Husky

August 9, 2019

Canadian Environmental Assessment Agency
200-1801 Hollis Street
Halifax, Nova Scotia
B3J 3N4

Doc. No.: HUS-CEA-ED-LTR-00008

Attention: **Ms. Amanda Park**

Dear Ms. Park;

Subject: **Response to Husky Energy Exploration Drilling Project – Round II Information Requirements.**

On July 12, 2019, the Canadian Environmental Assessment Agency (CEAA) provided Husky with Round II Information Requirements (IRs) relating to the 110 IRs and 29 Clarifications submitted by Husky to the Canadian Environmental Assessment Agency on March 21, 2019.

Fifteen Information Requirements (01, 09, 11, 20, 22, 23, 25, 28, 36, 41, 43, 58, 72, 104, 107/108) required further detail to enable CEAA to proceed with its review. The attached report is Husky's response to CEAA's Round II request for additional information.

If you have any questions or concerns, please do not hesitate to contact the undersigned at 709-724-4004.

Yours sincerely,

HUSKY OIL OPERATIONS LIMITED

<Original signed by>

Steve Bettles,
Manager, Corporate Responsibility

SB/pk

cc: Gareth Igloliorte, Kathy Knox, Colleen McConnell, Nick Crosbie, Chris Payne – Husky

Encl: ED-HSE-RP-0040

Husky Exploration Drilling Project: Response to Round 2 Information Requirements from Environmental Impact Statement Review

Prepared for:
Husky Energy

Prepared by:
Stantec Consulting Ltd.
141 Kelsey Drive
St. John’s, NL A1B 0L2
Tel: (709) 576-1458
Fax: (709) 576-2126

Husky Control Doc No.

ED-HSE-RP-0040

File No: 121413837

August 9, 2019

Table of Contents

1.0 RESPONSES TO INFORMATION REQUIREMENTS

1.1 PROJECT DESCRIPTION

1.1.1 Information Requirement: IR-01-02

Reference to EIS:

Section 2.5.2 Drilling

Context and Rationale

In IR-01, the Agency required the proponent to provide clarification on the circumstances under which simultaneous drilling could occur. The proponent indicated that simultaneous exploration drilling is not anticipated within any one exploration licenses, but likely to occur in the project area. However, the proponent has not provided comment on if simultaneous drilling may occur between exploration licenses within the scope of the project.

Specific Follow-up Question / Information Requirement

Provide clarification on the potential for there to be simultaneous drilling in separate exploration licenses included in the scope of the project (i.e. drilling in exploration license 1155 and 1152).

Response

The Project Area encompasses the White Rose, Terra Nova, Hibernia, and Hebron development projects as well as multiple ELs and Significant Discovery Licences. Over the life of Husky's Exploration Drilling Project, there may be drilling as part of any or all of these projects at the same time that Husky may be drilling on exploration licences 1151, 1152, or 1155. At this time, Husky is not planning on conducting simultaneous drilling within ELs 1151, 1152 or 1155, and Husky can confirm if more than one MODU were to be engaged on the Project, these MODUs would not be working within the same EL at the same time. Although unlikely to occur, if simultaneous drilling did occur in the future (i.e., drilling on more than one Project EL at a time), cumulative effects would be similar to those assessed between the Project and other ongoing development projects (White Rose, Terra Nova, Hibernia and Hebron) in the Jeanne d'Arc Basin.

References

N/A

1.2 ALTERNATIVE MEANS

1.2.1 Information Requirement: IR-09-02

Reference to EIS:

Section 2.5.4 Well Testing; Section 2.9.1.5 MODU Lighting and Flaring

Context and Rationale

In IR-09 the Agency required additional information on the technical feasibility of reduced flaring and if well testing while tripping or any other type of test were considered as alternative means. The proponent stated that alternative well testing technologies are continually evaluated, including but not limited to formation testing while tripping, and that well testing technology is assessed on a well-by-well basis. While Husky indicated that formation testing while tripping may be considered when assessing alternative well testing technology there was no discussion on how the test is carried out, how they may interact with the environment and potential environmental effects.

Specific Follow-up Question / Information Requirement

As the proponent has indicated that well testing while tripping may be considered an alternative well testing technology, provide a discussion of this alternative means of carrying out the Project in accordance with the Agency's Operational Policy Statement: Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012. Provide information on how the tests are carried out, how they might interact with the environmental, and potential environmental effects. Given that this method, and potentially others, may reduce or eliminate the need for flaring, discuss under what circumstances or for what reasons it would not be selected as the preferred option for well testing.

Response

As described in Section 2.5.4 of the EIS, wells may be tested by multiple methods to gather additional details on a potential reservoir and to assess the associated commercial potential of a discovery. The EIS describes conventional testing (drill stem testing) which requires installation of topside process equipment, perforation of the well, and the flowing of reservoir fluids to the surface where they are flared to the atmosphere. An alternative to conventional testing is Formation Testing While Tripping (FTWT). FTWT offers several potential advantages over drill stem testing since it does not require installation of process equipment on the mobile offshore drilling unit (MODU) and reservoir fluids are not flared. Well fluids are sent through the wellbore to the MODU in a closed casing for testing using specialized equipment in the wellbore and therefore reservoir fluids do not interact with the marine or atmospheric environment. No adverse environmental effects are therefore predicted to occur due to FTWT. FTWT is technically and economically feasible, and a preferred option from an environmental perspective due to lack of interaction of reservoir fluid to the environment. However, there may be circumstances prescribed by the C-NLOPB where formation flow testing with flaring is required to address specific information requirements.

As per section 52(2) of the *Newfoundland Offshore Petroleum Drilling and Production Regulations*, a separate approval is required from the C-NLOPB for formation flow tests (in addition the Approval to Drill a Well). As part of this authorization process, a detailed testing program is required to be submitted to the C-NLOPB for approval. Husky will consult with the C-NLOPB to determine the need and method for well testing on a per-well basis.

References

N/A

1.3 AIR QUALITY

1.3.1 Information Requirement: IR-11-02

Reference to EIS:

Section 2.6.3.1. Atmospheric Emissions

Section 6.6.10.3 Characterization of Residual Project-related Environmental Effect

Context and Rationale

The Agency required the proponent to provide the assumed composition of waste being flared, volumes being flared, and emission factors used to determine the final total emission rates. The proponent did not provide the assumed composition and volumes estimated for flaring or the emission factors used to obtain the final total emission rates.

Environment and Climate Change Canada advised that while the proponent's response states that the emissions from power generation are included in the MODU GHG estimate, the basis of the GHG emissions calculation is not provided. The proponent refers to a 2012 Stantec report, to describe the assumptions used to calculate MODU emissions but does not describe how MODU GHG were derived. Detail regarding what emission factors or activity data were used to calculate MODU GHG emissions were not provided.

Further Natural Resources Canada recognizes that the GHG emissions have been updated from Table 2.14, to Table 1 in the proponent's response to IR-11. However, there has been no change or comment on any corresponding changes to update the criteria air contaminants emissions.

Specific Follow-up Question / Information Requirement

Provide the assumed composition of the waste being flared, the estimated volume of waste that will be flared, and the emission factors used to obtain the final total emission rates. If estimates related to the volume of waste and the composition is not known at this time, discuss when the information is anticipated and where or if the information is reported.

In order to verify the calculations used to determine the GHG emissions from the MODU, provide the basis of the GHG emissions calculations, including information related to emission factors and activity data.

Provide updated criteria air contaminants, if needed, based on updated GHG emissions.

Response

As previously noted in the response to IR-11, the actual volume of gas to be flared during a drill stem test and the composition of the gas are currently unknown as the Project is still in the planning phases. Such information would be reported to the Canada-Newfoundland and Labrador Offshore Petroleum Board throughout the exploration drilling program, when flaring, as a result of drill stem testing, is required. The greenhouse gas (GHG) emission estimates provided in Table 1 of IR-11 were based on information previously presented by another offshore operator (as such activities would be similar), and the emission factors used to calculate those estimates were from the EIS for the Flemish Pass Exploration Drilling Program (Statoil Canada Ltd. 2017) (Table 1).

The GHG emission estimates provided for the mobile offshore drilling unit (MODU) were based on information previously presented in the Husky Energy White Rose Extension Project Environmental Assessment (Husky Energy 2012). At that time the GHG estimates for the MODU were based on emission factors provided in the Canadian Association of Petroleum Producers guide for calculating GHG emissions (CAPP 2003) and fuel consumed by the *Transocean Barents* within a one-year period.

Table 1 Statoil (2017) EIS Table 2.16: Greenhouse Gas Emission Factors for the Drilling Installation, Supply Vessels, and Helicopter

GHG	Project Activity		
	Drilling Installation (g/L)	Supply Vessel (g/kwh)	Helicopter (g/L)
CO_2	2,690	646	2,560
CH_4	0.133	0.004	0.029
N_2O	0.4	0.031	0.071
Source: Statoil Canada Ltd. 2017			

The GHG emissions as originally presented in Table 2.14 of the Husky EIS for the Husky Exploration Drilling Project, were updated in the response to IR-11. As noted in that IR, the GHG emissions associated with the operation of the helicopters were updated to account for additional trips to the offshore Project site, and the flaring estimates were updated to reflect data previously reported by another offshore operator (Equinor Canada Ltd). Additional helicopter traffic increased GHGs by approximately 40%. Similarly, emissions of criteria air contaminants (CACs) from operation of helicopters (see Table 2.7 of the EIS) would be expected to increase by 40%. The CAC emission estimates previously presented for flaring in the Husky EIS would still be considered representative during a drill stem test flaring event and are similar to those presented by other offshore operators (such as Equinor Canada Ltd) in consideration of a two- to three-day flaring event per year (Statoil Canada Ltd. 2017).

References

CAPP (Canadian Association of Petroleum Producers). 2003. Guide: Calculating Greenhouse Gas Emissions. April 2003.

Husky Energy. 2012. Husky Energy White Rose Extension Project Environmental Assessment. Prepared by Stantec Consulting Ltd., St. John’s, NL, for Husky Energy. St. John’s, NL.

Statoil Canada Ltd. 2017. Flemish Pass Exploration Drilling Program – Environmental Impact Statement.

1.4 FISH AND FISH HABITAT

1.4.1 Information Requirement: IR-20-02

Topic: Fish and Fish Habitat

Reference to EIS:

Section 6.6.10.3 Characterization of Residual Project-related Environmental Effects

Context and Rationale

The Agency required the proponent to provide an assessment of the potential effects to swordfish from noise, spills and light. In its response the proponent did not discuss the possible effects of low frequency sound that are typical of offshore operations. While the proponent indicated that zone of influence of light may be small but did not discuss the effects of light.

Specific Follow-up Question / Information Requirement

Provide an assessment of the direct and indirect effects of light and low frequency sound on Swordfish. Update the proposed mitigation and follow-up, as well as effects predictions, accordingly.

Response

Swordfish are highly visual predators, even in dim light, with specialized mechanisms for warming the brain and eyes that allow for detection of rapidly moving prey (Fritsches et al. 2005; Hazin et al. 2005; Southwood et al. 2008; Ishibashi et al. 2009). Swordfish fisheries are conducted at night with light attractants (light sticks) attached on the longline (Bigelow et al. 1999; Stone and Dixon 2001; Hazin et al. 2005; Orbesen et al. 2017). However, it is unclear whether the light attracts prey, which in turn attracts swordfish or if the light attracts the swordfish themselves (Hazin et al. 2005).

Light will be generated from the MODU and supply vessels with some of this expected to penetrate a small footprint of the ocean surface layer at night. Swordfish exhibit vertical diurnal behaviour that suggests they follow the movement of mesopelagic organisms in the deep scattering layer. Thus, in northern latitudes they tend to forage in deep water during the day and at night move into the shallower waters of the oceanic mixed layer (Trenkel et al. 2014). As a result, swordfish are known to be attracted to surficial artificial light and may be attracted to the MODU or supply vessels based on increased foraging opportunities and better lighting for predation (Franks 2000; Hazin et al. 2005; Orbesen et al. 2017). Swordfish and other pelagic fishes have been shown to be attracted to marine structures, including oil platforms, fish farms, and offshore wind turbines (Franks 2000; Fayram and de Risi 2007; Arechavala-Lopez et al. 2013).The combination of mobile offshore drilling unit (MODU) presence, colonization opportunities and artificial light emissions from the operating decks and navigation may create a temporary “reef effect”, in which fish may aggregate underneath in response to increased foraging and shelter opportunities even in areas with underwater sound (see EIS section 6.1.10 for further information). Swordfish may be attracted to these areas based on increased foraging opportunities and better lighting for predation (Franks 2000; Hazin et al. 2005; Orbesen et al. 2017).

Other than attraction either direct or indirect (increased foraging and predation opportunities), there is little published research on the biological and behavioural responses of swordfish to light. Project-related lights are not projected into the water column far beyond the physical footprint of the MODU or supply vessel, therefore the potential impact area is limited to the area immediately around (i.e. within 100 m) of the MODU or supply vessel.

There are few studies on the hearing capabilities for swordfish, and as such, auditory abilities are inferred from other large pelagic fishes, including tunas and sharks (Southwood et al. 2008). Tuna are considered hearing generalists as they lack specialized mechanisms for enhancing hearing; tuna are capable of detecting low frequency sounds (less than 1000 Hz). Yellowfin tuna have been shown to respond to sound cues in the frequency range of 200 to 700 Hz, with higher sensitivity to sounds between 200 to 400 Hz (Southwood et al. 2008). Sharks are considered low frequency specialists and are attracted to low frequency sounds in the range of 25 to 1,000 Hz (Southwood et al. 2008). Irregular pulsed sounds may attract shark species, as it is similar to what would be generated by struggling prey (Southwood et al. 2008). High intensity sound results in rapid avoidance behavior in sharks; however, they may become habituated to these types of sounds (Southwood et al. 2008).

Attraction to offshore infrastructure may expose individual swordfish to the emissions (sound, light) and discharges associated with drilling activities. There is little published research on the biological and behavioural responses of swordfish to low frequency sound. However, based on hearing capabilities of other pelagic fishes, swordfish may be attracted to low frequency sounds that are typical of offshore operations. It is expected that the highest levels of underwater sound will be generated during drilling and vertical seismic profiling (VSP) activities. Reviews of studies on the effects of seismic sound on marine life (Fisheries and Oceans Canada 2004a, 2004b; Payne et al. 2009; CEF 2011; Alexander 2015) report no direct evidence of mortality of adult fish or shellfish in response to seismic sound exposure at field operating levels.

The Project is expected to have little impact at the population level due to the ability of swordfish to avoid undesirable anthropogenic activities; this combined with their seasonal distribution in Project Area and non-schooling behavior (Arocha 2017), reduces any potential population effects from the Project. Spawning habitats for swordfish are also distant from the Project Area (Neilson et al. 2009), reducing potential interactions between the Project and important habitats or critical life stages that have less capability of avoidance.

The environmental effects of light attraction and sound are expected to be temporary and reversible. Project-related lights are not projected into the water column far beyond the physical footprint of the MODU or supply vessel, thereby limiting the potential impact area. Survey activities will adhere to the *Statement of Canadian Practice on Mitigation of Seismic Noise in the Marine Environment*, as appended to the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2019), and Husky will obtain required permits prior to survey activities. With the application of mitigation measures included in Section 6.1.10.2 of the EIS, which apply to the effects of sound and light on marine fish and fish habitat, the environmental effects of planned and routine Project activities on swordfish are predicted to be not significant.

References

Alexander, R. 2015. A Gap Analysis Regarding Potential Impacts of Seismic Exploration on Snow Crab (*Chionoecetes opilio*). Prepared for The Canadian-Nova Scotia Offshore Petroleum Board, Halifax, NS. 32 pp.

Arechavala-Lopez, P., D. Izquierdo-Gomez, and P. Sanchez-Jerez. 2013. First report of a swordfish (*Xiphias gladius* Linnaeus, 1758) beneath open-sea farming cages in the Western Mediterranean Sea.

Arocha, F. 2017. Resiliency for North Atlantic swordfish using life history parameters. Collective Volume of Scientific Papers. ICCAT. 74(3): 1306-1321

Bigelow, K.A., C.H. Boggs and X.I. He. 1999. Environmental effects on swordfish and blue shark catch rates in the US North Pacific longline fishery. Fisheries Oceanography, 8(3): 178-198.

CEF Consultants Ltd. 2011. Report on a Workshop on Fish Behaviour in Response to Seismic Sound held in Halifax, Nova Scotia, Canada, March 28-31, 2011. Environmental Studies Research Funds Report, No. 190: 109 pp.

C-NLOPB (Canadian-Newfoundland and Labrador Offshore Petroleum Board). 2019. Geophysical, Geological, Environmental and Geotechnical Program Guidelines: Appendix 2 - Statement of

Canadian Practice on Mitigation of Seismic Noise in the Marine Environment. vii + 55 pp. Available at: https://www.cnlopb.ca/wp-content/uploads/guidelines/ggegpg.pdf

de Sylva, D.P., W.J. Richards, T.R. Capo and J.E. Serafy. 2000. Potential effects of human activities on billfishes (Istiophoridae and Xiphiidae) in the western Atlantic Ocean. Bulletin of Marine Science, 66(1): 187-198.

Fayram, A.H. and A. de Risi. 2007. The potential compatibility of offshore wind power and fisheries: an example using bluefin tuna in the Adriatic Sea. Ocean & Coastal Management, 50(8), 597-605.

Fisheries and Oceans Canada. 2004a. Potential impacts of seismic energy on snow crab. Canadian Scientific Advisory Secretariat Habitat Status Report, 2004/003: 5 pp.

Fisheries and Oceans Canada. 2004b. Review of scientific information on impacts of seismic sound on fish, invertebrates, marine turtles and marine mammals. Canadian Scientific Advisory Secretariat Habitat Status Report, 2004/002: 15 pp.

Franks, J. 2000. A review: Pelagic fishes at petroleum platforms in the Northern Gulf of Mexico; diversity, interrelationships, and perspective. In Pêche thonière et dispositifs de concentration de poissons, Caribbean-Martinique, 15-19 Oct 1999.

Fritsches, K.A., R.W. Brill and E.J. Warrant. 2005. Warm eyes provide superior vision in swordfishes. Current Biology, 15(1): 55-58.

Hazin, H.G., F.H.V. Hazin, P. Travassos and K. Erzini. 2005. Effect of light-sticks and electralume attractors on surface-longline catches of swordfish (*Xiphias gladius*, Linnaeus, 1959) in the southwest equatorial Atlantic. Fisheries research, 72(2-3): 271-277.

Husky Energy. 2012. Husky Energy White Rose Extension Project Environmental Assessment. Prepared by Stantec Consulting Ltd., St. John's, NL, for Husky Energy. St. John's, NL.

Ishibashi, Y., T. Honryo, K. Saida, A. Hagiwara, S. Miyashita, Y. Sawada, T. Okada and M. Kurata. 2009. Artificial lighting prevents high night-time mortality of juvenile Pacific bluefin tuna, *Thunnus orientalis*, caused by poor scotopic vision. Aquaculture, 293(3-4): 157-163.

Orbesen, E.S., D. Snodgrass, G.S. Shideler, C.A. Brown and J.F. Walter. 2017. Diurnal patterns in Gulf of Mexico epipelagic predator interactions with pelagic longline gear: Implications for target species catch rates and bycatch mitigation. Bulletin of Marine Science, 93(2): 573-589.

Payne, J.F., J. Coady, and D. White. 2009. Potential effects of seismic airgun discharges on monkfish eggs (*Lophius americanus*) and larvae/ Environmental Studies Research Funds Report, No.170 (St. John's, NL): 32 pp.

Stone H.H., and L.K. Dixon. 2001. A comparison of catches of swordfish, Xiphias gladius, and other pelagic species from Canadian longline gear configured with alternating monofilament and multifilament nylon gangions. Fishery Bulletin-National Oceanic and Atmospheric Administration 99:210–216.

Southwood, A., K. Fritsches, R. Brill and Y. Swimmer. 2008. Sound, chemical, and light detection in sea turtles and pelagic fishes: Sensory-based approaches to bycatch reduction in longline fisheries. Endangered Species Research, 5(2-3): 225-238.

Trenkel, V.M., G. Huse, B.R. Mackenzie, P. Alvarez, H. Arrizabalaga, M. Castonguay, N. Goni, F. Gregoire, H. Hatun, T. Jansen, J. A. Jacobsen, P. Lehodey, M. Lutcavage, P. Mariani, G. D. Melvin, J. D. L. Neilson, G. J. Oskarsson, M. R. Payne, D. E. Richardson, I. Senina, D. C. Speirs. 2014. Comparative ecology of widely distributed pelagic fish species in the North Atlantic: implications for modelling climate and fisheries impacts. Progress In Oceanography, 129, 219-243.

1.4.2 Information Requirement: IR-22-02

Reference to EIS:

Section 6.1.10.3.1.3 Waste Management

Context and Rationale

The Agency requested an updated description of corals and sponges in the project area. While Figure 1 provided in response to IR-22 provided an illustrated update of the distribution of corals and sponges in the project area, the information presented does not correspond with all the information provided in Table 4.19 of the EIS. For example, Table 4.19 of the EIS indicates the presence of Coral Gorgonia (no-skeleton and skeleton) in exploration license 1152, however Figure 1 indicates there are no Gorgonia corals in exploration license 1152).

It is noted that Table 4.19 of the EIS is based on data collected in 2014-2015 DFO RV surveys, however the source of information for Figure 1 in the response to IR-22 is “DFO, 2016”. No reference is provided for DFO 2016.

Specific Follow-up Question / Information Requirement

Revise table 4.19 of the EIS, based on most recent information or provide a rationale as to why information presented in Table 4.19 of the EIS and Figure 1 of the response to IR-22 may differ.

Provide the reference for the data used to develop Figure 1 in response to IR-22.

Response

During the course of responding to Information Requirements (IRs) and Clarification Requirements to update specific components of the EIS with certain information, different data sets were used, creating an inconsistency in data presentation. EIS Table 4.19 was based on 2014-2015 Fisheries and Oceans Canada (DFO) Research Vessel (RV) survey data (DFO 2016). Figure 1 in the response to IR-22 was based on 2016 DFO RV data (DFO 2018).

References

DFO (Fisheries and Oceans Canada). 2016. Research Vessel Data provided by Fisheries and Oceans Canada.

DFO (Fisheries and Oceans Canada). 2018. Research Vessel Multi-species Bottom Trawl Survey Database.

1.4.3 Information Requirement: IR-23-02

Reference to EIS:

Section 2.6.1.1.1 Drill Cuttings Deposition and Dispersion on the Grand Banks

Section 2.6.1 Drilling Waste

Context and Rationale

In IR-23 the Agency required a rationale to support how the model and inputs from the 2012 WREP model are applicable to the current project. The proponent stated that "the model inputs used in 2012 were the same as would have been used in a cuttings discharge model for a MODU drilling in ELs adjacent to the White Rose field with a couple of important exceptions." However, as advised by Fisheries and Oceans Canada a rationale is required to demonstrate how the model inputs are applicable to the current project. Specifically, mean current speeds and velocities presented in Table 4.6 for ELs 1151 and 1155 are considerably higher than those used in the 2012 modelling. For example: near surface mean speed presented in Table 4.6 for ELs 1151 and 1155 ranges from 30.5 to 35.8 cm/s; near surface mean speed in the 2012 report ranges from 12 to 20 cm/s. Similarly, the mean near surface velocity presented in Table 4.6 for ELs 1151 and 1155 is 15.9 to 13.5 cm/s whereas in the 2012 modelling report the mean near surface velocity range is 2 to 4 cm/s.

Specific Follow-up Question / Information Requirement

Taking into consideration the information provided by Fisheries and Oceans Canada, discuss how the currents used in the 2012 model for the WREP are applicable to the current Project considering data presented in Table 4.6 of the EIS.

Response

The current values in Table 4.6 of the EIS were presented to demonstrate the geographic and seasonal variability as suggested by the numerical model results presented in Figure 4-13 as part of an overall description of the physical environment and ocean circulation in the Project Area. As a result of this variability, it is expected that there would be some variations in the drill cuttings dispersion patterns depending on the location of drilling operations within each EL and between ELs, as well as in which season they would take place. There are no other moored current meter observations in the Project Area besides the 3-year White Rose site data set. While it is acknowledged that the data set used for the 2012 WREP drill cutting dispersion modeling may not be precisely representative of the whole Project Area, it is still considered more appropriate as observations have a better chance to capture the time variability resulting from the combination of the multiple and complex physical processes at play. In addition, water depth in the Project Area is relatively homogeneous and comparable to the White Rose field. Assuming that the differences between the currents statistics from the observations at White Rose and the numerical model values of Table 4.6 are representative of the geographical variability of the Project Area, it is possible to scale the 2012 dispersion results to stronger or weaker currents. The largest difference is for the mean drift (mean velocity) which implies that the footprint in regions with stronger mean drift (numerical model values) would stretch and be offset on a longer distance from the drilling site in the direction of the mean drift. The maximum currents from both sources are not very different, while the mean current values differ by about a factor of two. A higher mean drift (current velocity) would carry materials (e.g., cuttings) further away while a higher mean current speed would increase dispersion. Therefore, if mean current speed and mean velocity measurements at specific wellsite were closer to those presented in Table 4.6 than those assumed in the WREP modelling, one would expect to see a cuttings discharge dispersion footprint twice as large in radius but also twice as thin in deposition thickness (i.e., half the predicted deposition thickness). Therefore, instead of expecting potential mortality of coral (assuming a threshold of burial thickness of 6.5 mm) within a 100-200 m radius of the discharge site, this radius would be reduced to 50-100 m.

References

N/A

1.4.4 Information Requirement: IR-25-02

Reference to EIS:

Section 2.6.1 Drilling Waste

Context and Rationale

In IR-25, the Agency required the proponent to update the effects analysis for fish and fish habitat and special areas as a result of drilling waste discharges, considering the analysis of the dispersion modelling results and specific mitigation measures planned to avoid and/or mitigate impacts. In its response, the proponent stated that "Husky will conduct a visual survey (using a remotely operated vehicle) of the seafloor prior the start of drilling to assess the presence of any aggregations of habitat-forming corals or sponges", however no further information was provided on the visual survey.

Specific Follow-up Question / Information Requirement

Provide information on the spatial scope of the pre-drill visual survey, including how dispersion modelling results will be incorporated into the survey design.

Response

Drill cuttings dispersion modelling conducted within the Project Area concluded that there will be a well-defined cuttings patch covering an area which extends 100 -200 m out from the drill center. The patch has a varying thickness ranging from 1-10 mm, with some portions resulting in burial thickness of 25 to 50 mm. Recent research from Larsson and Purser (2011) have indicated that cold-water coral species could be affected by burial depths of 6.5 mm. As a result, there is the potential for mortality (albeit low) for coral species within the 100 to 200 m cuttings dispersion zone.

Husky will determine the need for pre-drill coral and sponge surveys in consultation with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and Fisheries and Oceans Canada (DFO). If it is determined that a survey will be needed in a certain area before a well can be drilled, it is expected that the survey will include a minimum radius of 200 m from the wellsite. Additional areas may be required to account for anchors and anchor chains (from touchdown point to anchor) if an anchored MODU is planned to be used. This survey will provide baseline data for the presence/absence of sensitive environmental features (e.g., corals and sponges) within a predicted zone of influence for potential mortality from drill waste deposition. If sensitive environmental features are identified during the survey, Husky will move the spud location to avoid affecting them if it is feasible to do so. If it is not feasible, Husky will consult with the C-NLOPB and DFO to determine an appropriate course of action.

References

Larsson, A. and A. Purser. 2011. Sedimentation on the cold-water coral *Lophelia pertusa*: Cleaning efficiency from natural sediments and drill cuttings. Marine Pollution Bulletin, 62(6): 1159-1168. doi: 10.1016/j.marpolbul.2011.03.041.

1.4.5 Information Requirement: IR-28-02

Reference to EIS:

Section 6.2.10.3.1.4 Supply and Servicing

Context and Rationale

IR-28 required the proponent to provide information to support the conclusion that sound from supply and servicing activities will not result in a change in risk of mortality, physical injury or health of fish.

The proponent has stated that the assessment is based on the relative sound level exposure to Project activities, as the quantitative metrics or guidelines for assessing behavioral effects of sound on fish are not available. Given that quantitative metrics or guidelines are not readily available nor readily applicable, it is necessary to focus the assessment of potential effects on the incremental effect on sound loading/biological exposure. The C-NLOPB has advised that since the proponent predicts no significant change in health effects, injury or mortality, it is necessary to discuss this in the context of the project area, including changes in operational support vessel traffic and standby time, how changes are measured, and the increase in the overall area of the offshore area impacted by operational support vessel traffic and standby.

Specific Follow-up Question / Information Requirement

In the context of the project area, provide information to support the prediction that sound from supply and servicing activities related to the Project will not cause significant change in health effects, injury or mortality to fish. The response should include the following:

- Describe how much operation support vessel traffic and standby time will be generated in comparison to the overall traffic and standby time in the project area, as well as how this is measured (i.e. exposure hours), and
- Describe how much of this traffic and standby time will be in areas already subject to operational support vessel traffic/standby sonic loading, as well as how much incremental loading will be experienced in these areas.

Response

The cumulative effects assessment on marine fish predicted that supply vessel-related emissions of artificial light and underwater sound will affect habitat quality in such a way that has potential to disturb fish and cause temporary behavioural effects (e.g., localized avoidance/displacement or attraction). However, a Change in Risk of Mortality, Physical Injury, or Health was not predicted to occur as a result of supply and servicing activities related to the Project or as a result of supply and servicing activities associated with production projects in the Project Area.

According to the St. John’s Port Authority, a total of 1,300 to 1,601 vessel transits in and out of the Port of St. John’s were recorded annually between 2010 and 2015; of these, supply vessels comprised 749 to 1,027 annual transits (R. McCarthy, pers. comm. 2016). Each of the four production projects in the Jeanne d'Arc Basin (Terra Nova, Hibernia, Hebron, White Rose), has a fleet of approximately four standby/supply vessels. As per s. 70 of the Newfoundland Offshore Petroleum Drilling and Production Regulations, the operator of a "manned installation" (e.g., platform, MODU) must keep a support vessel available at a distance that is not greater than that required for a return time of twenty minutes.

It is assumed that for this Project, Husky would call upon the four vessels employed on the White Rose Extension Project as needed for supply and servicing, and add another vessel to the fleet to ensure that one vessel is capable of serving as stand-by vessel for the Exploration Project at all times. Although the vessel designated for standby will change throughout the course of the drilling program, in accordance with regulations, it is mandatory to have a vessel present for the course of the drilling program while the MODU is on location. Therefore there would be a continuous presence of standby vessels associated with each production project and exploration drilling project during project operations (extending for months or years) along with intermittent traffic associated with supply vessel transit to and from project installations. This would be in addition to other marine traffic consisting of tankers, cargo vessels, fishing vessels, and passenger ships transiting in and around the Project Area, generating underwater sound (see Figure 3 in Delarue 2018 for a depiction of marine vessel traffic density off the east coast of Canada and the United

States). The incremental addition of one more vessel for Husky's Exploration Drilling Project is not predicted to cause a significant Change in Risk of Mortality, Physical Injury, or Health for marine fish.

References

Delarue, J., K.A. Kowarski, E.E. Maxner, J.T. MacDonnell, and S.B. Martin. 2018. Acoustic Monitoring Along Canada's East Coast: August 2015 to July 2017. Document Number 01279, Environmental Studies Research Funds Report Number 215, Version 1.0. Technical report by JASCO Applied Sciences for Environmental Studies Research Fund, Dartmouth, NS, Canada. 120 pp + appendices.

MacCarthy, R. Manager of Marine Operations, St. John's Port Authority, St. John's, NL. 2016.

1.5 MARINE MAMMALS AND SEA TURTLES

1.5.1 Information Requirement: IR-36-02

Reference to EIS:

Section 6.3.10.2 Mitigation

Context and Rationale

The Agency required the proponent to define "safe vessel speed" and to explain under which circumstances it would not be possible to travel at the defined safe vessel speed and to explain the factors that may influence the travel route. The proponent provided the definition of safe vessel speed as per the International Regulations for Preventing Collisions at Sea but did not explain what factors may influence the speed at which a vessel travels. Likewise, there was no discussion related to the factors that may influence the travel route.

Specific Follow-up Question / Information Requirement

Discuss factors which would influence the speed at which a vessel may travel and the travel route. Discuss the average speed at which supply vessels would travel in the project area.

In addition to the lookout maintained by the Officer on Watch, discuss if there would there be additional resources dedicated to avoiding concentrations of marine mammals and sea turtles. For example, confirm if there would there be marine mammal observers on all supply vessels.

Response

Transit speed and travel routes are generally designed to optimize fuel economy (i.e., reduce fuel consumption and associated costs). The average transit speed for a supply vessel would be an economical speed of approximately 10-12 knots. The speed may increase or decrease depending on the urgency of supply needs but would not exceed a maximum operating speed of 15 knots. If the Officer on Watch observes a concentration of marine mammals or sea turtles in close proximity to the vessel, the vessel would take evasive action to reduce risk of vessel strike. Supply vessels are very responsive and able to execute alterations in direction and speed much easier than larger vessels (e.g., cargo ships, tankers). There would be no dedicated marine mammal observer on supply vessels.

References

N/A

1.6 MIGRATORY BIRDS

1.6.1 Information Requirement: IR-41-02

Reference to EIS:

Section 6.4.10 Assessment of Residual Environmental Effects on Migratory Birds

Context and Rationale

In IR-41 the Agency required the proponent to provide additional information related to the potential available options to restrict flaring to a minimum, how flaring will be minimized during nighttime, poor weather conditions and during periods of bird vulnerability, and information regarding the episodic nature of incineration at flares. While the proponent did provide information related to episodic nature of incineration at flares, there was no information provided related to options to restrict flaring, or the ability to minimize flaring during nighttime, poor weather and periods of bird vulnerability.

Specific Follow-up Question / Information Requirement

Describe the potential available options to restrict flaring to the minimum required to characterize a well's hydrocarbon potential and as necessary for the safety of operation.

Describe how flaring will be minimized during night-time, poor weather conditions, and during periods of bird vulnerability.

Based on the information presented related to the episodic nature of incineration at flares, discuss how information would be or is used to develop effective measures to reduce effects on migratory birds.

Response

As indicated in the responses to IR-09 and IR-09-02, an alternative to conventional well testing with flaring would be formation testing while tripping (FTWT) which does not involve flaring. If a well test program is proposed for any well on this Project, Husky will require a separate authorization from the C-NLOPB in accordance with the *Newfoundland Offshore Petroleum Drilling and Production Regulations*. As part of that authorization process, Husky will discuss with the C-NLOPB proposed well testing methods and timing of well testing including measures to reduce effects on migratory birds. Husky would aim to avoid flaring from mid-September to mid-October, which has been identified as a period of vulnerability particularly for storm-petrels. Husky would also plan flaring associated with well testing such that it would not commence during night-time or periods of poor visibility when birds may be more susceptible to attraction to the flare. However, once well testing with flaring begins, data gathered during the well test could be compromised if the well flow was restricted during the test period. Flaring associated with well testing, if it occurs, is estimated to occur over a period of 1-2 days per well.

Data collected from bird stranding and mortality monitoring will be correlated with Project activities, to determine if stranding or mortality events increase during episodic flaring. Data collected will be shared with the C-NLOPB as well as with the Canadian Wildlife Service (as a condition of the bird handling permit required to conduct the survey).

References

N/A

1.6.2 Information Requirement: IR-43-02

Reference to EIS:

Section 6.4.10.2 Mitigation

Section 6.4.12 Follow-up and Monitoring

Context and Rationale

The Agency required a discussion of the need for and feasibility of using bird stranding and mortality data as an adaptive management tool. The proponent described the development of a systematic monitoring protocol, results reporting, and observer training, however did not provide a discussion on how ,or if, results would be used as an adaptive management tool by Husky. In addition, while it was stated that the data collected related to seabird strandings will be reported to the C-NLOPB within 90 days of well suspension or abandonment, it was not confirmed if information will be shared with Indigenous groups.

Specific Follow-up Question / Information Requirement

Discuss the feasibility of using bird stranding and mortality data as an adaptive management tool, providing information on how data collected will be incorporated into potential mitigation and monitoring measures. Confirm if information related to mortality and stranding and injury will be shared with Indigenous groups, and the involvement of Indigenous groups in the development of the follow up program.

Response

A follow-up program for migratory birds will consist of systematic daily searches in accordance with the Procedures for the Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada (ECCC 2016) and associated permit conditions under the Migratory Birds Convention Act, 1994 authorizing the capture and handling of migratory birds. Bird stranding and mortality data will be submitted to the C-NLOPB as well as to Canadian Wildlife Service (CWS); distribution to the CWS is a requirement of permit conditions.

Bird stranding and mortality data has been collected by Husky during its ongoing production operations on the Grand Banks for several years. The results of this monitoring, in addition to similar data collected by other operators, have identified periods of vulnerability for migratory birds (September-October). This finding is already resulting in adaptive management for mitigative procedures such as avoiding flaring to the extent possible during this period of vulnerability (see response to IR-41-02 for example). Future data collected by this Project, along with other exploration drilling projects and production projects, will be submitted to the C-NLOPB and CWS to determine if there are any additional learnings which may be incorporated into future mitigation and monitoring programs.

During consultation and engagement with Indigenous groups on the development of an Indigenous Fisheries Communication Plan, Indigenous groups requested to receive results of monitoring programs conducted during Project operations. Husky has committed to sharing results of monitoring programs when available as part of monthly operational updates to Indigenous groups, including results of bird stranding and mortality monitoring data collected for this Project.

References

ECCC (Environment and Climate Change Canada). 2016. Procedures for the Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada. 17 pp + Appendices.

1.7 INDIGENOUS PEOPLES

1.7.1 Information Requirement: IR-58-02

Reference to EIS:

Section 6.2.10.2 Mitigation

Context and Rationale

In IR-58 the Agency requested that the proponent discuss if, and how, communal-commercial harvesters and Indigenous groups would be engaged in the development of Husky's compensation programs. In its response the proponent has provided an overview of the compensation program resolution process, however, has not indicated how stakeholders will be engaged in development of Husky's compensation program.

Specific Follow-up Question / Information Requirement

Discuss if, and how, commercial and communal-commercial harvesters and Indigenous groups will be engaged in the development of Husky's compensation program.

Response

Husky has an established compensation program in place for its production projects (West White Rose Project and White Rose Project). Since this compensation program was developed over ten years ago, Husky has managed several claims and all have been resolved to the satisfaction of fisheries stakeholders. Husky regularly reviews its compensation program in consultation with the C-NLOPB and fisheries stakeholders to review lessons learned and identify opportunities for improvement. This program, which is consistent with the *Compensation Guidelines with Respect to Damages Relating to Offshore Petroleum Activity* (C-NLOPB and Canada-Nova Scotia Offshore Petroleum Board 2017), would be adopted for Husky's exploration drilling activities on this Project as well.

Husky will continue to engage with Indigenous groups and fisheries stakeholders, including during the development of the Indigenous Fisheries Communication Plan and the Fisheries Communication Plan. An Indigenous Fisheries Communication Plan has already been drafted in consultation with Indigenous groups and will help guide communications around routine operations and accidental events. This draft Plan will be revisited as necessary as Project planning advances to the implementation of exploration activities. A similar Fisheries Communication Plan will be developed in consultation with commercial fisheries stakeholders.

References

C-NLOPB (Canadian-Newfoundland and Labrador Offshore Petroleum Board) and CNSOPB (Canada-Nova Scotia Offshore Petroleum Board). 2017. Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity. Available at: http://cnsopb.ns.ca/sites/default/files/pdfs/CompGuidelines.pdf.

1.8 ACCIDENTS AND MALFUNCTIONS – DESCRIPTIONS, BLOWOUTS

1.8.1 Information Requirement: IR-72-02

Reference to EIS:

Section 7.2.1.3 Shallow Gas Versus Deep-well Blowout

Context and Rationale

In IR-72, the Agency required additional information regarding factors that have led to the decline in frequency of shallow water gas blowouts in the North Sea and Gulf of Mexico, if data on the frequency of blowouts post 1997 is available, and the applicability of this information to the proposed project. In addition, a comparison between shallow gas versus deep-well blowouts, and the applicability to the proposed project was required.

In its response the proponent did not discuss the applicability of shallow gas blowouts to the project, the reasons for the decline in frequency of shallow gas blowouts, and the applicability of the data from the North Sea and Gulf of Mexico to the Project.

Specific Follow-up Question / Information Requirement

Explain why shallow gas blowout frequencies in the North Sea and in the Gulf of Mexico have been on the decline in recent years, considering updated information (post 1997) if available.

Clarify the comparison between shallow gas versus deep-well blowout and applicability to the proposed project.

Response

A blowout is an uncontrolled release of fluids from a reservoir formation and is caused when the hydrostatic pressure of fluid in the well bore is lower than the formation pressure, resulting in an influx of formation fluids into the well bore. If this influx is not safely removed from the wellbore, and if the blowout preventer (BOP) equipment is ineffective, a blowout may occur. A shallow gas blowout occurs in shallow formations before the BOP is installed on the well. A deep-well blowout refers to a blowout that occurs after the BOP is installed on the well.

As explained in Section 7.2.1.3 of the EIS, a blowout might occur if shallow gas is encountered unexpectedly during drilling operations, which may be of concern from the mudline to approximately 914 m and below. Gas that is trapped in the shallow sediments can originate from deeper gas reservoirs but can also come from biogenic activity in the shallow sediments. The vast majority of blowouts and well releases are of the shallow gas variety. Shallow gas blowout frequencies in the North Sea and in the US Gulf of Mexico have been on the decline in the most recent years of the record. A recent spill probability assessment (SL Ross 2017) attributed blowout frequency decline in recent years due to regulatory and technology updates, including the use of a blowout preventer (BOP). Most recently available data indicates the blowout frequency for the US Outer Continental Shelf as 3.62×10^{-3} per well drilled and 3.1×10^{-4} per well drilled in the North Sea. These statistics would be representative of risk calculations for offshore exploration drilling projects in Atlantic Canada given similar regulatory regimes and technology use.

The *Newfoundland Offshore Petroleum Drilling and Production Regulations* require that operators "ensure that adequate equipment, procedures and personnel are in place to recognize and control normal and abnormal pressures, to allow for safe, controlled drilling operations and to prevent pollution". This includes the use of a BOP and backup systems to intervene and actuate the BOP stack (e.g., autoshear system, remotely operated vehicle [ROV] intervention) in the event of a BOP malfunction.

Husky will conduct a geohazard analysis prior to drilling to determine the potential risk of encountering geohazards such as shallow gas pockets prior to drilling and will manage blowout risks through a combination of equipment (e.g., BOP stack, shear rams), processes and procedures (e.g., BOP testing, monitoring formation pressure) and use of competent personnel.

References

SL Ross. 2017. Spill Probability Assessment for Nexen Energy ULC Flemish Pass Exploration Drilling Environmental Assessment. 20 pages. https://www.ceaa-acee.gc.ca/050/documents/p80117/122072E.pdf

1.9 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

1.9.1 Information Requirement: IR-104-02

Reference to EIS:

Section 8.2.2.3 Seismic Events and Tsunamis

Context and Rationale

In IR-104 the proponent was required to discuss whether long distance tsunami waves would break when they hit the shallow waters of the Grand Banks, and to discuss the effects this would have on the Project if it was to occur. The proponent has discussed the cause and frequency of tsunamis, as well as the potential effects of tsunamis. However, there is no discussion on whether the tsunami wave would break on the relatively shallow waters of the Grand Banks and how much the wave could potentially grow in height and narrow in width. Natural Resources Canada indicated that Lynett, 2011 states that tsunami wave height will increase on the shelf. In addition, measures taken to minimize the impact of a tsunami on the project infrastructure within their engineering design plans, providing references to support statement is required.

Reference: Lynett, P.J. and Liu, P.L.F., 2011, Numerical Simulation of Complex Tsunami Behavior, IEEECs and AIP.

Specific Follow-up Question / Information Requirement

Discuss whether a tsunami wave would break on the relatively shallow waters of the Grand Banks and describe how much the wave could potentially grow in height and narrow in width.

Provide a discussion on measures taken to minimize the impacts of a tsunami on the project infrastructure within engineering design plans.

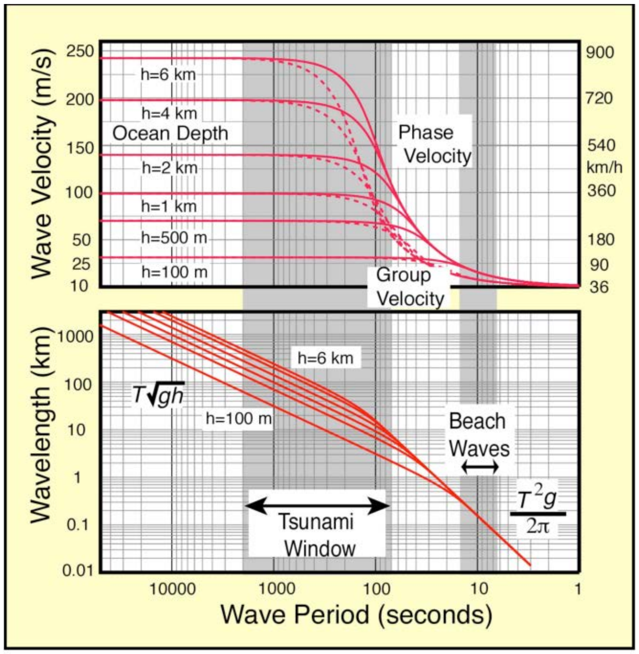
Response

<u>Tsunami Characteristics</u>

Tsunamis can be created by a submarine earthquake, a landslide, or - extremely rarely - a meteor impact (Lynett and Liu 2011). Tsunami waves behave like shallow-water waves, as their wavelength is much larger than the ocean water depth. Typical tsunami waves have periods ranging from 70 s to even 2,000 s (Figure 1). The tsunami velocity can be approximated by the formula of the phase speed of shallow water waves

$$c = \sqrt{gH} \quad (1)$$

where g is the acceleration due to gravity (9.8 m/s^2) and H is the depth of water. Depending on the wave depth, tsunami waves can travel at 160 to 250 m/s (Figure 1). In the open ocean, tsunami waves have a wavelength of 10 to even 100 km (Figure 1). Tsunami wave height in the open ocean is imperceptible and smaller than 1 m.



Source: Ward 2010 (Figure 1)

Figure 1 Phase Speed (solid lines) and Group Speed (dashed lines) of Tsunami Waves on a Flat Earth Covered by Oceans of 100 m to 6 km depth (top). Wavelength Associated with Each Wave Period (bottom)

Wave Shoaling

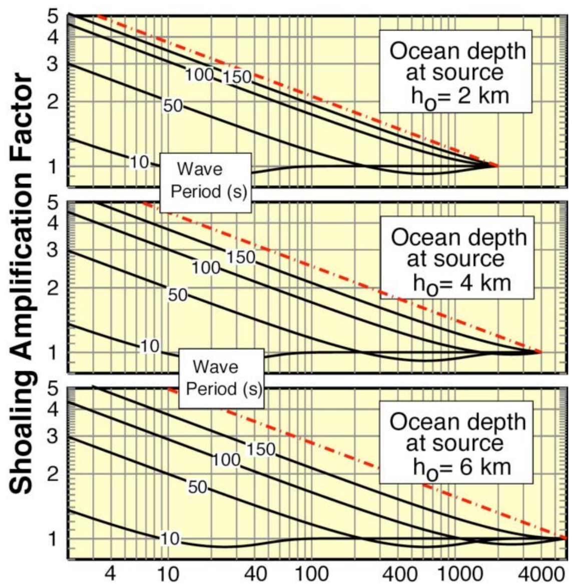
As a tsunami travels at a speed related to the water depth, when it leaves the deep wave of the open ocean and enters shallower water, it slows down and the wavelength decreases, causing the wave height to be much higher. This is called “shoaling”.

The increase of the tsunami’s wave height as it enters shallow water is given by Green’s law

$$\frac{\mathrm{h_s}}{\mathrm{h_d}} = \left(\frac{\mathrm{H_d}}{\mathrm{H_s}}\right)^{1/4} \quad (2)$$

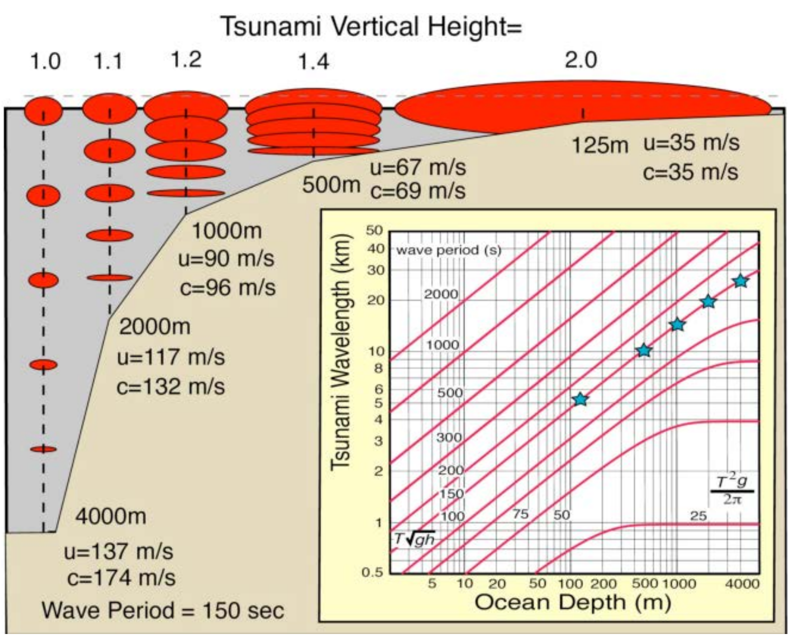
where hs and hd are wave heights in shallow and deep water and Hs and Hd are the depths of shallow and deep water. Ward (2010) showed that the increase in tsunami’s wave height also depends on wave periods, and shorter wave period corresponds to smaller increase in wave height, which is smaller than that as computed by Green’s law (Figure 2).

A tsunami with a wave height of 1 m in the Atlantic, where the water depth is 4,000 m, would have a wave height of 3.2 to 2.2 m over the Grand Bank, where the water depth is from 36 to 185 m. If the wave period in the open ocean is 200 s, the wavelength would decrease from 40 km in the open ocean to ~4 to 8 km as the wave approaches the Grand Bank (Figure 3).



Source: Ward 2010 (Figure 12)
Note: The dashed red line is Green's Law.

Figure 2 Shoaling Amplification Factor (hs/hd) for Ocean Waves of Various Frequencies and Source Depths



Note: The shallowing ocean near shore concentrates wave energy into smaller volumes and tsunami grow in response.

Figure 3 Effect of Shoaling on Tsunami Wavelength

Wave Breaking

When the approaching tsunami shoals to a wave height roughly equal to the water depth and the wave begins to break (Ward 2010). As computed above, the wave shoaling over the Grand Bank leads to steepened waves, which heighten in shallow water, but do not become steep enough to break.

Tsunami waves in rare scenarios do break offshore over the continental shelves. Wave breaking of large waves on continental slopes and shelved is sometimes referred to as the "Van Dorn effect" (Van Dorn et al. 1968). Korycansky and Lynett (2005) investigated typical tsunami waves due to sub-km impactors, such as asteroids and comets into the deep ocean. Tsunami generated by these impactors generates waves of heights up to 100 m and periods 20 to 100 s that are outside the range of those due to earthquake or landslide tsunami. They found that the tsunami waves should indeed break in relatively shallow water (<100 m depth) on continental shelves. They argued that the observed Van Dorn effect of wave breaking is the logical consequence of non-linear shoaling.

Dzvonkovskaya et al. (2014) used high-frequency radar data to study shoaling of waves due to the disturbance of the 11 March 2011 tsunami, which originated near Japan. They found that non-linear processes reduced half of the tsunami wave amplitude as it approached the continental slope from deep water, and the shoaling process up the continental slope followed the linear theory. It means that the rise in wave height over the continental slope would be smaller according to Green's Law, which makes wave breaking even less possible.

Conclusion

A typical submarine earthquake generated tsunami in the Atlantic Ocean may have a wave height of 1 m, a wave period of 200 s and a wavelength of 40 km. As it travels from its epicenter in the Atlantic Ocean, where the water depth is supposed to be 4,000 m, to the Grand Banks (36 to 185 m water depth), its wave height would increase from 1 m to 3.2 to 2.2 m, and its wavelength would decrease from 40 km to ~4 to 8 km, correspondingly.

As the tsunami steepens over the Grand Banks, it does not become steep enough to become overturning breaking waves. Sometimes tsunamis due to sub-km impactors might break far offshore, but it rarely happens to tsunamis caused by submarine earthquakes and landslides.

Mitigation Measures

The effects of a tsunami would be mitigated through standard mitigation measures for working in harsh weather environments with extreme wave heights. Husky will use a MODU that meets harsh weather design criteria. As part of the C-NLOPB authorizations required to conduct the drilling program, and in accordance with the *Newfoundland Offshore Certificate of Fitness Regulations*, Husky will obtain a Certificate of Fitness from an independent third party Certifying Authority for the MODU prior to commencement of drilling operations. The Certifying Authority reviews installations to confirm they are fit for purpose, function as intended, can be operated safely without polluting the environment, and meet the requirements of the regulations. Husky will also continuously monitor meteorological and oceanographic conditions during drilling and observe operating limits and implement stop-work procedures (including riser disconnect procedures as applicable) in the event of unsafe conditions.

References

Dzvonkovskaya, A., M. Heron, D. Figueroa, and K.-W. Gurgel. 2014. Observations and theory of a shoaling tsunami wave. 10.1109/OCEANS.2014.7003236.

Korycansky, D.G. and P.J. Lynett. 2005. Offshore breaking of impact tsunami: The Van Dorn effect revisited, Geophys. Res. Lett., 32: L10608.

Lynett, P.J. and P.L.F. Liu. 2011. Numerical simulation of complex tsunami behavior. Comput. Sci. Eng., 13: 50-57.

Van Dorn, W.G., B. Le Méhauté and L.-S. Hwang. 1968. Handbook of explosion-generated water waves. Rep. TC-130, Tetra Tech Inc., Pasadena, Calif.

Ward, S.N. 2010. Tsunami, Encyclopedia of Solid Earth Geophysics. Springer.

1.10 CUMULATIVE EFFECTS

1.10.1 Information Requirement: IR-107-02 and 108-02

Reference to EIS:

Section 9.2.1.2 Offshore Exploration Drilling and Production Projects

Table 9.4 Potential Residual Effects Associated with Offshore Exploration Drilling and Production Projects in the Study Area

Context and Rationale

In IR- 107 and 108 the Agency required a discussion related to the potential cumulative environmental effects of artificial light from the Project on migratory birds, in particular related to the potential effect of altered or disturbed migration routes. In addition, the contribution of the Project to overall amounts of artificial light required discussion.

With respect to the contribution of the Project to overall light in the region, the proponent states that project lighting and flaring will represent only a 'small increase over existing levels of lighting and flaring in the study area, will be temporary and localized, and will occur by licence areas from other light sources'. However, no information provided to support the statement related to the contribution of the Project to light levels.

The proponent indicated that the distance between projects operating in the Newfoundland and Labrador offshore would allow birds to pass between projects without being influenced. However, this statement is not supported in the response.

Specific Follow-up Question / Information Requirement

Provide information to support the statement related to the contribution of light from the Project to the area.

Provide information to support the statement that the distance between projects operating in the Newfoundland and Labrador offshore would allow birds to pass between projects without being influenced.

Response

Figure 1 illustrates the zones of influence (ZOI) of light created by existing production platform locations within the Study Area, which include Hibernia, Hebron, Terra Nova and White Rose. It has been noted that lighting attraction effects are anticipated to be confined to within approximately 5 km (Poot et al. 2008) to 16 km (Rodríguez et al. 2014, 2015) of the source. For the purpose of Figure 1, the largest anticipated ZOI (16 km) was used.

With regards to the contribution of the Project to light levels, it is anticipated that similar to the existing platforms within the Study Area, the Project would produce light that could influence birds up to a radial distance of 16 km, resulting in a ZOI of 804 km^2. This light will be produced by the Project's mobile offshore drilling unit (MODU) and offshore supply vessels, and will be constant during the 60 to 90 days required to drill a well. Depending on the location of the wellsite, the ZOI of light produced could overlap with existing ZOIs from the production platforms, or could cover an area currently unaffected by other offshore exploration or production activities. If a wellsite is located greater than 32 km from existing platforms, then the Project ZOI will not overlap with their ZOIs, and the subsequent new area influenced by light would cover a maximum of 804 km^2.

The previous IR response indicated that birds could pass between projects without being influenced by the artificial light produced by offshore exploration activities. Based on Figure 1, this is currently true for some of the current platforms. A migrating bird could currently pass between White Rose and any other platform, without entering a ZOI. The ability for birds to pass between the Project and other platforms without being influenced by light will depend on the location of the wellsite. If a wellsite is located in the northern third of the Project Area, the ZOI of light would have little or no overlap with ZOIs from existing platforms. As such, birds would have the ability to pass between ZOIs. However, if a wellsite is located in close proximity to an existing platform, if may not be possible for a migrating bird to pass between the wellsite and one or more existing platforms without being influenced. In this case, birds are still able to avoid the area, as the Project Area represents a small percentage of the vast ranges of most migratory bird species expected in the area. Drilling represents a temporary activity (60 to 90 days) that will contribute to cumulative effects, but would not result in significant adverse effects (refer to EIS Section 6.4.10.3 for a full assessment of the effects of lighting on marine birds).

It is also important to note that oil and gas exploration and production activities are not the only sources of artificial light in the offshore environment; fishing fleets and cargo vessels are other mobile sources. These are not shown in Figure 1, as they could occur throughout the Project Area at any time.

References

Poot, H., B. Ens, H. de Vries, M. Donners, M. Wernand and J. Marquenie. 2008. Green light for nocturnally migrating birds. Ecology and Society, 13(2).

Rodríguez, A., G. Burgan, P. Dann, R. Jessop, J.J. Negro and A. Chiaradia. 2014. Fatal attraction of short-tailed shearwaters to artificial lights. PLoS ONE 9(10): e110114.doi:10.1371/journal.pone.0110114

Rodríguez, A., B. Rodriguez and J.J. Negro. 2015. GPS tracking for mapping seabird mortality induced by light pollution. Sci. Rep., 5, 10670; doi: 10.1038/srep10670.

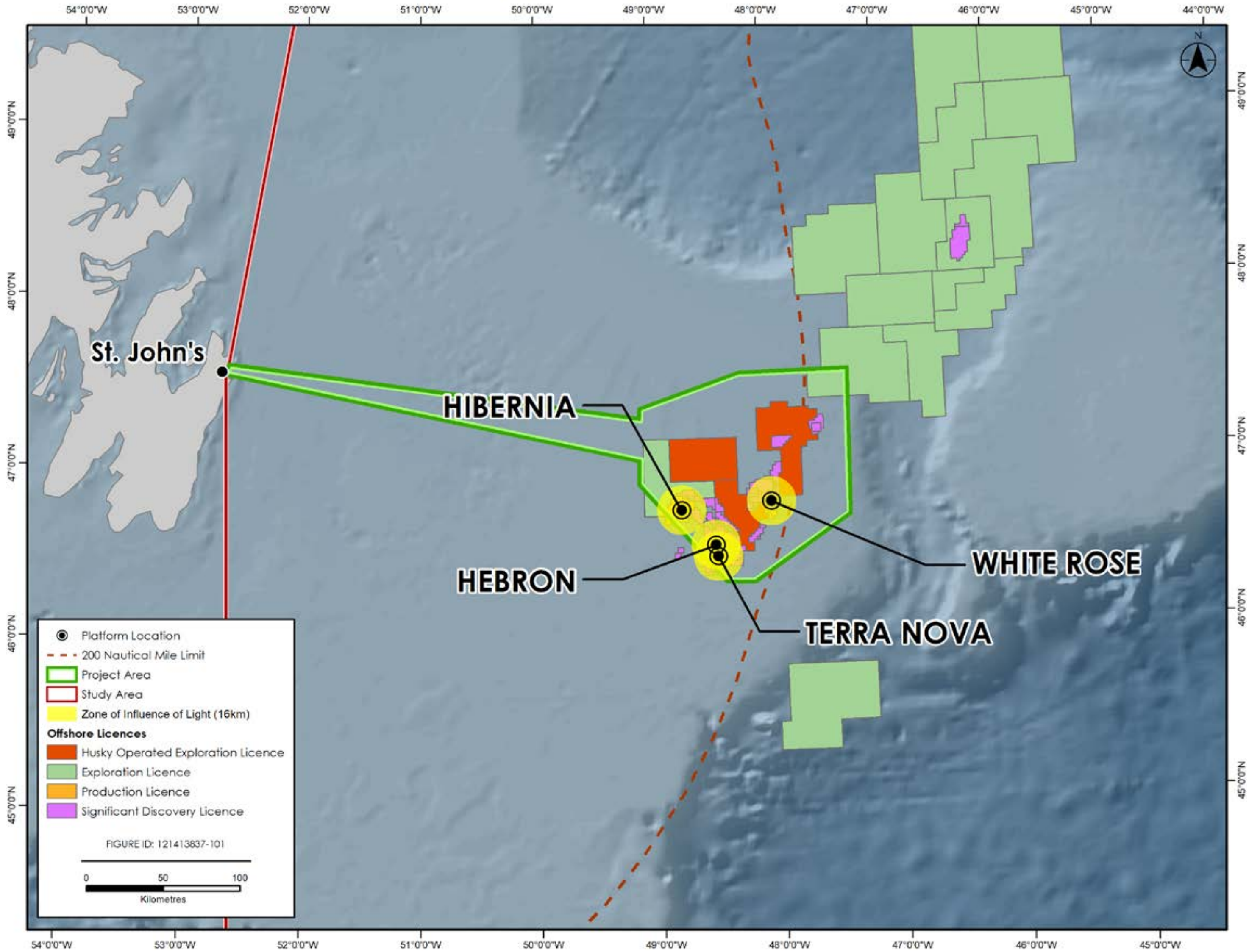


Figure 1 **Zone of Influences from Permanent Light Sources in the Project Area (assuming a 16 km radius from light source)**