

**WESTERN NEWFOUNDLAND GEOPHYSICAL
SURVEY PROJECT DESCRIPTION FOR
EXPLORATION LICENSES
1097, 1098, 1103 AND 1104, GSI**



GSI Admiral Program

(Formerly NWest Energy Inc. Program, CEAR No. 07-01-33771)



**Prepared for
the Canada-Newfoundland and Labrador Offshore Petroleum Board**

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CONTENTS

1.0 INTRODUCTION AND APPLICATION CONTEXT / HISTORY	2
1.1 RELATION TO NWest PROJECT, EA AND SCREENING	2
1.2 PROJECT INTRODUCTION	2
1.3 PROPONENT CONTACT INFORMATION	4
1.4 REGULATORY CONTEXT	5
1.5 CANADA- NEWFOUNDLAND AND LABRADOR BENEFITS	6
1.6 STAKEHOLDER CONSULTATION	6
2.0 PROJECT DESCRIPTION	7
2.1 PROJECT NAME AND LOCATION	7
2.1.1 Project Overview	7
2.1.2 Project Activity Area	9
2.2 ALTERNATIVES TO THE PROJECT & ALTERNATIVES FOR THE PROJECT	11
2.3 OTHER SEISMIC PROGRAMS	12
2.3.1 WELL SITE/GEOHAZARD SURVEYS	12
2.3.2 VERTICAL SEISMIC PROFILE (VSP) Surveys	12
2.4 SURVEY VESSEL	13
2.5 LOGISTICS & SUPPORT	13
2.6 ROUTINE DISCHARGES	13
2.7 ACCIDENTAL EVENTS	14
2.8 HEALTH & SAFETY	15
3.0 SETTING OF ENVIRONMENTAL COMPONENTS	15
3.1 METEOROLOGY AND CLIMATE	16
3.2 ICE CONDITIONS	16
3.3 PHYSICAL OCEANOGRAPHY	17
3.4 MARINE PHYSIOGRAPHY	17
3.5 MARINE BENTHOS	17
3.6 MARINE MAMMALS	18
3.7 SEA TURTLES	18
3.8 MARINE BIRDS	19
3.9 MARINE FISH AND SHELLFISH	19
3.10 FISH EGGS AND LARVAE	20
3.11 SPECIES AT RISK	20
3.12 SENSITIVE AREAS	21
3.13 COMMERCIAL FISHERY	21
3.14 MARINE TRAFFIC	21
4.0 REFERENCES	22
APPENDIX 1: ARRAY / SOUND SOURCE DETAILS	24
APPENDIX 2: DETAILS / SPECIFICATIONS ON THE <i>GSI ADMIRAL</i>	27

LIST OF FIGURES

Figure 1 - Areas of Interest for GSI's Geophysical Seismic Surveys	10
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LIST OF TABLES

Table 1: NWest Exploration Licences Offshore Western Newfoundland	3
Table 2: Seismic Survey Parameters (<i>GSI Admiral</i>)	9

1.0 INTRODUCTION AND APPLICATION CONTEXT / HISTORY

1.1 RELATION TO NWest PROJECT, EA AND SCREENING

Geophysical Service Incorporated (GSI) proposes to acquire non-exclusive 3-D geophysical (seismic survey) data offshore of Newfoundland's west coast. The initial phase of the survey is planned to commence in the second to fourth quarter 2008. This project is the same survey proposed by NWest Energy Inc. (NWest) as filed with the C-NLOPB on 1 October 2007. (The only change from what was proposed then is the operator of the program, which will now be GSI rather than NWest, based on business considerations between the two companies.)

GSI is a Nova Scotia and Calgary based seismic services and exploration company which has conducted dozens of seismic surveys offshore Newfoundland and Labrador (including the Gulf of St. Lawrence) over the past several decades (often with the GSI Admiral), as well as in many other areas of Atlantic Canada and the world - for itself (as operator), under contract to petroleum companies and for the Government of Canada (GSC).

The C-NLOPB notified federal agencies about the proposed Project (under NWest's name) in October 2007, and, based on their responses, issued a Scoping Document on 26 October 2007. With guidance from the Scoping Document, a screening level Environmental Assessment (EA) was prepared (including consultations) and submitted to the Board on 14 March 2008 (*Environmental Assessment of Geophysical Surveys for Exploration Licences 1097, 1098, 1103 and 1104 Western Newfoundland*, Conestoga-Rovers & Associates for NWest, March 2008, Ref. no. 50016 (2)).

The EA has been reviewed by the relevant agencies and it is expected that the screening will be completed soon by the Board.

NWest provided GSI with the EA scoping document and the EA report, and GSI is familiar with the mitigations, commitments and other undertakings contained therein, and will adhere to all of those stated.

1.2 PROJECT INTRODUCTION

GSI's proposed survey (as described also in the NWest Project Description) will occur in the area of NWest's four exploration licenses (ELs). These are ELs 1097, 1098, 1103 and 1104. Two of these licenses were issued on January 15th, 2006, and two additional licenses were successfully acquired on January 15th, 2007. These exploration licences were issued by the Canada-

Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB). The total area of the combined licenses is 659,880 hectares (1,630,599 acres). A summary of the exploration licences is presented in Table 1 below.

Table 1: NWest Exploration Licences Offshore Western Newfoundland

Area	Interest (%)	Gross Hectares	Net Hectares
Working Interests			
Offshore:			
Block 1097	100	96,100	96,100
Block 1098	100	159,872	159,872
Block 1103	100	216,164	216,164
Block 1104	100	187,744	187,744
Total, Unproved Properties		659,880	659,880

Sources: Geophysical Interpretation, Resource Assessment, and Valuation of Certain Exploration Licence Blocks, Offshore Western Newfoundland for NWest Energy Inc., Sproule Associates Limited.

There is the potential for 2-D surveys on the licenses and geohazard surveys in areas of interest. The NWest environmental assessment for the program also addresses vertical seismic profiles which is an activity related to drilling exploration, but due to its seismic nature is assessed in the EA for the current environmental assessment. In total, seismic-related activities could potentially extend over an eight year period, as required.

The Project requires approval through the C-NLOPB. This document is a project description, which is required to initiate the Federal Coordination Regulations process under the *Canadian Environmental Assessment Act (CEAA)* to which this Project is subject. The *CEAA* identifies a marine seismic survey with an output level of 275.79 kPa at a distance of one meter from the seismic energy sources (*i.e.* 228.69 dB re 1 μ Pa@1m) as a trigger for an environmental screening level of assessment. This project is not supported by federal funding. Federal lands are involved and administered by the C-NLOPB.

The purpose of the project description is to identify the basic features of the Project to be assessed under the *CEAA*, as well as potentially affected areas. This project description is provided to federal departments with potential decision-making responsibility under the *CEAA* Responsible Authorities (RAs) or expert knowledge relevant to the evaluation of potential project impacts.

This Project Description, as directed under the *C-NLOPB Geophysical, Geological, Environmental and Geotechnical Program Guidelines (April 2004)*, is intended to provide

information on GSI's Geophysical Program. A screening level environmental assessment has been prepared (for NWest) based on the C-NLOPB scoping document provided.

1.3 PROPONENT CONTACT INFORMATION

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1.4 REGULATORY CONTEXT

In accordance with its mandate under the *Atlantic Accord Implementation Acts*, the C-NLOPB may issue an *Authorization to Conduct a Geophysical Program* to allow GSI to carry out the seismic survey program described herein. Offshore geophysical surveys (including geohazard surveys) on federal lands are subject to screening under the *Canadian Environmental Assessment Act (CEA Act)*. In addition, Section 19.1 (a) of the *CEAA's Inclusion List Regulations* identifies those projects relating to seismic surveys for which a screening level of assessment is required. Under Part II Oil and Gas Projects, physical activities that require an authorization referred to in paragraph 138(1)(b) of the *Canada-Newfoundland Atlantic Accord Implementation Act* or paragraph 142(1)(b) of the *Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation Act* and relate to a marine or freshwater seismic survey during which the air pressure measured at a distance of one meter from the seismic energy source is greater than 275.79 kPa (40 psi) requires completion of an environmental assessment.

The C-NLOPB is the designated federal representative mandated under the *Atlantic Accord Implementation Acts* as well as the *Canadian Environmental Assessment Act (CEA Act)*. The C-NLOPB acts as the federal environmental assessment coordinator in this context. Because seismic survey activities have the potential to affect seabirds, marine mammals, and fish and fisheries, both Fisheries and Oceans and Environment Canada are the primary federal agencies with interests and expertise in the environmental aspects of the proposed program. Relevant government regulations and guidelines to be reviewed during the issues scoping process will include:

- *Canada-Newfoundland Atlantic Accord Implementation Acts*
- *Canadian Environmental Assessment Act*
- *Fisheries Act*;
- *Oceans Act*
- *Migratory Birds Convention Act* and Regulations;
- *Canadian Environmental Protection Act*;
- Committee on Endangered Wildlife in Canada (COSEWIC)
- *Species at Risk Act*
- *Navigable Waters Act*
- *Canada Shipping Act*
- Offshore Waste Treatment Guidelines (NEB *et al.* 2002); and
- Geophysical, Geological, Environmental and Geotechnical Program Guidelines, (C-NLOPB 2004)

Per the C-NLOPB Geophysical, Geological, Environmental and Geotechnical Program Guidelines (April 2004), an approval to conduct the planned survey must be granted from the C-NLOPB.

1.5 CANADA- NEWFOUNDLAND AND LABRADOR BENEFITS

GSI is committed to benefits for Canadian companies with emphasis on organizations from Newfoundland and Labrador. A benefits plan is being finalized for GSI which will govern all company operations in the future with its guiding principles as follows:

- Companies from Canada and Newfoundland and Labrador in particular will be given full and fair opportunity to provide goods and services to GSI;
- GSI must make decisions based on what optimizes value to its projects;
- Value to GSI will be quantified through vendor impact on project economics, product and/or service quality, timing, vendor experience and reputation and other similar metrics.

GSI and its proposed survey ship the *GSI Admiral* have a strong contingent of Atlantic Canadian (particularly Newfoundland and Labrador resident) crew members and support people.

1.6 STAKEHOLDER CONSULTATION

GSI recognizes the importance of communications to keep stakeholders informed about its proposed program and to obtain valuable input that may serve to contribute to the Project's overall success. A focused environmental assessment requires a process of scoping to define the components and activities that are to be considered in the assessment, to identify the key environmental issues, and to set the spatial and temporal boundaries of the assessment. Candidates for stakeholder consultations are well established in the environmental assessment arena of Newfoundland and Labrador and include (as reflected in the NWest EA):

- Fisheries and Oceans Canada
- Environment Canada/Canadian Wildlife Service
- Parks Canada
- NL Department of Fisheries & Aquaculture
- Fisheries Product International
- Fish, Food and Allied Workers
- One Ocean
- Local fishers (not affiliated with organisations)
- Clearwater Seafoods

- Association of Seafood Producers
- Atlantic Coast Action Program
- Area Regional Economic Developers
- Federation of Newfoundland Indians
- Atlantic Salmon Association

Other interest groups and stakeholders have also been identified during the consultation process.

2.0 PROJECT DESCRIPTION

2.1 PROJECT NAME AND LOCATION

The official Project name is Western Newfoundland Geophysical Survey Project for Exploration Licenses 1097, 1098, 1103 and 1104 (GSI). The blocks are located on the central area of the western coast of Newfoundland.

The current licences are held by NWest, exclusively. Not all Project details are presently known, however, based on acquired 2-D seismic survey information, areas of interest have been chosen. Not all contractors and suppliers have been selected for the survey, though the survey vessel is known (the *GSI Admiral*)

2.1.1 PROJECT OVERVIEW

The project area (in the vicinity of NWest's holdings) lies offshore along the western coast of Newfoundland between Corner Brook to the south and Port au Choix to the north. In this area, a thick Late Proterozoic to Ordovician sedimentary package, consisting of shallow marine to nearshore carbonate and clastic facies and co-eval deeper marine mudstone dominated facies, was deposited on the passive margin of the continent. Taconic, Salinic and Acadian crustal plate convergence and associated deformation have juxtaposed high quality source rocks with potential reservoir facies, creating structurally enhanced and possibly hydrocarbon-charged stratigraphic and structural traps in the present-day onshore and nearshore areas.

Oil seeps in the area have been observed as early as 1812 and sporadic hydrocarbon exploration has continued in the area for at least 165 years. To date, all hydrocarbon samples analyzed appear to have been generated in pre-Devonian clastic source rocks from Type I/II organic (mostly algal) matter. Shales within the Green Point Formation, having a total organic content up to 10.35 percent, have been recovered, and are considered as marginally mature to mature source rocks. Thermal maturity increases to the north, along the holdings.

The proposed Project is a marine 3-D geophysical program with the potential to perform a yet-to-be-determined area of 2-D and or geohazard survey. Vertical seismic profiling (VSPs), which is required for future exploration drilling activity, is also included in the environmental assessment to address all petroleum exploration seismic-related activities.

The seismic survey vessel will tow an active sound source (tuned air source array) and streamer (s) containing passive receiving hydrophones. Survey lines will be spaced within 100 m apart. If performed, geohazard surveys will be conducted over a much shorter time frame using a smaller configuration and a combination of smaller scale seismic equipment, sonars, sparkers and boomers.

As stated in the EA, a marine mammal observer and fisheries liaison officer will form a component of the operational crew. Furthermore, procedures will be implemented to minimize effects on the local marine ecosystem. For example, “soft-starts” or “ramp-ups” industry standard procedures of the air source arrays will be implemented.

The general coordinates of the application area are

Northern Boundary
5578000m N

Southern Boundary
5450000m N

Western Boundary
370000m E

Eastern Boundary
1.5 to 5 nautical miles (3 to 8 km) from the coastline

Key technical specifications for the survey and for the 3-D parameters are indicated in Appendix 1. The energy source will be a dual air source array system. A soft start approach would occur at the beginning of a new line within the perimeter or at the start of operations anywhere within the program area. Table 2 summarizes the survey acquisition parameters.

Table 2: Seismic Survey Parameters (GSI Admiral)

Total Linear Length of Lines (km)	2500 to 3000 km
Number and Length of Streamers	4 x 5000 m
Group Interval	12 groups per section; 12.5 m
Streamer separation	400 m maximum spread; 100 m between each
Record Length	7 secs
Tuned Air source Arrays	6 streamers, 2 air source arrays, 0.05 to 0.10 m ³ in total volume (3000 to 6000 in ³)
Air source Operating Pressure	138 to 172bar (2000 to 2500 psi)
Activation Pressure	2000 to 2500 psi
Hydrophones	4 to 8 in total, towed 5 to 6 km behind vessel, depth of 4 to 8m
Sample Rate	2 msecs
Source Array Tow Depth	6 to 9 m
Vessel Speed	4 knots while recording, 10 knots in transit
Turning Radius	2.5 to 3.0 km

2.1.2 PROJECT ACTIVITY AREA

The Project Activity Area encompasses the geographic area within which GSI expects to undertake seismic survey and associated activities within the next eight years. The 3-D surveys would be conducted over the exploration licences in the areas of interest as depicted in Figure 1. Five areas of interest are shown on this map. Note that Option 5 will not extend outside of the lease area. At this stage of planning, it is unknown which areas have priority for 3-D surveys. The scope of the Project to be assessed in the EA Report extends over several years, during which time the regulatory, biophysical, and socio-economic environment may change from that assessed in this report. GSI will periodically review the existing EA Report, as directed by the C-NLOPB, for current applicability, will continue stakeholder consultations, and will work with regulatory authorities to ensure that the EA remains fit for purpose as required.

Geohazard surveys will be conducted on areas of drilling interest in advance of exploration drilling. During drilling operations, vertical seismic profiles (VSPs) may be conducted at the well sites. These latter two seismic activities could occur following the 3-D (and possibly 2-D) seismic surveys.

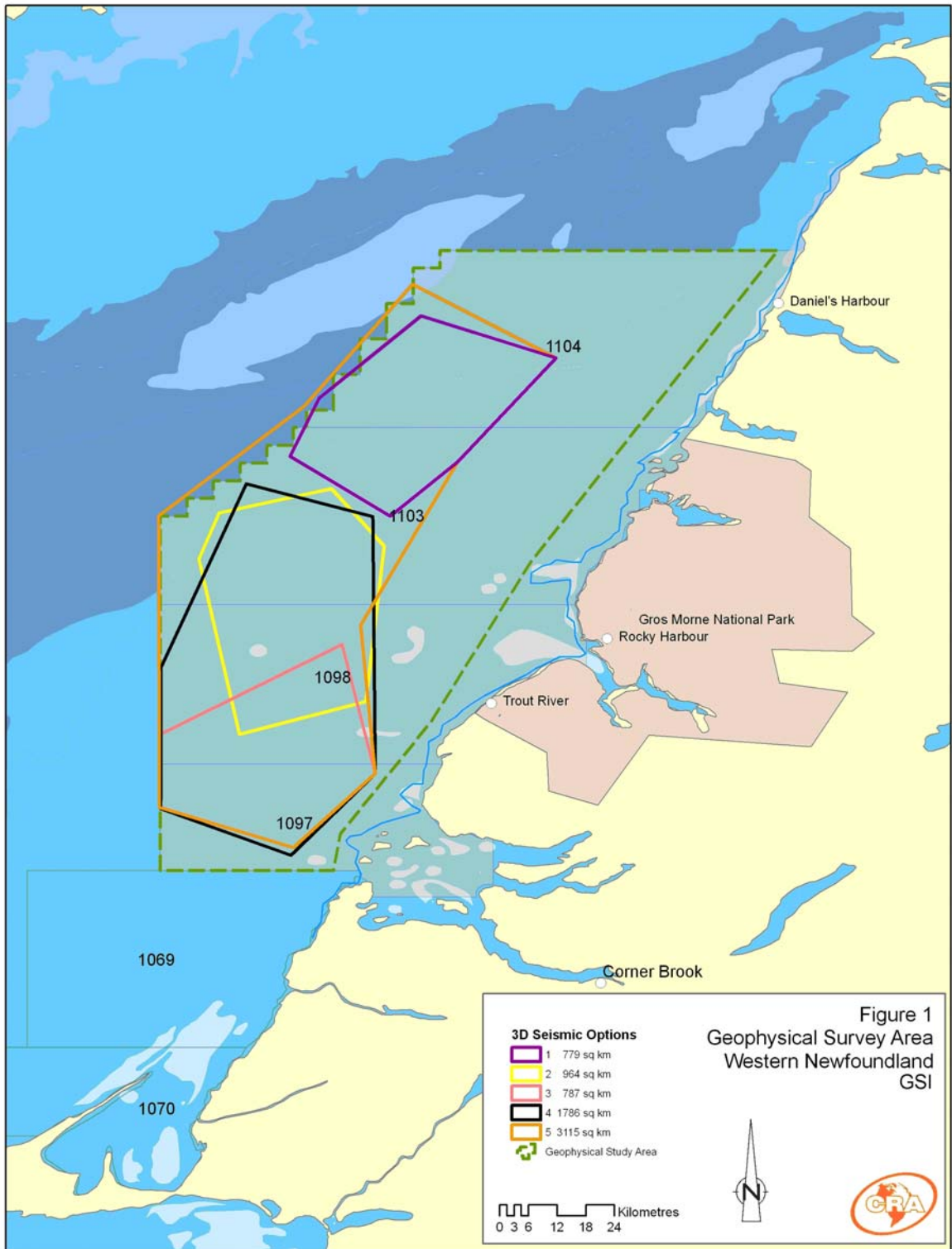


Figure 1 - Areas of Interest for GSI's Geophysical Seismic Surveys

Note:

- Coordinates UTM Zone 21, NAD 83;
- Exact survey area to be finalized when a seismic acquisition company has been chosen;
- Cost and vessel availability may impact survey area;
- Survey area will have an allocation for seismic vessel turn radius;
- Geohazard surveys and VSPs on drilling locations may be conducted in the survey area as well.

2.2 ALTERNATIVES TO THE PROJECT & ALTERNATIVES FOR THE PROJECT

Alternatives to the Project are defined as functionally different ways of achieving the same end (CEA Agency 1997). An alternative to the proposed 3-D/2-D seismic survey is the 'do-nothing' scenario, or null alternative.

The 3-D survey can cover relatively large geographical areas, but have a short-term duration at any given location. A 2-D survey is typically used for exploring a large area to identify potential prospects which require further study (Davis *et al.* 1998). The 3-D seismic survey enables a greater resolution of potential existing oil and gas reservoirs. These surveys provide a detailed picture of the area under investigation allowing for a more detailed analysis of the potential quantity and distribution of hydrocarbons (Davis *et al.* 1998). Results of 3-D surveys are then used to find potential locations for exploration drilling. With regard to location, the proposed lines were selected based on a current understanding of the geological conditions.

Alternative means for the Project are defined as methods of similar technical character or methods that are functionally the same (CEA Agency 1997). Alternative means for carrying out this Project include variations in technology, Project schedule and location.

The proposed program is scheduled to commence between Summer and Fall 2008. Specific timing of the program within this period depends on a variety of factors, including vessel availability, weather conditions, timing and sensitivities associated with biological and socio-economic constraints. For example, mitigative options to minimise impacts include modification of the operations schedule within specific areas (*e.g.*, scheduling of specific lines so as to minimise fisher interactions).

With respect to the technology proposed, tuned air source arrays are the most common, environmentally responsible and practical energy sources for marine geophysical surveys (Richardson *et al.* 1995). Noise pulses with high peak levels are produced; however, each pulse is short, limiting total energy. Richardson *et al.* (1995) also indicated that pulses from air source arrays generally decrease in intensity, but increase in duration further away from the site. Sleeve

exploders and gas guns have similar effects to air source arrays. Although marine vibrators produce lower instantaneous pressure than air source arrays, the total acoustic energy transmitted is similar due to the extended duration of the signal. Marine vibrators are also in their development infancy and are not a practical alternative. Marine vibrators cannot substitute for the air source array in seismic surveys as they provide a lower output at low frequencies.

2.3 OTHER SEISMIC PROGRAMS

2.3.1 WELL SITE/GEOHAZARD SURVEYS

It is possible that a well site geohazard survey will be conducted at one or more locations within the geophysical survey area. GSI will communicate any plans to the C-NLOPB if a well site geohazard survey becomes a part of the geophysical program.

A typical well site survey uses the following acquisition equipment: side-scan sonar, sub-bottom profiler and echosounder, multichannel seismic and magnetometer. The survey vessel will trail one streamer of approximately 600 metres in length. The air source array that is used is much smaller than traditional seismic and is usually <200 in³, which produces a higher frequency and lower power signal. This results in a faster attenuation of sound to background levels and less impact on potential VEC's in the area.

2.3.2 VERTICAL SEISMIC PROFILE (VSP) SURVEYS

During drilling exploration, VSPs of each proposed exploration well may be required. It is estimated that each VSP could take place within a radius of 2.5 km from each well site. The number of well sites not known at this stage.

VSP are typically acquired using a cluster of medium size air source units (total volume of 450 to 1500 cu in) and a peak pressure of 240 to 250 dB re 1µPa at 1m (Davis *et al.* 1998). The sound source to be used in VSP surveys is typically deployed from the drill rig. However the source may also be deployed from a vessel and actuated in a pattern all around the drilling platform but rarely more than 500 m away. The source units will be charged with nitrogen or compressed air at 2000 psi and suspended at a constant depth of four to seven metres, depending on sea-state. VSP surveys are usually a one-time event and extend from one day to over a week. No streamers are deployed for these kinds of surveys.

2.4 SURVEY VESSEL

The survey vessel will be the GSI Admiral. Vessel speed will be approximately 4.5 knots when the survey gear is deployed. It is estimated that the survey vessel will require a turning radius of 2.5 to 3 kilometres outside the identified survey area. Seismic operations can generally continue up to a Sea State of 5 or wave heights of about 3 m.

More details and vessel specifications are included in Appendix 2.

2.5 LOGISTICS & SUPPORT

Details of logistical operations to support the subject geophysical program will largely depend on seismic acquisition company, season and weather.

Helicopters

Helicopters will not be used, except in case of an emergency.

Shore Base

Due to the location of the planned geophysical survey area, it is possible a shore base and supply area will be staged out of the West Coast region or Avalon Peninsula.

Support Vessels

Supply vessels may be utilized for crew changes and supply of materials and consumables. Also, it is possible the seismic vessel may interrupt its geophysical program for logistical requirements. The final determination on these points can only be made when the season of operations is known.

The vessels incorporate a scout (chase) boat that scouts for other vessels or fishing gear that may interact with the survey while underway. The bridge crew on the seismic vessel maintains close surveillance of approaching vessels. Radar reflectors are attached to the streamers for detection by other vessels.

2.6 ROUTINE DISCHARGES

Discharges and emissions from this program will be similar to or less than those of any standard marine vessel. They will be minor and could include the following:

- *Atmospheric Emissions* - emissions from ship engines and onboard equipment will comply with the Air Quality Management (Newfoundland and Labrador *Environmental Protection Act*) and the Ambient Air Quality Objectives (*Canadian Environmental Protection Act*).
- *Ballast Water* - ballast water is stored in dedicated ballast tanks to improve vessel stability. No oil will be present in these tanks or in any discharged ballast/preload water. If oil is suspected to be in the water, it will be tested and, if necessary, treated to ensure that oil concentrations in the discharge do not exceed 15 mg/L as required by the MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships, 1973, and the Protocol of 1978 related thereto), International Maritime Organisation (IMO) and the Offshore Waste Treatment Guidelines (OWTG) (NEB *et al.* 2002).
- *Bilge Water* - Bilge water often contains oil and grease that originate in the engine room and machinery spaces. Before discharge, bilge water is treated in accordance with MARPOL 73/78, IMO and OWTG, using an oil/water separator. The extracted water is tested to ensure that the discharges contain no more than 15 mg/L of oil.
- *Grey and Black Water* - It is anticipated that the survey ship will carry a crew of 30 to 50 people. For accommodating about 100 people, Mobil (1983) estimated that grey water discharge (showers, dishwashing, deck drains, *etc.*) would be 40 m³/d and that black water discharge would be 19 m³/d. The survey vessel should produce less than half of this volume. Sanitary and food wastes will be macerated to a particle size of 6 mm or less and then discharged as per the OWTG.
- *Solid Waste* - All solid waste will be either incinerated onboard meeting MARPOL 73/78 and other applicable standards or transferred to shore and disposed of at an approved on-shore-based facility. Any hazardous materials (*e.g.*, oily rags) will be handled separately in hazardous materials containers.

More information on the GSI Admiral's Waste Management capabilities is included in Appendix 2.

2.7 ACCIDENTAL EVENTS

There will be limited amounts of marine fuel and lube oil on board that could potentially be spilled to the ocean. Small spill events of kerosene and mineral oil (*i.e.* floatation fluid) from streamers can result from tears in the streamers from rough weather-induced entanglement, debris damage and possibly shark bites.

There is some potential for flotation fluid to be lost from a non-solid-streamer if the streamer becomes damaged. Accidental spills will be reported to the C-NLOPB immediately.

Other accidental events could include damage or loss of seismic gear, entanglement of seismic gear with fishing gear, and vessel collisions. Best management practices will be used on the seismic vessel to avoid gear loss or damage. Gear will be retrieved from the water if wave heights reach or exceed unacceptable limits. In case of severe weather, the vessel may return to shore until conditions improve. A trained fisheries observer will be on board during the seismic program to liaise with fishers who may have gear deployed in the Project Activity Area, in order to ensure effective and ongoing communication and avoid unnecessary gear conflicts and possible vessel collisions. Entanglement of marine mammals in seismic gear is not likely since streamers have no tangle gear and marine mammals are expected to avoid the vessel during operations. The onboard fisheries observer will be trained to keep watch for marine mammals during the program.

More information on the GSI Admiral's Emergency Response capabilities is included in Appendix 2.

2.8 HEALTH & SAFETY

GSI will submit a Safety Plan to the C-NLOPB outlining the company's commitment and philosophy toward ensuring personnel's health and safety are first and foremost in all GSI operations.

3.0 SETTING OF ENVIRONMENTAL COMPONENTS

A number of studies have already been performed in the area which have been key references to the environmental assessment (EA) NWest has performed for the project area. These are:

- Western Newfoundland and Labrador Offshore Area Strategic Environmental Assessment (2005) and;
- Seismic Exploration Program Environmental Assessment for Exploration Lease 1069 (2005).

The Western Newfoundland and Labrador SEA Report concluded that petroleum exploration activity generally can proceed in the Western Newfoundland and Labrador Offshore Area with the application of standard mitigation measures currently applied to offshore exploratory activities elsewhere in the NL offshore. The findings of this SEA Report identified areas potentially impacted by the planned geophysical program proposed by GSI; specifically, the North Head and Trout River Lobster Nursery Areas. In addition, the sensitivity of marine-associated birds in the planned geophysical survey area is also an important consideration to be addressed.

3.1 METEOROLOGY AND CLIMATE

The Project Area is governed by a prevailing westerly wind common in the mid-latitudes. The westerly flow is considerably stronger in the winter months than in the summer months. Typically, the periods of southerly winds and mild conditions have relatively long durations and, in general, the incidence of extended storm conditions is likely to be relatively infrequent. Precipitation types are more likely to be in the form of rain or drizzle, with relatively infrequent periods of continuous snow. Periods of snow will prevail in the unstable air in the wake of cold fronts associated with the lows. Generally, the Project Activity Area is less susceptible to heavy storm conditions in the summer than in the winter months.

The incidence of advection fog and the frequency of poor visibility are normally highest in July, although visibility can be low in January, February and March depending on snow fall levels. October has the lowest occurrence of visibilities less than one kilometre because advection fog is minimal and the winter snow has yet to arrive.

The air temperature follows a normal annual cycle with the minimum mean temperature occurring in February (-6.5°C) and the maximum mean temperature occurring in August (16°C).

The minimum mean surface seawater temperatures are in February (-0.79 °C) and March (-0.75 °C). The maximum means are in August (15.32 °C) and September (15.52 °C).

The highest waves typically occur between October and January. The maximum significant wave height of 9.43 m was recorded in January. Significant wave heights >5 m occur every month except for June, July and August.

3.2 ICE CONDITIONS

There are three main sources of sea ice on the west coast of Newfoundland: locally formed ice fields, movement of ice from the St. Lawrence River Estuary; and movement of ice, including small icebergs, from the Labrador Shelf by passing through the Strait of Belle Isle. Based on the 38 year record from 1970 to 2007 and evaluation of data for April, May and June, the median sea ice break up occurs by March 19 along the shore and the area is ice-free by June. Some berg bits from the Strait occur about 20 % of time in June. Median ice cover is 1/10th by June 1st. The Project Area is subject to sea ice with infrequent incursions of icebergs.

3.3 PHYSICAL OCEANOGRAPHY

The Gulf of St. Lawrence is a highly stratified semi-enclosed sea with an approximate surface area of 226,000 km² (Koitusky and Bugden 1991). It exchanges salt with the North Atlantic Ocean and receives considerable input of fresh water from the St. Lawrence River and lesser amounts from other rivers. As a consequence, the Gulf of St. Lawrence acts like a large estuary where Coriolis effects (from force generated by the earth's rotation), geostrophic currents, baroclinic processes, formation of eddies, and wind stress effects are all important.

Current flow in the Project Activity Area is usually in the northeast direction along the west coast of Newfoundland where seawater enters the Gulf of St. Lawrence at the Cabot Strait and exits via the Strait of Belle Isle. Surface currents are in the order of 10 to 20 cm/s (0.2 to 0.4 knots). The net flow out of the Strait ranges from 1.3×10^5 m³/s in the summer and 3×10^5 m³/s in the winter. However, clockwise and counterclockwise gyres occur which complex the circulation pattern.

3.4 MARINE PHYSIOGRAPHY

Water depths within the Project Area range from 20 m to about 200 m.

3.5 MARINE BENTHOS

Benthos are relevant to offshore planning because benthic communities are relatively immobile, are an important link to commercial fisheries, and generally exhibit some level of zonation in their distribution. Benthic community assemblages are mainly dictated by substrate type. Subtidal sedimentary, soft bottom habitats are dominated by marine worms, crustaceans such as ostracods, amphipods, isopods, tanaids, mysids and small decapods. Echinoderms are common and include brittle stars, urchins, sea dollars, sea cucumbers and sea stars. Subtidal hard substrates support low-growing encrusting plants and animals. Dominant species include sponges, tunicates, bryozoans and various cnidarians like anemones and hydroids. Macrobenthos in the Project Area that are particularly important to fishermen on the west coast of Newfoundland include lobster and snow crab. These are presently the two most valuable commercial species in the Project Area.

In general, much of the coastline fauna of Newfoundland remains to be inventoried (Gilkinson 1996) and there are considerable data gaps for certain geographic regions. Surveys that assess benthic community composition rather than species-specific studies are limited for this region. Intertidal sand habitats are dominated by bivalves and gastropods; mud and gravel sediments

have the same groups as well as marine worms. Rocky shores are dominated by barnacles, bivalves and gastropods.

3.6 MARINE MAMMALS

Thirteen species of cetacean, including dolphins, small and large toothed whales, and baleen whales occur in the western Newfoundland offshore region. The North Atlantic right whale and the blue whale are listed under Schedule 1 of the Species-At-Risk Act (*SARA*) as *endangered*. The fin whale and the Scotian Shelf population of the northern bottlenose whale are listed under Schedule 3 of *SARA* as species of *special concern*. The St. Lawrence Estuary population of beluga whales and the harbour porpoise are currently listed under Schedule 1 of *SARA* as *threatened*.

Four species of seals (pinnipeds) are known to occur regularly in the western Newfoundland offshore region: harbour seal, harp seal, hooded seal and grey seal. None of these species are listed under *SARA*. Two other species of pinniped could potentially occur in the western Newfoundland offshore region. These are the ringed seal and the bearded seal. However, although they are known to occur in the Gulf of St. Lawrence, which includes the western Newfoundland offshore region, these pinnipeds are likely to be rare visitors to the Project Activity Area, as their usual distributions are thought to be much further north.

The other species of marine mammal that could occur in the western Newfoundland offshore region is the North American river otter. North American river otters occur in rivers and streams throughout much of North America; in the northern portion of their range, they occur in coastal marine areas as well (Estes and Bodkin 2002). The abundance of this species along the Atlantic coast of North America is unknown (Estes and Bodkin 2002), but they are thought to be relatively common in most of Canada where suitable habitat exists (Melquist *et al.* 2003). Preferred habitat consists of rugged coastal areas with irregular shorelines that have short intertidal lengths (Melquist *et al.* 2003). Otters in Newfoundland belong to a distinct subspecies, *L. canadensis degener* (Parks Canada n.d.). Their abundance is unknown.

3.7 SEA TURTLES

Three species of sea turtle could potentially occur in the Western Newfoundland. In order of decreasing abundance in North American waters, these are as follow: (1) the loggerhead turtle (2) the leatherback turtle, and (3) the Kemp's ridley turtle. Both loggerheads and leatherbacks are common in the waters off Newfoundland during the summer and fall (Goff and Lien 1988; Marquez 1990; Witzell 1999). Less is known about the distribution of Kemp's ridley turtles in western Canada, although they are thought to be rare (Breeze *et al.* 2002). Adults of this species

are rarely found beyond the Gulf of Mexico; however, juvenile animals range as far north as Newfoundland (Ernst *et al.* 1994).

3.8 MARINE BIRDS

Marine-associated bird abundance is low in the Project Activity Area compared to other parts of Newfoundland and Labrador. Their peak vulnerability occurs between January and March. Common Eiders, Harlequin Ducks, Black Ducks and Canada Geese are the highest profile coastal waterfowl occurring in the Project Activity Area.

The marine coast and waters of western Newfoundland have lower abundances of seabirds than other coastal areas of Newfoundland (Lock *et al.* 1994) likely because they are less influenced by the major oceanic currents. This also may be due to a lack of breeding habitat along the west coast and the lower productivity of the adjacent waters compared to the east coast (Lock *et al.* 1994). Seabirds in the area include shearwaters, fulmars, petrels, jaegers, skuas, phalaropes, gannets, cormorants, alcids, kittiwakes and gulls. Northern Gannets, Razorbills, Common Murres, and lesser numbers of Atlantic Puffins that breed along the Quebec North Shore occur pelagically in the Project Activity Area. Only the large gulls and terns and gannets are reported common in the Project Activity Area. Foraging strategies of these seabird groups vary from plunge diving (gannets) and pursuit diving (alcids), through surface feeding (phalaropes) to kleptoparasitism (jaegers and skuas).

Nesting areas and Important Bird Areas (IBAs) within the Project Activity Area include Guernsey Island, Gregory Island, Middle Island and Little Island in St. Paul's Inlet, White Rocks and Stearling Island (Gros Morne National Park). Migrant shorebird concentrates in the Project Area occur in Bonne Bay, St. Paul's Inlet and Parsons Pond.

One breeding area for Common Eiders in the Project Activity Area is located in St. Paul's Inlet. Wintering areas this species is in the Bay of Islands. Harlequin Duck nesting sites in the Project Area are located in Cow Head.

3.9 MARINE FISH AND SHELLFISH

The important commercial invertebrate species in the Project Activity Area are lobster, snow crab and northern shrimp. The important commercial finfish species include Atlantic cod, mackerel, herring, capelin, redfish, Greenland halibut, Atlantic halibut, witch flounder, American plaice and white hake. Atlantic salmon and wolffish are considered important non-commercial fish species.

3.10 FISH EGGS AND LARVAE

The distribution of fish eggs and larvae is poorly understood in the Project Area. Specific areas have been identified as spawning areas for various species but little information related to the passive movements of these ichthyoplankton exists. Fifty species of ichthyoplankton are found in the Gulf of St. Lawrence, representing about two-thirds of the adult fish found in the region. Ichthyoplankton populations in the northern Gulf are dominated by benthic spawning cold-water species such as herring, capelin, snailfish, shanny and sculpin. Boreal shrimp larvae are found in deep waters. Cunner, radiated shanny and winter flounder may comprise a large portion of the ichthyoplankton in nearshore waters at certain times of the year.

3.11 SPECIES AT RISK

The following is a list of species in the Project Area with their designation under one or more endangered species acts or conventions: *Species at Risk Act* (SARA), Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and *Endangered Species Act* – Government of Newfoundland and Labrador

- Blue whale (*Balaenoptera musculus*) (Atlantic population) – SARA, COSEWIC endangered
- North Atlantic right whale (*Eubalaena glacialis*) – SARA, COSEWIC endangered
- Beluga whale (*Delphinapterus leucas*) (St. Lawrence Estuary population) – *threatened*
- Harbour porpoise (*Phocoena phocoena*)– SARA, COSEWIC species of special concern
- Atlantic walrus (*Odobernus rosmarus rosmarus*) – COSEWIC species of special concern
- Fin whale (*Balaenoptera physalus*) – SARA, COSEWIC species of special concern
- Leatherback sea turtle (*Dermochelys coriacea*) – SARA, COSEWIC endangered
- Atlantic cod (*Gadus morhua*) – COSEWIC species of special concern
- Northern wolffish (*Anarhichas denticulatus*) – SARA, COSEWIC threatened
- Spotted wolffish (*Anarhichas minor*) – SARA, COSEWIC threatened
- Atlantic wolffish (*Anarhichas lupus*) - SARA, COSEWIC threatened
- Porbeagle shark (*Lamna nasus*) – SARA, pending consultation, COSEWIC endangered
- White shark (*Carcharodon carcharias*) – SARA, pending consultation, COSEWIC endangered
- Shortfin mako (*Isurus oxyrinchus*)- COSEWIC threatened
- Cusk (*Brosme brosme*) – COSEWIC threatened
- Piping Plover (*Charadrius melodus melodus*) – SARA, Provincial endangered

- Ivory Gull (*Pagophila eburnea*) SARA species of special concern, Provincial vulnerable
- Harlequin Duck (*Histrionicus histrionicus*) – SARA, COSEWIC species of special concern, Provincial vulnerable

3.12 SENSITIVE AREAS

Several sensitive areas directly associated with fish and invertebrates occur within the Project Area. Areas highlighted by fishers included Bonne Bay, the Bay of Islands area (lobster nursery), and Port au Port Bay (lobster spawning). These locations occur nearshore within the Project Area, but well beyond the exploration areas of interest. Specific mitigative measures will be established during site-specific EAs.

Gros Morne National Park occurs within the Project Area. It was declared a UNESCO World Heritage Site in 1987. Unique areas of the park include Bonne Bay, Western Brook Pond and St. Paul's Bay. Discussions on IBAs in this area are provided above.

3.13 COMMERCIAL FISHERY

Groundfish (primarily cod, redfish and greysole flounder), herring, mackerel, capelin, lobster, shrimp and snow crab make up more than 99% of the 4Rb,c, harvest in recent years. The groundfish harvest has been drastically reduced in Division 4R (NL and NS data) over the last two decades, owing largely to changes in the cod fisheries. Although still important socially and economically, in 2004 the groundfisheries were only about 5% of what they had been two decades earlier. Rather similar declines occurred in some other groundfish harvests, such as redfish, while halibut and greysole (witch) flounder harvests have not followed these same trends.

The Project Area fisheries are conducted primarily in the May to November period, owing in large part to ice and weather conditions. This is also when offshore exploration is likely to be active for the same reasons. As a consequence, there is very likely to be temporal overlap between exploration activities and commercial fisheries. Depending on locations chosen by the petroleum industry, there may also be spatial overlap.

3.14 MARINE TRAFFIC

The west coast sees some shipping activity, nationally through ports in Stephenville and Corner Brook, and internationally through the Strait of Belle Isle, mostly active during summer for ships coming from Europe. There is also local boat traffic, mostly fishing vessels and DFO research vessel surveys.

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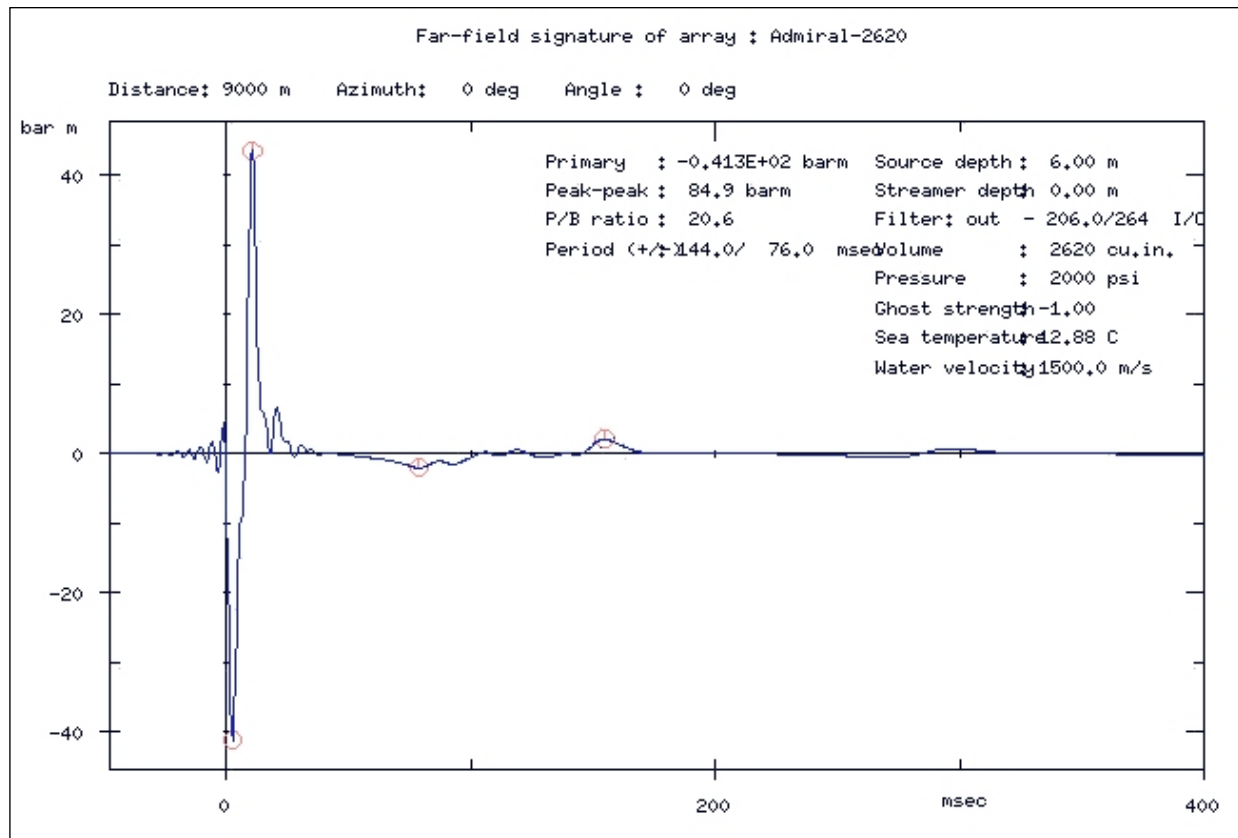
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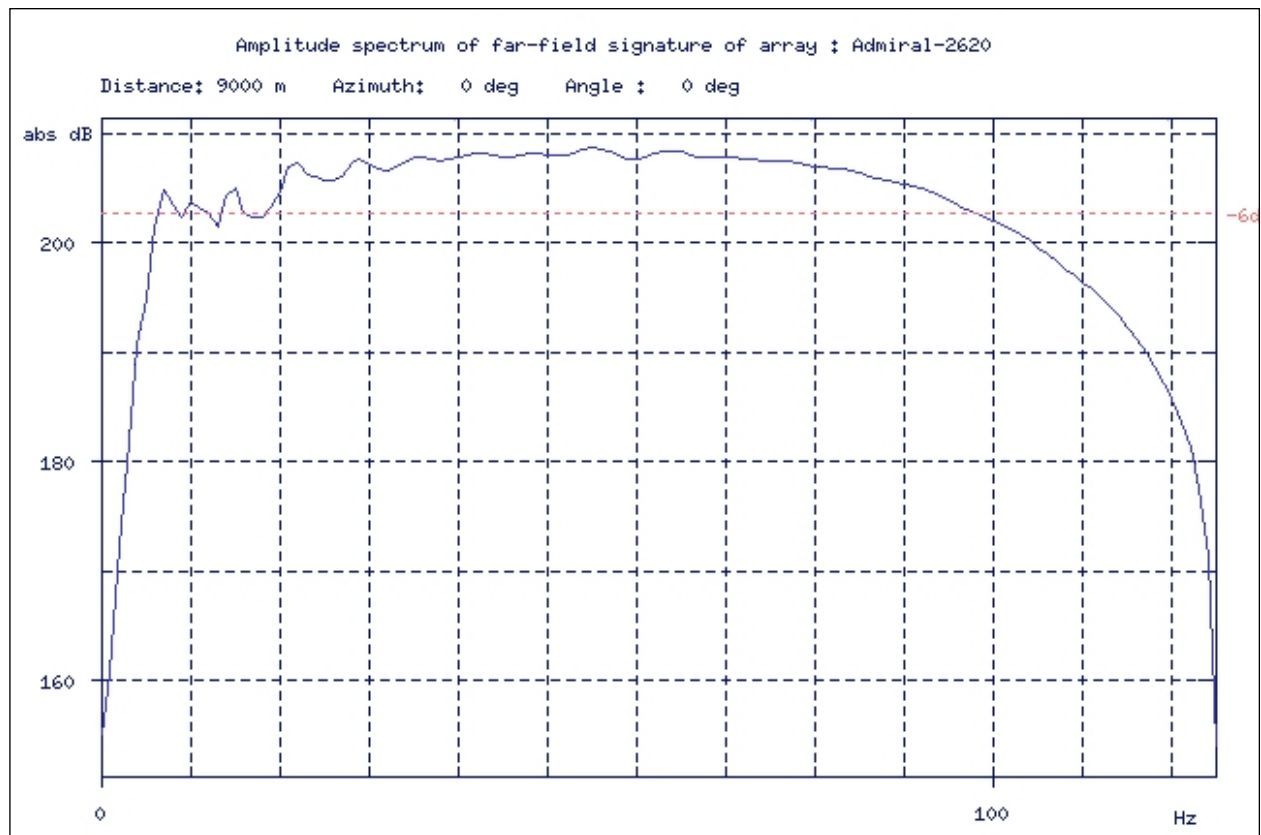
APPENDIX 1: GSI ADMIRAL ARRAY / SOUND SOURCE DETAILS

GSI ADMIRAL ENERGY SOURCE General Parameters

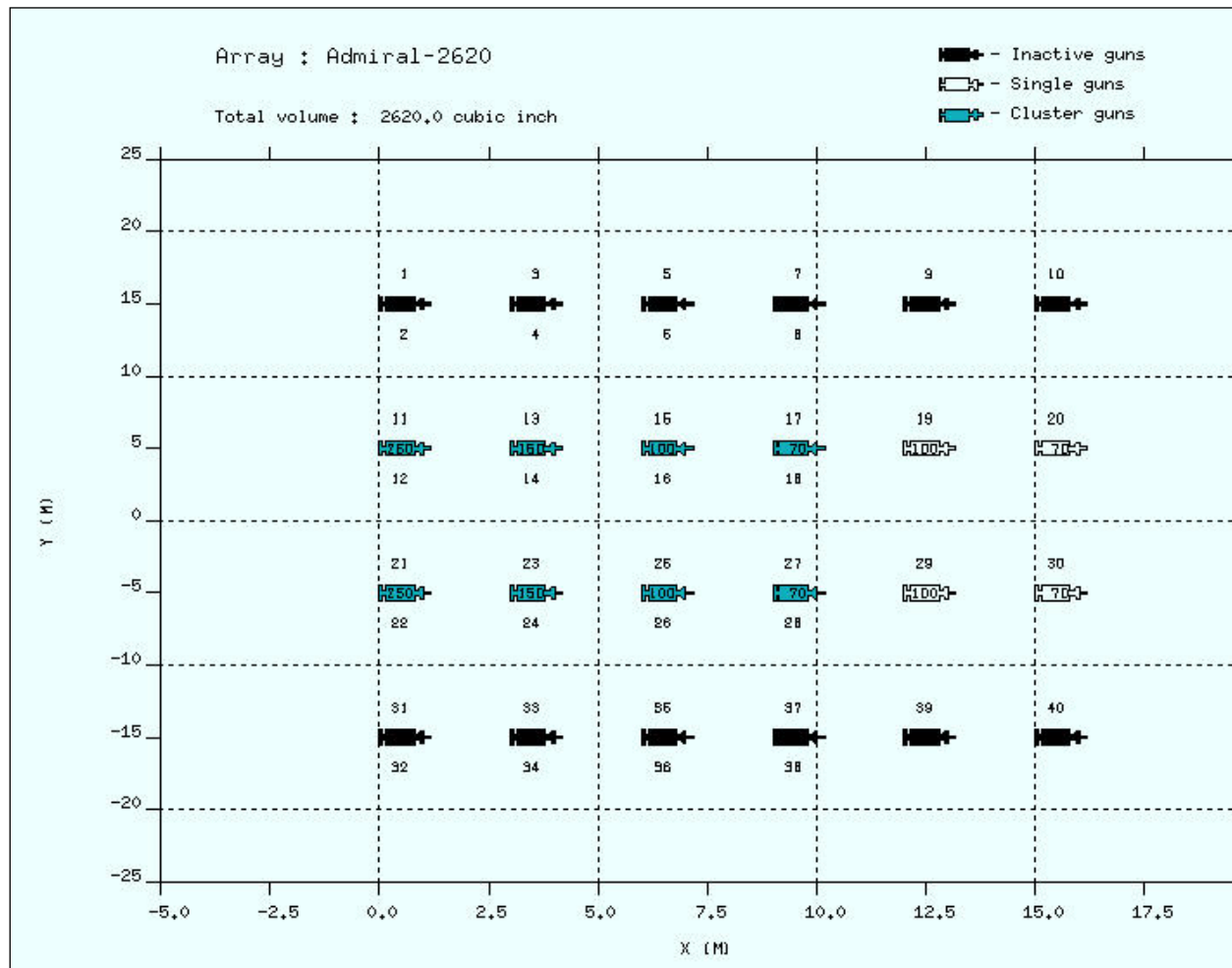
GUN TYPE	Bolt Technology "LL" Air Source Units
SOURCE ARRAY SIZE	2 x 2620 cu. in. for 3D (capability up to 7,860 cu. in.; for 2D 5,240 cu. in is commonly used)
PRESSURE RELEASE	Solenoid
SENSOR RETURN	Bolt Technology sensors
COMPRESSOR	3 X Hamworthy 800E (800 SCFM each) 3 X Hamworthy 425E (390 SCFM each)
NOMINAL SOURCE PRESSURE	2,000 psi
GUN CONTROLLER	Syntron GCS-90
TIMING RESOLUTION	<1 ms
CLOSURE COMMAND SOURCE	Navigation system
NEAR FIELD PHONES	Two per string
DEPTH INDICATORS	Two per string



GSI Admiral 3D 2620 Cu In Array Far-Field Signature



GSI Admiral 3D 2620 Cu In Array Far-Field Amplitude Spectrum



GSI Admiral 3D 2620 Cu In Array Geometry

APPENDIX 2: DETAILS / SPECIFICATIONS FOR THE *GSI ADMIRAL*



GSI ADMIRAL

VESSEL AND EQUIPMENT



MAIN DATA

SHIP NAME	GSI Admiral
CALL SIGN	VOCC
OWNER	Geophysical Service Incorporated (GSI)
PREVIOUS NAME	Geco Alfa, Austral Horizon
OPERATOR	Geophysical Service Incorporated (GSI)
FLAG	Canadian
PORT OF REGISTRATION	Halifax, NS, Canada
OFFICIAL NO.	823 287
SEISMIC TYPE	2D/3D vessel
DATE OF BUILT	1976
DATE CONVERTED	1998
CLASSIFICATION	DNV + 1A1 Heldk
IMO NO.	7384314

PRINCIPAL PARTICULARS

GRT. INTERNATIONAL	3435 GRT
GRT. PANAMA	3922.58
GRT. SUEZ	3705.86
NRT. NATIONAL	1031
NRT. INTERNATIONAL	1031
NRT. PANAMA	2777.89
NRT. SUEZ	2663.92
D. W. TONNAGE	2017.7
LIGHTSHIP DISPLACEMENT	2841.15 t
LENGTH OVERALL	89.59 m
LBP	82.02.m
BREADTH (MOULDED)	17.4 m
BREADTH (EXTREME)	19 m
DEPTH (MOULDED)	9.40 m (Working deck); 6.80 m (Freeboard deck-main)
DEPTH (EXTREME)	9.40 m
DRAFT (LIGHTEST)	3.99 m
DRAFT (MAX)	5.85 m
DRAFT (MEAN)	4.92 m
HEIGHT WATERLINE TO HIGHEST FIXED ANTENNA	26 m

CAPACITIES AND ENDURANCES

TRANSIT SPEED MAX	13 knots
TRANSIT SPEED ECON	10 knots

FUEL CONSUMPTION IN TRANSIT	10 m ³ /day
FUEL CONSUMPTION WHILE RECORDING	13 m ³ /day
MAX. DAYS AT MAX TRAN. SPEED	60
MAX. DAYS AT ECON TRAN. SPEED	100 days
PRODUCTION SPEED MAX	5 knots (depending on streamer used)
PRODUCTION SPEED MIN	3.5 knots (depending on streamer used)
MAX. DAYS AT MAX PROD. SPEED	approx. 60
MAX. DAYS AT MIN PROD. SPEED	approx. 60

SAFETY EQUIPMENT

LIFEBOATS TYPE	N/A
LIFEBOAT RADIO (Make/Model)	3 Sperry VHF SP3110
LIFERAFTS TYPE	8 Type A 1 Type B
NUMBER OF LIFERAFTS	6 x 25 Man, 2 x 16 Man, 1 x 4 Man
POSITION OF LIFERAFTS	4 Port 4 Stbd 1 aft
MAN OVERBOARD BOAT (Make/Model)	1 x UFAS / Weedo 17, 2 x 60HP
SURVIVAL SUITS (No./Type)	56 Fitzwright
LIFE JACKETS (No./Type)	84 DOT SOLAS approved
WORK VESTS (No./Type)	24 Mustang vest
WORK SUITS (No./Type)	12 Mustang work suits
EPIRB (No./Type)	1 x Float Free, Pains Wessex 406 KHz
PORTABLE FIRE EXTINGUISHER. (Locn)	All over vessel and portable foam in fire room
FIXED FFE IN COMPRESSOR ROOM	Dry chemical and CO2 cylinders
FIXED FFE IN CABLE STORE	Water cannon foam
FIXED FFE FOR STREAMER REELS	Foam
FIXED FFE FOR INSTRUMENT ROOM	CO2 extinguishers
FIXED FFE FOR ACCOMMODATION	Dry chemical
FIXED FFE FOR GUN DECK	Dry chemical and CO2 and water cannon/foam
FIXED FFE FOR OTHER AREAS	CO2 for galley and paint locker
MAIN FIRE PUMP (Type/Capacity)	Iron AS Ovp-5-300 100cu m. per hr.
MAIN FIRE PUMP (Locn./No.)	Stbd side engine room two units
EMERGENCY FIRE PUMP (Type/Capacity)	Heinrich BEHRENS Vrf/350g 100cu m hr
EMERGENCY FIRE PUMP (Locn./No)	Aft fire pump room one unit
FIRE FIGHTING EQUIPMENT (FFE)	Designated location
SHIPS SECURITY SYSTEMS	As per the ISPS Code

BRIDGE EQUIPMENT

NO. 1 RADAR (Make/Model)	Decca Bridgemaster ARPA BM 343/12
NO. 2 RADAR (Make/Model)	Decca Bridgemaster ARPA BM 252/6
ARPA	Decca Bridgemaster ARPA BM 343/12
AUTOPILOT	Robertson STS 500
MAGNETIC COMPASS	J. R. Krohn 79047
SATNAV	Concept Spectra Console

GPS RECEIVER (Make/Model)	Leica MX 400 DGPS
SPEED LOG (Make/Model)	SRD 331 MDV
ECHO SOUNDER (Make/Model)	Skipper NaN Jing GDS 101
NO. 1 VHF (Make/Model)	Sperry RY 6102
NO. 2 VHF (Make/Model)	Jotron TR 6102
NO. 3 VHF (Make/Model)	Delcom GN 2940

COMMUNICATION EQUIPMENT

RADIO STATION LIC. NO	4906344
INMARSAT TYPE B (Make/Model)	Sperry 2098
INMARSAT TYPE C (Make/Model)	Sperry H2095B
INMARSAT B NO. (PHONE)	331 600 337
INMARSAT B NO. (FAX)	331 600 339
BROADBAND SYSTEM	128 Kbps C-Band satellite communication
OTHER VOICE COMMUNICATIONS (Specify type)	Sperry RE 2100 (SSB Radio Telephone) Mousson-2, 250 W (SSB Radio)
SATELLITE COMMUNICATION SYSTEM	BRIDGE 1-954-518-7446
SATELLITE FAX	1-954-518-7444
SATELLITE COMMUNICATION SYSTEM	1-954-518-7442
SATELLITE EMAIL	Admiral_bridge@yahoo.ca
MAIN TRANSMITTER (Make/Model)	Sperry T2130
MAIN RECEIVER (Make/Model)	Sperry RE 2100
WATCHKEEPING RECEIVER (Make/Model)	Delco Electro DC-303
NAVTEX	JRC NCR 330
WEATHER FAX (Make/Model)	Taiyo TF 721
PORTABLE VHF (Make/Model)	Delcom GN 2940
PORTABLE VHF GMDSS	3 Sperry VHF SP3110
PORTABLE UHF (No./Make/Model)	6 Motorola Radius GP300
RADIO ACCOUNTING AUTHORITY	Industry Canada

MACHINERIES

PROPELLER	Kamewa Controllable Pitch, 4 Blades
PROPULSION TYPE	Diesel
PROPULSION MOTORS (Type/Kw)	Azimuth Thruster Type UL 2001/6100 Kamewa Power 1491 kW (Retractable)
MAIN ENGINES (Make/Model/Hp/Kw)	Zgoda Sulzer ZL40/80, BHP 4800 @ 500 rpm
AUX. ENGINES (No./Make/Model/Hp/Kw)	1 x 950 kVA @750 rpm H. Cegielski/Sulzer Model 6 AL 25/30

ALTERNATORS (No./Make/Model/Kw/Hp/v)	1 x 190 kVA / 400 v / 50 Hz Diesel set Make Skania Type DS14A01LR 1 x 1200 kVA/400v / 50 Hz Shaft Alternator Make DKBL 536/06 + DEA 434
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HULL OUTFITTINGS

NON-DIRECTIONAL BEACON (Man/Freq)	Sencea STR 25
SHIP/ AIR COMMUNICATION (Make/Mode/Qty/Freq)	Jotron TR 6102
FIXED FFE FOR HELIDECK	Foam cannon
ACCOMMODATION - TOTAL BERTHS	42
NO. OF CABINS EXCLUDING MARITIME CREW	19
TOTAL NO. SINGLE BED CABINS	16
TOTAL NO. DOUBLE BED CABINS	13

SEISMIC EQUIPMENT

RECORDING SYSTEM

TYPE	I/O MSX Marine Recording System
MANUFACTURER	Input/Output Inc. (I/O)
RECORDING FORMAT	8015 SEG D
RECORDING MEDIA	3590-tape cartridges
RAID system	RAID 5 with 2.3 TB total Hard Disk capacity
RECORDING DEVICES	4 X IBM Magstar 3590

NAVIGATION SYSTEM

TYPE	DGPS integrated navigation system
MANUFACTURER / MODEL	Concept Systems Spectra, version 9.8.6 Based on Dell Precision 370 Workstations, OS: Red Hat Workstation Enterprise Linux v.3
REAL TIME NAVIGATION UNIT	Concept Systems RTNU CSL 400000
PRIMARY DGPS	Skyfix XP
SECONDARY DGPS	Spotbeam / Trimble
RECORDING FORMAT	UKOOA P2/91, P2/94
RECORDING MEDIA	HD, Exabyte, CD ROM (preferred media)

RECORDING DEVICE	HD, Exabyte, CD ROM (preferred media)
NAVIGATION PROCESSING	Concept Systems Sprint v.4.3.2, Reflex v.1.9.4
ACOUSTIC IN-WATER POSITIONING SYSTEM	I/O DigiRANGE Acoustic Ranging System
ECHO-SOUNDER	ODIM ECHOTRAC DS3200 MK II

STREAMER SYSTEM

TYPE	I/O MSX, 24 bit Digital
MANUFACTURER	Input/Output Inc.
MAXIMUM CAPACITY	2D: 1 x 9,000 m; 3D 4 x 6 6,000 m
GROUP LENGTH	12.5 m
GROUP INTERVAL	12.5 m (25 m group-summing option)
HYDROPHONES PER GROUP	14
HYDROPHONE	I/O Preseis 2517
SECTION LENGTH	100 m
MAXIMUM ACTIVE CABLE LENGTH	9,000 m
CABLE OIL	Isopar M
ELECTRONIC MODULE:	MSX, CSX, TSX and HSX
DATA CHANNELS PER MODULE	16
AUXILIARY CHANNELS	16
SAMPLE RATE	0.5-1-2-4 ms
LOW CUT FILTER	2 Hz, 6dB/octave built-in analog
HIGH CUT FILTER	824.3 /411.9/205.9/102.9 Hz
STREAMER CONTROL DEVICE:	Compass Birds
TYPE	DigiCourse Model 5011
MANUFACTURER	Input/Output, Inc.
STREAMER COMMUNICATION	Serial, FSK
HEADING SENSOR	DigiCourse model 5011
ACCURACY	± 0.5°
DEPTH SENSOR	DigiCourse model 5011
DEPTH ACCURACY	± 0.15 m

ENERGY SOURCE

SOURCE UNIT TYPE	Bolt Technology "LL" Air Source Units
SOURCE ARRAY SIZE	up to 7,860 cu. in.; commonly used 5,240 cu. in. for 2D; and 2 x 2620 cu. in. for 3D
PRESSURE RELEASE	Solenoid
SENSOR RETURN	Bolt Technology sensors
COMPRESSOR	3 X Hamworthy 800E (800 SCFM each) 3 X Hamworthy 425E (390 SCFM each)
NOMINAL SOURCE PRESSURE	2,000 psi
GUN CONTROLLER	Syntron GCS-90
TIMING RESOLUTION	<1 ms

CLOSURE COMMAND SOURCE	Navigation system
NEAR FIELD PHONES	Two per string
DEPTH INDICATORS	Two per string

OTHER

SINGLE AND MULTI TRACE PLOTTER	Seis QC, 20" Color Monitor, Versatec 24" Plotter, HP Postscript Laser Printer
ONBOARD SEISMIC QC	Recording system's Embedded Visualization Processor and ProMax
ONBOARD SEISMIC PROCESSING OPTION ONE	ProMax v.2003.3.3 2xPentium PCs with Linux OS -IBM3590 tape drives -OYO 24" plotter -Associated image capture and plotting software
ONBOARD SEISMIC PROCESSING Option 2	ProMAX 3D Sun Ultra80 workstation -Sun 300GB StorEDGE -IBM3590 tape drive -OYO 24" plotter -8mm Exabyte drive -Associated image capture and plotting software
MARINE MAGNETOMETER	SeaSpy
MARINE GRAVIMETER	LaCoste & Romberg Air-Sea Gravity Meter Sys II