APPENDIX N

Newfoundland and Labrador Offshore Area
2018 Coral, Sponge and Fish Habitat Survey Plan

Equinor Canada Ltd.
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2018 Coral, Sponge and Fish Habitat Survey Plan

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1 Introduction

Equinor Canada Ltd. (formerly Statoil Canada Ltd.) (herein referred to as Equinor Canada) plans to undertake coral, sponge and fish habitat surveys in the Flemish Pass area offshore Newfoundland and Labrador (NL) in 2018. This Coral, Sponge, and Fish Habitat Survey Plan (herein referred to as the Plan) outlines the survey methodology that Equinor Canada (and/or its contractors) will implement during the survey.

The purpose of the survey is to collect baseline data in support of potential exploration and/or development activities in the Flemish Pass area. The data will also be used in support of project design activities. The survey methodology, as described herein, follows the methodology outlined in the *Monitoring of Drilling Activities in Areas with Presence of Cold Water Corals* (NOROG 2013) (herein referred to as the NOROG Guideline), as described in the "Flemish Pass Exploration Drilling Program Environmental Impact Statement" (EIS) (herein referred to as the Exploration Drilling EIS) (Statoil 2017).

As described the NOROG Guideline, side scan sonar (SSS) and multibeam echosounder (MBES) have been effective in mapping coral reefs on the Norwegian Continental Shelf (NCS). However, as indicated by DFO during the regulatory review of the Exploration Drilling EIS, this technology is not likely to detect smaller corals and sponges that are known or likely to be present offshore NL. The intent of this survey is to validate the use of MBES/SSS technology as a tool for coral mapping and to determine the presence of corals and sponges in the survey area. The survey will be conducted with an autonomous underwater vehicle (AUV) equipped with MBES and SSS with a resolution of 0.2 m. By using the higher resolution, it is anticipated that the smaller hard corals may be detected. Anomalies mapped by MBES/SSS will be investigated with a remotely operated vehicle (ROV) equipped with a high definition (HD) camera to capture video and photographs. As for soft corals and sponges, which cannot be detected using acoustic data, visual data will be collected in areas where seabed contact is anticipated. Refer to Section 3 for further details.

The proposed 2018 seabed survey will also include a fish habitat survey to collect data that may be required to support an application for a Fisheries Act Authorization. To ensure a cohesive survey plan, information regarding the fish habitat survey is also included in this document in Section 4. Although these plans are detailed separately, video collected for assessing fish habitat will also be utilized for determining the distribution of corals and sponges.

2 Background

2.1 Anticipated Species Offshore Newfoundland and Labrador

According to DFO, there are approximately 25 to 30 coral species present in waters offshore Atlantic Canada, and are typically found at depths greater than 150 metres (m) (DFO 2017). However, bottom

trawling and video surveys have identified over 50 species of corals and sea pens within, and adjacent to, the Exploration Drilling EIS project area (Statoil 2017).

According to DFO, approximately 34 sponge species have been identified in waters offshore Atlantic Canada and are present throughout a vast range of depths (e.g. inter-tidal zone, depths of 8 kilometres [km]) (DFO 2017). The Exploration Drilling EIS indicated that at least 32 sponge species were observed in, and adjacent to, the project area (Statoil 2017).

As specified in the Exploration Drilling EIS, the following corals and sponges have been observed in the project area (Statoil 2017):

- Black-wire corals
- Large gorgonians
- Small gorgonians
- Soft corals
- Solitary stony corals
- Sea pens
- Numerous sponge species

2.2 Potentials Impacts from Project Activities

Associated with drilling, and potential future development activities in the survey area, potential activities which may affect benthic habitat included the discharge of drill cuttings, and the installation of flowlines, moorings, riser based and other subsea equipment. These activities may result in the depositon of material in excess of defined biological thresholds. As described in the Exploration Drilling EIS, average burial depths of 6.5 millimetres (mm) is the predicted no effect threshold (PNET) for non-toxic sedimentation based on benthic invertebrate species tolerances to burial, however, some species (e.g. *Lophelia pertusa*) may be more susceptible to shallower burial depths, and therefore a conservation PNET of 1.5 mm could also be considered. According to DFO, *Lophelia pertusa* are not known to be present in waters offshore Newfoundland (CEA Agency 2018a, Buhl-Mortensen et al. 2017).

3 Coral and Sponge Survey Details

The 2018 survey may be undertaken in the area, or a portion of the area, shown in Figure 1.

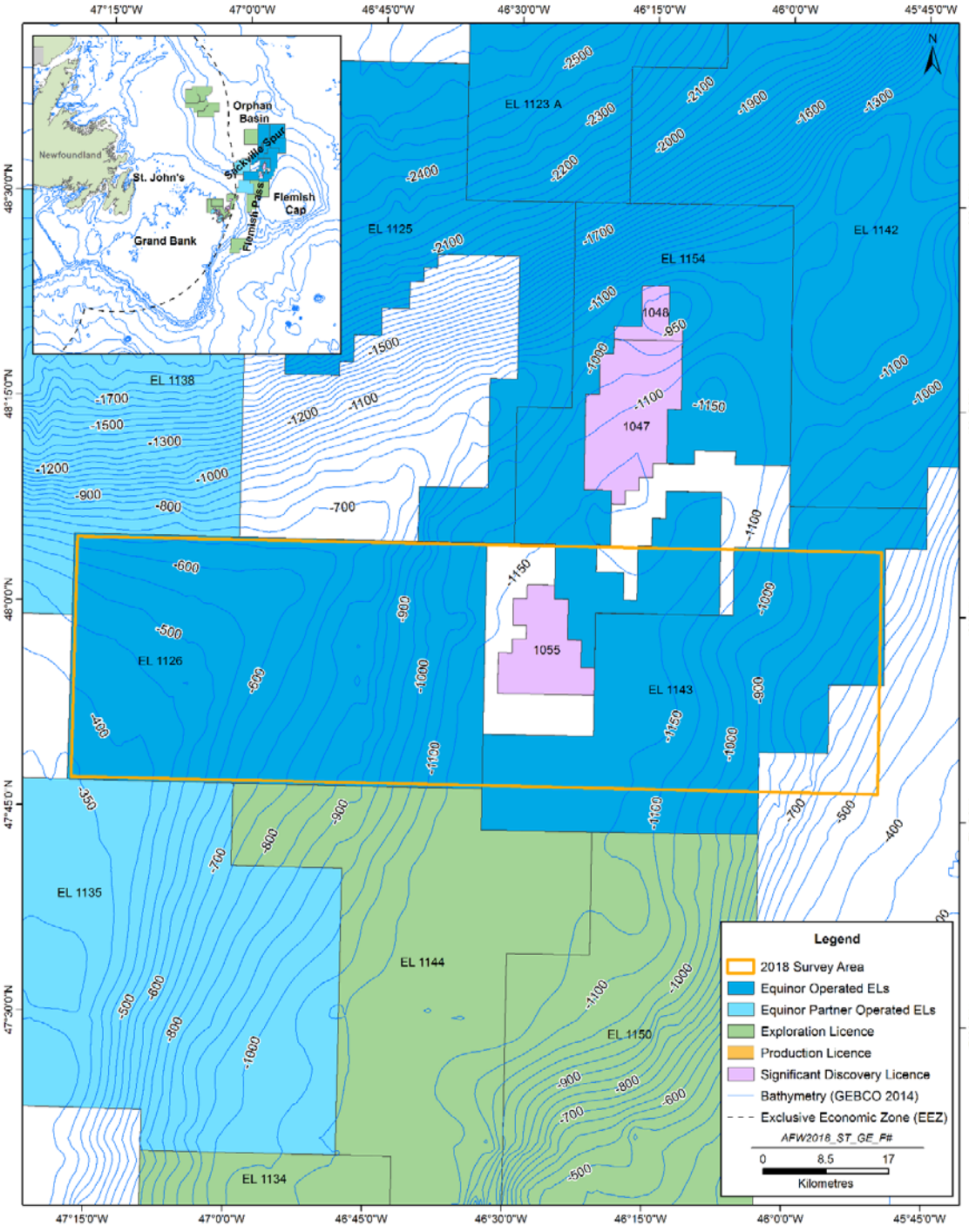

Figure 1. 2018 Survey Area

3.1 Survey Area

Table 1 provides a planned survey area per infrastructure type. In the case of all infrastructure the survey areas outlined in the NOROG Guideline are used as a reference. For drilling locations, including drilling templates, the drill cuttings modelling results from the 2018 Exploration Drilling EIS (Statoil 2018) will be used to determine possible extent of survey coverage areas. The water depth in the proposed seabed survey area ranges from approximately 380 m to 1,200 m. The Exploration Drilling EIS completed drill cuttings dispersion modelling for the 1,110 and 362 m (Statoil 2017); therefore the results provide a useful reference for the 2018 survey area with respect to survey of proposed drill locations.

The proposed coverage areas per infrastructure type is provided in Table 1. The information is a guide only, as biologists on-board, in consultation with the Equinor vessel representative, will decide final areas in the field upon review of the acoustic data.

Table 1. General Survey Plan by Infrastructure Type.

Infrastructure Type	NOROG Guideline	Drill Cuttings Dispersion Modelling	Planned Coverage (minimum)
Drilling Template Locations	500 m radius	100 - 2,000 m	500 m to 1000 m radius
Mooring Locations	50 m radius	n/a	50 m radius
Flowline Corridors	100 m on either side	n/a	100 m on either side of flowline corridor
Other Subsea Infrastructure (pumps, riser base)	100 m radius	n/a	100 m radius

Acoustic data will be collected with MBES and SSS mounted on an AUV. Visual surveys, using high defintition video camera on an ROV, will validate / groundtruth the acoustic information. Additionally, In areas where seabed contact is likely, and where no structures have been identified by acoustic data, the area will be visually inspected with the ROV-camera to determine the presence or absence of corals and sponges in these areas.

Figure 2 provides a preliminary plan for visual surveys with the ROV for each type of infrastructure outlined in Table 1. As data is collected in the field, the proposed survey plans may be modified.

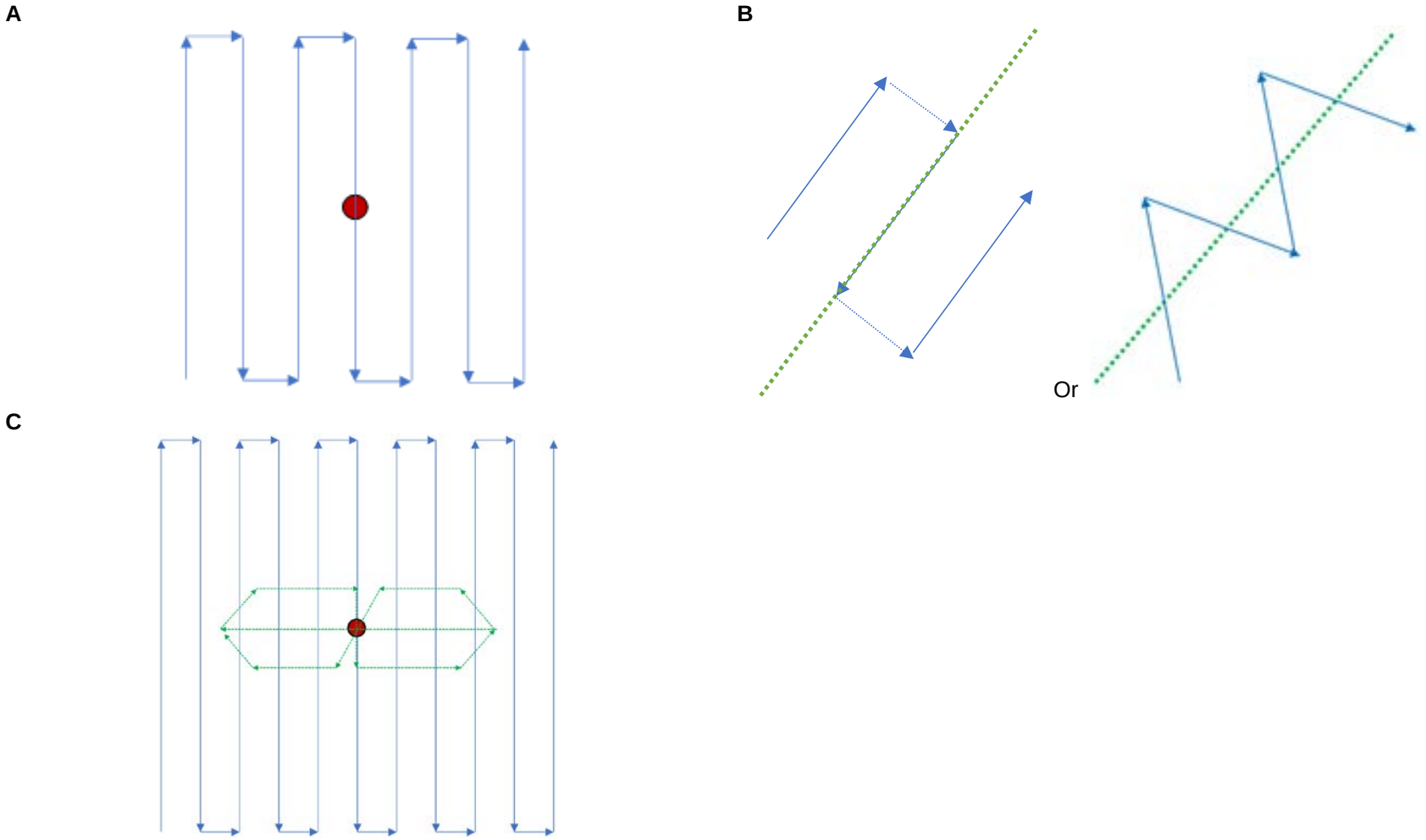

Figure 2. Generalized proposed ROV "S", zig-zag and "butterfly" pattern surveys for A) point infrastructure, B) linear infrastructure, and c) drilling template locations.

3.2 Schedule

The survey is anticipated to start in late summer/early fall 2018 and will take approximately 45 days to complete.

3.3 Survey Team

The survey team on the vessel will consist of the following:

- Geophysical mapping technician
- AUV and ROV technicians and operators
- Marine biologists
- Equinor personnel

3.4 Survey Methodology

For the 2018 survey, the following methodology will be carried out. The following methodology, which is based on the NOROG guideline, may be modified in the field. Biologists on-board and Equinor vessel representatives will decide final areas in the field upon review of the acoustic data as well as optimizing ROV bottom time. As acoustic data and video data are gathered, the methodology may be refined; validation of acoustic data may allow for modifications to the areas selected for ROV video coverage. In addition, video coverage of linear infrastructure (such as flowlines) can be increased by concentrating the effort close to the structure, a longer stretch (linearly) of the actual pipeline/cable route can be surveyed with the same effort.

Equipment for the 2018 survey will include an AUV and inspection class ROV
The AUV is the Fugro EchoSurveyor IV (Appendix 1), which can provide a 0.2 m resolution, and will be equipped with the following:

- MBES bathymetry
- MBES backscatter
- SSS

The Inspection Class ROV will be equipped with the following:

- HD video/stills camera with resolution of 1920x1080 JPEG format for stills and video storage in H264 (MPEG4) format
- Georeferencing capabilities
- Scaling lasers

The AUV will collect acoustic data using MBES and SSS over approximately 144 km^2 within the survey area (Figure 1). Within this survey area, structures elevated at least 0.2 m above the seabed will be

mapped from the acoustic data. In areas where seabed contact is likely, these structures will be investigated with the ROV-camera to determine if the structures are corals. Video data will be collected to provide information on abundance, species type, health, for corals and sponges, if present.

In areas where seabed contact is likely, and where no structures have been identified by acoustic data, the areas will also be inspected with the ROV-camera to identify presence or absence of corals and sponges. Video data will be collected to provide information on abundance, species type, health, for corals and sponges, if present.

The primary factor to determine locations for ROV visual investigations are those locations where seabed infrastructure, including drill locations, is likely to be located. Other factors will also be considered to determine to determine ROV locations, which may include, but not limited to the following:

- Potential coral species locations mapped using acoustic data
- Iceberg plough marks identified by acoustic data
- Areas within, or adjacent to, ecologically and biologically sensitive areas (EBSAs) and/or vulnerable marine ecosystems (VMEs)

3.5 Documentation and Mapping

Two marine biologists will be stationed on the vessel and will be responsible for reviewing ROV footage and documenting the following:

- Species
- Abundance
- Condition (health)
- Size
- Substrate observation
- Other observations (e.g. effects from trawl fishing)

Equinor will use the results of the survey regarding coral and sponge observations to provide baseline data for the area, to assist with planning in drilling locations and subsea infrastructure. The data will also be used to determine appropriate mitigations.

4 Fish Habitat Survey

4.1 Potentials Impacts from Project Activities

The installation of subsea infrastructure, including drilling templates , flowlines, anchors/mooring locations and other subsea infrastructure (riser base) have the potential of affect fish habitat.

4.2 Survey Area

The same survey data will be used for both the fish habitat component and the coral and sponge component. The survey area is based on the predicted areas of interaction for the installation of subsea infrastructure. The following survey coverage is provided as a guide. Modifications to survey locations may be undertaken in the field, as data becomes available.

Table 2. General Survey Plan by Infrastructure Type.

Infrastructure Type	Proposed Survey Type	Coverage	Total Length per unit (m)
Drilling Template Locations	S-Pattern	1000 m x 1000 m	12,000
	Butterfly-pattern[1]	700 m x 200 m	~2,400
Anchors/Mooring Locations	S-Pattern	100 m x 100 m	2,950
Flowline Corridors	S-Pattern	200 m x 750 m [1]	2,450
Other Subsea Infrastructure (pumps, riser base)	S-Pattern	200 m x 200 m	2,400
		Total	**22,200**

[1] Based on most common design used at NCS (R. Stundt, Prin. Eng. SUS Env. Tech., Equinor, pers. comm., 20 June 2018).

It is planned to assess the areas using a “S”, zig-zag or “butterfly” pattern to ensure appropriate coverage of fish habitat with the proposed footprint and area of potential environmental interaction (Figure 2). Linear infrastructure (flowlines) may be surveyed with the AUV-equipped camera or with the ROV HD video camera. If using the ROV, the survey will be will be conducted in an “S” or zig-zag pattern to include the proposed footprint and 100 m corridor on either side of the proposed infrastructure. Approximately 10% of the total length of linear infrastructure will be assessed for fish and fish habitat, surveyed in three separate sections to ensure adequate coverage of habitats in the area. Surveys for any infrastructure within, or adjacent to, ecologically and biologically sensitive areas (EBSAs) and/or vulnerable marine ecosystems (VMEs) may be expanded by 50% to provide additional details on fish and fish habitat.

4.3 Schedule

The survey is anticipated to start in late summer/early fall 2018 and will take approximately 45 days to complete.

4.4 Survey Team

The survey team on the vessel will consist of the following:

- Geophysical mapping technician
- AUV and ROV technicians and operators
- Marine biologists

- Equinor personnel.

4.5 Technical Requirements

The AUV is the Fugro EchoSurveyor IV (Appendix 1), which can provide a 0.2 m resolution, and will be equipped with the following:

- CathX camera;
- Georeferencing capabilities;
- MBES bathymetry;
- MBES backscatter; and
- SSS.

The Inspection Class ROV will be equipped with the following:

- HD video/stills camera with resolution of 1920x1080 JPEG format for stills and video storage in H264 (MPEG4) format;
- Georeferencing capabilities; and
- Scaling lasers.

In areas of proposed infrastructure, either the AUV-equipped camera and/or an ROV camera will be used to assess fish habitat and identify any fish or invertebrates in the area.

4.6 Documentation and Mapping

Two marine biologists will be stationed on the vessel and will be responsible for reviewing AUV imagery and ROV footage and documenting the following:

- Macrofauna species identification and abundance
- Macroflora species identification and abundance
- Substrate observations (Wentworth Scale)
- Other observations (e.g. effects from fishing)
- Discussion on the use and applicability of using acoustic data to identify potential coral targets for offshore NL

5 Additional Information

5.1 Abbreviations

AUV	Autonomous underwater vehicle
C-NLOPB	Canada-Newfoundland and Labrador Offshore Petroleum Board

DFO	Fisheries and Oceans Canada
EBSA	Ecologically and Biologically Sensitive Area
EPA	Eastern Project Area
EIS	Environmental Impact Statement
HD	High Definition
km	Kilometres
MBES	Multi-Beam Echo Sounder
m	Metres
mm	Millimetres
NCS	Norwegian Continental Shelf
NL	Newfoundland and Labrador
PNET	Predicted No Effect Threshold
ROV	Remotely Operated Vehicle
SBM	Synthetic Based Mud
SPA	Southern Project Area
SSS	Side Scan Sonar
VME	Vulnerable Marine Ecosystem
WBM	Water Based Mud

5.2 Select Definitions

Equinor – Equinor Canada Ltd., and formerly known as Statoil Canada Ltd.

Exploration Drilling EIS – Flemish Pass Exploration Drilling Program Environmental Impact Statement.

NOROG Guideline – Monitoring of Drilling Activities in Areas with Presence of Cold Water Corals.

Plan – Coral and Sponge Survey Plan.

5.3 Changes from Previous Version

N/A – This is the first version of this Plan.

5.4 References

Buhl-Mortensen, P., Gordon Jr, D.C., Buhl-Mortensen, L., and Kulka, D.W. (2017). First description of a Lophelia pertusa reef complex in Atlantic Canada. *Deep Sea Research Part I: Oceanographic Research Papers*, *126*, 21-30.

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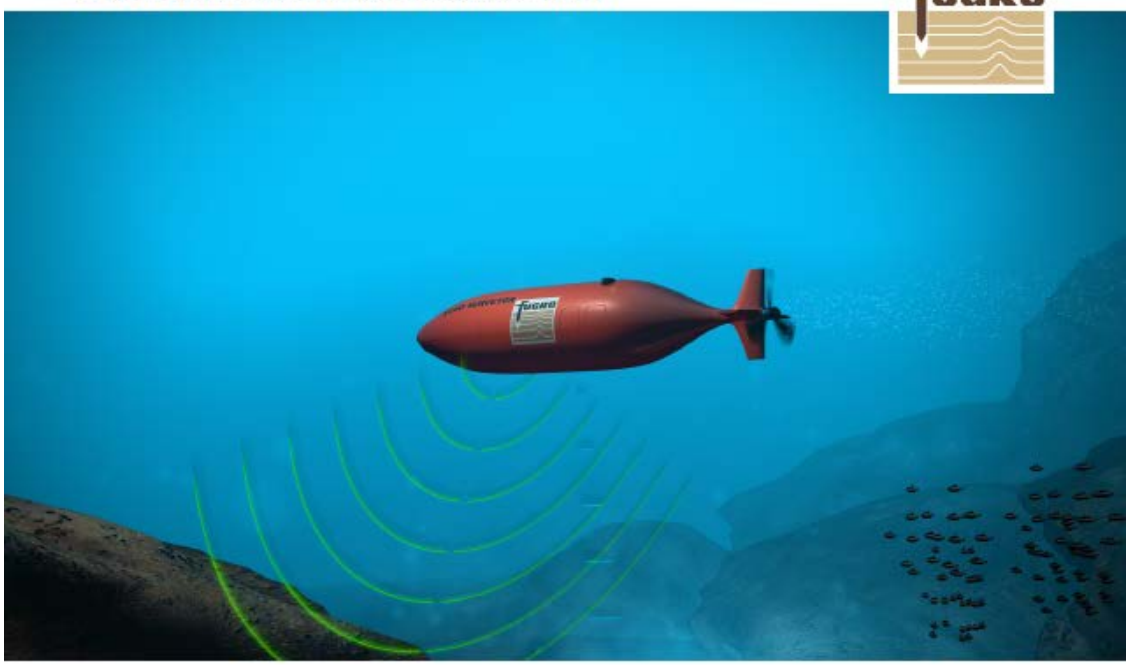
Statoil (Statoil Canada Ltd.). 2017. Flemish Pass Exploration Drilling Program – Environmental Impact Statement. Prepared by Amec Foster Wheeler and Stantec Consulting. St. John's, NL Canada. November 2017. Available online: http://ceaa-acee.gc.ca/050/evaluations/document/121309?culture=en-CA

Appendix 1 – Fugro Echo Surveyor VI – Equipment Sheet

EQUIPMENT SHEET OFFSHORE SURVEY



FUGRO
ECHO SURVEYOR VI

Echo Surveyor VI is a "state of the art" Kongsberg Hugin 1000, specifically designed for high resolution and efficient survey operations in water depths down to 3000 metres. AUV's are the ultimate choice of instrument platform for deep sea and remote surveys.

ENGINEERING GRADE HIGH RESOLUTION DATA

Echo Surveyor VI is one of our state of the art Kongsberg Hugin Autonomous Underwater Vehicles (AUV). This particular vehicle is depth rated to 3000m with a payload selected by Fugro to meet the demands of the offshore survey industry.

Fugro's fleet of Kongsberg Hugin AUV's have extensive track records in many deep water and often remote environments around the Globe. Use of such a proven survey platform and experience will provide enhanced productivity, continuity and reliability ensuring optimum adherence to project schedules.

The Hugin 1000 is a modular design and is equipped with enhanced obstacle avoidance radar, Kongsberg EM2040 multibeam echosounder, LED illuminated Digital stills camera to identify seabed features of interest and the option to mobilise one of two sub-bottom profilers to best suit the local geology.

Fugro own and operate six deep water Echo class AUV's which can be mobilised either from one of Fugro's dedicated fleet of international survey vessels or from 3rd party charter ship's.

Hugin 1000 AUV

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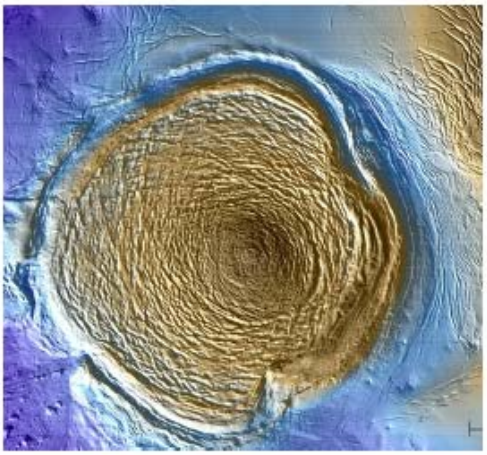
EQUIPMENT SHEET OFFSHORE SURVEY

ECHO SURVEYOR VI

Capabilities

Echo Surveyor VI is installed with the latest lithium polymer battery technology allowing a operational duration of up to 48 hours. With a nominal survey speed of 3.6 knots, large areas can be covered within a single deployment. Our standard payload comprises Multibeam Echosounder, Side Scan Sonar, Sub-Bottom Profiler and LED Digital Stills Camera capable of supporting deep water field developments, site surveys, pipeline and cable routes and regional mapping.

The camera system may be used to assess the characteristics of benthic communities and habitats including deep water coral reefs and chemosynthetic communities. In addition to ascertaining the presence of sensitive species or biotopes. The high resolution stills enable scientists to zoom into the photograph without a significant deterioration in photograph quality and permits identification of specimens to species level



High Resolution Bathymetric Data

Technical Specifications

Physical Data - Hugin 1000	
Length	6.2 m
Weight (air)	1600 kg
Diameter	0.75 m
Depth Rating	3000 m
Survey Speed	2-6 knots (nominal 3.6 knots, maximum 6 knots)
Hull Material	Carbon Fibre Reinforced Syntactic Foam

Physical Data - Launch and Recovery System	
Launch and recovery Container	9.0 m (L), 4.0 m (W), 3.3 m (H), 16080 kg (Weight)
Storage Container 1	6.1 m (L), 2.4 m (W), 2.6 m (H), < 10400 kg (Weight)
Storage Container 2	6.1 m (L), 2.4 m (W), 2.6 m (H), <10400 kg (Weight)

Power System	
Battery	Lithium Polymer
Battery Capacity	458Wh (48 hours approx.)
Propulsion	Smart Motor, Rudders and Propellor

Acoustic Navigation System	
Aided Inertial Navigation System	HIPAP 501 USBL
Inertial Measurement Unit (IMU)	Honeywell HG9900
Depth Pressure Sensor	Paroscientific Digiquartz
Doppler Velocity Log (DVL) + ACDP	RDI Workhorse Navigator WHN - 300

Acoustic Communication	
cNODE Transducer	Kongsberg TD40V, TD30H, TD180
Emergency Link	Kongsberg 25 to 25.6 kHz, 10 bps via HIPAP 501

Surface Communication	
Primary	Radio Link
Secondary	WLAN Link
Emergency	Iridium Data Link

Control Sensors	
CTD	Seiv 208 CTD
Avoidance Sonar	Mesotech 675 kHz
Altimeter Height	Mesotech 675 kHz

Payload Sensors	
Multibeam Echo Sounder	Kongsberg EM2040, 140° Coverage, 200-400 kHz
Sidescan Sonar	Edgetech Full Spectrum,120 & 410 kHz
Sub-bottom Profiler	DW106 (1-10kHz)
Digital Stills Camera	Kongsberg LED illuminated digital stills camera

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