, three blowout scenarios and three batch spill events.

While the study showed a certain trend of the possible trajectory of spills and spatial distribution of the probability of oiling in Bull Arm in Trinity Bay and around the future offshore Hebron exploitation site, the method used to conduct the modelling study is questionable as shown in the following comments.

1. The use of three different oil spill models to conduct this study is misleading and did not bring any benefit to the study, evaluation of the risk/impact associated with oil spills because:
    a. for the purpose of this study, trajectory modelling and tracking of the mass balance (weathering) should be integrated in the same model as in the Oilmap model. The use of ADIOS model to address the weathering and AMEC model to predict the trajectory is not a correct approach as movement of the oil is strongly affected by its weathering states and vice-versa.]

   b. Oilmap model is worldwide known oil spill software that can be used to conduct trajectory modelling in both deterministic and stochastic modes. Trajectory and weathering modelling are coupled in this model.
   c. ADIOS software model designed to estimate weathering and masse balance, but does not have any capability to model oil trajectory.
   d. From the description provided in the report, AMEC is not an oil spill model suitable for this study as described below.
2. Modelling results obtained with the AMEC model and relate to probability of oiling are questionable for the following reasons:
   a. As described in the report, the AMEC model include oil advection to hydrodynamic current and wind, evaporation and vertical dispersion only. Important processes such as spreading, emulsification and interaction with shorelines.
   b. The trajectory of the slick is modeled by tracking the centre of the slick only. For large spills, spatial distribution of the probability of oiling obtained with such approach is not correct as the edge of large slicks may reach the shoreline but not its centre. Also, the same reasoning applies for the time for oiling. Trajectory of oil slicks is commonly tracked using Lagrangian approach using thousands of particles or spillets. This method is used in Oilmap software.
   c. The method used to model vertical dispersion is not based on the state-of-knowledge. Much better methods have been developed during the last two decades and were validated with several data sets. The method used is elementary and does not include the effects of oil type and weathering (increase of oil viscosity and emulsification, for instance) in a systematic way (use of appropriate behaviour models).
3. Hydrodynamic currents used to conduct the study in the Bull Arm site are based on one point conditions and cannot represent the hydrodynamic of the entire modelling grid. In such complex domain, it recommended to use proper gridded current data, such as those provided by the BIO finite element model for Northwest Atlantic area. Vector field of surface currents used in the simulations should be displayed on a couple of figures for illustration for both spill sites.
4. While it is recognized in the report (section 3.5 and 4.5) that there is a good chance that ice coverage at the two spill sites may be significant (50% or more) during the winter season, no modelling under ice condition was performed. The fate and weathering of oil spill in ice-infested waters is known to be highly affected by ice.
5. A long series (hourly) of wind data (30 years) were used, which is very good to conducting the stochastic simulation, assuming that the data are of good quality. But, what's the rational to using 30 simulations per day, while there are 24 hours in a day (section 4.6.1)? The fact that the number of simulation is greater than the data point (in a day), they will be duplicates of the extra simulations (in this case 6 per day). The bad result of this is that the simulations cannot be considered as independent and the resulting statistics (probability of oiling) become biased.
6. The maximum of the simulations was set between 7 and 45 days. We learned from many spills resulting from well blowout (including the recent Gulf of

Mexico spill) that the spill may last for months. So, how the modelling resulting obtained with such short period of time may be used to assess the risk of oiling?

7. The predicted 17% (section 14.2.3) of the evaporation of IFO 180 is questionable. One note that ADIOS is known to overestimate the evaporation of under wind condition for many oils. Revision is necessary.
8. the word “any” in the last paragraph of section 14.2.3 should be removed, as the modeling results cover a small portion only of all possible spill events.

Appendix II

Document submitted by the Proponent to redo the spill trajectory modelling work. The document was submitted to ESTS in September 20, 2010

SIMAP SIMULATIONS OF OIL SPILLS OFF THE COAST OF NEWFOUNDLAND

ASA Project Number: 2010-261

PREPARED FOR:

ExxonMobil Biomedical Sciences

AUTHOR:

Chris Galagan

DATE SUBMITTED

1 September, 2010

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Introduction

The SIMAP model will be used to simulate spills of fuel oil in Bull Arm, Trinity Bay, and crude oil spills at the Hebron offshore site southeast of St. Johns. The model scenarios will utilize wind and current data developed in previous studies plus additional hydrodynamics provided by the ASA HYDROMAP model and global ocean models. A combination of stochastic and deterministic (both surface and subsurface) model simulations will be completed to determine the range of possible water surface, subsurface and shoreline oiling.

Modeling Approach

The oil spill modeling will be performed using ASA's Spill Impact Model Application Package (SIMAP), which uses wind data, current data, and transport and weathering algorithms to calculate the mass of oil components in various environmental compartments (water surface, shoreline, water column, atmosphere, sediments, etc.), oil pathway over time (trajectory), surface oil distribution, and concentrations of the oil components in the water and sediments.

The SIMAP stochastic model evaluates area exposed over a minimum threshold thickness and exposure mass per unit area or concentration. ASA will run a set of stochastic simulations with the number of simulations set to adequately sample the variability in the wind and current records available. From these outputs probability distributions of the sea surface having surface oil, the shoreline being impacted by oil, and areas within the water column with subsurface oil (entrained oil) will be shown for defined thresholds. In addition, probability distributions are available for dissolved aromatics in the water column, sediment dissolved aromatic concentrations and total hydrocarbons.

For blowout simulations we will use the ASA deep-water blowout model. The model solves equations for the conservation of water mass, momentum, buoyancy, and gas mass using integral plume theory following McDougall (1978). Equilibrium hydrate formation and dissociation for methane gas are determined by a multi-phase flash calculation developed by Bishnoi et al. (1979, 1989).

Of critical importance in blowout releases is the oil droplet size distribution as it affects the rise velocity of the discharged oil. Large droplets will reach the surface faster and small droplets will remain in the water column longer and be subjected to subsurface advection-diffusion transport from the ambient ocean current and from turbulence.

The oil droplet size distribution calculated using the blowout model is based on the Rosin-Rammler distribution (Rye et al 1998, Lefebvre 1989), and depends primarily on the exit velocity of the discharged oil and gas. For a given exit dimension (e.g., a 5 inch well pipe), exit velocity is primarily a function of the gas/oil ratio (GOR). Figure 1 shows a plot of oil droplet size distributions for a common range of GOR values and a droplet rise velocity curve. The higher the GOR the smaller the oil droplets will be and the longer they will take to reach the surface.

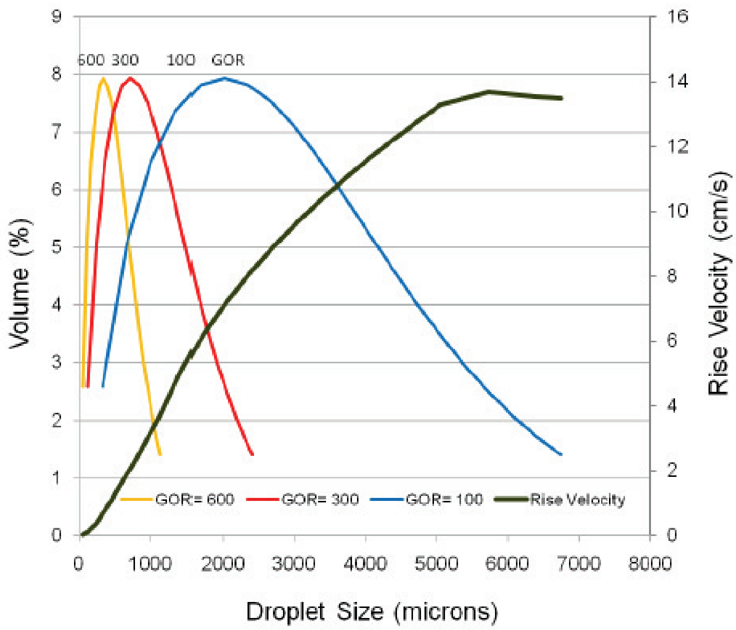

Figure 1. Oil droplet size distribution and rise velocity for GOR of 100, 300 and 600.

Nearshore Spills - Bull Arm, Trinity Bay

The SIMAP stochastic model will be used to simulate a small spill of IFO180 or diesel fuel from a single location within Bull Arm. Wind data for the simulations will be the 54-year hindcast data provided by the Meteorological Service of Canada (MSC) for the period 1954 to 2008 in combination with any available wind time series data collected in the vicinity. Currents for the nearshore spill simulations will be generated using ASA's HYDROMAP hydrodynamic model. Spills will be simulated using environmental conditions from the different seasons and include ice coverage from the Canadian Ice Service as appropriate. ExxonMobil will provide the necessary inputs to define the spill scenarios, including the following:

- Oil type
- Spill volume and duration

Stochastic model results will be used to identify worst case individual spills that will be performed to determine the mass balance of the spilled oil in the environment. Individual spill simulations will be completed for the different seasons using season specific wind, current and ice coverage data. The results of these simulations will provide a time series of the oil entrained, dissolved, evaporated, on the water surface and on the shoreline for a period of time sufficient to account for all spilled fuel in the environment.

Offshore Spills - Hebron Platform

The goal of simulating the offshore spills is to determine the fate of oil released from production facilities at the Hebron site. Both blowout and surface release spills will be simulated at the offshore site. ExxonMobil will provide the necessary inputs to define the spill scenarios, including the following:

- Oil type
- Spill amount and duration
- Gas/oil ratio (blowout only)
- Well diameter (blowout only)
- Discharge temperature (blowout only)

ASA will use its blowout model to calculate the oil droplet size distribution for the blowout scenarios from the parameters provided and use this data to initiate a subsurface release simulation in the SIMAP model.

As with the nearshore spills, the SIMAP stochastic model will be used to simulate spills at the site, both subsea blowout and surface spills, using seasonally varying wind, current and ice data. Winds for the simulations will be the 54-year hindcast data provided by the Meteorological Service of Canada (MSC) for the period 1954 to 2008 in combination with any available wind time series data collected in the vicinity of the Hebron site (possible 9-year time series from the Hibernia location collected for Mobil Oil Canada, Ltd.).

Currents for the offshore spill simulations may come from multiple sources. Data archived from two global ocean models, NCOM and HYCOM, can be obtained for the offshore for recent years. NCOM, the Navy Coastal Ocean Model, is an operational model operated by the U.S. navy that provides hindcasts in 3 hour intervals on a grid spacing of approximately 14 kilometers. HYCOM, the Hybrid Coordinates Ocean Model, is a U.S. Navy model implemented on a variable size grid that provides hindcasts as daily average surface current. HYCOM currents are available in 2D and 3D.

The surface release spills will be modeled using 2D currents but the blowouts may require 3D currents if the release parameters are such that small oil droplet sizes result and the oil remains in the water column for extended periods and is subject to sub-surface transport over large distances. In this event 3D currents would need to be obtained and used to drive the blowout simulations.

Offshore Spill Scenarios – Stochastic and Deterministic

Release Type	Volume/Release Rate	Duration	Season	Ice
Blowout	12,000 m^3/day (~75,500 bbl/day)	90 d*	summer	no ice
Blowout	12,000 m^3/day (~75,500 bbl/day)	90 d	winter	no ice
Blowout	12,000 m^3/day (~75,500 bbl/day)	90 d	winter	ice
Surface – batch spill – transfer	800 m^3	instantaneous	summer	no ice
Surface – batch spill - transfer	800 m^3	instantaneous	winter	ice
Surface – batch spill - transfer	800 m^3	instantaneous	winter	No ice
Surface – batch spill – OLS	5000 m3 (200 m3/hr for 24 hr)	24 hours	Summer	

Surface – batch spill – OLS	5000 m3 (200 m3/hr for 24 hr)	24 hours	Winter	No ice
Surface – batch spill – OLS	5000 m3 (200 m3/hr for 24 hr)	24 hours	Winter	ice
NEARSHORE				
Surface – batch spill – diesel	100 m3	Instantaneous	Summer	
Surface – batch spill – IFO	1000 m3	Instantaneous	Summer	
Surface – batch spill – diesel	100 m3	Instantaneous	Winter	Ice
Surface – batch spill – IFO	1000 m3	Instantaneous	Winter	No Ice
Surface – batch spill – diesel	100 m3	Instantaneous	Winter	Ice
Surface – batch spill – IFO	1000 m3	Instantaneous	Winter	No Ice

Appendix III

Khelifa,Ali [NCR]

From: Khelifa,Ali [NCR]
Sent: September 24, 2010 6:28 PM
To: Troke,Glenn [St. John's]
Cc: Thomas,Graham [St. John's]; Corkum,Jeffrey [Dartmouth]; Brown,Carl [NCR]
Subject: RE:

Hi Glenn et al.,

Sorry I was not able to get back to you sooner than this, I had many other priorities since I received your note below.

Anyway, I read the document. It sounds the document provides some basis information on the work that will be done. But, the proposal is not detailed enough to make any fare evaluation of the work that is proposed. I would call such document a pre-proposal instead.

As for the time to discuss the document, what about Wednesday 10:00am our time (EDT)? I am not sure what is expected from such discussion as, but having the author of the proposal participating in the discussion is important. In any cases, I feel that such discussion can only be useful for the preparation of the full (detailed) proposal and not make fare evaluation of the work proposed, as I mentioned above.

Hope this helps.

Thanks,

Ali

-----Original Message-----
From: Troke,Glenn [St. John's]
Sent: September 20, 2010 9:17 AM
To: Khelifa,Ali [NCR]
Cc: Thomas,Graham [St. John's]; Corkum,Jeffrey [Dartmouth]
Subject:

Good morning Ali,

We are in receipt of a revised proposal with respect to oil spill trajectory modelling for Hebron project.

Would you look over the attachment and indicate whether it provides a suitable basis to redo the modelling?

If so could you identify a time when we can discuss w/ ExxonMobil?

Best regards,
Glenn

-----Original Message-----
From: Young, Elizabeth [mailto:EYoung@cnlopb.nl.ca]
Sent: September 15, 2010 11:16 AM
To: Burley, Dave; Troke,Glenn [St. John's]; Thomas,Graham [St. John's]
Subject: FW: Hebron spill trajectory model

Good Morning,

Fyi. Can you identify a suitable time to meet with ExxonMobil to discuss this.

Appendix IV

Khelifa,Ali [NCR]

From: Khelifa,Ali [NCR]
Sent: January 18, 2011 1:40 PM
To: Troke,Glenn [St. John's]
Cc: Brown,Carl [NCR]; Zwicker,Stephen [Dartmouth]; Thomas,Graham [St. John's]
Subject: RE: Hebron Project - Meeting to Discuss Trajectory Modelling

Attachments: RE: ; FW: Hebron Oil Spill Trajectory Modelling; FW: Hebron spill trajectory model

RE: FW: Hebron Oil Spill Trajector... FW: Hebron ...ill trajectory mo

Hi Glenn,

I agree with your reasoning. There is a need to work with the Proponent to ensure that the models and approaches they are using are appropriate in conducting this project, as it was discuss during the conference of Aug. 17, 2010. As I said, I am keen to collaborate in reviewing the modelling work.

But, as for any project, the Proponent should provide a complete description of the models, approaches and conditions they plan to use, kind of full proposal. As clear as it sounds, this should be prepared and submitted to the concerned before the start of the modelling work.

In this perspective, based on the information I was given, the Proponent did submit what I called a pre-proposal (see you email of Sep. 20, 2010, attached), as a follow up to our conference call of Aug. 17, 2010. I reviewed the document and submitted my comments on Sep. 24, 2010 (attached). Additional questions regarding the document were raised by Dave Burley. As shown in the attached document, I answered the questions the same day.

Briefly, the conclusion was that additional information on the conditions and scenarios to be run using the SIMAP model were lacking. I suggested requesting a full proposal that provide full description of the conditions and scenarios to be used in the project. I was hopping to receive such document and use it as a reference to track/evaluate the end product of the project. I never received such documents (full proposal).

Based on this background, I doubt that a conference call will replace the so-called full proposal to evaluate the approach and conditions that will be used in the project. I have no problem attending the conference call you mention in you message below. But, I inform you that I can not provide any evaluation/comment on what will be discussed verbally.

If the Proponent is keen to consider our suggestions and comments regarding the modelling work, this is what I propose:

1. A conference call or a face-to-face meeting is not appropriate at this stage as there is no sufficient information on the approaches and conditions to be used in conducting the modelling work.
2. The Proponent should submit a full proposal to describe the models, approaches and conditions that will be used to conduct the modelling work. For this, please see my comments on the pre-proposal I received on Sep. 20, 2010.
3. The full proposal will be reviewed by the concerned.
4. Finally, discuss the details in a face-to-face meeting.

Hope this helps,

Ali

Appendix IV

CANADA-NEWFOUNDLAND and LABRADOR OFFSHORE PETROLEUM BOARD

February 25, 2011

Distribution

SUBJECT: Hebron Project - Comprehensive Study Report
ExxonMobil Canada Ltd. Response to Review Comments, Part 2

On February 25, 2011, ExxonMobil Canada Ltd. (ExxonMobil), as Operator acting on behalf of the Hebron Project Proponents, ExxonMobil Canada Ltd. Chevron Canada Ltd., Petro-Canada Hebron Partnership, Statoil Canada Ltd., and Nalcor Energy, submitted to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) Part 2 of their response to review comments on the Comprehensive Study Report (CSR). The "*Hebron Project Comprehensive Study Report: Response to Comments, Part II*" (February 2011) report addresses the comments that were provided to ExxonMobil on September 7, 2010 related to spill trajectory modeling, which were not included in the Part 1 submission. ExxonMobil also included, in support of the Part 2 submission, revised spill trajectory modeling reports for the Bull Arm Nearshore Area and the Offshore Area as well as revised Sections 14.2 and 14.3 of the CSR. *The "Hebron Project Comprehensive Study Report: Response to Review Comments, Part I"* (November 26, 2010) report, submitted by ExxonMobil on December 1, 2010, provided a response to the review comments forwarded by the C-NLOPB to ExxonMobil on September 7, 2010.

Please review the enclosed report to determine whether the responses provided by ExxonMobil respecting your department's comments have been addressed satisfactorily. Please provide your response no later than **March 21, 2011.**

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