TotalEnergies EP Danmark A/S *04-04-2024*

Dagny CCS Geophysical Survey

Note about USBL use during geophysical survey

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1 Background

TotalEnergies EP Danmark A/S (TEPDK) submitted to the DEA an Environmental Significance Assessment Report (ESAR) on March 8th 2024 to undertake a geophysical survey around the Dagny CCS area. The ESAR is currently under Authorities evaluation.

Now, *the DEA has become aware of the fact that many USBLs emit sound within a frequency range hearable for harbour porpoise (HP) and at a dB-level that can cause PTS for HP. In other words, for USBLs which emit harmful noise, it is necessary to implement a mitigation measure to ensure that no injury for appendix IV-species can occur.*

This note has been developed to explain the use of the USBL during geophysical surveys and its potential noise impact on marine mammals. Mitigation measures will be proposed if significant impacts on marine mammals due to USBL are assessed.

2 Survey activities and sequence

Geophysical investigation includes:

- 2DHR seismic data acquisition (with the activation of airgun)
- 2DUHRS seismic data acquisition (with the activation of mini-airgun)
- Standard analogue site investigation (MBES, SBES, SSS, SBP) with the support of USBL.

Seismic survey is undertaken to investigate the geological formations beneath the seabed and is carried out by a survey vessel towing an acoustic source (airgun array) and a streamer with multiple acoustic receivers (hydrophones, called steamers).

Two-dimensional high-resolution (2DHR) and ultra-high-resolution (2DUHR) geophysical data will be acquired over the site survey area using a 160 cubic inch (cu.in.) airgun array and 24 cu.in. airgun array, respectively.

Noise impact related to the airgun arrays activation has been explained and assessed in detail in the submitted ESAR and it will not be considered further.

Standard analogue data will be acquired using sub-bottom profiler (SBP), multi-beam echosounder (MBES), single-beam echosounder (SBES) and side scan sonar (SSS). During the survey, USBL is used for positioning the towed survey equipment behind the vessel, such as the SSS. SSS is approximately towed at a distance that is 3 times the water depth (e.g. 150-180 m).

USBL (ultra-short baseline) is a method of underwater acoustic positioning. The USBL system consists of a transceiver, which is mounted on a pole under the vessel, and a transponder (or responder) that is mounted on the SSS. A computer, or "topside unit", is used to calculate a position from the ranges and bearings measured by the transceiver.

An acoustic pulse is transmitted by the transceiver and detected by the subsea transponder, which replies with its own acoustic pulse. This return pulse is detected by the shipboard transceiver. The time from the transmission of the initial acoustic pulse until the reply is detected is measured by the USBL system and is converted into a range.

When deploying 2DHR/analogue or 2DUHR/analogue equipment, the seismic equipment is deployed first and then the analogue. The streamer is deployed first and then the airgun. The

airgun soft start is activated as soon as the seismic equipment is fully deployed. After this, also the analogue equipment is deployed and USBL is turned on.

Two properly qualified, trained and equipped marine mammal observers (MMOs) will be engaged as per DEA and JNCC guidelines and TEPDK standard procedure.

The MMOs will carry out a 30-minute pre-data acquisition survey of the 500m safety zone and, if a marine mammal is detected, the soft-start of the seismic sources will be delayed for at least 20 minutes following the last sighting.

If the airgun array has been inactive for a period of 10 minutes, the MMO will perform a visual inspection of the 500 m safety zone. If a mammal is detected within the 500 m safety zone, the start of the seismic sources will be delayed for at least 20 minutes following last sighting.

Passive Acoustic Monitoring (PAM) will be operated during the pre-data acquisition survey, during the soft-start procedure and during seismic acquisition in association with the MMOs to detect marine mammal presence.

3 Technical Details

Table 1 lists the acoustic equipment and noise specifications that are likely to be used for the underwater positioning of the analogue equipment.

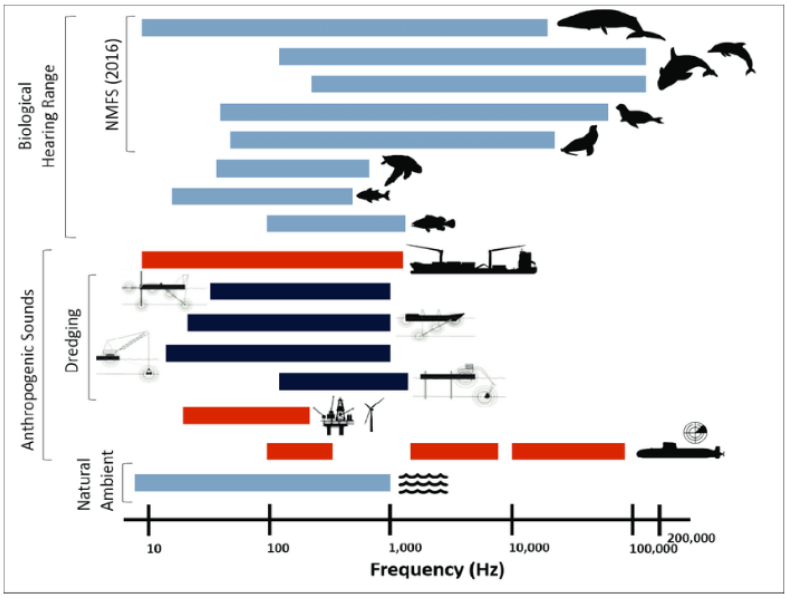
Table 1. Potential acoustic survey equipment.

Equipment	Fitted to	Operating frequency (kHz)	Source Level SPL (dB rel. 1 µPa)
USBL			
Kongsberg HiPAP 502 system (USBL transducer)	Vessel	21 - 31	207
USBL transponder (cNODE Mini 34-180 or similar)	SSS	22.0 - 32.5	206

4 Underwater Noise Impact Assessment

The temporary increase in underwater noise has the potential to impact marine mammals near the survey activities due to the sensitivity of marine mammal hearing.

This section compares the potential underwater noise from USBL to known or estimated marine mammal impact thresholds to determine the consequence of received sound levels on Annex IV marine mammals. Figure 1 presents the hearing frequency ranges for selected marine animals and energy frequencies for selected anthropogenic sources. Marine mammal frequency hearing range is generally 0.01-200 kHz.



Source: Suedel *et al*. 2019.

Figure 1. Hearing frequency ranges for selected marine animals and energy frequencies for selected anthropogenic sources

The USBL transducer and transponder equipment proposed for the survey emit pulses of medium frequency in short 'chirps or pings' of 3 to 40 milliseconds every few seconds (e.g., every 5 seconds). Sound frequencies are approximately 21-33 kHz with sound pressure levels (SPL) of approximately 207 dB re 1 µPa (Table 1).

The USBL operating frequencies overlap with marine mammals bandwidth of hearing in particular with Harbour porpoises.

Woodside (Xodus Group, 2020) addressed underwater noise from similar USBL activities in an Appropriate Assessment according to the EU Habitats Directive for a geotechnical survey off the Irish west coast. The USBL SPL was 204-206 dB re 1 µPa[1], which is equivalent to the USBL SPL proposed for this survey; therefore, the Xodus Group (2020) results are considered representative for this assessment.
An empirical spreading loss equation, estimated based on field measurements in Warner and McCrodan (2011), was then applied to these source levels to estimate the radii at which different pressures were received (Austin *et al,* 2012). Table 2 presents the radii estimates (from Austin et al. (2012), (Xodus Group, 2020)).

Table 2. Ranges to SPL isopleths for USBL systems

SPL (dB re 1 µPa)	Radius (m)
200	2-5
190	5-9
180	7-8
170	18-30
160	36-42

[1] USBL noise is impulsive. Source sound levels are normally described in decibel (dB) re 1 µPa at 1 m from the source. In practice, it is not usually possible to measure at 1 m from an active noise source that is physically distributed over an area of several square metres. However, this method allows different source levels to be compared and reported on a standardised scale (Xodus Group, 2020).

SPL thresholds for the onset of Temporary Threshold Shift (TTS), Permanent Threshold Shift (PTS) and behavioural disturbance have been used as the criteria in this assessment, as data is readily available for marine mammal thresholds and acoustic equipment output; however, other threshold values may also be used.

Table 3 presents the Southall et al. (2019) underwater acoustic SPL thresholds for the onset of PTS and TTS. Table 3 also shows the Southall *et al*. (2007) conservative SPL threshold for the onset of behavioural disturbance in marine mammals, which is used as it is an integration of the highly variable data for individual marine mammal species and the onset of behavioural impacts due to impulsive noise.

Table 3. TTS, PTS and behavioural SPL thresholds for marine mammals

Hearing Group	TTS Onset Thresholds Peak SPL (dB re 1 uPa)	PTS Onset Thresholds Peak SPL (dB re 1 uPa)	Behavioural Disturbance RMS SPL (dB re 1 uPa)
LF Cetaceans	213	219	160 Conservative for all species
MF Cetaceans	224	230	
HF Cetaceans	196	202	
Pinnipeds in Water	212	218	

The sound propagation results for the USBL equipment and the radii of the potential TTS, PTS and behavioural disturbance thresholds are summarised in Table 4. All results presented are for the underwater noise generated within the acoustic beam from the hull-mounted transducer, as it is directed towards the SSS. Fugitive lateral underwater noise may also occur outside the acoustic beam but at much lower and quickly diminishing levels.

The PTS SPL threshold for HF cetaceans, e.g., the harbour porpoise, may be reached within 2-5 m of the acoustic beam (202 dB re 1 uPa SPL threshold compared with a calculated SPL of 200 dB re 1 uPa). The TTS SPL threshold for HF cetaceans may be exceeded within 5-9 m of the acoustic beam. PTS and TTS SPL thresholds for LF, MF cetaceans and pinnipeds are unlikely to be exceeded.

The behavioural disturbance SPL threshold for all marine mammals may be exceeded 36-42 m from the acoustic beam.

Table 4. Sound propagation results: Potential TTS, PTS and behavioural onset distances for USBL impulsive sound

Hearing Group	TTS Onset Thresholds Peak SPL (dB re 1 uPa)	PTS Onset Thresholds Peak SPL (dB re 1 uPa)	Behavioural Disturbance RMS SPL (dB re 1 uPa)
LF Cetaceans	Not exceeded	Not exceeded	36-42 m
MF Cetaceans	Not exceeded	Not exceeded	36-42 m
HF Cetaceans (Harbour porpoise)	9 m	Not exceeded but marginal (2-5 m)	36-42 m
Pinnipeds in Water (Grey and Harbour seal)	Not exceeded	Not exceeded	36-42 m

These distances are derived based on the assumption that a marine mammal individual remains stationary within the acoustic beam when the USBL is operating, which is unrealistic. Any marine mammals are likely to move away from the sound source upon hearing the onset of the USBL activity, hence the first pulse would provide the highest sound received, with each subsequent pulse contributing less to their exposure as they move away from the source. These results interpreted from the Woodside geotechnical survey appropriate assessment (Xodus, 2020) are considered representative of the proposed survey.

Furthermore, it is highly unlikely that a marine mammal would be within the survey area and within the acoustic beam during USBL operation, because:

- The acoustic beam has a very narrow maximum diameter of approximately 10-15° (Kongsberg, *undated*);
- The USBL will be activated when the airgun soft start period begins that is after 30 minutes of MMOs observation and PAM activation, that means that no marine mammals are expected within 500 m from the USBL;
- The additional noise emanating from the survey vessel, which would act as a deterrent;
- The low level of fugitive acoustic noise from the USBL is also likely to deter any marine mammals from approaching the USBL acoustic beam where the highest levels of underwater noise may be encountered.

The potential impact on marine mammals due to the USBL activity during the geophysical survey is assessed as negligible.

Xodus Group (2020) also compared calculated cumulative sound exposure levels (SEL_{cum}) for 200 pings of the USBL system with the relevant threshold values from Southall (2007, 2019). The greatest distance to the TTS threshold was 170 m for HF cetaceans and 70 m to the PTS threshold, also for HF cetaceans. These distances are greater than for the SPL thresholds; however, it is unlikely that a marine mammal would remain in the focused acoustic beam for 200 pings (equivalent to several minutes). The mitigating factors for marine mammal impacts listed previously would also apply to these results and any potential impacts on marine mammals would still be negligible.
Also, all predicted distances are well below the 500 m safety zone monitored by MMOs and PAM before and during the activity.

5 Conclusions

During the geophysical survey, USBL is used to get the correct position of the analogue underwater equipment that is towed behind the vessel.

Sound frequencies of the proposed USBL equipment is approximately 21-33 kHz with sound pressure levels (SPL) of approximately 207 dB re 1 µPa. The USBL operating frequencies overlap with marine mammals bandwidth of hearing in particular with Harbour porpoises.

Impacts on marine mammals are negligible based on the interpreted results proposed by the Woodside (Xodus Group, 2020) Appropriate Assessment including a comparable USBL equipment.

USBL is turned on when analogue equipment is deployed in the water that is after the deployment of seismic equipment, the MMOs starting of observation and PAM activation and the commencement of airgun soft start period.

Mitigation measures are not deemed necessary for the USBL activation during the Dagny CCS geophysical survey, other than those already included, based on what stated above.

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