

Non-Technical Summary

Proposed Project

TGS-NOPEC Geophysical Company ASA (TGS) proposes to undertake a two dimensional (2D) seismic survey and seabed sampling in the off South West Greenland between 1 June and 15 October 2012. The Survey Area (Figure A) lies to the south of areas where significant sea ice is expected. The survey will mainly take place offshore in relatively deep water beyond the continental shelf but there are some areas of banks which are relatively shallow.

The purpose of the project is to acquire geophysical and geological data that will be used by various clients (exploration companies) to prospect for hydrocarbon resources. The data acquired by the survey will contribute to a more accurate and advanced understanding of the geology and hydrocarbon potential of the area. Conducting the project as a multi-client project will eliminate (or significantly reduce) the need for the various different exploration companies to acquire the same data independently and thereby limit the overall impact to the environment.

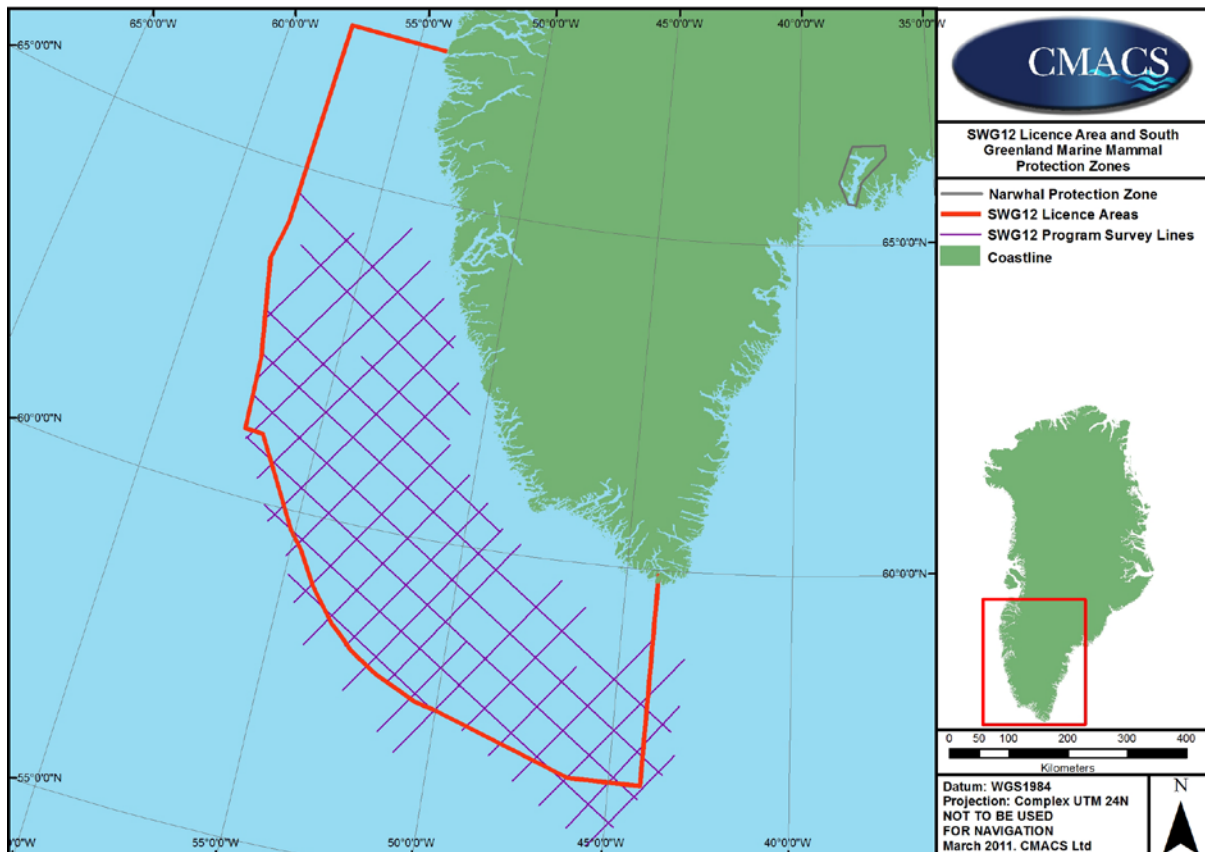


Figure A. Location of proposed seismic survey lines (crossed green lines, known as the Survey Area) within TGS Licence Area (thick red line). Seismic Protection Zones for marine mammals are also indicated.

The survey lines are widely spaced (around 50km). Up to 5,000 km of lines will be surveyed; these are nowhere closer than 10 nautical miles (18.5km) from the coast and extend up to around 450km offshore. Seismic surveys acquire data on seabed geology using subsurface acoustic (sound) reflections to identify boundaries between different geological layers. The

acoustic source is provided by an array of airguns towed approximately 250m behind a 'source' vessel (the *M/V Akademik Shatskiy*) which also tows an array of hydrophones to 'listen' to the reflected sound. The hydrophone arrays are known as streamers and will be towed around 8km behind the source vessel. The source vessel will be assisted by a support vessel the *M/V Kvitbjørn*.

2D seismic surveys such as this contrast with more intensive 3D surveys where lines are much more closely spaced and very detailed information is collected, often over smaller areas. This is an important point in relation to the assessment since it means that any environmental effects at a given location will be very short term. In contrast, the survey will take place over a relatively large area and thus has potential to affect a wider area, albeit less intensively.

Two airgun arrays will be available: one of up to 3350 cubic inch and a larger array with a total volume of up to 5025 cubic inch. The smaller array will generate less noise and will be used whenever possible; the larger array is proposed to be available where there are deep-lying targets (i.e. deep in the seabed- these will also more likely be in deep water). The smaller array is therefore more likely to be used in shallow waters.

The vessel will conduct the survey whilst travelling at 5 knots with a firing interval of 10 seconds (approximately every 25m separation). The survey vessel is intended to be operational 24 hours a day except in periods where weather does not allow for data acquisition.

Whilst there may be some drift ice present no ice breaker will be used.

Following submission of a Scoping Document which outlined the proposed survey specifications, Bureau Minerals and Petroleum (BMP), National Centre for Energy and Environment (DCE) and Grønlands Naturinstitut (GINR) have advised TGS that an Environmental Mitigation Assessment (EMA) should be prepared. Comments have been received from BMP and its technical advisers which have been taken into account in the EMA.

Centre for Marine and Coastal Studies Ltd (CMACS) has prepared the EMA with support from NIRAS who have provided information on background environmental conditions (marine ecology and human activities) and undertaken detailed underwater noise modelling of the proposed airgun array, including predictions of propagation in relation to local conditions (i.e. the expected noise at varying distances from source and at different depths).

Human Activities and Ecology of the Area

The EMA summarises the various human activities and natural environment features that could potentially be affected by the survey. The natural environment includes seabed communities which in shallow areas, especially below 100m, are important areas of production supporting wider marine species. The area is of considerable importance to commercial and subsistence fishing and there is some hunting of marine mammals, focused in coastal waters inshore of the seismic survey area.

Coastal areas are also of considerable importance to seabirds over summer months, some of which will pass through or may forage in the survey area.

A wide range of marine mammal species occur off South West Greenland and may be present in or around the survey area. The area is of very high importance in winter because it is generally not iced over but in summer species that are not associated with ice visit to feed on rich resources associated with areas of upwelling around the banks, especially to the north and south of the survey area.

Potential Impacts

A number of potential impacts of the seismic and seabed surveys were identified. Effects potentially giving rise to impacts are summarised in Table A, below.

Table A. Potential Impacts

Effect (Section)	Receptors Considered	Potential Impact(s)
Underwater noise of airgun array	Fish, Marine Mammals	Physical Injury Disturbance/displacement
Accidental oil/fuel spills	Fish, Birds, Marine Mammals, Benthic Habitats	Direct/indirect impacts through contamination of the marine environment as discussed
Conflicts with other human activities	Fishing, Hunting, Tourism	Lost time and income
Physical disturbance from seabed samplers	Benthic habitats	Damage to sensitive habitats
Attraction to vessels	Birds	Collisions/interference with normal behaviour, potentially fatal to individuals.

- Other potential effects, including emissions to the environment (atmosphere or sea), collisions between survey vessels and wildlife and cumulative effects (with other seismic surveys or in combination with other human activities) are considered.

The guidance documentation for EMA places considerable emphasis on noise modelling to underpin the assessment of effects and to support mitigation to reduce or avoid significant adverse impacts. A detailed noise modelling report is appended to the EMA. The modelling made use of best available information to develop predictions of Sound Pressure Level (noise) at source, to a range of over 100km from the source and at all depths to the seabed. Wherever there was uncertainty conservative 'worst case' assumptions were made to ensure that, if anything, the magnitude of sound and predicted effects are over-estimated. This represents a precautionary approach in that any impacts should in reality be rather less than predicted (and mitigation more effective). Key assumptions made include the following:

5. It was assumed that the larger array, with higher noise level, would be used.
6. The source noise level is assumed to be 264dB re. 1 μ Pa @ 1 m. This is known to be higher than the true source noise level because in reality the airgun array is not a point source but an area.
7. The airgun array is assumed to be omnidirectional whereas in reality it will be focused vertically downwards, towards the seabed, since it is in the interests of the survey to target the energy here to maximise data return. The horizontal pressure (sound) can in fact be up to around 20dB lower than the vertical pressure (a drop of 6dB represents a halving of the noise).
8. Finally, conservative assumptions were made for key environmental parameters such as seabed sediment character that influence effects at distance.

A detailed summary of the Noise Report (itself appended to the EMA) is provided in Section 6.2 of the EIA. In summary:

- sound propagation from the seismic survey is expected to be much greater for lower frequency components of the sound spectrum;
- there will be rapid attenuation (noise reduction) over short distances (the first few hundred metres), especially of higher frequency noise;
- levels of noise that could injure marine mammals are not expected to be present more than 400m from the airgun array (conversely, it is acknowledged that potentially dangerous levels of noise may be present close to the airguns);
- taking into account the parts of the sound spectrum over which different marine mammal species have maximum sensitivity (hearing ability), levels of noise that could disturb (displace) sensitive marine mammals, such as bowhead whale, may be present to a considerable distance from the survey. Conservatively, distances at which such effects could occur are estimated as being up to around 100km.

Whilst there is a focus on potential impacts relating to noise effects the EMA addresses the range of issues summarised in Table A and below. Controls are essential to minimise risk of impacts from oil (fuel) spills but with such controls in place (as standard best practice) there are not considered likely to be any other significant adverse impacts.

Certain mitigation is suggested and summarised below to avoid adverse impacts, especially to marine mammals from high levels of underwater noise close to the survey vessel.

Mitigation is also proposed to avoid damaging sensitive seabed habitats (cold water coral) by seabed sampling. A known area of coral off SW Greenland will be avoided during the seabed surveys.

Mitigation

Mitigation is proposed to avoid significant adverse impacts, such as death or injury, to marine mammals. Mitigation relating to noise from the airguns will follow current guidance from DCE which is based on JNCC (UK) best practice procedures with some extra measures to protect animals in Greenlandic waters. The detailed mitigation, to be led by a dedicated marine mammal and seabird observer (MMSO) team is explained in the EIA; key mitigation and best practice proposals include:

- the smaller seismic array will be used wherever possible;
- a mitigation gun will be available if needed, this is a single gun of low output;
- airguns will not be used unnecessarily away from the transect line;
- two qualified marine mammal and seabird observers (MMSO) will be present on the source vessel with a minimum of one observer continuously monitoring during pre-firing watches;
- Passive Acoustic Monitoring (PAM) will be deployed during hours of darkness and during times of poor weather (above sea state 3);
- If a mammal approaches within 200m of the airguns the gun output will be minimised, to a single mitigation gun if possible;
- The Mitigation Zone around the airguns will be 500m.

No other effects are considered to require mitigation beyond control measures currently planned.