Environmental Assessment
East Canada CSEM Survey, 2014–2018
Amendment

Prepared by

LGL LIMITED
environmental research associates

Prepared for

emgs

27 February 2017
LGL Report No. FA0110

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Introduction

This document is an Amendment of the Environmental Assessment (EA) of the Electromagnetic Geoservices Canada Inc. (EMGS) East Canada Controlled Source Electromagnetic (CSEM) Survey, 2014–2018 (LGL 2014a), and the associated Addendum (LGL 2014b), two Amendments (LGL 2014c, 2015a), and 2015 EA Update (LGL 2015b). The proposed changes to the Project activities assessed in this Amendment are as follow:

- a one-year extension to the Project's temporal scope to include 2019;
- the inclusion of solid streamer use; and
- an increase in source output from 1,250 A to 10,000 A.

Extension of Temporal Scope

EMGS proposes to extend the temporal scope of the Project from 31 December 2018 to include the period 1 May–31 December 2019. EMGS has interest in a three-year exploration program in the Project Area (i.e., 2017–2019). The total duration of exploration activities with an extension for 2019 would still be less than the five years initially permitted for in the original EA considering that CSEM activities took place in 2014, but not in 2015 and 2016.

Inclusion of Solid Steamer

EMGS proposes to use a new CSEM streamer that it has developed. It uses thermoplastic rubber (TPR) instead of Isopar M fluid for flotation, as previously indicated in Section 2.9 of LGL (2014a). The CSEM streamer consists of tow and conductor cables, as well as a floatation section. The 300–500 m long flotation section consists of 5 to 30 buoyancy tubes made of TPR that are braided together. The total length of the tow package will depend on the depth of the survey area, with a maximum length of several thousand metres. Compared to a typical 3D seismic survey, a CSEM towed system is very different in that it consists of only one streamer and it is much shorter. As such a CSEM survey occupies relatively little "sea-space" and other vessels can pass safely as close as one kilometre astern.

This change represents an improvement to the program by removing the potential risk for flotation fluid discharge.

Increase in Source Output

The new Deep Blue Source System proposed for use by EMGS is a more powerful source capable of transmitting 10,000 A and has a voltage of 135 V. The previously proposed conventional source transmitted 1,250 A with a voltage of 85 V (see Table 5.1 in Section 5.7.1 of LGL 2014a). The new Deep Blue Source System can transmit from 0 Hz (equal to DC) to 25 Hz, but operations are currently planned for 0–10 Hz (same frequency range as the conventional source). The new source has a maximum operating depth of 4,000 m, 500 m deeper than the conventional source described in the original EA. The technical specifications of the new Deep Blue Source System are provided in Appendix 1.

Electromagnetic (EM) fields are generated by anything that carries or produces electricity. EM fields consist of an electric field component and a magnetic field component that travel together in space at the speed of light. Simulations of EMGS seabed logging operations with the conventional source (1,250 A) produce magnetic fields with a maximum value of 10 µT at a distance of about 100 m from the source and an electric field of 18mV/m in magnitude at 30 m from source (Johnsson and Oftedal 2011). An eightfold increase in the current would result in an increase of the magnetic and electric fields by about the same factor (Johnsson and Oftedal 2011); ~ 80 µT at 100 m and 144mV/m at 30 m.

The geographic extent of effects (i.e., zone of influence or ZOI) of EM fields generated by the CSEM source was determined in the EA (LGL 2014a) through modeling conducted by the EM survey industry. Results of modeling were then combined with a theoretical biological threshold based on the scientific literature across a wide range of organisms (see Buchanan et al. 2011). Based on presently available scientific information and the professional judgment of the authors, 200 nT and 386 nV/cm were selected as generic thresholds of effects for magnetic and electric fields generated by EM surveys (see Buchanan et al. 2011 and LGL 2014a). Effects in this case simply mean an elicited response of some kind with no negative or positive implications. Many animals will have no reactions to these levels while others may be able to detect fields below these values.

For a 10 Hz deep-towed source, combining the EM field results modeling with a 200 nT threshold (see Buchanan et al. 2011) and adjusting for the more powerful Deep Blue Source System results in a maximum ZOI radius of 500 m for the magnetic field. Modeling with a 386 nV/cm threshold (see Buchanan et al. 2011) and adjusting for the more powerful Deep Blue Source System results in a maximum ZOI radius of 800 m for the electric field. These ZOI radii are in general agreement with the results obtained for the conventional source (400 m and 800 m radius of ZOI for the magnetic and electric fields, respectively; see LGL 2014a). Again, these zones of influence are based on reported abilities of some of the more sensitive groups of animals (e.g., elasmobranchs) to detect fields and do not imply any effects *per se*.

Effects Assessment

Effects on the valued environmental components (VECs) have been reviewed based on the proposed Project amendments. EM emissions from the new Deep Blue Source System may potentially be detected by some animals, especially elasmobranchs. The geographic extent (area) used in the assessment is conservative and on the order of 0.8 km^2 – 2.0 km^2. However, duration of exposure of a fixed point along the axis of the tow (i.e., "worst case") would be short; on the order of 16–26 minutes with the vessel moving at 2 kts. This duration of exposure to EM emissions is too short to interfere with any known processes such as orientation, movements or prey detection (see LGL 2014a). Thus, any residual effects are considered *negligible* to *low* in magnitude and hence are predicted to be *not significant*. The only notable change from the previous CSEM source assessment (see LGL 2014a) is a slight increase in the geographic extent from a rating of 1 (*<1 km^2*) to a rating of 1–2 (*<1 km^2* to *1–10 km^2*) for all VECs.

Otherwise, all predictions of significance of residual effects of the Project activities on the VECs (Fish and Fish Habitat, Commercial Fisheries, Seabirds, Marine Mammals, Sea Turtles, Species at Risk, and Sensitive Areas) remain the same. In fact, the proposed change in streamer type decreases the potential for accidental spills.

Proposed mitigation procedures intended to minimize the potential effects of the Project activities associated with CSEM surveys are discussed in detail in Sections 5.5 and 6.0 of the EMGS EA (LGL 2014a).

Conclusion

The proposed one-year extension to the Project's temporal scope to include 2019 does not change any of the EA conclusions. There will be *no significant* residual environmental effects caused by this extension.

The proposed inclusion of solid streamer use is an improvement to the program and does not change any of the EA conclusions. There will be *no significant* residual environmental effects caused by the use of a solid streamer.

The proposed increase in source output from 1,250 A to 10,000 A does not change any of the EA conclusions. There will be *no significant* residual environmental effects caused by the new source system.

Literature Cited

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Appendix 1

Deep Blue Source System

Technical Specifications

1 Source System Specification

1.1 Deep Towed Source System

1.1.1 Deep Blue Source System Overview

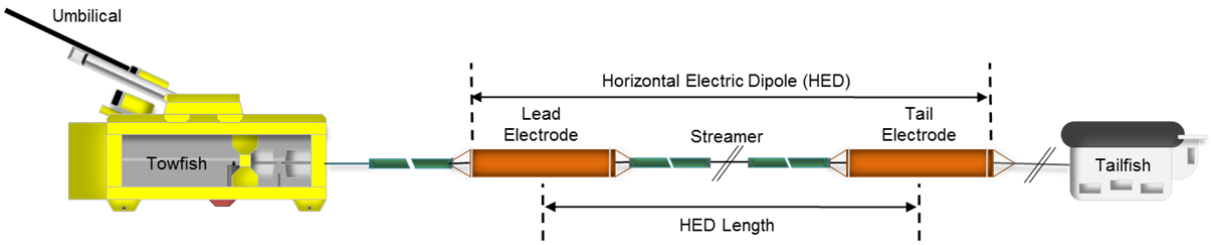
System Overview

The Deep Blue Source Systems' design is the latest EM equipment development with respect to performance, physical dimensions and safety when handling the equipment.

The EM source system is based on the same principals as the conventional system, but with improved timing control and output strength. The system consists of a:

- Top Side System consisting of a Power Supply and Operator Console
- Subsea System consisting of Tow fish, Antenna (Horizontal Electric Dipole) and Tail fish
- Communication System consisting of Umbilical, Multiplexer and a Slip Ring

The Top Side System is controlling the power to generate the predefined EM pulse at the electric dipole. The power is transformed to high voltage / low current and transferred via umbilical to the Subsea System. In the Tow fish, the power is transformed to low voltage / high current and rectified to DC. This antenna is fed from the Tow fish with a controllable periodic current. The waveform, amplitude and periodic time of this current are controlled at the Operator Console top side. A separate power supply feeds the auxiliary instrumentation on the Tow fish.



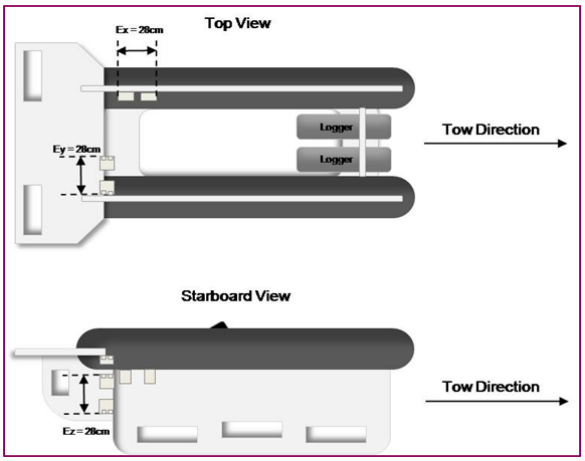
Schematic drawing of the source

The Figure shows the general schematic of the subsea configuration. The electric dipole (antenna) is neutrally balanced for in-line towing operation. The Tow fish and Tail fish are carrying attitude instrumentation.

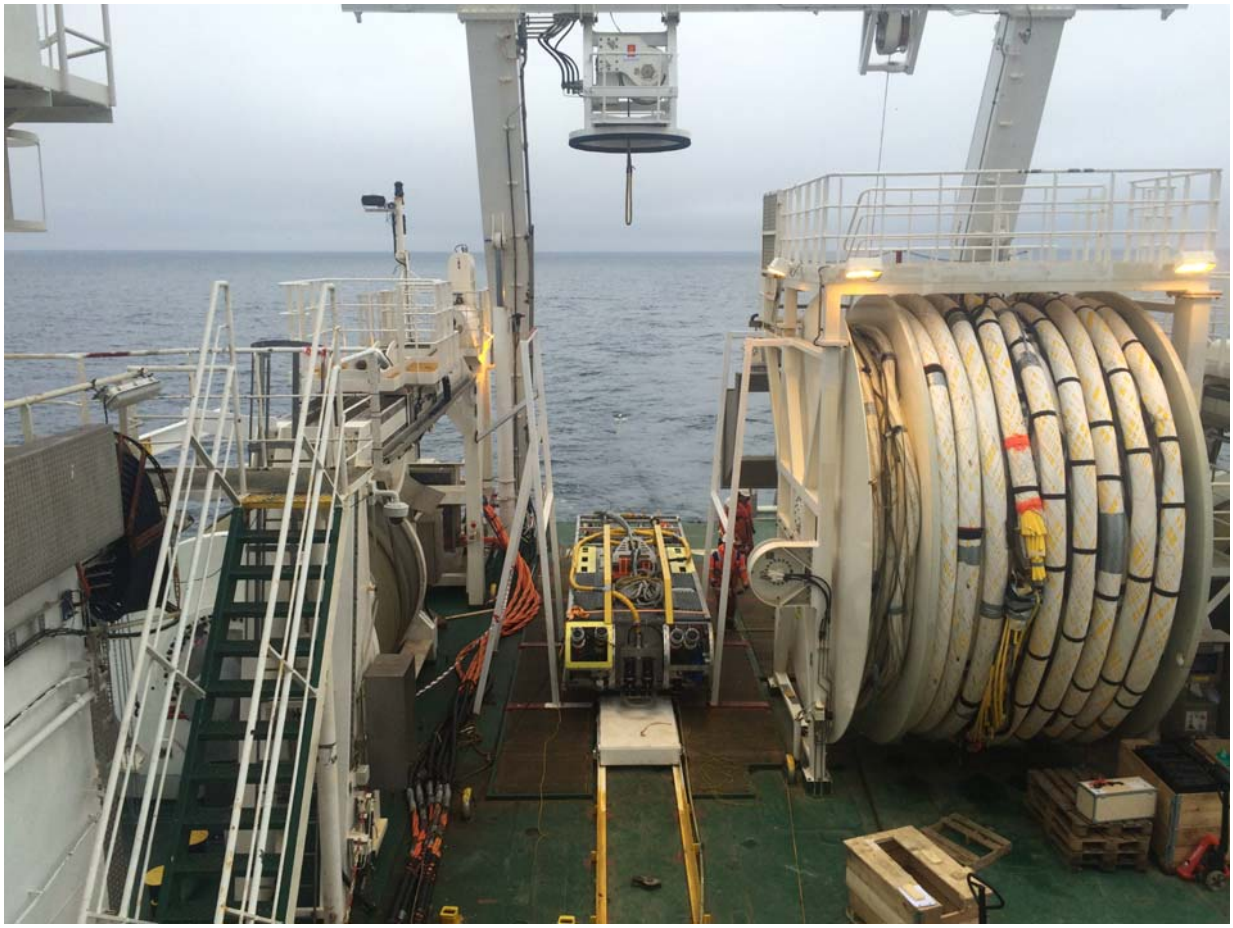
The Communication System includes an 5.500 meter long armoured Umbilical that encompasses high voltage power conductors for the signal source, low voltage conductors for supply of instrument supply and fibre optic leads for instrument communication. A fibre optical high voltage Slip Ring allows the Umbilical to be winded up on a Winch. All signals are fed through a fibre optical Multiplexer into the Umbilical.

A logger is mounted on the Tail fish and is able to provide a method for monitoring and verifying the source signal. Sensors are placed as described in the picture and sketch below.

Tail fish logger



E-Sensor offsets on Tail fish fins



System overview with the Towfish in the centre and streamer section on the winch to the left

1.1.2 Deep Blue Source Technical Specifications

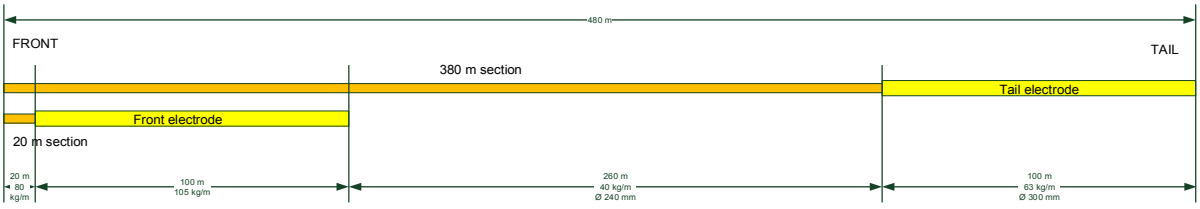
DEEP BLUE SOURCE SYSTEM	
Top Side System Technical Specification	
Manufacturer	Ultra Electronics PMES
Supply from vessels mains supply	690 V / 1500 A - Three phase 60 Hz
	440 V / (400 A Fuse) - Three phase 60 Hz
Output to transformer	0-590 V / 2500 A - Three phase 200 Hz
Output to umbilical	24 kV / 40 A - Three phase, 200 Hz (Power to EM-Source)
	3 kV / 1A - Single phase (Power to instrumentation)
Subsea System Technical Specification	
Manufacturer	Siemens Norway AS
Current, Subsea	10 000 A (peak)
Repeatability for current	Better than +/- 2%
Peak Power	1 500 kW (peak)
Voltage	135 V @ 10 000 ADC
Frequency	DC - 25 Hz
Time accuracy	+/- 100 us (Synchronised to GPS Clock)
Maximum operational depth	4000 m
Tow fish weight in air (incl. instruments)	12 500 kg
Tow fish Instrument Interface	3/4 x PGT (one configured as responder), DLV, Gyro, CDT, Digiquarts, iUSBL

DEEP BLUE UMBILICAL TECHNICAL SPECIFICATION	
Manufacturer	Nexans Norway AS
Length	5.000 - 5.500 m
Outer Diameter [mm]	52.7 mm
Weight in air	8 kg/m
Weight in seawater	5.8 kg/m
Minimum bending diameter @ SWL	1.6 m
Armouring breaking strength	1220 kN
Safe working load (max repeated)	345 kN

Power Conductors	3x 16mm^2 / 24 kV
Fibre optic element	4 x Single mode 9/125µm
Power Conductors	3x 2mm^2 / 3.3 kV

DEEP BLUE SLIP RING TECHNICAL SPECIFICATION	
Manufacturer	Focal Technologies Corp.
Voltage / Current	3x 24 000 V/40 A, 2x 3500 V/20 A, 1x GND/40A , 2x SM Fibre 9/125µm/1300nm/1550nm
Rotation Speed	Maximum 28 rpm
Protection Class	IP 56
Operating Temperature	+10°C to +55°C

DEEP BLUE MULTIPLEXER TECHNICAL SPECIFICATION	
Manufacturer	MacArtney AS
Interface	PGT, Doppler, CTD, Gyro, Ethernet, Gyro iUSBL Digiquartz 1+2, Dual RS232 Spare, RS486/422 & RS232 Spare Power and Fibre Optical Link (2 pass)
Maximum operational depth	4000 meter



10000A SOLID ANTENNA, TECHNICAL SPECIFICATION	
Manufacturer	EMGS ASA
Cu Electrode Length	100 meters
Cu Electrode Diameter	1050 mm2 copper wire, 3x350mm2
Front-section length	120 meters

Front-section weight in air	40-60 kg/m
Mid-section length	1 x 480 meter
Mid-section weight in air	40 - 60kg/m
Type of Buoyancy	TPR, Thermo Plastic Rubber
Maximum operational depth	4500m

TAIL FISH TECHNICAL SPECIFICATION	
Manufacturer	Partnerplast AS
Weight in air	263 kg, with all components mounted. -2kg
Weight in water	
Instrument Interface	2 x PGT, 2 x SSM, Source Signal Monitoring System
Maximum operational depth	3.500 meters