

MARINE SEISMIC SURVEYS: THE SEARCH FOR OIL AND NATURAL GAS OFFSHORE



Photo Credit: Shell Canada

WHAT IS A MARINE SEISMIC SURVEY?

Marine seismic surveys use sound energy to map geological structures under the seabed. Towed devices use compressed air to produce pulses of high-energy, low-frequency sound waves that travel through the water and can penetrate more than 6,000 metres into rock layers below the sea floor. These sound waves bounce back to the ocean surface where receivers, called hydrophones, record the strength and return time of each sound wave. From this data, maps of the geology below the seabed are developed.

THERE ARE VARIOUS TYPES OF MARINE SEISMIC SURVEYS, INCLUDING:

TWO DIMENSIONAL (2D): Uses one sound source and one set of receivers to provide a general picture of the geological characteristics over a wide area.

THREE DIMENSIONAL (3D): When a 2D survey detects a geological structure that may contain oil and natural gas, a 3D survey is used to provide more detailed information about a smaller area. These surveys deploy multiple synchronized sound sources and hydrophones.

FOUR DIMENSIONAL (4D): Similar to a 3D survey, with the added dimension of time. 3D surveys are conducted over a producing field multiple times, using precisely the same coordinates, so they can be compared to understand changes in the amount and location of oil and natural gas in the reservoir as a result of production activity.

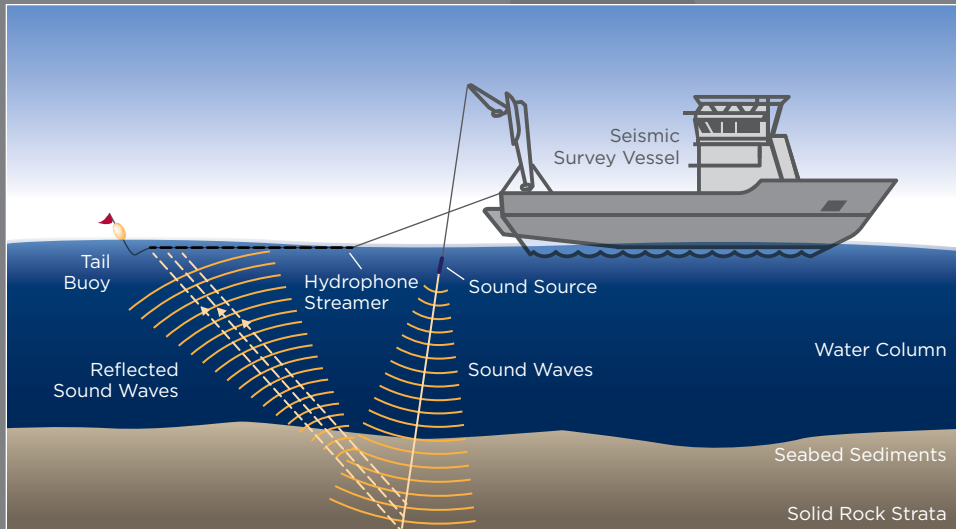
During a survey, the seismic vessel travels about five knots in a predetermined pattern and tows one or two sound sources to generate sound waves, and one or several long cables or “streamers,” containing hundreds of evenly-spaced hydrophones.

The position of the vessel and equipment must be carefully controlled, using advanced navigation and acoustic systems, to ensure geological features are pinpointed accurately. Each streamer can be up to 12 kilometres long and is towed six to 15 metres below the water surface to reduce the effect of ocean waves on the data. In the most technically advanced seismic surveys, up to 12 streamers are towed at the same time, each about 50 to 150 metres apart.



A seismic vessel tows streamers containing hydrophones, receivers used to record sound waves.

Photo credit: Shell Canada



The marine seismic survey process

WHY ARE SEISMIC SURVEYS CONDUCTED?

Marine seismic surveys are an essential part of exploring for crude oil and natural gas. They provide information on the depth, position and shape of underground geological formations that may contain petroleum.

Seismic data helps companies decide whether:

- The available information is sufficient to justify drilling an exploratory well;
- Additional surveys are needed to better define the structures before drilling; or
- The features present are not attractive enough to warrant further interest.

The survey results do not show definitively whether oil or natural gas is present, but they do indicate where the resources are likely to be found and help to narrow the search area.

WHAT ARE THE IMPACTS OF SEISMIC SURVEYS ON OCEAN LIFE?

Current research indicates that there is minimal risk of mortality in marine mammals, fish and invertebrates when the sound energy of seismic surveys is released into the water column, and additional research is ongoing.

Marine mammals, depending on the species and proximity to the seismic survey, can experience temporary changes to their hearing thresholds and in some extreme cases of unmitigated exposure, these effects can be permanent. Similarly, laboratory research has shown some physiological responses in invertebrates – crab, shrimp, scallop etc.

More research will broaden our understanding of the potential impacts of seismic surveys. The industry is committed to ongoing research and to employing mitigation measures to minimize the impact on marine life.



Offshore employees at work.

HOW DO OFFSHORE OIL AND NATURAL GAS COMPANIES WORK TO PROTECT MARINE LIFE DURING MARINE SEISMIC SURVEYS?

Before a company can perform a marine seismic survey it must first undertake a thorough Environmental Assessment (EA), which reviews potential environmental impacts in the proposed survey area along with feedback from the public and marine stakeholders. The EA is reviewed by the Department of Fisheries and Oceans (DFO) and the Department of Environment and Climate Change, and must be approved by the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) or the Canada-Nova Scotia Offshore Petroleum Board (C-NSOPB) before a survey can proceed. Additionally, seismic survey operators must comply with guidelines established by the C-NLOPB and C-NSOPB.

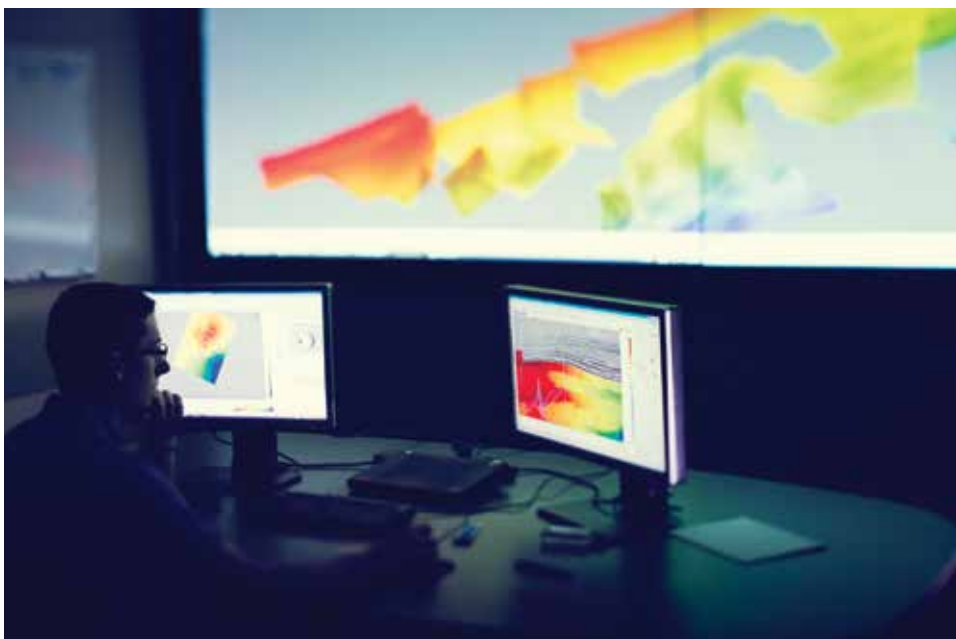
Seismic vessels and their operators are also guided by DFO's Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment, which includes the following measures to be considered in planning and implementing seismic surveys:

- Minimizing the sound energy employed to achieve the purpose of the survey;
- Gradual start-up of a sound source to allow marine mammals, sea turtles and other species to move away;
- Immediate shut down of sound sources if marine mammals or sea turtles listed as endangered are observed within 500 metres of the sound source;
- Use of qualified observers to monitor survey operations;
- Avoidance of known, critical habitats specified under species-at-risk legislation;
- Avoidance of known species migration routes, spawning areas and habitats.



A seismic vessel during a marine seismic survey.

Photo credit: Shell Canada.



A geoscientist reviews and interprets seismic data.

DO SEISMIC SURVEYS INTERFERE WITH FISHING OR OTHER MARINE ACTIVITY?

Seismic surveys are scheduled during optimal weather conditions from June to September as rough seas affect the quality of data collected. June to September is also peak fishing season in Atlantic Canada. Effective communication and coordination between seismic ships and fishing vessels is essential in areas where both industries are active.

A number of proactive mechanisms are in place to minimize potential conflicts and respond effectively should they occur. The EA process requires coordination and communication with the fishing industry, which is advised of marine seismic surveys through direct communication, notices to fishers via local media and notices to mariners.

When seismic surveys take place in Newfoundland and Labrador waters, operators arrange for a land-based Single Point of Contact (SPOC). The SPOC provides support to the offshore project and communicates with the fishing industry. A Fisheries Liaison Officer (FLO) may also be required on board the survey vessel. The FLO communicates directly with fishing vessels and, at times, with the SPOC to resolve situations where overlaps and conflicts could occur.

One Ocean was established in 2002 as a liaison organization to facilitate communication and resolve issues between the fishing and petroleum industries in Newfoundland and Labrador. In Nova Scotia, the C-NSOPB has established a fisheries advisory committee to assist in minimizing the impact of petroleum industry activity on the fishing industry.

Oil and natural gas companies are required to have compensation programs in place to reimburse fishers in the unlikely event of economic loss resulting from marine seismic surveys.

USEFUL LINKS:

Atlantic Canada's Offshore: www.atlanticcanadaoffshore.ca

C-NLOPB: www.cnlopb.nl.ca

C-NSOPB: www.cnsopb.ns.ca

One Ocean: www.oneocean.ca

Fisheries and Oceans Canada: www.dfo-mpo.gc.ca



A fisheries liaison officer reviews maps of fishing grounds during a seismic survey.