

# 3D Marine Seismic Survey

### MMO Report Marine Seismic Survey EPI Report No. E001902

Client	Western Geco
Area	US Gulf of America
Survey	3D OBN Seismic Survey

Project Name:	Engagement 5
Contract No	E001902
Vessels/Dates	REM Andes: 14 July to 30 October 2024
	Sanco Spirit: 19 July to 28 October 2024
	Artemis Athene: 21 June to 30 October 2024
Contractor	PXGeo

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Appendix A: PSO-PAM Data Collection Forms Appendix B: Visual Sightings Photographs Appendix C: Visual Sightings Location Maps Appendix D: Passive Acoustic Monitoring Screenshots Appendix E: Mitigation Action Summary Appendix F: PAM Setup Descriptions Appendix G: Other Wildlife Appendix H: PAM Calibration Report Appendix I: Report Certification Appendix J: Vessel Tracklines

### 1. Executive Summary

#### 1.1. Overview

The Engagement 5, Multiclient (MC) 3D Ocean Bottom Node (OBN) seismic survey was conducted by PXGEO on behalf of WesternGeco LLC. The program was conducted in federal waters of the Gulf of America (GOA) located within Green Canyon, Ewing Bank, and Atwater Valley block area. Protected species monitoring was conducted in accordance with Bureau of Ocean Energy Management (BOEM) and National Marine Fisheries Service (NMFS) standards, as well as Geophysical Survey Plan Approval Conditions for Lease Outer Continental Shelf (OCS) Permit L24-011. This report is the Final Protected Species Report for the Engagement 5, MC 3D OBN Survey, where the protected species monitoring and seismic survey operations were undertaken by Research Vessels (R/V) *REM Andes, Sanco Spirit*, and *Artemis Athene*. The program took place from June 21 to October 30, 2024.

PXGEO/WesternGeco took a best practice approach by adopting guidelines for the mitigation of protected species over the span of this project. The Client and Vessels operated under the regulatory guidelines jointly stipulated by the NMFS Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico (BO), BOEM, Bureau of Safety and Environmental Enforcement (BSEE), U.S. Environmental Protection Agency (EPA) as well as additional guidelines outlined in the Letter of Authorization (LOA) and the Environmental Management Plan (EMP).

Throughout the reporting timeframe, three trained visual Protected Species Observers (PSO) and four Passive Acoustic Monitoring (PAM) Operators, contracted through EPI Group (EPI) remained on board the *REM Andes* to uphold the regulatory guidelines and reporting requirements. The PSOs/PAM Operators were certified by BOEM and had previous survey experience. Mitigation measures were implemented to minimize potential impacts to marine mammals and sea turtles throughout the duration of the survey. The mitigation protocols for this survey included the establishment of buffer zones (BZ) and exclusion zones (EZ) around the acoustic sound source to create a reasonable separation distance in regard to the protected species, conducting visual and acoustic monitoring consistently for 24 hours a day, determining and implementing delays of the sound source initiation based on the animals' distance to their relevant BZ and EZ, and executing shutdowns or strike avoidance maneuvers if necessary to ensure protection to all animals and to maintain regulatory compliance.

There were 150 mitigation actions and zero non-compliance issues for the duration of the project. All communication between the PSOs/PAM Operators and seismic crew was effective in ensuring all source operations were conducted in compliance with the guidelines set forth for this project. Please refer to **Appendix A** for details on observation data and **Table 1** for a report overview.

	REM Andes	Sanco Spirit	Artemis Athene
Number of survey days	109 days	52 days	132 days
Survey dates	15 July to 30 October 2024	19 July to 27 October 2024	21 June to 30 October 2024
Visual observation time	1386:24	849:19	1454:07
Acoustic monitoring time	2141:21	1111:34	2005:30
The total number of source sequences	318 (81 tests and 237 production lines)	133 (18 tests and 115 production lines)	268 (32 tests and 236 production lines)
Total source activity	1602:54	908:22	1554:09
Number of visual observations	85	64	102
Number of acoustic detections	120	66	60
Number of source mitigation actions	77	30	43
Number of non-compliance issues	0	0	0

Table 1. Report overview.

### 2. Introduction

#### 2.1. Project Information

The R/V *REM Andes, Sanco Spirit,* and *Artemis Athene* undertook the Engagement 5, MC 3D OBN seismic survey that was conducted by PXGEO on behalf of WesternGeco LLC. The survey took place in deep waters within the Green Canyon, Ewing Bank, and Atwater Valley US GOA.

The full fold 3D seismic acquisition area was approximately 4019.46 kilometers (km)<sup>2</sup> with a greater working area of 10237.63 km<sup>2</sup> around it to allow for vessel line turns, equipment deployment and recovery, and source testing. Water depths during the program ranged from 120 meters (m) to 1300 m.

The objectives during this survey were to collect data to support: site characterization, development of a ground model, ensure the seabed is clear of any obstructions, and proper identification of buried archaeological features in compliance with the NMFS BO, BOEM, BSEE, EPA as well as additional guidelines outlined in the LOA and the EMP.

The survey is a shooting methodology where nodes are rolled, and source operations are conducted centrally within the active node patch, started in the west and finished in the east.

Engagement 5 is located approximately 100 nautical miles (NM) south of Port Fourchon, in water depths ranging between approximately 120 m and approximately 1,300 m.

#### 2.2. Location Map

The location of the acquisition area for Engagement 5 in relation to the US coast in the GOA is shown in **Figure 1**. **Figure 2** shows the limits and distribution of the survey area. **Figure 3** represents the shooting nodes design.



Figure 1. Location map of Engagement 5.



Figure 2. Limits and distribution of the survey area of Engagement 5.



Figure 3. Shooting nodes design of Engagement 5

#### 2.3. Protected Species Occurrence

Protected species, including marine mammals and sea turtles, occur both nearshore and offshore throughout the biodiverse waters of the GOA and extending into the greater Atlantic Ocean. Distribution, abundance, and seasonality of protected species are varied. These factors may be limited by diet and seasonal changes, such as temperature, tides, and currents. Moreover, these factors are potentially driven by anthropogenic effects, including offshore oil and gas research. There are 30 protected species known to be present in the GOA, which consists of 25 marine mammals and five sea turtles. **Table 2** lists these species and their IUCN status.

There were six species of marine mammals identified during this survey program as expected within the shallow waters during transits and the deep waters of the greater working and acquisition areas. These included one species of large whale and five small cetaceans, as well as two sea turtle species all covered by the BOEM permit L24-011 and NMFS BO guidelines to minimize the potential impacts from seismic operations.

ODONTOCETI (Toothed whales)Image: Constraint of the system of
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Tursiops truncates Common bottlenose dolphin Least concern
Globicephalinae
Feresa attenuataPygmy killer whaleLeast concern
Globicephala macrorhynchus Short-finned pilot whale Least concern
Grampus griseus Risso's dolphin Least concern
Pepenocephala electra         Melon-headed whale         Least concern
Pseudorca crassidensFalse killer whaleNear threatened
Steno bredanensis Rough-toothed dolphin Least concern
Orcininae
Orcinus orca Orca Data deficient
MYSTICETI (Baleen whales)
Balaenopteridae
Balaenoptera physalusFin whaleVulnerable
Balaenoptera riceiRice's whaleCritically endangered
Megaptera novaeangeliae Humpback whale Least concern
SIRENIA
Family: Trichechidae Manatees
Trichechus manatusWest Indian manateeVulnerable

Table 2.	Known	Marine	Mammals	of the	Gulf of	America
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#### 2.3.1. Marine Mammals

There are 25 species of cetaceans known to inhabit the GOA. The most common species are the odontocetes, with common bottlenose dolphins (*Tursiops truncatus*) heading the list, found mostly in shallow waters.

Atlantic spotted dolphins (*Stenella frontalis*) are also common in shallow waters, while pantropical spotted dolphins (*S. attenuata*) inhabit mostly deep waters. Sperm whales (*Physeter macrocephalus*) are not uncommon at depths greater than 1000 meters, while rough-toothed dolphins (*Steno bredanensis*), short-finned pilot whales (*Globicephala macrorhynchus*), and false killer whales (*Pseudorca crassidens*) are frequently recorded in areas around the continental shelf. Several odontocetes are uncommon but not rare, including Clymene dolphins (*Stenella clymene*), striped dolphins (*S. coeruleoalba*), spinner dolphins (*S. longirostris*), Fraser's dolphins (*Lagenodelphis hosei*), and melon-headed whales (*Peponocephala electra*). Rare species include the pygmy killer whale (*Feresa attenuata*), orca (*Orcinus orca*), Risso's dolphin (*Grampus griseus*), pygmy sperm whale (*Kogia breviceps*), dwarf sperm whale (*K. sima*), Longman's beaked whale (*Indopacetus pacificus*), Cuvier's beaked whale (*Ziphius cavirostris*), Blainville's beaked whale (*Mesoplodon densirostris*), and Gervais's beaked whale (*M. europaeus*). Mysticetus are rare in the GOA, and only one species, the Rice's whale (*Balaenoptera ricei*), lives in the region year-round as it is endemic to the continental shelf, especially off Florida's western coast. There are records of both humpback whales (*Megaptera novaeangliae*) and fin whales (*Balaenoptera physalus*), but such occurrences in the GOA are uncommon.

The West Indian manatee (*Trichechus manatus*) is the only other species to be found in the GOA. However, this species is restricted to shallow nearshore waters.

#### 2.3.2. Marine Turtles

There are five species of sea turtles known to the GOA, the most common being the green sea turtle (*Chelonia mydas*). The loggerhead sea turtle (*Caretta caretta*), hawksbill sea turtle (*Eretmochelys imbricata*), and Kemp's ridley sea turtle (*Lepidochelys kempii*) are also common. The leatherback sea turtle (*Dermochelys coriaceae*), while not rare, is the least frequently observed of the five sea turtle species.

#### 2.4. Local Activity

There was one platform in the survey area and numerous subsurface assets present in the survey area.

#### 2.4.1. Marine Debris

When marine debris was detected, it was usually found around the oil platforms. Plastic pieces, ballons, pieces of wood, and old buoys were the most common debris observed.

#### 2.5. Military Warning Areas

Prior to any activity within the W-92 area or any other military warning area the appropriate military command headquarters were contacted concerning the control of electromagnetic emissions and use of vessels within the area.

The planned source acquisition area covers the W-92 Military Warning area as highlighted below.



Figure 4. Adjacent survey areas.

#### 2.6. Marine Traffic

There were few, if any, fishing vessels working in the prospect area for a short time. Commercial traffic was observed daily with the occurrence of tankers, bulk carriers, container vessels, other cargo vessels, and cruise ships.



Figure 5. Shipping traffic.

#### 2.7. Obstructions

There was one platform in the survey area and numerous subsurface assets present the survey area. Within the survey boundary, there were several known obstructions. Fifteen rigs and tension-leg platforms – two have been decommissioned (Genesis Par and Morpeth East). There was likely to be additional subsea assets including: mooring lines, pipeline, flowlines, and risers, umbilical's, well heads, and well centers.



Figure 6. Known obstacles (platforms, wellheads, pipelines).

#### 2.8. Seismic Interference

BP Atlantis started at the end of June and would end mid-August.

- 1. Olympic Artemis
- 2. Fulmar Explorer



Figure 7. Seismic interference during Engagement 5.

### 3. Vessels & Equipment

#### 3.1. Vessels on the Survey

*REM Andes, Sanco Spirit,* and *Artemis Athene* were the source vessels for the project. All source vessels were equipped with triple source arrays of 5000 cubic inches (cu.in.).

#### 3.1.1. Source Vessels

#### **R/V** REM ANDES

Classification: Source Vessel IMO: 9606699 MMSI: 311000913 Flag: Bahamas Call Sign: C6EJ6 Length X Breadth: 87 x 18m



Figure 8. R/V REM Andes.

#### SANCO SPIRIT

Classification: Source Vessel IMO: 9429936 MMSI: 236538000 Flag : Gibraltar Call Sign: ZDJN3 Length X Breadth: 86 x 16m



Figure 9. R/V Sanco Spirit.

#### ARTEMIS ATHENE

Classification: Source Vessel IMO: 8805626 MMSI: 257156000 Flag: Norway (NO) Call Sign: LDIA3 Length X Breadth: 91.6 x 18m



Figure 10. R/V Artemis Athene.

#### 3.1.2. Node Vessels

Havila Subsea and Siem Spearfish were the dedicated node vessels for this project. The node vessels were equipped with dual Remotely Operated Vehicles (ROVs) with a minimum node inventory of 3000 MANTA nodes.

#### SIEM SPEARFISH

Classification: Offshore Subsea Construction Vessel	Flag: Bahamas
IMO: 9676280	Call Sign: C6DA7
MMSI: 311000623	Length X Breadth: 120.8m x 27m



Figure 11. Siem Spearfish.

#### HAVILA SUBSEA



Figure 12. Node Vessel Havila Subsea.

#### 3.2. Seismic Equipment and Sound Emissions

The *REM Andes, Sanco Spirit*, and *Artemis Athene* vessels towed a 3-source array (flip-flop-flap) Bolt 1900LL-X Bolt 1500LL source clusters with a total volume of 5000 cu. in. approximately 300 m astern of the vessel at a depth of 10 m. The shot point interval was 16.66 m. Each source was made up of two sub-arrays where each sub-array was equipped with 14 source elements, varying volume from 80 to 320 cu in. **Table 3** through **Table 5** outline survey area information, source parameters, and recording parameters.

#### 3.2.1. Specifications

Table 3. Survey Area	
Area	Gulf of America
Survey Design	Parallel (Inline)
Number of sail lines	383
Heading (deg)	360
Reciprocal heading (deg)	180

#### **Table 4. Source Parameters**

Source type	GGUN II
Number of source arrays	3
Alternatively fired sources (flip-flop-flap)	Yes
Source array separation	100 m
Shot point interval	16.6667m
Shot point interval per source	Time based
Array volume per source	5000 in <sup>3</sup>
Operating pressure	2000 psi
Source depth	10 m
Number of sub arrays per source	2
Sub array separation	12 m
Number of airguns per sub array	14
Sub array length (m)	15
Gun synchronization	± 1.5 ms
Source control system	GunLink 2000

#### Table 5. Recording Parameters

Recording system	PGS GAS
Recording format	SEGD-8036
Recording length	42 s
Sample rate	2 ms
Lo-cut recording filter	Out
Hi-cut recording filter	216.5 Hz

#### 3.3. Towed Equipment Diagram

The diagram in **Figure 13** shows the towing and source array configurations. The survey was conducted using a total of 84 source elements (**Figure 14**). At full power, the three source sub-arrays operated at a pressure of 2,000 psi and a volume of 5,000 cu. in. (**Figure 15, Figure 16**). Individual source elements ranged in volume from 80 to 320 cu. in. Soft starts were conducted under the agreed guidelines and had a duration of 23 to 24 minutes. GunLink 2000 software was used to automatically increase power at a gradual rate.



Figure 13. Towed equipment diagram.



Figure 14. Engagement 5 layout towing display.

#### 3.3.1. Source Layout



Figure 15. Source Array layout display.

#### 3.3.2. Sub-Array Diagram



Figure 16. Gun string offsets.

### 4. Operations

#### 4.1. Project Overview

Equipment deployment and acquisition commencement for Engagement 5 commenced on 15 July 2024 on the *REM Andes* and 19 July 2024 on the *Sanco Spirit* and *Artemis Athene*. The 3D OBN seismic survey was completed for the *Sanco Spirit* on 28 October 2024 and 30 October for the *Artemis Athene* and *REM Andes*. During this project, source tests, test lines, and streamer maintenance have all been conducted in addition to the standard acquisition of survey lines. Delays have occurred due to project obstacles such as marine traffic, protected species detections with mitigation actions, air leaks, and adverse weather.

During this project, production sequences and source tests were all conducted in addition to the standard acquisition of survey lines. See **Table 6** below for number of production lines and source tests events during the survey days throughout this program.

Source events for source testing equaled a total of 131. Overall, there were 589 production sequences across a total of 255 survey days.

Research Vessel	Production sequences	Source tests	Survey days
REM Andes	237	81	109
Sanco Spirit	115	18	52
Artemis Athene	237	32	94
Survey Total	589	131	255

#### Table 6. Number of production lines and source test events during the program.

#### 4.1.1. Pre-searches

Seismic source activity was preceded by a pre-search under the BOEM and NMFS BO guidelines, where a 30minute search period must be conducted prior to turning on the seismic source for any reason (**Table 7**). The pre-search category consists of two separate categories.

- The pre-search during daylight was conducted simultaneously, visually by two PSOs and acoustically by one PAM Operator.
- The pre- search during nighttime was conducted only acoustically by a PAM Operator.

Research Vessel	Daylight PAM and Visual Pre-Watches	Nighttime PAM Pre- Watches Only	Total Pre-Watches
REM Andes	190	128	318
Sanco Spirit	77	56	133
Artemis Athene	163	105	269
Survey Total	430	289	720

#### Table 7. Total Pre-Watch Events

#### 4.1.2. Soft Starts

Soft starts were conducted before all source operations resulting in the activation of both Tuned Pulse Sources (TPS). The soft start procedure for this survey consisted of the initiation of one of two TPS sources operating at a shot interval equal to half of the shot interval used for data acquisition when two sources were operational. Total duration of the soft start was no less than 20 minutes. Every soft start was preceded by a 30-minute period of monitoring the BZ and EZ for protected species by visual PSOs and PAM Operators during the day and by PAM only during periods of low visibility and nighttime. If the BZ was determined to be clear of protected species during the 30 minutes prior soft start, PSOs and/or PAM Operators gave clearance for the initiation of soft start.

In total, 592 soft starts were performed across the three vessels (**Table 8**). This included 425 soft starts during daylight hours and 295 soft starts during nighttime hours.

Vessel Name	Soft start daylight	Soft start nighttime	Total soft start
REM Andes	129	108	237
Sanco Spirit	70	49	119
Artemis Athene	125	111	236
Total	324	425	592

Table 8. Number of day	vtime and nighttime	soft starts during	the n	rogram.
	yanne ana mgneanne	Sont Starts during	s uic pi	ogram

#### 4.1.3. Source Silence

Except during the occasional source testing after the end of line, the source was immediately silenced after completion of survey lines. As per BOEM regulations, no soft start was required to return to full power providing the silent period was less than 30 minutes during day light and 10 minutes during night periods or low visibility, PSOs and PAM Operators monitored continuously throughout the silence, and no protected species were observed within the EZ during daylight hours.

#### 4.1.4. Record of Operations

All seismic source operations were recorded in the operations form provided by EPI, which included the duration of the soft start, the time the source was disabled, and the duration of the pre-clearance watch. The seismic crew provided data on the duration of the soft start and the time source was active, (**Table 9**) which were verified against the PSO and PAM Operator logs, recorded during daily protected species observation sessions.

Vessel Name	Full Volume Production (hh:mm)	Soft Start (hh:mm)	Full Volume Testing (hh:mm)	Reduced Volume Testing (hh:mm)
REM Andes	1434:20	90:29	N/A	31:36
Sanco Spirit	895:56	24:30	1:06	05:44
Artemis Athene	1438:22	85:04	N/A	15:58
Total	3768:38	200:03	01:06	53:18

#### Table 9. Source operations summary.

## 5. Mitigation Protocol

#### 5.1. Protected Species Mitigation Action Procedures

To minimize the potential impacts of seismic operations on certain protected species, including marine mammals and sea turtles, BOEM, NMFS, and BSEE, have outlined monitoring, mitigation, and reporting procedures that survey operators and permit holders are expected to implement during their seismic survey operations. Protected species monitoring, mitigation, and reporting procedures that were applicable to the 3D OBN Survey are contained in the following regulatory documents:

- 1. The Biological Opinion (BO) issued by the NMFS on March 13, 2020
- 2. The survey permit issued by BOEM, permit L24-011.

PSOs established and monitored applicable BZ and EZ, depending on the species and source activity status, as shown in **Table 10**. These zones were based upon the radial distance from the edges of the source array.

During use of the acoustic source (i.e., anytime the acoustic source is active, including ramp-up), occurrence of marine mammals within the relevant BZ (but outside the EZ) was communicated to the operator to prepare for the potential shutdown of the acoustic source (when required).

#### Table 10. Established exclusion and buffer zone distances.

Species / Species Group	Separation distance	Buffer Zone	Exclusion zone
Rice's whale, beaked whale, Kogia species	500 m	1500 m	1500 m
Sperm whale	100 m	1500 m	1500 m
All other marine mammals	50 m	1000 m	500 m <sup>1</sup>
Sea turtles	50 m	1000 m	100 m <sup>2</sup>
ESA-listed fish (Gulf sturgeon, oceanic, white-tipped shark, giant manta ray)	50 m	N/A	N/A

- 1. Shutdown is not required for dolphins of the following genera: *Steno, Tursiops, Stenella,* and *Lagenodelphis.* (rough-toothed dolphin, bottlenose dolphin, Atlantic spotted dolphin, pantropical spotted dolphin, spinner dolphin, Clymene dolphin, striped dolphin, Fraser's dolphin)
- 2. Turtles inside 100 m implement 7 shot turtle pause to allow 200m from array upon resumption of source activity.

#### 5.2. Survey Equipment Subject to Mitigation

All survey equipment that produced sound below 200 kiloHertz (kHz) was subject to the following monitoring and mitigation protocols apart from the USBL, which is considered to be navigational equipment.

#### 5.3. Buffer Zones & Exclusion Zones

Two types of zones were established around the seismic sources, both with radii that extended from the outer edge of the source array.

**Buffer Zones (BZ):** Applicable during the pre-clearance search periods conducted prior to initiating the sound source from silence, where detections of a protected species inside its applicable BZ during the search resulted in a delay to activating the source:

- 1500 meters: All true whale species (i.e. Rice's whale, sperm whales, *Kogia* species, and all beaked whales)
- 1000 meters: All other marine mammals and sea turtles

**Exclusion Zones (EZ):** Applicable once the source has been activated, where detections of a protected species inside its applicable EZ resulted in a shutdown of the sound source:

- 1500 meters: All true whale species (i.e. Rice's whale, sperm whales, *Kogia* species and all beaked whales)
- 500 meters: All other marine mammals

• 100 meters: A 7-shot turtle pause shall be implemented for any turtles within 100 meters of the ship, such that the turtle is greater than 200 meters from array upon resumption of source activity.

#### 5.4. Mitigation Measures

Visual monitoring of protected species is a standard procedure during seismic surveys in the Gulf of America since 2002 (MMS, 2002). During the seismic operations and transiting phases of the project, the client and contractor adhered to the mitigation protocols as outlined in the NMFS Biological Opinion of 2020, the survey permit issued by BOEM, and the EMP. The mitigation measures are summarized in **Table 11**.

#### Table 11. Summary of mitigation measures.

	1500 meters - All true whales
Source mitigation zone	100 meters - Sea turtles
	30 minutes of consecutive monitoring
Pre-watch period	2 PSO's and 1 PAM operator during daylight
	1 PAM operator during nighttime or reduced visibility
Soft start length	20 minutes
Soft start dolays	15 minutes (Delphinid sp.)
Soft start delays	30 minutes all other marine mammals and sea turtles
Shut down during full volume	Any marine mammal detected in their exclusion zone (except for
source	four delphinid genera)
Shutdown during Soft start	Any marine mammal detected in their exclusion zone with no
Shutuown during Soft Start	exceptions
Turtle pause	7 turtle-pause shots allowed for turtles inside their exclusion zone
	500 meters – All true whales
Vessel Strike Avoidance	100 meters – Sperm whale
	50 meters – All other marine mammals
Applicable species	Marine mammals and sea turtles

#### 5.4.1. Pre-clearance

- To activate the sound source, a search period of at least 30 minutes was conducted.
- During the daytime (30 minutes before sunrise to 30 minutes after sunset), the search was conducted visually by the PSOs and acoustically by the PAM Operator.
- During nighttime, the PAM Operator will acoustically conduct the search.
- The PSO and PAM Operator on watch should be notified of the intent to turn on the source from silence, either to conduct a ramp-up or for testing, at least 60 minutes prior to the planned start.

#### 5.4.2. Delays to Activation of the Acoustic Source

If any marine mammal or sea turtle was detected inside its respective BZ during the 30-minute search period, initiation of the seismic source was delayed until:

- All marine protected species that were observed inside the relevant BZ were confirmed by the visual observer to have exited the relevant BZ.
- 15 minutes passed from the last detection for small odontocetes if not observed exiting the BZ
- 30 minutes passed from the last detection for all other protected species, including sea turtles, if not observed exiting the BZ
- 30 minutes passed from the last detection for acoustic-only detections.

#### 5.4.3. Ramp Up & Testing Procedures

The intent of ramp-up is to warn marine mammals and sea turtles of pending seismic operations and to allow sufficient time for those animals to leave the immediate vicinity. For all acoustic source activity, including

source testing involving more than one source element, ramp-up procedures were conducted to allow marine mammals and sea turtles to depart the EZ before surveying begins.

- The vessel tested a single source element or cluster without ramp-up regardless of volume. If using more than a single cluster, ramp-up was required from the smallest volume source element to the size needed for testing.
- In order to minimize the time, the sound source was active, ramp-up was planned for immediately before the start of the survey.
- Seismic source activation only occurred at times of poor visibility (including night) where operational planning could not reasonably avoid such circumstances.

Ramp-up procedures were as follows:

- Visually and acoustically (day) or acoustically (night) monitor the BZ and adjacent waters for the absence of marine mammals and sea turtles for at least 30 minutes before initiating ramp-up procedures.
- Seismic personnel confirmed with the PSOs on watch (daytime) and/or the PAM Operator (day and night) that the BZs were clear of protected species.
- If no protected species were visually or acoustically detected inside their respective BZs, ramp-up procedures began. If animals were detected, procedures detailed in 5.1.4 were followed to clear the BZs prior to start of source operations.
- Ramp-ups began by activating a single source element of the smallest volume in the array.
- Ramp-ups continued in stages by doubling L11-024 of active elements at the commencement of each stage, with each stage being approximately the same duration.
- Total duration of the ramp-up averages 23 to 24 minutes

#### 5.4.4. Shutdown Due to Protected Species

#### 5.4.4.1. Shutdown During Ramp-Up

If any marine mammal or sea turtle was visually or acoustically detected within its EZ, an immediate shutdown of the seismic source in ramp-up was required.

- 1) No shutdown of the ramp-up was required for marine mammals or sea turtles detected inside the BZ during ramp-up; however, notifications were made that a shutdown could be called for if those animals moved into the EZ.
- 2) No shutdown of the ramp-up was required for acoustic-only detections (day or night) unless those acoustic-only detections could be localized inside the appropriate EZ. Notification should still was made that a shutdown could be called for if the animals were able to be localized.

#### 5.4.5. Shutdown During Full Volume Operation

If **any marine mammal** was detected visually or acoustically within its EZ, an immediate shutdown of the seismic source was required. The shutdown requirement was waived under the following circumstances:

- 1) Shutdown was not required for dolphins of the following genera: *Steno, Tursiops, Stenella*, and *Lagenodelphis* (this only applies at full volume, not ramp-up).
- 2) Shutdown was not required for acoustic detections of delphinids inside the EZ unless the PSO or PAM Operator could confirm that the dolphin(s) present were from a different genus than those listed above.

If there was uncertainty, visual PSOs used their best professional judgment in making the decision to call for a shutdown. Such instances included determining if the animal belonged to one of the delphinid genera for which shutdown was waived, or if it was a species with a larger EZ.

The vessel operator complied immediately with any shutdown request made by a PSO or PAM Operator. Any discussion occurred only after the shutdown was implemented.

Subsequent restart of the seismic source only occurred following clearance of the EZ of all marine protected species under the following conditions:

- All marine mammals were visually confirmed by the PSO exiting the relevant EZ (not BZ), OR
- When a marine mammal was not observed exiting the EZ, an additional 30 minutes had elapsed following the last detection inside the EZ.

All resumptions of source activity following a protected species shutdown began with a ramp-up.

#### Silent Periods in Source Operation During Daylight

As occasional short periods of silence were required for reasons other than mitigation, the seismic source was silenced for periods of time not exceeding 30 minutes, then restarted at the same volume for operations without a ramp-up if:

- Visual and acoustic monitoring was continued diligently through the silent period, AND
- No marine protected species were visually observed in their respective EZ during the silent period, and no acoustic detections were made at any distance.

Procedures for returning to full volume without ramp-up after silent periods also applied to returning to full volume from reduced volume. However, if the source was operating at a reduced volume for more than 30 minutes, a ramp-up was required to return to full volume.

#### Silent Periods in Source Operation During Night and Reduced Visibility

As occasional short periods of silence were required for reasons other than mitigation, the seismic source was silenced for periods of time not exceeding 10 minutes, then restarted at the same volume for operations without a ramp-up if:

- Acoustic monitoring was continued diligently through the silent period, AND
- No acoustic detections were made at any distance.

#### Non-Production Source Testing & Miscellaneous Source Operation

The acoustic source was deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Unnecessary use of the acoustic source was avoided.

#### 5.4.6. Vessel Strike Avoidance (VSA) Mitigation

The PSOs maintained a continuous watch during all daylight hours to ensure that the vessel maintained a safe distance from protected species, both while the vessel was in production or in transit. Vessels are not required to shift into neutral for animals that approach the vessel voluntarily. Separation distances established are as follows:

- 500 m: All baleen whales including the Rice's whale (formerly known as the Bryde's whale)
- 100 m: Sperm whales
- 50 m: All other marine mammals (including manatees), sea turtles, and ESA-listed fish species.

Any large whale for which a species could not be identified was treated as a baleen whale.

There were no observations of vessel strikes for the duration of the project. When protected species approached the vessel, such as bow riding dolphins, abrupt changes in course were avoided as to not disturb the animals. The speed at which the vessel was operating was well under 10 knots, and therefore, allowed time for marine mammals and/or sea turtles to avoid the vessel path (NOAA, 2008).

#### **Vessel Speed Restrictions**

Vessel speeds must be reduced to 10 knots or less when mother/calf pairs, pods, or large assemblages (greater than three) of any marine mammal are observed near a vessel.

#### **Vessel Separation Distances**

When protected species were sighted while the vessel was underway, the vessel took action as necessary to avoid violating the relevant separation distance (e.g. attempt to remain parallel to the animal's course and avoid excessive speed or abrupt changes in direction until the animal has left the area).

If marine protected species were sighted within the relevant separation distance, the vessel would reduce speed and shift the engine to neutral, not engaging the engines until animals were clear of the area. While Appendix C of the BO states that this does not apply to any vessel that is towing gear, an effort was still made by the vessel, as was operationally feasible, to maintain a separation distance. PSOs provided suggestions for VSA, then allowed the vessel crew to determine whether that procedure could be executed without risk to the safety of the vessel and crew.

### 6. Observational Effort

#### 6.1. Marine Mammal Visual Observer Survey Methods

During the reporting period from 15 July 2024 to 30 October 2024, visual observations were conducted to gather data on the presence, distribution, behavior, and abundance of marine mammal species and turtles. Monitoring was conducted during all daytime hours, from 30 minutes before the sunrise until 30 minutes after the sunset. Three PSOs were deployed on each vessel. When source activities were planned, two PSOs were stationed on the bridge and used a combination of binoculars (7x50mm), big eyes (Nikon binocular telescope, 25x120 2.9°), and spotting scopes to meticulously scan the ocean surface and ensure continuous monitoring. On days when there was no seismic activity and the gear was fully on board, one PSO at a time conducted an ancillary watch. The PSOs conducted a maximum of two hours on watch followed by one hour of rest. The PSOs collected environmental data hourly and at every change of source activity. Additional information was gathered when a protected species was observed.

When marine fauna was observed, distance and bearing to the animal(s) from the observer's position were recorded, along with the species (or as much detail of the animal as possible), time, position, behavior, and other data required for the completion of the sighting form. Distances to sightings were determined using reticule binoculars, estimated by eye, and by reference to the known distances to seismic gear and guard vessels. Species identification was based on the observer's previous experience, aided, when possible, by photographic records of sightings and field guides.

Sightings, observer effort, operations, weather, and sea state data were recorded using EPI forms to comply with BOEM guidelines for sightings, seismic operations, and observer effort.

- Sighting form: records time and location, number, species, behavior, and description of the animal. The closest approach to the source, and any required mitigation action are also recorded.
- Seismic operations form recorded pre-watch search, soft start, and source activity timing records.
- Observer effort form: record of the time, vessel position, source activity, and a range of environmental conditions during PSO and PAM watches.

#### 6.2. Marine Mammal Observer Monitoring Effort

#### 6.2.1. Visual Monitoring Effort

Visual monitoring effort was maintained from port to port, during all source activity, when the source was inactive, while the vessel was in transit, and within the greater and working prospect areas. The R/V *REM Andes* suspended operations between 6 - 10 October 2024 due to inclement weather and again between 16 - 21 October 2024. The R/V *Sanco Spirit* commenced data acquisition on July 20, 2024, suspending operations between 10 August 2024 and 18 September 2024 for scheduled dry dock maintenance. Survey operations continued with survey operations until 27 October 2024 for the *Sanco Spirit* and 30 October 2024 for the *REM Andes* and *Artemis Athene* when the survey program was completed.

PSOs conducted a total of 3,689 hours and 50 minutes of visual monitoring, consisting of 2,343 hours and 32 minutes while the source was deployed and active, and 1,346 hours and 18 minutes when the source was not deployed or deployed but silent. The visual effort hours are summarized in **Table 12**.

Research Vessel	Visual Monitoring	Source Active	Source Silent
REM Andes	1386:24	950:35	435:49
Sanco Spirit	849:19	513:34	335:45
Artemis Athene	1454:07	879:23	574:44
Survey Total	3689:50	2343:32	1346:18

#### Table 12. Summary of visual monitoring hours.

#### 6.3. Passive Acoustic Survey Methods

PAM), designed to detect most species of marine mammals, was installed on all three survey vessels. PAM was conducted with a system provided by Seiche, comprising a 250-meter array cable with six hydrophones, a deck cable, an audio processing unit, and a computer. PAMGuard software was used for monitoring and detecting marine mammals when the array cable was deployed. A main system and full spare were provided for full redundancy. The hydrophone cable included two Low Frequency (LF) hydrophones (10 hertz [Hz] to 24 kHz), two ultra-broadband hydrophones (200 Hz to 200 kHz), and two broadband hydrophones ( 2kHz to 200 kHz). The six hydrophones are arranged in three pairs of identical specifications with appropriate physical separation to provide direction-finding and localization.

Four PAM Operators maintained a continuous watch for 24 hours whenever source operations were planned or being conducted, except during brief moments when malfunction was being resolved.

The 6-channel hydrophone array allows PAM Operators to view displays of processed and analyzed sound signals in two designations, by grouping the hydrophones into pairs for low, mid, and high frequency analyzation. Four hydrophones are utilized for low-mid frequency (MF) analyzation, target a frequency range between 0.2 kHz and ~24-48 kHz, targeting broad frequency sperm whale clicks and delphinid calls. The hydrophones used for high frequency (HF) analyzation target a frequency range of 2-200 kHz and are processed by the National Instruments USB 6251 data acquisition (DAQ), before being displayed on two scrolling click detector displays. Click detector shows two scrolling time displays, one with a scale for bearing and the other a scale for amplitude, and targets HF echolocation clicks of delphinid species and clicks of beaked whales. PAMGuard software can localize, or approximate distance of HF clicks, and LF and MF signals on a map display, with BZ and EZ overlays relative to the source.

Raw feed from the two designated HF hydrophone elements was digitized in the buffer unit using an analog-digital National Instruments DAQ soundcard at a sampling rate of 500 kHz. The output was filtered for HF content and visualized using the PAMGuard software. A scrolling bearing/time module displayed the filtered data in real time, allowing for the detection and directional mapping of click trains. Additional components of the HF click detector system in PAMGuard were an amplitude/time display that registered click intensity data in real time, as well as click waveform, click spectrum, and Wigner plot displays, providing the PAM Operator immediate review of individual click characteristics in the identification process.



Figure 17. Schematic diagram of the hydrophone array cable indicating the position and separation of individual hydrophone elements and hydrophone pairs

PAM observations began at least 30 minutes before source activation, often extending to an hour or more, following deployment of the PAM hydrophone array and tow cables. The 230-meter tow cable portion of the array was wound on a hydraulic winch, located on the streamer deck at the vessel's stern. The 25 m six hydrophone array was connected via a subsea connection to the tow cable and remained connected and coiled on deck when not deployed. PAM deployment began with a toolbox by PAM and vessel source mechanics, followed by crew carefully lowering the array portion of the cable over the rail at the stern of the vessel into the water. The deployment required the PAM Operator and one to two additional people to complete.

#### 6.4. Acoustic Monitoring Effort

Acoustic monitoring was maintained during all source activity, when the source was inactive, and within the greater and working prospect areas when operations and conditions allowed for the deployment of the PAM system. Acoustic monitoring efforts were conducted before, during, and after all source activities, including periods when the source was inactive. This included conducting the one-hour acoustic post-watch requirement per the survey LOA.

PAM was conducted for a total of 5258 hours and 25 minutes, 4057 hours and 42 minutes while the source was active and 1200 hours and 43 minutes when the source was silent. **Table 13** provides a detailed summary of acoustic monitoring effort hours for each vessel.

Research Vessel	Acoustic Monitoring	Source Active	Source Silent
REM Andes	2141:21	1595:11	546:10
Sanco Spirit	1111:34	908:22	203:12
Artemis Athene	2005:30	1554:09	451:21
Survey Total	5258:25	4057:42	1200:43

#### Table 13. Acoustic monitoring by source activity

### 7. Detections and Mitigation Actions

#### 7.1. Descriptions of Protected Species Encountered

#### 7.1.1. Visual Protected Species Detection Overview

Protected species sightings occurred during transit to the prospect area, inside the survey working and greater area, on the transit to port, and during weather patterns. There were 251 visual detections of protected species, 53 whale detections, 152 dolphin detections, and 46 sea turtle detections. Summaries of the visual detections by source activity (**Table 14**) and the number of visual detections of marine mammals by species (**Table 15**) are below. **Table 18** provides a detailed summary of protected species sightings that occurred while the source was active. Sighting location maps are available in **Appendix C**.

Source activity at detection	Number of whale observations	Number of dolphin observations	Number of turtle observations	
	REM Andes			
Silent	9	16	2	
Soft start*	0	3	0	
Full volume	9	29	17	
Total	18	48	19	
	Sanco Spirit			
Silent	3	20	1	
Soft start	0	1	0	
Full volume	11	17	11	
Total	14	38	12	
	Artemis Athene	2		
Silent	7	33	4	
Soft start	0	2	0	
Full volume	14	31	11	
Total	21	66	15	
Project Total				
Silent	19	69	7	
Soft start*	0	6	0	
Full volume	34	77	39	
Project Total	53	152	46	

Table 14.	Visual	sightings b	v source	activity
			,	

\*Includes reduced volume testing

#### Table 15. Visual sightings by species

Species	Number of observations	Total number of individuals	
REM Andes			
Atlantic spotted dolphin	2	20	
Bottlenose dolphin	14	140	
Green sea turtle	7	8	
Leatherback sea turtle	11	11	
Pantropical spotted dolphin	1	25	
Pygmy killer whale	2	100	
Rough-toothed dolphin	11	119	
Short-finned pilot whale	3	22	
Sperm whale	15	24	
Unidentified dolphin	15	120	
Unidentified sea turtle	1	1	
Species	Number of observations	Total number of individuals	
-----------------------------	---------------------------	--------------------------------	--
Unidentified whale	3	6	
Total	85	596	
Sanco Spirit			
Bottlenose dolphin	11	133	
Hawksbill sea turtle	1	1	
Kemp's Ridley sea turtle	1	1	
Leatherback sea turtle	8	8	
Pantropical spotted dolphin	7	59	
Sperm whale	13	25	
Unidentified dolphin	20	72	
Unidentified sea turtle	2	2	
Unidentified whale	1	1	
Total	64	302	
Artemis Ather	ne		
Atlantic spotted dolphin	2	32	
Bottlenose dolphin	26	163	
Clymene dolphin	1	20	
False killer whale	1	10	
Green sea turtle	6	6	
Leatherback sea turtle	3	3	
Melon-headed whale	2	70	
Pantropical spotted dolphin	2	40	
Short-finned pilot whale	5	29	
Sperm whale	21	26	
Unidentified dolphin	27	279	
Unidentified sea turtle	6	6	
Total	102	684	
Project Total	251	1,582	

#### 7.1.2. Acoustic Protected Species Detection Overview

There were 246 acoustic detections of marine mammals, 183 dolphin detections, 62 sperm whale detections, and one unidentified odontocete detection across all three vessels for this survey. **Table 16** summarizes the acoustic detections by source activity. **Table 17** summarizes the number of acoustic detections recorded by species and number of individuals for Engagement 5. **Table 19** provides a detailed summary of protected species sightings that occurred while the source was active.

#### Table 16. Acoustic detections by source activity

Source activity at detection	Number of whale observations	Number of dolphin observations							
	REM Andes								
Silent	15	34							
Soft start	2	2							
Full volume	20	47							
Total	37	83							
Sanco Spirit									
Silent	11	13							
Soft start	0	2							
Full volume	10	30							
Total	21	45							
Artemis Athene									
Silent	4	29							
Soft start	0	4							

Source activity at detection	Number of whale observations	Number of dolphin observations								
Full volume	1	22								
Total	5	55								
Project Total										
Silent	30	76								
Soft start	2	8								
Full volume	31	99								
Project Total	63	183								

# Table 17. Acoustic detections by species

Species	Number of observations	Total number of individuals	
REM Andes			
Bottlenose dolphin	6	13	
Common dolphin	1	10	
Rough-toothed dolphin	1	3	
Short-finned pilot whale	3	5	
Sperm whale	36	65	
Spinner dolphin	1	6	
Unidentified dolphin	71	178	
Unidentified Odontocete	1	1	
Total	120	281	
Sanco Spirit			
Bottlenose dolphin	2	7	
Pantropical spotted dolphin	2	9	
Rough-toothed dolphin	2	23	
Sperm whale	21	35	
Unidentified dolphin	39	60	
Total	66	134	
Artemis Athene			
Atlantic spotted dolphin	1	3	
Bottlenose dolphin	7	20	
Short-finned pilot whale	1	12	
Sperm whale	5	9	
Unidentified dolphin	46	177	
Total	60	221	
Project Total	246	636	

# Table 18. Visual protected species detection overview (active source).

Detection Number	Date	Common Name	Initial Behavior	Behavior Cue 2	Behavior Cue 3	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action	Duration of Mitigation Action (HH:MM) <sup>1</sup>
					REM Andes					
2	7/15/2024	Bottlenose dolphin	Feeding	Slow travel	Bow riding	8	Full volume	425	None	0:00
3	7/16/2024	Short-finned pilot whale	Slow travel	Diving		6	Full volume	200	Shutdown	0:46
4	7/17/2024	Short-finned pilot whale	Surfacing	Slow travel	Diving	6	Full volume	250	Shutdown	0:42
6	7/22/2024	Green sea turtle	Fast travel	Diving		1	Full volume	370	Turtle pause	0:01
7	7/22/2024	Unidentified dolphin	Porpoising	Fast travel	Diving	4	Soft start	800	None	0:00
8	7/22/2024	Rough-toothed dolphin	Fast travel	Diving	Jumping	11	Full volume	720	None	0:00
9	7/23/2024	Green sea turtle	Fast travel	Diving		1	Full volume	380	Turtle pause	0:01
11	7/24/2024	Bottlenose dolphin	Fast travel	Bow riding	Slow travel	4	Soft start	390	None	0:00
14	7/28/2024	Green sea turtle	Slow travel	Surfacing	Diving	1	Full volume	370	Turtle pause	0:01
15	7/29/2024	Bottlenose dolphin	Porpoising	Bow riding	Acrobatic behavior	15	Full volume	5	None	0:00
17	7/30/2024	Bottlenose dolphin	Slow travel	Porpoising	Diving	6	Full volume	500	None	0:00
18	7/31/2024	Unidentified dolphin	Porpoising			5	Full volume	4000	None	0:00
19	1/8/2024	Unidentified dolphin	Fast travel			2	Full volume	200	None	0:00
20	2/8/2024	Unidentified dolphin	Tail slapping	Jumping	Acrobatic behavior	20	Full volume	3500	None	0:00
21	5/8/2024	Rough-toothed dolphin	Slow travel	Diving		1	Full volume	400	None	0:00
22	7/8/2024	Bottlenose dolphin	Slow travel	Bow riding		12	Full volume	370	None	0:00
23	8/8/2024	Green sea turtle	Surfacing	Fast travel	Diving	1	Full volume	350	Turtle pause	0:01
27	12/8/2024	Bottlenose dolphin	Fast travel	Bow riding	Acrobatic behavior	14	Full volume	270	None	0:00
28	12/8/2024	Unidentified dolphin	Bow riding	Fast travel		1	Full volume	4020	None	0:00
29	13/8/2024	Unidentified dolphin	Slow travel	Diving	Fast travel	8	Full volume	800	None	0:00
30	13/8/2024	Leatherback sea turtle	Feeding	Diving		1	Full volume	420	Turtle pause	0:01
31	13/8/2024	Green sea turtle	Resting	Floating	Diving	1	Full volume	330	Turtle pause	0:02
33	14/8/2024	Atlantic spotted dolphin	Slow travel	Porpoising	Fast travel	12	Full volume	5	None	0:00
34	15/8/2024	Unidentified dolphin	Fast travel	Diving		15	Full volume	1600	None	0:00
35	16/8/2024	Pygmy killer whale	Slow travel	Porpoising		50	Full volume	1000	None	0:00
36	19/8/2024	Bottlenose dolphin	Bow riding	Slow travel	Diving	2	Full volume	200	None	0:00
38	27/8/2024	Pantropical spotted dolphin	Feeding	Fast travel	Diving	25	Full volume	2500	None	0:00
40	2/9/2024	Sperm Whale	Blowing	Slow travel	Diving	2	Full volume	1200	Shutdown	1:24
41	4/9/2024	Sperm Whale	Blowing	Slow travel	Diving (flukes seen)	1	Full volume	800	Shutdown	0:37
42	17/9/2024	Unidentified dolphin	Fast travel	Diving		2	Full volume	450	None	0:00

Detection Number	Date	Common Name	Initial Behavior	Behavior Cue 2	Behavior Cue 3	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action	Duration of Mitigation Action (HH:MM) <sup>1</sup>
43	18/9/2024	Sperm Whale	Slow travel	Blowing	Diving	1	Full volume	1900	None	0:00
44	18/9/2024	Leatherback sea turtle	Slow travel	Floating	Diving	1	Full volume	400	None	0:00
45	18/9/2024	Rough-toothed dolphin	Slow travel			17	Full volume	1100	None	0:00
46	18/9/2024	Unidentified dolphin	Slow travel	Feeding		15	Full volume	900	None	0:00
47	18/9/2024	Leatherback sea turtle	Surfacing	Floating	Diving	1	Full volume	550	None	0:00
48	18/9/2024	Leatherback sea turtle	Surfacing	Floating	Diving	1	Full volume	850	None	0:00
49	18/9/2024	Leatherback sea turtle	Slow travel	Floating	Diving	1	Full volume	450	None	0:00
50	19/9/2024	Sperm Whale	Blowing	Slow travel	Diving	1	Full volume	4400	None	0:00
51	19/9/2024	Leatherback sea turtle	Floating	Slow travel	Diving	1	Full volume	390	Turtle pause	0:01
52	20/9/2024	Sperm Whale	Blowing	Slow travel	Diving	1	Full volume	5300	None	0:00
53	20/9/2024	Pygmy killer whale	Porpoising	Diving		50	Full volume	400	Shutdown	0:43
56	25/9/2024	Sperm Whale	Slow travel			1	Full volume	2200	None	0:00
57	25/9/2024	Unidentified dolphin	Fast travel	Surfacing		30	Full volume	2100	None	0:00
58	25/9/2024	Unidentified sea turtle	Floating	Slow travel	Diving	1	Full volume	300	Turtle pause	0:02
59	25/9/2024	Leatherback sea turtle	Resting	Slow travel		1	Full volume	100	Turtle pause	0:01
60	25/9/2024	Leatherback sea turtle	Slow travel	Resting	Diving	1	Full volume	100	Turtle pause	0:01
63	28/9/2024	Leatherback sea turtle	Slow travel	Resting	Diving	1	Full volume	100	Turtle pause	0:01
64	30/9/2024	Rough-toothed dolphin	Bow riding	Milling	Slow travel	15	Full volume	350	None	0:00
65	30/9/2024	Leatherback sea turtle	Slow travel	Resting	Diving	1	Full volume	300	None	0:00
66	30/9/2024	Leatherback sea turtle	Slow travel	Resting	Diving	1	Full volume	100	Turtle pause	0:01
71	10/1/2024	Rough-toothed dolphin	Surfacing	Fast travel		3	Full volume	400	None	0:00
74	10/11/2024	Bottlenose dolphin	Fast travel	Surfacing	Bow riding	3	Full volume	300	None	0:00
							Reduced			
75	10/11/2024	Unidentified dolphin	Bow riding			1	volume	420	None	0:00
76	10/11/2024	Sperm whale	Blowing	Slow travel	Diving (flukes seen)	5	Full volume	1050	Shutdown	0:48
77	10/12/2024	Rough-toothed dolphin	Surfacing	Fast travel		1	Full volume	400	None	0:00
78	10/13/2024	Sperm whale	Blowing	Fast travel	Diving (flukes seen)	2	Full volume	2366	None	0:00
79	10/13/2024	Sperm whale	Blowing			2	Full volume	1956	None	0:00
84	10/26/2024	Rough-toothed dolphin	Surfacing	Fast travel		10	Full volume	400	None	0:00
					Sanco Spirit					
4	07/20/2024	Bottlenose dolphin	Surfacing	Jumping	Bow riding	25	Soft start	100	Shutdown	1:05
5	07/21/2024	Unidentified dolphin	Fast travel	Diving		4	Full volume	500	None	0:00

Detection Number	Date	Common Name	Initial Behavior	Behavior Cue 2	Behavior Cue 3	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action	Duration of Mitigation Action (HH:MM) <sup>1</sup>
6	07/26/2024	Bottlenose dolphin	Surfacing	Slow travel		10	Full volume	600	None	0:00
10	07/28/2024	Pantropical spotted dolphin	Surfacing	Slow travel		2	Full volume	320	None	0:00
11	07/29/2024	Pantropical spotted dolphin	Fast travel	Porpoising		4	Full volume	312	None	0:00
12	07/29/2024	Unidentified dolphin	Porpoising	Slow travel		1	Full volume	490	None	0:00
13	07/30/2024	Unidentified dolphin	Porpoising	Blowing	Slow travel	4	Full volume	200	None	0:00
14	07/31/2024	Unidentified dolphin	Surfacing	Slow travel		2	Full volume	900	None	0:00
15	07/31/2024	Unidentified whale	Blowing			1	Full volume	2500	None	0:00
				Acrobatic						
16	08/02/2024	Unidentified dolphin	Porpoising	behavior		12	Full volume	160	None	0:00
27	09/18/2024	Leatherback sea turtle	Surfacing	Slow travel		1	Full volume	100	Turtle pause	0:01
28	09/18/2024	Unidentified sea turtle	Surfacing	Slow travel		1	Full volume	300	None	0:00
29	09/18/2024	Unidentified sea turtle	Surfacing	Diving		1	Full volume	310	None	0:00
31	09/19/2024	Unidentified dolphin	Surfacing	Jumping		3	Full volume	350	None	0:00
33	09/19/2024	Pantropical spotted dolphin	Fast travel	Porpoising	Acrobatic behavior	30	Full volume	700	None	0:00
34	09/20/2024	Sperm whale	Slow travel	Surfacing	Diving (flukes seen)	3	Full volume	500	Shutdown	0:52
35	09/22/2024	Sperm whale	Blowing	Slow travel		1	Full volume	2000	None	0:00
36	09/22/2024	Sperm whale	Surfacing	Blowing	Diving	1	Full volume	900	Shutdown	2:47
37	09/23/2024	Leatherback sea turtle	Surfacing	Resting		1	Full volume	100	Turtle pause	0:01
38	09/28/2024	Leatherback sea turtle	Surfacing	Resting	Diving	1	Full volume	75	Turtle pause	0:01
39	09/29/2024	Unidentified dolphin	Fast travel	Porpoising		1	Full volume	3000	None	0:00
40	09/29/2024	Bottlenose dolphin	Slow travel	Surfacing	Blowing	4	Full volume	300	None	0:00
41	09/29/2024	Unidentified dolphin	Slow travel	Jumping		10	Full volume	1000	None	0:00
42	09/30/2024	Leatherback sea turtle	Slow travel	Diving		1	Full volume	170	Turtle pause	0:01
43	09/30/2024	Hawksbill sea turtle	Surfacing	Diving		1	Full volume	100	Turtle pause	0:01
44	09/30/2024	Leatherback sea turtle	Slow travel	Surfacing	Fin slapping	1	Full volume	50	Turtle pause	0:01
45	10/01/2024	Sperm whale	Slow travel	Blowing		1	Full volume	2000	None	0:00
46	10/05/2024	Sperm whale	Logging	Surfacing	Blowing	2	Full volume	150	Shutdown	0:43
47	10/05/2024	Sperm whale	Blowing	Slow travel		1	Full volume	2000	None	0:00
50	10/11/2024	Sperm whale	Blowing			1	Full volume	2800	None	0:00
51	10/12/2024	Unidentified dolphin	Surfacing	Surfacing		2	Full volume	550	None	0:00
52	10/12/2024	Sperm whale	Blowing	Breaching	Surfacing	3	Full volume	500	Shutdown	1:21
53	10/12/2024	Sperm whale	Blowing	Surfacing	Slow travel	2	Full volume	2100	None	0:00

Detection Number	Date	Common Name	Initial Behavior	Behavior Cue 2	Behavior Cue 3	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action	Duration of Mitigation Action (HH:MM) <sup>1</sup>
54	10/14/2024	Sperm whale	Blowing	Surfacing	Slow travel	3	Full volume	1200	Shutdown	0:46
55	10/14/2024	Unidentified dolphin	Surfacing			1	Full volume	620	None	0:00
56	10/14/2024	Unidentified dolphin	Surfacing			3	Full volume	540	None	0:00
57	10/14/2024	Leatherback sea turtle	Slow travel	Surfacing		1	Full volume	20	Turtle pause	0:01
58	10/15/2024	Leatherback sea turtle	Fast travel			1	Full volume	20	Turtle pause	0:01
59	10/15/2024	Leatherback sea turtle	Slow travel			1	Full volume	20	Turtle pause	0:01
60	10/15/2024	Pantropical spotted dolphin	Slow travel	Surfacing		10	Full volume	150	None	0:00
·		·		Ar	temis Athene					
2	6/23/2024	Short-finned pilot whale	Breaching	Blowing	Surfacing	5	Full volume	450	Shutdown	2:02
14	7/13/2024	Green sea turtle	Slow travel			1	Full volume	50	Turtle pause	0:01
16	7/15/2024	Unidentified dolphin	Porpoising	Fast travel	Surfacing	20	Full volume	1885	None	0:00
17	7/15/2024	Unidentified dolphin	Surfacing			3	Full volume	900	None	0:00
19	7/16/2024	Short-finned pilot whale	Surfacing	Porpoising	Diving	5	Full volume	1280	None	0:00
20	7/16/2024	Short-finned pilot whale	Surfacing	Porpoising	Blowing	1	Full volume	1170	None	0:00
22	7/20/2024	Bottlenose dolphin	Bow riding	Surfacing	Fast travel	3	Full volume	482	None	0:00
24	7/25/2024	Unidentified turtle	Fast travel			1	Full volume	15	Turtle pause	0:01
25	7/26/2024	Unidentified turtle	Fast travel			1	Full volume	10	Turtle pause	0:01
26	7/26/2024	Unidentified dolphin	Surfacing	Diving		1	Full volume	700	None	0:00
29	7/29/2024	Unidentified turtle	Fast travel			1	Full volume	20	Turtle pause	0:01
30	7/29/2024	Bottlenose dolphin	Surfacing			3	Full volume	30	None	0:00
31	7/30/2024	Unidentified dolphin	Surfacing	Porpoising	Fast travel	20	Full volume	1300	None	0:00
32	7/31/2024	False killer whale	Surfacing	Blowing	Slow travel	10	Full volume	100	Shutdown	0:45
32	7/31/2024	Melon-headed whale	Surfacing	Slow travel	Fast travel	10	Full volume	100	Shutdown	*00:00
34	7/31/2024	Bottlenose dolphin	Surfacing	Bow riding	Milling	15	Full volume	490	None	0:00
35	8/1/2024	Pantropical spotted dolphin	Fast travel	Breaching	Porpoising	20	Full volume	460	None	0:00
35	8/1/2024	Bottlenose dolphin	Fast travel	Breaching	Porpoising	20	Full volume	460	None	0:00
36	8/1/2024	Bottlenose dolphin	Surfacing	Bow riding		4	Full volume	490	None	0:00
39	8/2/2024	Unidentified dolphin	Surfacing	Slow travel		6	Full volume	40	None	0:00
40	8/2/2024	Bottlenose dolphin	Jumping	Surfacing	Bow riding	5	Full volume	200	None	0:00
41	8/3/2024	Unidentified dolphin	Surfacing			3	Full volume	600	None	0:00
43	8/9/2024	Leatherback sea turtle	Slow travel	Surfacing	Fast travel	1	Full volume	100	Turtle pause	0:01
45	8/10/2024	Unidentified dolphin	Surfacing	Blowing		3	Full volume	2080	None	0:00

Detection Number	Date	Common Name	Initial Behavior	Behavior Cue 2	Behavior Cue 3	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action	Duration of Mitigation Action (HH:MM) <sup>1</sup>
46	8/10/2024	Unidentified turtle	Surfacing	Slow travel		1	Full volume	80	Turtle pause	0:01
47	8/13/2024	Bottlenose dolphin	Surfacing	Porpoising	Slow travel	8	Full volume	620	None	0:00
49	8/14/2024	Unidentified dolphin	Slow travel	Porpoising	Tail slapping	15	Full volume	550	None	0:00
51	8/15/2024	Green sea turtle	Resting			1	Full volume	10	Turtle pause	0:01
53	8/16/2024	Bottlenose dolphin	Porpoising	Bow riding	Surfacing	8	Soft start	15	Shutdown	0:32
58	8/19/2024	Unidentified dolphin	Surfacing	Surfacing	Slow travel	5	Full volume	400	None	0:00
59	8/19/2024	Unidentified turtle	Surfacing	Feeding	Diving	1	Full volume	100	Turtle pause	0:01
66	9/3/2024	Sperm whale	Blowing	Slow travel		1	Full volume	1400	Shutdown	0:03
67	9/4/2024	Short-finned pilot whale	Surfacing	Slow travel		12	Full volume	300	Shutdown	0:10
68	9/13/2024	Bottlenose dolphin	Surfacing	Slow travel		2	Full volume	300	None	0:00
				Diving (flukes						
69	9/13/2024	Sperm whale	Blowing	seen)		1	Full volume	2000	None	0:00
				Diving (flukes						
70	9/14/2024	Sperm whale	Blowing	seen)		1	Full volume	2500	None	0:00
				Diving (flukes						
71	9/15/2024	Sperm whale	Blowing	seen)		1	Full volume	2400	None	0:00
				Diving (flukes						
72	9/15/2024	Sperm whale	Blowing	seen)	Slow travel	2	Full volume	810	Shutdown	0:34
73	9/16/2024	Green sea turtle	Fast travel			1	Full volume	100	Turtle pause	0:01
74	9/17/2024	Sperm whale	Blowing	Logging	Diving (flukes seen)	1	Full volume	1450	Shutdown	0:30
75	9/18/2024	Leatherback sea turtle	Surfacing	Slow travel	Diving	1	Full volume	100	Turtle pause	0:01
76	9/18/2024	Unidentified dolphin	Surfacing	Slow travel	Porpoising	8	Full volume	550	None	0:00
77	9/18/2024	Clymene dolphin	Surfacing	Slow travel	Porpoising	20	Full volume	600	None	0:00
78	9/18/2024	Unidentified dolphin	Slow travel	Milling		18	Full volume	5100	None	0:00
				Diving (flukes						
79	9/19/2024	Sperm whale	Blowing	seen)		1	Full volume	5000	None	0:00
				Diving (flukes						
80	9/20/2024	Sperm whale	Blowing	seen)	Logging	2	Full volume	800	Shutdown	0:28
83	9/20/2024	Melon-headed whale	Blowing	Slow travel		60	Soft start	800	None	0:00
				Diving (flukes						
84	9/22/2024	Sperm whale	Blowing	seen)		2	Full volume	5000	None	0:00
85	9/23/2024	Leatherback sea turtle	Slow travel			1	Full volume	100	Turtle pause	0:01

Detection Number	Date	Common Name	Initial Behavior	Behavior Cue 2	Behavior Cue 3	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action	Duration of Mitigation Action (HH:MM) <sup>1</sup>
90	10/11/2024	Unidentified dolphin	Blowing	Slow travel		6	Full volume	1800	None	0:00
91	10/13/2024	Sperm whale	Blowing	Surfacing	Diving (flukes seen)	1	Full volume	2780	None	0:00
92	10/13/2024	Sperm whale	Blowing	Surfacing		1	Full volume	2000	None	0:00
93	10/13/2024	Unidentified dolphin	Blowing	Slow travel		3	Full volume	2200	None	0:00
94	10/13/2024	Short-finned pilot whale	Blowing	Porpoising		6	Full volume	3050	None	0:00
97	10/24/2024	Sperm whale	Blowing	Surfacing	Diving (flukes seen)	2	Full volume	800	Shutdown	1:41
98	10/25/2024	Sperm whale	Blowing	Slow travel	Diving (flukes seen)	1	Full volume	2025	None	0:00
99	10/25/2024	Sperm whale	Blowing	Surfacing	Diving (flukes seen)	1	Full volume	1300	Shutdown	1:35
100	10/25/2024	Unidentified dolphin	Porpoising	Fast travel	Jumping	50	Full volume	1080	None	0:00

<sup>1</sup>Duration of mitigation measures calculated as follows: ramp-up delay is the difference between the time the vessel would have begun ramp-up had the mitigation zones been clear and the time the PSOs gave clearance to begin ramp-up; shut-down is the entire period from when the source was turned off plus through the required waiting period following the last observation within the exclusion zone.

-- Indicates no secondary or tertiary behaviors observed.

\*Mitigation time included in previous row that corresponds to a concurrent detection of multiple species.

#### Table 19. Acoustic protected species detection overview (active source).

Detection Number	Date	Common Name	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m) <sup>1</sup>	Mitigation Action	Duration of Mitigation Action (HH:MM) <sup>2</sup>
			REM	Andes			
1	7/15/2024	Unidentified dolphin	2	Full volume	100	None	0:00
2	7/16/2024	Short-finned pilot whale	1	Full volume	100	Shutdown	*0:00
3	7/17/2024	Short-finned pilot whale	2	Full volume	250	Shutdown	*0:00
5	7/19/2024	Unidentified dolphin	1	Full volume	200	None	0:00
12	7/29/2024	Bottlenose dolphin	2	Full volume	100	None	0:00
13	7/30/2024	Bottlenose dolphin	1	Full volume	400	None	0:00
14	7/31/2024	Unidentified dolphin	1	Full volume	200	None	0:00
16	8/1/2024	Unidentified Dolphin	1	Full volume	300	None	0:00
17	8/7/2024	Bottlenose dolphin	3	Full volume	400	None	0:00
19	8/9/2024	Unidentified Dolphin	4	Full volume	400	None	0:00
20	8/12/2024	Sperm Whale	2	Full volume	600	Shutdown	0:41

Detection Number	Date	Common Name	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m) <sup>1</sup>	Mitigation Action	Duration of Mitigation Action (HH:MM) <sup>2</sup>
21	8/12/2024	Bottlenose dolphin	1	Full volume	500	None	0:00
22	8/13/2024	Unidentified Dolphin	2	Full volume	500	None	0:00
23	8/16/2024	Sperm Whale	1	Full volume	900	Shutdown	1:08
25	8/23/2024	Unidentified Dolphin	2	Full volume	500	None	0:00
26	8/23/2024	Unidentified Dolphin	2	Full volume	500	None	0:00
27	8/24/2024	Unidentified Dolphin	6	Full volume	500	None	0:00
28	8/27/2024	Unidentified Dolphin	4	Full volume	400	None	0:00
29	8/29/2024	Unidentified Dolphin	3	Full volume	200	None	0:00
31	9/1/2024	Sperm whale	3	Full volume	500	Shutdown	3:33
33	9/2/2024	Sperm whale	3	Full volume	500	Shutdown	*0:00
34	9/2/2024	Sperm whale	2	Full volume	600	Shutdown	0:35
35	9/4/2024	Unidentified dolphin	4	Full volume	100	None	N/A
37	9/5/2024	Unidentified dolphin	2	Full volume	500	None	N/A
38	9/6/2024	Sperm whale	3	Full volume	500	Shutdown	1:06
39	9/7/2024	Unidentified dolphin	1	Full volume	150	None	N/A
42	9/10/2024	Sperm whale	3	Full volume	500	Shutdown	0:47
46	9/14/2024	Sperm whale	1	Full volume	500	Shutdown	0:40
47	9/16/2024	Sperm whale	2	Full volume	1000	Shutdown	0:37
49	9/20/2024	Sperm whale	3	Full volume	238	Shutdown	1:57
58	9/30/2024	Unidentified dolphin	5	Full volume	71	Shutdown	8:53
59	10/1/2024	Unidentified dolphin	1	Full volume	349	None	0:00
60	10/1/2024	Unidentified dolphin	3	Full volume	100	None	0:00
62	10/1/2024	Sperm whale	1	Soft start	80	Shutdown	0:57
65	10/1/2024	Unidentified dolphin	3	Full volume	100	None	0:00
66	10/2/2024	Sperm whale	1	Full volume	82	Shutdown	1:00
67	10/2/2024	Unidentified dolphin	6	Full volume	58	Delay	8:36
68	10/2/2024	Sperm whale	2	Full volume	100	Shutdown	1:40

Detection Number	Date	Common Name	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m) <sup>1</sup>	Mitigation Action	Duration of Mitigation Action (HH:MM) <sup>2</sup>
69	10/3/2024	Sperm whale	2	Full volume	32	Shutdown	1:10
74	10/4/2024	Unidentified dolphin	1	Soft start	300	Shutdown	0:35
75	10/4/2024	Sperm whale	1	Full volume	2000	None	0:00
76	10/4/2024	Unidentified dolphin	1	Full volume	200	None	0:00
77	10/4/2024	Sperm whale	1	Full volume	2000	None	0:00
79	10/6/2024	Unidentified dolphin	2	Full volume	300	None	0:00
80	10/6/2024	Unidentified dolphin	2	Full volume	200	None	0:00
82	10/11/2024	Bottlenose dolphin	2	Full volume	200	None	0:00
84	10/12/2024	Unidentified dolphin	3	Full volume	200	Delay	0:30
85	10/12/2024	Unidentified dolphin	2	Full volume	350	Shutdown	1:46
87	10/13/2024	Unidentified dolphin	4	Full volume	44	Shutdown	6:25
88	10/14/2024	Unidentified dolphin	1	Full volume	112	None	0:00
89	10/14/2024	Unidentified dolphin	2	Full volume	150	None	0:00
90	10/14/2024	Unidentified dolphin	2	Full volume	200	Shutdown	1:28
92	10/15/2024	Sperm whale	3	Full volume	495	Shutdown	0:46
93	10/15/2024	Unidentified dolphin	1	Full volume	100	None	0:00
94	10/16/2024	Sperm whale	2	Soft start	200	Shutdown	1:20
95	10/21/2024	Unidentified dolphin	1	Full volume	100	Delay	6:25
96	10/21/2024	Unidentified dolphin	2	Soft start	200	None	0:00
98	10/22/2024	Unidentified dolphin	2	Full volume	239	None	0:00
100	10/23/2024	Unidentified dolphin	1	Full volume	300	None	0:00
101	10/24/2024	Unidentified dolphin	1	Full volume	90	None	0:00
102	10/24/2024	Unidentified dolphin	1	Full volume	300	None	0:00
103	10/25/2024	Spinner dolphins	6	Full volume	40	Delay	1:17
104	10/25/2024	Sperm whale	2	Full volume	50	Shutdown	3:24
108	10/25/2024	Sperm whale	1	Full volume	2000	None	0:00
110	10/27/2024	Sperm whale	2	Full volume	138	Shutdown	3:24

Detection Number	Date	Common Name	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m) <sup>1</sup>	Mitigation Action	Duration of Mitigation Action (HH:MM) <sup>2</sup>
112	10/27/2024	Unidentified dolphin	1	Full volume	288	None	0:00
116	10/28/2024	Unidentified dolphin	1	Full volume	300	None	0:00
117	10/29/2024	Unidentified dolphin	1	Full volume	420	None	0:00
118	10/29/2024	Unidentified dolphin	4	Full volume	114	None	0:00
119	10/29/2024	Sperm whale	2	Full volume	39	Shutdown	1:44
120	10/29/2024	Unidentified dolphin	2	Full volume	59	None	0:00
			Sanco	Spirit			
502	7/26/2024	Bottlenose dolphin	3	Full volume	700	None	0:00
503	7/29/2024	Pantropical spotted dolphin	4	Full volume	550	None	0:00
504	7/30/2024	Unidentified dolphin	2	Full volume	800	None	0:00
505	7/30/2024	Unidentified dolphin	2	Full volume	600	None	0:00
506	7/31/2024	Sperm whale	1	Full volume	2000	None	0:00
507	7/31/2024	Unidentified dolphin		Full volume	400	None	0:00
510	8/7/2024	Unidentified dolphin	1	Full volume	350	None	0:00
511	8/9/2024	Unidentified dolphin	1	Full volume	500	None	0:00
512	9/18/2024	Unidentified dolphin	2	Full volume	500	None	0:00
518	9/24/2024	Unidentified dolphin	2	Full volume	500	None	0:00
519	9/25/2024	Unidentified dolphin	2	Full volume	750	None	0:00
520	9/28/2024	Unidentified dolphin	3	Full volume	500	None	0:00
521	9/29/2024	Unidentified dolphin	1	Full volume	800	None	0:00
522	9/29/2024	Unidentified dolphin	2	Full volume	300	None	0:00
523	10/1/2024	Unidentified dolphin	1	Full volume	500	None	0:00
524	10/1/2024	Unidentified dolphin	1	Full volume	500	None	0:00
525	10/1/2024	Unidentified dolphin	1	Full volume	200	None	0:00
526	10/2/2024	Sperm whale	1	Full volume	300	Shutdown	0:37
527	10/2/2024	Sperm whale	3	Full volume	2000	None	0:00
528	10/2/2024	Unidentified dolphin	1	Full volume	500	None	0:00

Detection Number	Date	Common Name	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m) <sup>1</sup>	Mitigation Action	Duration of Mitigation Action (HH:MM) <sup>2</sup>
529	10/3/2024	Sperm whale	3	Full volume	100	Shutdown	1:17
530	10/3/2024	Sperm whale	2	Full volume	2000	None	0:00
531	10/4/2024	Unidentified dolphin	1	Full volume	500	None	0:00
532	10/4/2024	Unidentified dolphin	1	Full volume	500	None	0:00
533	10/4/2024	Unidentified dolphin	3	Full volume	88	Delay	3:07
537	10/6/2024	Unidentified dolphin	1	Full volume	100	None	0:00
538	10/6/2024	Unidentified dolphin	1	Full volume	500	None	0:00
544	10/12/2024	Sperm whale	1	Full volume	3000	None	0:00
545	10/12/2024	Sperm whale	3	Full volume	94	Delay	0:53
549	10/13/2024	Sperm whale	2	Full volume	NL	None	0:00
550	10/14/2024	Sperm whale	2	Full volume	2000	None	0:00
553	10/14/2024	Unidentified dolphin	1	Full volume	500	None	0:00
555	10/14/2024	Unidentified dolphin	3	Full volume	500	None	0:00
556	10/15/2024	Sperm whale	2	Full volume	130	Shutdown	0:47
558	10/15/2024	Unidentified dolphin	1	Full volume	500	None	0:00
559	10/15/2024	Pantropical spotted dolphin	5	Full volume	150	None	0:00
560	10/22/2024	Unidentified dolphin	1	Full volume	500	None	0:00
561	10/23/2024	Unidentified dolphin	1	Soft start	600	None	0:00
563	10/26/2024	Unidentified dolphin	1	Full volume	500	None	0:00
564	10/26/2024	Unidentified dolphin	1	Full volume	500	None	0:00
565	10/27/2024	Unidentified dolphin	1	Full volume	500	None	0:00
566	10/27/2024	Unidentified dolphin	3	Soft start	230	Shutdown	0:37
			Artemis	Athene			
503	7/16/2024	Unidentified dolphin	3	Full volume	500	None	0:00
505	7/20/2024	Bottlenose dolphin	2	Full volume	240	None	0:00
507	7/21/2024	Unidentified dolphin	2	Full volume	500	None	0:00
511	7/23/2024	Unidentified dolphin	1	Full volume	227	None	0:00

Detection Number	Date	Common Name	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m) <sup>1</sup>	Mitigation Action	Duration of Mitigation Action (HH:MM) <sup>2</sup>
512	7/23/2024	Unidentified dolphin	2	Full volume	500	None	0:00
518	7/27/2024	Unidentified dolphin	2	Full volume	500	None	0:00
521	7/31/2024	Unidentified dolphin	3	Full volume	500	None	*0:00
523	8/1/2024	Unidentified dolphin	2	Full volume	500	None	0:00
524	8/1/2024	Unidentified dolphin	2	Full volume	235	None	0:00
527	8/2/2024	Unidentified dolphin	2	Full volume	280	None	0:00
528	8/2/2024	Bottlenose dolphin	1	Full volume	260	None	0:00
532	8/4/2024	Unidentified dolphin	3	Full volume	240	None	0:00
533	8/6/2024	Unidentified dolphin	2	Full volume	232	None	0:00
534	8/6/2024	Unidentified dolphin	1	Full volume	296	None	0:00
535	8/7/2024	Unidentified dolphin	6	Full volume	500	None	0:00
538	8/13/2024	Bottlenose dolphin	3	Full volume	230	None	0:00
540	8/16/2024	Bottlenose dolphin	3	Soft start	500	None	*0:00
542	8/16/2024	Atlantic spotted dolphin	3	Soft start	180	None	0:00
543	8/16/2024	Unidentified dolphin	5	Soft start	241	Shutdown	0:40
546	9/15/2024	Unidentified dolphin	2	Full volume	500	None	0:00
549	10/11/2024	Unidentified dolphin	1	Soft start	500	Shutdown	1:43
553	10/23/2024	Unidentified dolphin	2	Full volume	160	None	0:00
555	10/26/2024	Unidentified dolphin	5	Full volume	500	None	0:00
556	10/26/2024	Unidentified dolphin	5	Full volume	500	None	0:00
557	10/26/2024	Unidentified dolphin	5	Full volume	75	None	0:00
558	10/26/2024	Unidentified dolphin	2	Full volume	500	None	0:00
559	10/28/2024	Sperm whale	2	Full volume	500	Shutdown	0:55

<sup>1</sup>NL = not localized

<sup>2</sup> Duration of mitigation measures calculated as follows: ramp-up delay is the difference between the time the vessel would have begun ramp-up had the mitigation zones been clear and the time the PSOs gave clearance to begin ramp-up; shut-down is the entire period from when the source was turned off plus through the required waiting period following the last observation within the exclusion zone. \*Mitigation by visual observers.

# 7.2. Initial and Closest Point of Approach

During this survey across all three survey vessels there were 156 sightings where the source was active at the initial detection. There were 95 protected species sightings when the source was silent at the initial detection. See **Figure 18** for a breakdown of average closest approaches to source based on the source activity at the initial time of detection for each vessel. **Table 20** summarizes the average closest approach to inactive and active sources by species group and **Table 21** summarizes the average closest approach by species. It should be noted that for sightings during transit or when the source was on board and not deployed the location of the source at the stern of the vessel was used for reference.



Figure 18. Average Closest Approach to Source per Source Activity at Initial Detection

Species Type	CPA to Inactive source (m)	CPA to Active Source (m)	Overall CPA (m)
Dolphins*	347	852	636
Whales	1455	2003	1806
Sea turtles	278	200	212
Total	581	940	810

#### Table 20. Average closest point of approach by species type.

\*Dolphins are inclusive of all delphinid species, including blackfish

# Table 21. Average closest point of approach by species.

Species Type	CPA to Inactive source (m)	CPA to Active Source (m)	Overall CPA (m)
Atlantic spotted dolphin	228	5	173
Bottlenose dolphin	316	327	321
Clymene dolphin	NA	600	600
False killer whale	NA	100	100
Green sea turtle	346	245	284

Species Type	CPA to Inactive source (m)	CPA to Active Source (m)	Overall CPA (m)
Hawksbill sea turtle	NA	100	100
Kemp's Ridley sea turtle	15	NA	15
Leatherback sea turtle	NA	210	210
Melon-headed whale	NA	450	450
Pantropical spotted dolphin	249	740	544
Pygmy killer whale	NA	700	700
Rough-toothed dolphin	53	539	362
Short-finned pilot whale	100	957	850
Sperm whale	1342	1987	1777
Unidentified dolphin	493	1286	994
Unidentified sea turtle	200	142	148
Unidentified whale	2060	2500	2170
Total	581	940	810

# 7.3. Observation Rates

Visual sighting rate overall was 0.06291 sightings per hour of monitoring effort, and a source active sighting rate of 0.06401 sightings per hour of monitoring. Visual sighting rate while the source was inactive was 0.07056 sightings per hour of monitoring effort. Acoustic detection rate while the source was active was 0.03450, 0.08828 when the source was inactive, and an overall rate of 0.04678 detections per hour of monitoring effort. A complete summary of sighting rates by source activity can be seen in **Table 22** and by species in **Table 23** and **Table 24**.

#### Table 22. Visual and acoustic observation rates by source activity.

Detection Rate (Detections per hour of Monitoring Effort)						
	Source Active	Source Inactive	All Monitoring			
Visual Monitoring	0.06401	0.07056	0.06291			
Acoustic Monitoring	0.03450	0.08828	0.04678			

# Table 23. Visual observation rates by species.

Species	Number of observations	Observation rate per number of observations	Total number of individuals	Observation rate per number of individuals
	REM Andes	5		
Atlantic spotted dolphin	2	0.00144	20	0.01443
Bottlenose dolphin	14	0.01010	140	0.10098
Green sea turtle	7	0.00505	8	0.00577
Leatherback sea turtle	11	0.00793	11	0.00793
Pantropical spotted dolphin	1	0.00072	25	0.01803
Pygmy killer whale	2	0.00144	100	0.07213
Rough-toothed dolphin	11	0.00793	119	0.08583
Short-finned pilot whale	3	0.00216	22	0.01587
Pygmy killer whale Rough-toothed dolphin Short-finned pilot whale	2 11 3	0.00144 0.00793 0.00216	100 119 22	0.07213 0.08583 0.01587

Species	Number of observations	Observation rate per number of observations	Total number of individuals	Observation rate per number of individuals
Sperm whale	15	0.01082	24	0.01731
Unidentified dolphin	15	0.01082	120	0.08656
Unidentified sea turtle	1	0.00072	1	0.00072
Unidentified whale	3	0.00216	6	0.00433
Total	85	0.06131	596	0.42989
	Sanco Spiri	t		
Bottlenose dolphin	11	0.01295	133	0.15660
Hawksbill sea turtle	1	0.00118	1	0.00118
Kemp's Ridley sea turtle	1	0.00118	1	0.00118
Leatherback sea turtle	8	0.00942	8	0.00942
Pantropical spotted dolphin	7	0.00824	59	0.06947
Sperm whale	13	0.01531	25	0.02944
Unidentified dolphin	20	0.02355	72	0.08477
Unidentified sea turtle	2	0.00235	2	0.00235
Unidentified whale	1	0.00118	1	0.00118
Total	64	0.07535	302	0.35558
	Artemis Athe	ne		
Atlantic spotted dolphin	2	0.00138	32	0.02201
Bottlenose dolphin	26	0.01788	163	0.11210
Clymene dolphin	1	0.00069	20	0.01375
False killer whale	1	0.00069	10	0.00688
Green sea turtle	6	0.00413	6	0.00413
Leatherback sea turtle	3	0.00206	3	0.00206
Melon-headed whale	2	0.00138	70	0.04814
Pantropical spotted dolphin	2	0.00138	40	0.02751
Short-finned pilot whale	5	0.00344	29	0.01994
Sperm whale	21	0.01444	26	0.01788
Unidentified dolphin	27	0.01857	279	0.19187
Unidentified sea turtle	6	0.00413	6	0.00413
Total	102	0.07015	684	0.47039
Project Total	251	0.06291	1,582	0.39651

# Table 24. Acoustic observation rates by species.

Species	Number of observations	Observation rate per number of observations	Total number of individuals	Observation rate per number of individuals
	REM Andes			
Bottlenose dolphin	6	0.00280	13	0.00607
Common dolphin	1	0.00047	10	0.00467
Rough-toothed dolphin	1	0.00047	3	0.00140

Species	Number of observations	Observation rate per number of observations	Total number of individuals	Observation rate per number of individuals
Short-finned pilot whale	3	0.00140	5	0.00233
Sperm whale	36	0.01681	65	0.03035
Spinner dolphin	1	0.00047	6	0.00280
Unidentified dolphin	71	0.03316	178	0.08313
Unidentified Odontocete	1	0.00047	1	0.00047
Total	120	0.05604	281	0.13123
	Sanco Spirit			
Bottlenose dolphin	2	0.00180	7	0.00630
Pantropical spotted dolphin	2	0.00180	9	0.00810
Rough-toothed dolphin	2	0.00180	23	0.02069
Sperm whale	21	0.01889	35	0.03149
Unidentified dolphin	39	0.03509	60	0.05398
Total	66	0.05938	134	0.12055
	Artemis Athene	e		
Atlantic spotted dolphin	1	0.00050	3	0.00150
Bottlenose dolphin	7	0.00349	20	0.00997
Short-finned pilot whale	1	0.00050	12	0.00598
Sperm whale	5	0.00249	9	0.00449
Unidentified dolphin	46	0.02294	177	0.08826
Total	60	0.02992	221	0.11020
Project Total	246	0.04678	636	0.12095

#### 7.4. Source Mitigation Actions

The mitigation procedures in place for this survey were as follows:

- **Delay** Applicable during the pre-clearance search periods conducted prior to initiating the sound source from silence, where detections of a protected species inside its applicable BZ result in a delay to activating the source.
- Shut Down The source array must be shut down if a protected species is observed entering its exclusion zone when the array is active. An exclusion zone of 1500 meters applies to sperm whale, Rice's whale, beaked whale, and Kogia species. All other marine mammals have a 500-meter exclusion zone and sea turtles have an exclusion zone of 100 meters. During a soft start, the source array must be shut down if any protected species enters its respective exclusion zone. Shutdown is not required for the following dolphin genera: *Steno, Tursiops, Stenella,* and *Lagenodelphis,* during full volume firing. Additionally, sea turtles are exempt from shutdown requirements during full volume firing. There are no shutdown species exemptions during soft start operations.
- Turtle pause A voluntary 7-shot turtle pause is implemented for any turtles within 100 meters
  of the source array such that the turtle is allowed to float past the array while the source is
  inactive, and it is a distance greater than 100 meters from the array upon resumption of source
  activity.

In total, 150 source mitigation actions were implemented during the survey program. There were 97 delays to the initiation of the source that resulted in 143:19 of mitigation time. There were 33 source shutdowns that resulted in 42:21 of mitigation time. There were 20 turtle pauses that resulted in 00:20 of mitigation time. **Table 25** summarizes the number of source mitigation actions by species group and **Table 26** provides a detailed summary of each mitigation action. Mitigation narratives are provided in **Appendix A and E**.

Species Group	Number of Turtle Pauses	Number of Delays	Number of Shutdowns	Total Duration of Mitigation Action (HH:MM)
Whales	0	31	17	57:32
Dolphins	0	54	16	127:54
Turtles	20	12	0	00:34
Total	20	97	33	186:00

#### Table 25. Source mitigation actions by species group.

\*Dolphins are inclusive of all delphinid species, including blackfish

# Table 26. Source mitigation action details.

Detection Number	Date (mm/dd/yyyy)	Detection Type	Species	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action	Duration of Mitigation Action (HH:MM)
			REM And	es				
3, 502	7/16/2024	Both	Short-finned pilot whale	6	Full volume	200	Shutdown	0:46
4, 503	7/17/2024	Both	Short-finned pilot whale	6	Full volume	250	Shutdown	0:42
5, 504	7/17/2024	Both	Short-finned pilot whale	10	None	100	Delay	0:18
6	7/22/2024	Visual	Green sea turtle	1	Full volume	370	Delay	0:01
9	7/23/2024	Visual	Green sea turtle	1	Full volume	380	Delay	0:01
507	7/24/2024	Acoustic	Unidentified dolphin	4	None	100	Delay	0:35
508	7/24/2024	Acoustic	Unidentified dolphin	2	None	100	Delay	0:47
509	7/27/2024	Acoustic	Unidentified dolphin	5	None	10	Delay	0:38
14	7/28/2024	Visual	Green sea turtle	1	Full volume	370	Delay	0:01
518	8/8/2024	Acoustic	Unidentified Dolphin	3	None	100	Delay	2:40
23	8/8/2024	Visual	Green sea turtle	1	Full volume	350	Delay	0:01
520	8/12/2024	Acoustic	Sperm Whale	2	Full volume	600	Delay	0:41
30	8/13/2024	Visual	Leatherback sea turtle	1	Full volume	420	Delay	0:01
31	8/13/2024	Visual	Green sea turtle	1	Full volume	330	Delay	0:02
32	8/13/2024	Visual	Unidentified whale	3	None	1000	Delay	0:56
523	8/16/2024	Acoustic	Sperm Whale	1	Full volume	900	Delay	1:08
524	8/17/2024	Acoustic	Sperm Whale	1	None	1000	Delay	0:35
530	9/1/2024	Acoustic	Unidentified dolphin	4	None	200	Delay	1:26
39, 531	9/1/2024	Both	Sperm whale	3	Full volume	500	Delay	3:33
40, 533	9/2/2024	Both	Sperm Whale	2	Full volume	1200	Delay	1:24
534	9/2/2024	Acoustic	Sperm whale	2	Full volume	600	Delay	0:35

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Detection Number	Date (mm/dd/yyyy)	Detection Type	Species	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action	Duration of Mitigation Action (HH:MM)
41, 536	9/4/2024	Both	Sperm Whale	1	Full volume	800	Delay	0:37
538	9/6/2024	Acoustic	Sperm whale	3	Full volume	500	Delay	1:06
540	9/8/2024	Acoustic	Sperm whale	3	None	400	Delay	0:51
541	9/8/2024	Acoustic	Unidentified dolphin	3	None	50	Delay	2:35
542	9/10/2024	Acoustic	Sperm whale	3	Full volume	500	Delay	0:47
543	9/10/2024	Acoustic	Unidentified dolphin	8	None	50	Delay	1:50
545	9/13/2024	Acoustic	Unidentified dolphin	3	None	50	Delay	1:04
546	9/14/2024	Acoustic	Sperm whale	1	Full volume	500	Delay	0:40
547	9/16/2024	Acoustic	Sperm whale	2	Full volume	1000	Delay	0:37
548	9/16/2024	Acoustic	Sperm whale	2	None	800	Delay	0:53
51	9/19/2024	Visual	Leatherback sea turtle	1	Full volume	390	Delay	0:01
549	9/20/2024	Acoustic	Sperm whale	3	Full volume	238	Delay	1:57
53	9/20/2024	Visual	Pygmy killer whale	50	Full volume	400	Delay	0:43
58	9/25/2024	Visual	Unidentified turtle	1	Full volume	300	Delay	0:02
59	9/25/2024	Visual	Leatherback sea turtle	1	Full volume	100	Delay	0:01
60	9/25/2024	Visual	Leatherback sea turtle	1	Full volume	100	Delay	0:01
62, 551	9/27/2024	Both	Unidentified dolphin	2	None	50	Delay	0:21
63	9/28/2024	Visual	Leatherback sea turtle	1	Full volume	100	Delay	0:01
552	9/29/2024	Acoustic	Unidentified dolphin	2	None	150	Delay	1:22
553	9/29/2024	Acoustic	Unidentified dolphin	4	None	100	Delay	1:22
554	9/29/2024	Acoustic	Unidentified dolphin	2	None	241	Delay	1:22
555	9/29/2024	Acoustic	Unidentified dolphin	1	None	400	Delay	1:22
556	9/29/2024	Acoustic	Unidentified dolphin	2	None	334	Delay	1:23

Detection Number	Date (mm/dd/yyyy)	Detection Type	Species	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action	Duration of Mitigation Action (HH:MM)
557	9/29/2024	Acoustic	Unidentified dolphin	5	None	150	Delay	7:25
558	9/30/2024	Acoustic	Unidentified dolphin	5	Full volume	71	Delay	8:53
66	9/30/2024	Visual	Leatherback sea turtle	1	Full volume	100	Delay	0:01
562	10/1/2024	Acoustic	Sperm whale	1	Soft start	80	Delay	0:57
70, 565	10/1/2024	Both	Unidentified dolphin	3	None	100	Delay	0:21
564	10/1/2024	Acoustic	Unidentified dolphin	2	None	200	Delay	0:45
566	10/2/2024	Acoustic	Sperm whale	1	Full volume	82	Delay	1:00
72, 567	10/2/2024	Both	Rough-toothed dolphins, Unidentified dolphin	6	Full volume	58	Delay	8:36
568	10/2/2024	Acoustic	Sperm whale	2	Full volume	100	Delay	1:40
569	10/3/2024	Acoustic	Sperm whale	2	Full volume	32	Delay	1:10
570	10/3/2024	Acoustic	Unidentified dolphin	4	None	36	Delay	9:10
574	10/4/2024	Acoustic	Unidentified dolphin	1	Soft start	300	Delay	0:35
578	10/5/2024	Acoustic	Unidentified dolphin	6	None	100	Delay	1:20
76, 583	10/11/2024	Both	Sperm whale	5	Full volume	1050	Delay	0:48
584	10/12/2024	Acoustic	Unidentified dolphin	3	Full volume	200	Delay	0:30
585	10/12/2024	Acoustic	Unidentified dolphin	2	Full volume	350	Delay	1:46
586	10/12/2024	Acoustic	Unidentified dolphin	2	None	132	Delay	0:58
587	10/13/2024	Acoustic	Unidentified dolphin	4	Full volume	44	Delay	6:25
590	10/14/2024	Acoustic	Unidentified dolphin	2	Full volume	200	Delay	1:28
592	10/15/2024	Acoustic	Sperm whale	3	Full volume	495	Delay	0:46
594	10/16/2024	Acoustic	Sperm whale	2	Soft start	200	Delay	1:20
595	10/21/2024	Acoustic	Unidentified dolphin	1	Full volume	100	Delay	6:25
597	10/22/2024	Acoustic	Sperm whale	3	None	72	Delay	0:47

Detection Number	Date (mm/dd/yyyy)	Detection Type	Species	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action	Duration of Mitigation Action (HH:MM)
603	10/25/2024	Acoustic	Spinner dolphins	6	Full volume	40	Delay	1:17
604	10/25/2024	Acoustic	Sperm whale	2	Full volume	50	Delay	3:24
605	10/25/2024	Acoustic	Unidentified dolphin	1	None	114	Delay	1:11
82, 606	10/25/2024	Both	Sperm whale	2	None	200	Delay	1:58
607	10/25/2024	Acoustic	Sperm whale	2	None	400	Delay	1:02
609	10/26/2024	Acoustic	Common dolphin	10	None	84	Delay	5:35
610	10/27/2024	Acoustic	Sperm whale	2	Full volume	138	Delay	3:24
613	10/28/2024	Acoustic	Unidentified dolphin	1	None	289	Delay	0:37
614	10/28/2024	Acoustic	Unidentified dolphin	3	None	150	Delay	2:12
619	10/29/2024	Acoustic	Sperm whale	2	Full volume	39	Shutdown	1:44
			Sanco Spi	rit				
4, 501	07/20/2024	Both	Bottlenose dolphin	25	Soft start	100	Shutdown	01:05
508	8/1/2024	Acoustic	Unidentified dolphin	1	None	114	Delay	00:30
19, 509	08/04/2024	Both	Sperm whale	3	None	900	Delay	0:14
20	08/06/2024	Visual	Pantropical spotted dolphin	3	None	325	Delay	0:15
27	09/18/2024	Visual	Leatherback sea turtle	1	Full volume	100	Turtle pause	0:01
34, 515	09/20/2024	Both	Sperm whale	3	Full volume	500	Shutdown	00:52
516	9/22/2024	Acoustic	Unidentified dolphin	1	Full volume	900	Delay	00:15
36, 517	09/22/2024	Both	Sperm whale	1	Full volume	900	Shutdown	02:47
37	09/23/2024	Visual	Leatherback sea turtle	1	Full volume	100	Turtle pause	00:01
38	09/28/2024	Visual	Leatherback sea turtle	1	Full volume	75	Turtle pause	00:01
42	09/30/2024	Visual	Leatherback sea turtle	1	Full volume	170	Turtle pause	00:01
43	09/30/2024	Visual	Hawksbill sea turtle	1	Full volume	100	Turtle pause	0:01

Detection Number	Date (mm/dd/yyyy)	Detection Type	Species	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action	Duration of Mitigation Action (HH:MM)
44	09/30/2024	Visual	Leatherback sea turtle	1	Full volume	50	Turtle pause	0:01
526	10/2/2024	Acoustic	Sperm whale	1	Full volume	300	Shutdown	00:37
529	10/3/2024	Acoustic	Sperm whale	3	Full volume	100	Shutdown	01:17
533	10/4/2024	Acoustic	Unidentified dolphin	3	Full volume	88	Shutdown	03:07
34	10/5/2024	Acoustic	Unidentified dolphin	3	Full volume	30	Shutdown	00:12
46, 535	10/05/2024	Both	Sperm whale	2	Full volume	150	Shutdown	00:43
539	10/11/2024	Acoustic	Rough-toothed dolphin	20	Full volume	20	Shutdown	05:49
52, 545	10/12/2024	Both	Sperm whale	3	Full volume	500	Shutdown	03:43
546	10/13/2024	Acoustic	Sperm whale	1	Full volume	60	Shutdown	00:50
548	10/13/2024	Acoustic	Unidentified dolphin	2	Full volume	500	Shutdown	01:43
551	10/14/2024	Acoustic	Unidentified dolphin	1	Full volume	100	Shutdown	01:59
552	10/14/2024	Acoustic	Unidentified dolphin	1	Full volume	70	Shutdown	00:22
54, 554	10/14/2024	Both	Sperm whale	3	Full volume	1200	Shutdown	01:01
57	10/14/2024	Visual	Leatherback sea turtle	1	Full volume	20	Shutdown	0:01
556	10/15/2024	Acoustic	Sperm whale	2	Full volume	130	Shutdown	00:47
58	10/15/2024	Visual	Leatherback sea turtle	1	Full volume	20	Shutdown	0:01
59	10/15/2024	Visual	Leatherback sea turtle	1	Full volume	20	Shutdown	0:01
566	10/27/2024	Acoustic	Unidentified dolphin	3	Soft start	230	Shutdown	00:37
	' '		Artemis Ath	ene				
2	6/23/2024	Visual	Short-finned pilot whale	5	Full volume	450	Shutdown	2:02
14	7/13/2024	Visual	Green sea turtle	1	Full volume	50	Turtle pause	0:01
506	7/20/2024	Acoustic	Unidentified dolphin	1	None	500	Delay	1:48
23, 508	7/21/2024	Both	Bottlenose dolphin	3	None	440	Delay	0:18

Detection Number	Date (mm/dd/yyyy)	Detection Type	Species	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action	Duration of Mitigation Action (HH:MM)
510	7/23/2024	Acoustic	Unidentified dolphin	5	None	220	Delay	0:33
24	7/25/2024	Visual	Unidentified turtle	1	Full volume	15	Turtle pause	0:01
25	7/26/2024	Visual	Unidentified turtle	1	Full volume	10	Turtle pause	0:01
515	7/27/2024	Acoustic	Unidentified dolphin	5	None	201	Delay	1:57
516	7/27/2024	Acoustic	Unidentified dolphin	4	None	500	Delay	2:21
29	7/29/2024	Visual	Unidentified turtle	1	Full volume	20	Turtle pause	0:01
520	7/31/2024	Acoustic	Unidentified dolphin	4	None	500	Delay	0:35
32, 521	7/31/2024	Both	False killer whale & Melon-headed whale	10	Full volume	100	Shutdown	0:45
33, 522	7/31/2024	Both	Bottlenose dolphin	6	None	500	Delay	0:28
525	8/2/2024	Acoustic	Unidentified dolphin	5	None	500	Delay	3:19
37	8/2/2024	Visual	Sperm whale	1	None	700	Delay	0:44
526	8/2/2024	Acoustic	Unidentified dolphin	6	None	190	Delay	0:29
38	8/2/2024	Visual	Unidentified dolphin	3	None	480	Delay	0:17
529	8/3/2024	Acoustic	Unidentified dolphin	4	None	214	Delay	0:50
42, 531	8/3/2024	Both	Unidentified dolphin	10	None	235	Delay	1:45
43	8/9/2024	Visual	Leatherback sea turtle	1	Full volume	100	Turtle pause	0:01
46	8/10/2024	Visual	Unidentified turtle	1	Full volume	80	Turtle pause	0:01
51	8/15/2024	Visual	Green sea turtle	1	Full volume	10	Turtle pause	0:01
53, 540	8/16/2024	Both	Bottlenose dolphin	8	Soft start	15	Shutdown	0:32
54, 541	8/16/2024	Both	Unidentified dolphin	3	None	500	Delay	1:17
55, 542	8/16/2024	Both	Atlantic spotted dolphin	20	None	5	Delay	0:56
56, 543	8/16/2024	Both	Unidentified dolphin	5	Soft start	241	Shutdown	0:40
59	8/19/2024	Visual	Unidentified turtle	1	Full volume	100	Turtle pause	0:01

Detection Number	Date (mm/dd/yyyy)	Detection Type	Species	Number of Individuals	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action	Duration of Mitigation Action (HH:MM)
66	9/3/2024	Visual	Sperm whale	1	Full volume	1400	Shutdown	0:03
67, 545	9/4/2024	Both	Short-finned pilot whale	12	Full volume	300	Shutdown	0:10
72	9/15/2024	Visual	Sperm whale	2	Full volume	810	Shutdown	0:34
73	9/16/2024	Visual	Green sea turtle	1	Full volume	100	Turtle pause	0:01
74	9/17/2024	Visual	Sperm whale	1	Full volume	1450	Shutdown	0:30
75	9/18/2024	Visual	Leatherback sea turtle	1	Full volume	100	Turtle pause	0:01
547	9/19/2024	Acoustic	Unidentified dolphin	35	None	500	Delay	0:56
80	9/20/2024	Visual	Sperm whale	2	Full volume	800	Shutdown	0:28
85	9/23/2024	Visual	Leatherback sea turtle	1	Full volume	100	Turtle pause	0:01
549	10/11/2024	Acoustic	Unidentified dolphin	1	Soft start	500	Shutdown	1:43
550	10/14/2024	Acoustic	Unidentified dolphin	3	None	500	Delay	1:34
96, 551	10/17/2024	Both	Sperm whale	2	None	275	Delay	0:19
97	10/24/2024	Visual	Sperm whale	2	Full volume	800	Shutdown	01:41
99, 554	10/25/2024	Both	Sperm whale	1	Full volume	1300	Shutdown	01:35
559	10/28/2024	Acoustic	Sperm whale	2	Full volume	500	Shutdown	0:55
560	10/28/2024	Acoustic	Sperm whale	2	None	90	Delay	1:32

#### 7.5. Vessel Strike Avoidance Mitigation

Three VSA mitigations were implemented during the course of the survey consisting of two events where speed was decreased and course was maintained, and one event where the course was changed. Details for each mitigation are provided in **Table 27** below. Information for sightings where the vessel was towing equipment and could not safely implement VSA, where animals voluntarily approached the vessel, or where the separation distances were maintained can be found in **Appendix A**. There were no observations of vessel strikes for the duration of the project.

Sighting Number	Date (mm/dd/yyyy)	Species	Number of Individuals	CPA to Vessel (m)	Vessel Strike Avoidance			
Sanco Spirit								
4	07/20/2024	Bottlenose dolphin	25	1	Yes, decrease speed, maintain course			
29	09/18/2024	Unidentified sea turtle	1	75	Yes, change course			
Artemis Athene								
32	7/31/2024	False killer whale	10	60	Yes, decrease speed, maintain course			

#### Table 27. Vessel strike avoidance mitigation action details.

#### 7.6. Injured or Dead Protected Species Sightings

There were no sightings of dead or injured protected species during the survey.

#### 7.7. Other Wildlife Occurrence

Throughout the observation period, a wide range of wildlife was recorded. Incidental observations highlighted various species including Brown Booby (*Sula leucogaster*), Masked Booby (*S. dactylatra*), Brown Pelican (*Pelecanus occidentalis*), Laughing Gull (*Leucophaeus atricilla*), Royal Tern (*Thalasseus maximus*), Cattle Egrets (*Bubulcus ibis*), and Magnificent Frigatebirds (*Fregata magnificens*) and several unidentified species. Additionally, several fish species were also sighted such as flying fish (Family Exocoetidae), grouper (Family Serranidae), mahimahi (*Coryphaena hippurus*), alongside unidentified fish species.

The Brown Booby was the most common avian species seen in the survey area and was observed nearly every day. All other avian sightings were infrequent.

# 8. Weather Conditions

#### 8.1. Weather Conditions

Environmental conditions can impact the probability of detecting protected species in a survey area. The weather conditions varied throughout the project duration, but all remained within the typical range for the GOA considering the time of year. Weather conditions were in general good, with sunny days and scattered clouds for the most part. Visibility was measured in kilometers and categorized as poor (< 1 km), moderate (1 – 5 km) good (>5 km). The sea state was described as glassy (mirror-like), slight (no or few white caps), choppy (many white caps), rough (big waves, foam, spray). Swell height was categorized as low (<2 m), medium (2 - 4m), large (>4 m). Glare was classified as none, slight, moderate, or severe. The majority of monitoring efforts were conducted in conditions where visibility extended greater than 5 km. The duration of monitoring conducted in each category classification is provided below.

Light rains and mists were also present with a few strong rains. Beaufort scale 4 was predominant, showing seas with small waves becoming longer, fairly frequent white caps. Winds were ranging on average from 10 to 25 knots and warm temperatures were present for the most part of the days, ranging between 23 and 35° Celsius.

#### 8.1.1. Visibility

Through the visual monitoring effort, visibility was mostly good, meaning it was possible to observe more than 5 km of radius, with a total of 3,205 hours and 16 minutes of good visibility, meaning 87% of the time of visual monitoring. Only 161 hours and 23 minutes of visual monitoring were conducted with poor visibility, meaning less than 1 km and 4% of the time of visual monitoring. For detailed information, see **Table 28**.

Visibility (hh:mm)							
	Poor (<1 km)	Moderate (1-5 km)	Good (>5 km)				
REM Andes	66:36	131:38	1188:10				
Sanco Spirit	32:39	47:16	769:24				
Artemis Athene	62:08	144:17	1247:42				
Project Total	161:23	323:11	3205:16				

#### Table 28. Summary of survey visibility

#### 8.1.2. Sea State

The sea state varied from Beaufort 1 to Beaufort 6. Most of the time, the sea state was categorized as slight, totaling 2,860 hours and 3 minutes, meaning 78% of the time of visual monitoring. Rough sea conditions were less frequent with 94 hours and 55 minutes, meaning 3% of the time of visual monitoring. For detailed information, see **Table 29**.

#### Table 29. Summary of survey sea state conditions

	Sea state (hh:mm)					
	Glassy	Slight	Сһорру	Rough		
REM Andes	30:15	1132:55	170:08	53:06		
Sanco Spirit	20:49	685:29	129:27	13:34		
Artemis Athene	28:12	1041:39	356:01	28:15		
Project Total	79:16	2860:03	655:36	94:55		

# 8.1.3. Swell Height

Swell height was low for the most part, with swells of less than two meters observed for 3,338 hours with 3 minutes, totaling 90% of the visual monitoring time. Large swells of up to four meters were less common, totaling less than 1% of the visual monitoring time. For detailed information see **Table 30**.

Table 30.	Summary	of survey	swell height
10010 001	Samura	01 301 40 9	Swenneight

Swell height (hh:mm)			
	Low (<2 m)	Medium (2-4 m)	Large (>4 m)
REM Andes	1280:29	104:55	01:00
Sanco Spirit	783:24	65:55	00:00
Artemis Athene	1274:10	179:57	00:00
Project Total	3338:03	350:47	01:00

# 9. Conclusions & Recommendations

#### 9.1. Compliance with Guidelines

All seismic operations, including pre-watches and soft starts, complied fully with current BOEM / NMFS BO, and required guidelines, survey consent (permit) requirements and the project recommendations. The survey was considered successful at minimizing the risk of disturbance and injury to marine mammals from the seismic survey.

There was no non-compliance events recorded.

- Marine mammal monitoring was undertaken by trained and experienced dedicated PSOs and PAM Operators who did not have any other duties.
- There were no instances of vessel strikes with marine fauna.
- There were no observations of protected species becoming entangled as a result of the seismic operation.

### 9.2. Conclusions

The Engagement 5 commenced with the 3D OBN Seismic Survey acquisition in Green Canyon, Ewing Bank and Atwater Valley block on June 21, 2024. The vessel concluded operations on October 30, 2024.

The BO issued by the NMFS on March 13, 2020, survey permit issued by BOEM (L23-022), consent guidelines, and project requirements were complied with. The seismic survey was successfully completed within the dates of its validity.

There were 251 visual sightings and 246 acoustic detections of protected species made during the survey. There were 97 mitigation actions necessary when marine mammals were observed/detected within the BZ during pre-watch which resulted in 143:19 delays to soft start. Thirty-three mitigation actions were necessary when marine mammals were observed/detected within the mitigation zone during ramp-up or full volume which resulted in 42:21 in mitigation time. Twenty turtle pauses were necessary when sea turtles were observed within the mitigation time.

Weather conditions were generally favorable for observing marine fauna throughout the survey. However, there were regular periods of poor weather which hampered sighting effectiveness, such as rough weather conditions due to hurricane Beryl and smaller local storms.

There was full cooperation from all personnel for the implementation of BOEM and NMFS BO guidelines and all pre-watches and soft starts were correctly executed.

Shipping traffic was light and had no impact on survey operations.

There were no observations of injuries or mortalities to cetaceans, marine mammals, sea turtles or seabirds.

#### 9.3. Recommendations

There are no major recommendations for the period this report covers. A diligent and positive interaction between the seismic crew and the environmental team was always kept.

# **10.Appendices**

#### Appendix A **PSO-PAM Data Collection Forms**

Visual and acoustic monitoring effort, protected species detections, and source operations are included as excel spreadsheets. Three (3) Enclosures:

- REM Andes\_Engagement 5 Recording Form\_Appendix A
   Sanco Spirit\_Engagement 5 Recording Form\_Appendix A
- 3. Artemis Athene\_Engagement 5 Recording Form\_Appendix A

# Appendix B Visual Sightings Photographs

# 1.1. REM Andes



Figure 1. VD#01 Rough-toothed dolphin



Figure 2. VD#02 Bottlenose dolphin



Figure 3. VD#03 Short-finned pilot whale



Figure 4. VD#04 Short-finned pilot whale



Figure 5. VD#05 Short-finned pilot whale



Figure 6. VD#06 Green sea turtle


Figure 7. VD#07 Unidentified dolphin



Figure 8. VD#08 Rough-toothed dolphin



Figure 9. VD#10 Bottlenose dolphin



Figure 10. VD#11 Bottlenose dolphin



Figure 11. VD#12 Green sea turtle



Figure 12. VD#13 Rough-toothed dolphins



Figure 13. VD#14 Green sea turtle



Figure 14. VD#15 Bottlenose dolphin



Figure 15. VD#16 Bottlenose dolphin



Figure 16. VD#17 Bottlenose dolphin



Figure 17. VD#22 Bottlenose dolphins



Figure 18. VD#23 Green sea turtle



Figure 19. VD#25 Bottlenose dolphin



Figure 20. VD#26 Atlantic spotted dolphin



Figure 21. VD#27 Bottlenose dolphin



Figure 22. VD#30 Leatherback sea turtle



Figure 23. VD#32 Unidentified whales



Figure 24. VD#34 Atlantic spotted dolphin



Figure 25. VD#40 Sperm whale



Figure 26. VD#41 Sperm whale



Figure 27. VD#47 Leatherback sea turtle



Figure 28. VD#51 Leatherback sea turtle



Figure 29. VD#53 Pygmy killer whale



Figure 30. VD#55 Sperm whale



Figure 31. VD#59 Leatherback sea turtle



Figure 32. VD#60 Leatherback sea turtle



Figure 33. VD#61 Rough-toothed dolphin



Figure 34. VD#64 Rough-toothed dolphin



Figure 35. VD#66 Leatherback sea turtle



Figure 36. VD#73 Sperm whale



Figure 37. VD#72 Rough-toothed dolphin



Figure 38. VD#74 Bottlenose dolphin



Figure 39. VD#76 Sperm whale



Figure 40. VD#77 Rough-toothed dolphin



Figure 41. VD#78 Sperm whale



Figure 42. VD#79 Sperm whale



Figure 43. VD#80 Green sea turtle



Figure 44. VD#85 Bottlenose dolphin

## 1.2. Sanco Spirit



Figure 45. VD#11 Pantropical spotted dolphin



Figure 46. VD#21 Bottlenose dolphin



Figure 47. VD#31 Unidentified dolphin



Figure 48. VD#34 Sperm whale



Figure 49. VD #42 Leatherback sea turtle



Figure 50. VD #43 Hawksbill sea turtle



Figure 51. VD #46 Sperm whale



Figure 52. VD#49 Kemp's Ridley sea turtle



Figure 53. VD #52 Sperm whale



Figure 54. VD #56 Unidentified dolphin

## 1.3. Artemis Athene



Figure 55. VD#05 Unidentified Dolphins



Figure 56. VD#08 Bottlenose dolphins



Figure 57. VD#12 Green sea turtle



Figure 58. VD#13 Atlantic spotted dolphins



Figure 59. VD#14 Green sea turtle



Figure 60. VD#15 Bottlenose dolphin



Figure 61. VD#16 Pilot whales



Figure 62. VD#17 Common bottlenose dolphins



## Figure 63. VD#21 Bottlenose dolphins



Figure 64. VD#24 Unidentified sea turtle



Figure 65. VD#28 Bottlenose dolphins



Figure 66. VD#33 Bottlenose dolphins



Figure 67. VD#34 Bottlenose dolphins



Figure 68. VD#35 Pantropical dolphins (left) and bottlenose dolphins (right)



Figure 69. VD#37 Sperm whale



Figure 70. VD#40 Bottlenose dolphins



Figure 71. VD#43 Leatherback sea turtle



Figure 72. VD#51 Green sea turtle



Figure 73. VD#53 Bottlenose dolphins



Figure 74. VD#55 Atlantic spotted dolphins



Figure 75. VD#60 Green sea turtle



Figure 76. VD#64 Bottlenose dolphins



Figure 77. VD#70 Sperm whale



Figure 78. VD#71 Sperm whale



Figure 79. VD#72 Sperm whale



Figure 80. VD#74 Sperm whale



Figure 81. VD#87 Bottlenose dolphins



Figure 82. VD#89 Pantropical spotted dolphins



Figure 83. VD#92 Sperm whale



Figure 84. VD#95 Sperm whale



Figure 85. VD#97 Sperm whale



Figure 86. VD#98 Sperm whale



Figure 87. VD#99 Sperm whale



Figure 88. VD#100 Unidentified dolphins
# Appendix C Visual Sightings Location Maps



Figure 89. Visual sightings map for Engagement 5 on the *Rem Andes*.



Figure 90. Visual sightings map for Engagement 5 on the Sanco Spirit.



Figure 91. Visual sightings map for Engagement 5 on the Artemis Athene.

### Appendix D Passive Acoustic Monitoring Screenshots

#### 1.1. REM Andes

Between July and October 2024, several acoustic detections of common bottlenose dolphins (*Tursiops truncatus*) were recorded using PAMGuard's MF spectrogram in combination with visual observations by PSOs. These detections consistently revealed dolphin vocalizations, including whistles and clicks, as well as their close proximity to the survey vessel. The acoustic signatures were dominated by MF whistles, ranging from 6.4 kHz to 29 kHz, with sinusoidal, upsweeping, down sweeping patterns, and harmonics. Maximum whistle amplitudes varied, reaching up to 116.1 dB re 1  $\mu$ Pa. Clicks were also observed on several occasions, with frequencies extending up to 83 kHz and average inter-click intervals (ICIs) of 0.2 seconds. These signals, characterized by both overlapping whistles and click trains, indicated the presence of multiple individuals, with pods ranging from two to as many as twelve dolphins. The dolphins approached the vessel on several occasions, with the CPA estimated to be as near as 5 m in some instances and up to several hundred meters in others. Typically, the animals were detected within a 500 or 1000 m BZ from the source, and their proximity was confirmed visually by the PSOs. Despite the vessel's sound source operating at full volume during most detections, no mitigation actions were required. These observations reflect typical bottlenose dolphin behavior, characterized by frequent vocalization and group dynamics.



Figure 1 Bottlenose Dolphin acoustic detection

The delphinid MF whistles were detected and identified as rough-toothed dolphins through PAMGuard's MF spectrogram and visual observation. The whistles ranged between 5.8 and 18.3 kHz, with a maximum amplitude of 107.3 dB re 1 $\mu$ Pa, displaying down sweep, convex, and sinusoidal signatures. Overlapping whistles indicated at least three dolphins. The estimated closest approach was within a 1000 m BZ.



Figure 2. Rough toothed dolphin acoustic detection

The detections of MF click trains and whistles on July 16 and 17, 2024, attributed to short-finned pilot whales, reveal consistent acoustic and visual characteristics of the species across multiple observations. The MF click trains exhibited frequency ranges between 8.4 to over 60 kHz, with maximum amplitudes varying between 54.4 and 109.7 dB re 1µPa. The ICI generally range between 1.15 and 1.71 seconds, occasionally accompanied by pulses, suggesting consistent echolocation behavior during these detections. MF whistles were also recorded during these events, characterized by either upsweep or down sweep patterns. These whistles spanned frequency ranges from 5.5 to 17.6 kHz, with amplitudes between 45.7 and 106.7 dB re 1µPa. In some instances,

multiple harmonic layers were observed, particularly in down sweep whistles. These acoustic signatures were detected at bearings ranging from 85 to 100 degrees relative to the source array. The animals were observed at distances between 100 to 300 m from the hydrophones, providing further confirmation of their proximity to the source. In all cases, the detections led to the request for a shutdown of the source array to mitigate potential impacts on the animals.



Figure 3. Short- finned pilot whale acoustic detection

A series of systematic acoustic detections of sperm whale clicks indicated significant activity in the area. Initial recordings identified click trains with frequencies averaging approximately 14.8 kHz (ranging from 5 kHz to 23.6 kHz) and sound levels averaging 62 dB re 1 $\mu$ Pa (ranging from 54 dB to 70 dB re 1 $\mu$ Pa). A peak amplitude of 102 dB re 1 $\mu$ Pa was recorded, suggesting a distance of less than 500 m from the detection point. Subsequent recordings showed clicks from multiple sperm whales, with frequencies averaging 34.8 kHz and sound levels reaching up to 170 dB re 1 $\mu$ Pa, indicating instances of exceptionally high amplitude click activity averaging 165 dB re 1 $\mu$ Pa over several days. Further monitoring confirmed the presence of multiple whales, with consistent detections approximating a distance of 500 m, and frequency ranges averaging 13 kHz (ranging from 2 kHz to 24 kHz). As monitoring progressed, additional click activity was recorded, with frequencies ranging from 5.2 kHz to 40 kHz. The maximum amplitudes reached 157 dB re 1 $\mu$ Pa, underscoring the ongoing vibrancy of sperm whale behavior in the region.



Figure 4. Sperm whale acoustic detection

Acoustic detections of delphinid clicks were made using PAMGuard's MF spectrogram and HF click detector. The clicks, with frequencies ranging from 5 to 119 kHz and a maximum amplitude of 168 dB re 1  $\mu$ Pa, were detected at a bearing of 90 to 270 degrees from the vessel, which was heading 173 degrees relative to true North. The range was 162 m and overlapping click trains indicated at least four vocalizing individuals. Whistles typical of *Pseudorca crassidens* (false killer whales) were detected at 240 m, featuring frequencies between 3 kHz and 9 kHz, prompting a shutdown as a mitigation measure.



Figure 5. False killer whale acoustic detection

Whistles and clicks produced were aurally and visually detected using PAMGuard MF spectrogram and HF click detector. The whistles had multiple inflection points and steps, ranging in frequency from 2-23 kHz, suggesting those of the blackfish species (*Feresa* spp, *Globicephala* spp, *Peponocephala* spp, *and Pseudorca* spp) The clicks ranged in frequency from 14 to 212 kHz, with a maximum amplitude of 176dB re 1  $\mu$ Pa. The whistles presented non-linear phenomena. Overlapping whistles and click trains suggest more than six individuals vocalizing during the encounter. The clicks were positioned at a bearing of 45-225 degrees relative to the vessel at a range of less than 280 m from the center of the source.



Figure 6. Black fish acoustic detection

On October 25, 2024, whistles and clicks produced were aurally and visually detected using PAMGuard MF spectrogram and HF click detector. The acoustic detection was characterized by the presence of several whistles: constant whistles with a frequency of 7 kHz; upsweep whistles with frequencies ranging from 11 to 21 kHz; and sinusoidal whistles ranging in frequency from 10 to 22 kHz. These patterns allowed the identification of the species as spinner dolphins (*Stenella longirostris*).



Figure 7. Spinner dolphin acoustic detection

On October 26, 2024, clicks and whistles were visually detected using PAMGuard's MF spectrogram and HF click detector. The clicks had frequencies ranging from 6 to more than 250 kHz, with a maximum amplitude of 180 dB re 1  $\mu$ Pa. The detection was characterized by the presence of several whistles: upsweep whistles with frequencies ranging from 08 to 23 kHz; and concave whistles ranging in frequency from 10 to 22 kHz. Based on the frequency ranges, whistle shapes, and acoustic patterns observed, the vocalizations were tentatively attributed to common dolphins (*Delphinus* sp.) at the lowest taxonomic level achievable through acoustic data.



Figure 8. Common dolphin Acoustic detection

A series of acoustic detections captured dolphin vocalizations, characterized by varied frequencies and amplitudes, providing insights into the proximity to the monitoring area. The detected whistles exhibited a broad frequency range, generally spanning from 7 to over 71 kHz, with distinct acoustic signatures such as down sweeps, upsweeps, convex, sinusoidal shapes, and burst pulses. The amplitudes recorded across these detections varied significantly, with peaks ranging from 43.1 dB to 109.5 dB re 1  $\mu$ Pa. The dolphins were often detected at distances estimated to be less than 100 m and up to 500 m from the hydrophones, inferred from the amplitude and propagation of the HF sounds in water. The presence of overlapping whistles and click trains suggested the vocalizations of multiple individuals during some encounters, highlighting the potential for social interaction or group foraging activity. Clicks, detected alongside the whistles, covered a wide frequency range from 15.2 kHz up to 105 kHz, with amplitudes reaching up to 104 dB re 1  $\mu$ Pa. This data provides a comprehensive snapshot of dolphin acoustic activity, shedding light on their vocal behavior and movement within the monitored area.



Figure 9. Unidentified Delphinidae acoustic detection

1.1. Sanco Spirit



Figure 10. AD #09 (509) Sperm whale clicks on PAMGuard's HF Click Detector



Figure 11. AD #04 (504) \_Bottlenose dolphin click trains on PAMGuard's HF Click Detector



Figure 12. AD #59 (559)\_Pantropical dolphin (Stenella attenuata)



Figure 13. AD #39 (539)\_Rought toothed dolphin (Steno bredanensis)



Figure 14. AD #65 (565)\_Unidentifiable dolphin click on MF Spectrogram



Figure 15. AD #65 (565)\_Unidentifiable dolphin click on HF Click Detector

### 1.2. Artemis Athene



Figure 16. PAMGuard MF scrolling spectrogram MF clicks – AD#506.



Figure 17. PAMGuard HF Click Detector display HF click trains – AD#510.



Figure 18. PAMGuard scrolling spectrogram delphinid whistle signatures – AD#515.



Figure 19. PAMGuard MF and LF scrolling spectrogram delphinid whistle signatures. – AD#516



Figure 20. PAMGuard HF click detector display click trains waveform and Wigner plot displays. – AD#520



Figure 21. PAMGuard MF scrolling spectrogram delphinid click and harmonic pulse burst signatures. - AD#525



Figure 22. PAMGuard HF click detector display click trains. – AD#526



Figure 23. PAMGuard MF scrolling spectrogram delphinid click signatures. – AD#529



Figure 24. PAMGuard scrolling MF and LF spectrogram displays delphinid click and whistle signatures. – AD#531



Figure 25. PAMGuard MF scrolling spectrogram delphinid click signatures. – AD#541



Figure 26. PAMGuard scrolling MF spectrogram display delphinid whistle signatures. – AD#543



Figure 27. PAMGuard MF scrolling spectrogram sinusoidal delphinid whistle signatures. – AD#547



Figure 28. PAMGuard MF scrolling spectrogram display delphinid buzz signatures. – AD#549



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Figure 29. PAMGuard MF scrolling spectrogram delphinid stacked harmonic whistle signatures. – AD#550



Figure 30.PAMGuard MF and LF scrolling spectrogram display MF delphinid click signatures. – AD#551



Figure 31. PAMGuard click detector display click trains. – AD#559

### Appendix E Mitigation Action Summary

#### 1.1. REM Andes

Visual sighting #3. On July 16, 2024, at 22:20 UTC, a shutdown of a full volume test line was implemented due to a visual sighting of a pod of six short-finned pilot whales; four individuals continued the direction of travel, while two individuals started swimming towards the vessel, entering the 500 m EZ at 22:28 UTC, therefore, a shutdown was requested and implemented at 22:29 UTC. This detection was correlated with acoustic detection AD#502. After confirming that no additional protected species were within the mitigation zone, clearance to initiate ramp-up was granted at 23:16 UTC. However, the vessel needed to reposition to resume seismic data acquisition and the clearance for a soft start was requested and initiated on July 17, 2024 at 00:14 UTC, resulting in a mitigation time of 46 minutes\_and a production loss estimated at\_2 hours and 45 minutes.

Visual sighting #4. On July 17, 2024, at 15:44 UTC, a shutdown of a survey line was implemented due to a visual sighting of a pod of six short-finned pilot whales approaching the 500 m EZ. This sighting was correlated with acoustic detection AD#503. The pod was last sighted while diving at 500 m from the seismic source at 15:56 UTC. A 30-minute search period was conducted and clearance to initiate ramp-up was granted at 16:26 UTC. This shutdown had a total of 42 minutes of mitigation action and 02 hours 30 minutes of production loss.

Visual sighting #5. On 17 July 2024, at 16:57 UTC, while the seismic source was silent, a pod of 10 short-finned pilot whales was observed entering the 1,000 meters buffer zone, approximately 600 meters from the port bow of the vessel at a true bearing of 180 degrees; consequently, the initiation of the seismic source was delayed. The pod was traveling in a variable direction, while surfacing, blowing and diving at a sedate pace. The pod was seen at 17:04 UTC at 100 meters from the silent source. This was the closest approach from the pilot whales to the source. The pod started traveling away from the source at 17:07 UTC and was finally seen outside of the buffer zone at 17:15 UTC, as they continued traveling away from the vessel on a final heading of 100 degrees at 1,200 meters from the seismic source. After confirming that no more protected species were inside the buffer zone, a clearance for ramp-up was given at 17:15 UTC. A soft start of the seismic source was initiated at 18:14 UTC. This detection was correlated with acoustic detection AD#504.

Visual sighting #6. On July 22, 2024, at 14:15 UTC, a turtle pause was implemented due to a green sea turtle observed approaching the EZ when the source was operating at full volume while on a survey line. The source resumed full volume at 14:16 UTC, after a pause of seven shots and a mitigation time and production loss of one minute.

Visual sighting #9. On July 23, 2024, at 14:08 UTC, a turtle pause was implemented due to a green sea turtle observed approaching the EZ when the source was operating at full volume while on a survey line. The source resumed full volume at 14:09 UTC, after a pause of seven shots and a mitigation time and production loss of one minute.

Visual sighting #14. On July 28, 2024, at 16:36 UTC, a turtle pause was implemented due to a green sea turtle observed approaching the EZ when the source was operating at full volume while on a survey line. The source resumed full volume at 16:37 UTC, after a pause of seven shots and a mitigation time and production loss of one minute.

Visual sighting #23. On August 08, 2024, at 15:49 UTC, a turtle pause was implemented due to a green sea turtle observed approaching the EZ when the source was operating at full volume while on a survey line. The source resumed full volume at 15:50 UTC, after a pause of seven shots and a mitigation time and production loss of one minute.

Visual sighting #30. On August 13, 2024, at 16:00 UTC, a turtle pause was implemented due to a green sea turtle observed approaching the EZ when the source was operating at full volume while on a survey line. The source resumed full volume at 16:01 UTC, after a pause of seven shots and a mitigation time and production loss of one minute.

Visual sighting #31. On August 13, 2024, at 21:13 UTC, a turtle pause was implemented due to a green sea turtle observed approaching the EZ when the source was operating at full volume while on a survey line. The source resumed full volume at 21:15 UTC, after a pause of seven shots and a mitigation time and production loss of two minutes.

Visual sighting #32. On August 13, 2024, at 22:22 UTC, a delay of soft start was implemented due to a pod of three unidentified whales within the BZ. At 22:46 UTC the animals were last observed. This delay resulted in the 56 minutes of mitigation time and 01 hour and 57 minutes of estimated production loss time.

Visual sighting #39. On 02 September 2024, at 00:04 UTC, while the seismic source was silent, a sperm whale was spotted at approximately 1,400 meters off the vessels at port side and 1200 meters from the source, at a true bearing of 55 degrees. The sperm whale was observed moving away from the vessel, heading to the north-east. The animal was last observed at 00:09 UTC, at a true bearing of 30 degrees, at approximately 1,600 meters from port stern side of the vessel and 1,000 meters from the seismic source, visual of the animal was lost due to low light. This was the closest approach of the sperm whale to the seismic source. As the animal was first detected by PAM monitoring, a shutdown was previously requested and implemented, so PSO didn't have to mitigate. Visibility was reduced due to light, and PAM made the species identification. This sighting was correlated with acoustic detection AD#531.

Visual sighting #40. On September 02, 2024, at 13:39 UTC, a shutdown of a survey line was implemented due to a visual sighting of two sperm whales at approximately 1200 m from the seismic source. This sighting was correlated with acoustic detection AD#33. At 14:32 UTC the animals were last observed diving, and a clearance of 30 minutes started. This shutdown had a total of 01 hour and 24 minutes of mitigation action and 02 hours and 22 minutes of estimated production loss time.

Visual sighting #41. On September 04, 2024, at 22:47 UTC, a shutdown of a survey line was implemented due to a visual sighting of two sperm whales at approximately 1400 m from the seismic source. This sighting was correlated with acoustic detection AD#36. At 22:54 UTC, the animals were last observed diving, and a clearance of 30 minutes started. This shutdown had a total of 37 minutes of mitigation action\_and 26 minutes of estimated production loss time.

Visual sighting #51. On September 19, 2024, at 17:24 UTC, a turtle pause was implemented due to a leatherback sea turtle observed approaching the EZ when the source was operating at full volume while on a survey line. The source resumed full volume at 17:25 UTC, after a pause of seven shots and a mitigation time and production loss of one minute.

Visual sighting #53. On September 20, 2024, at 15:25 UTC, a shutdown of a survey line was implemented due to a visual sighting of a pod of 50 pygmy killer whales at approximately 400 m from the seismic source. At 15:43 UTC, the whales were last observed swimming away from the vessel at 2300 m away from silent source. This shutdown had a total of 43 minutes of mitigation action and 03 hours and 06 minutes of estimated production loss time.

Visual sighting #58. On September 25, 2024, at 19:25 UTC, a turtle pause was implemented due to an unidentified sea turtle observed approaching the EZ when the source was operating at full volume while on a survey line. The source resumed full volume at 19:27 UTC, after a pause of 20 shots and a mitigation time and production loss of two minutes.

Visual sighting #59. On September 25, 2024, at 19:35 UTC, a turtle pause was implemented due to a leatherback sea turtle observed approaching the EZ when the source was operating at full volume while on a survey line. The source resumed full volume at 19:36 UTC, after a pause of seven shots and a mitigation time and production loss of one minute.

Visual sighting #60. On September 25, 2024, at 21:21 UTC, a turtle pause was implemented due to a leatherback sea turtle observed approaching the EZ when the source was operating at full volume while on a survey line. The source resumed full volume at 21:22 UTC, after a pause of seven shots and a mitigation time and production loss of one minute.

Visual sighting #62. On September 27, 2024, at 21:21 UTC, a delay of soft start\_was requested due to a visual sighting of two unidentified dolphins within the BZ. The animals were last observed at 21:27 UTC within the BZ and at 21:42 UTC clearance to initiate the source was granted. The mitigation time was 15 minutes and production loss totaled 20 minutes.

Visual sighting #63. On September 28, 2024, at 17:04 UTC, a turtle pause was implemented due to a leatherback sea turtle observed approaching the EZ when the source was operating at full volume while on a survey line. The source resumed full volume at 17:05 UTC, after a pause of seven shots and a mitigation time and production loss of one minute.

Visual sighting #66. On September 30, 2024, at 19:00 UTC, a turtle pause was implemented due to a leatherback sea turtle observed approaching the EZ when the source was operating at full volume while on a survey line. The source resumed full volume at 19:01 UTC, after a pause of seven shots and a mitigation time and production loss of one minute.

Visual sighting #70. On 01 October 2024, at 20:35 UTC, while the seismic source was on silent while a line change, three UID dolphins were observed surfacing at approximately 350 meters off the starboard-quarter of the vessel, at a true bearing of 135 degrees. The animals were spotted surfacing two consecutive times and swimming towards the stern of the vessel, at a distance of 100 meters from the silent source. Last observation occurred at 20;36 UTC, as due to the waves and glare, the animals were no longer visible. This detection was correlated with AD#565, and a delay of 21 minutes of a soft start was implemented as mitigation action.

Visual sighting #72. On 02 October 2024, at 11:30 UTC, a pod of Rough-toothed dolphins were observed bow riding at approximately 5 meters off the bow of the vessel, at a true bearing of 13 degrees. Briefly after, a bigger pod of at least 20 dolphins was sighted swimming in parallel and same direction as the boat, approximately 10 meters from the starboard paraben. The animals were jumping and surfacing, and at 11:58 UTC the closest approach to the inactive source was observed at approximately 50 meters away. Last detection occurred at 14:08 UTC, when the dolphins were no longer observed. This detection was correlated with AD#567 and a delay to the initiation of a soft start was implemented as mitigation action.

Visual sighting #76. On October 11, 2024, at 22:22 UTC, a shutdown of a survey line was implemented due to a visual sighting of five sperm whales at approximately 1050 m from the seismic source. This sighting was correlated with acoustic detection AD#83. At 23:10 UTC the animals were observed blowing outside the EZ at 3892 m off the astern, and clearance to initiate ramp-up was granted. This shutdown had a total of 48 minutes of mitigation action and 01 hours and 38 minutes of estimated production loss time.

Acoustic detection #502. On 16 July 2024, at 22:27 UTC, delphinid MF click trains were aurally detected and observed on PAMGuard's MF Spectrogram and LF Click Detector. The animals were visually confirmed as short-finned pilot whales by the Protected Species Observers (PSOs). MF whistles were also observed in the MF Spectrogram. The clicks had a frequency ranging between 10.4 to over 60 kHz and a maximum amplitude of 109.7 dB re 1 $\mu$ Pa. The regular inter-click interval (ICI) ranged between 1.30 and 1.71 seconds, but pulses were also recorded. The click trains were detected at a bearing of 85 degrees. The whistles were downsweep and sinusoidal and showed several layers of harmonics, ranged between 8.3 to 15.2 kHz and had a maximum amplitude of 106.7 dB re 1 $\mu$ Pa. The closest point of approach was estimated at 22:34 UTC, based on the highest amplitude of both clicks and whistles. No overlapping clicks or whistles were observed, but the detection was correlated with a visual sighting of six pilot whales. The animals could not be tracked on the map module of PAMGuard, but the CPA given by the visual observers was of 200 meters to the source array, which is consistent with the maximum amplitude calibrated with previous acoustic detections on dolphins. The last acoustic detection occurred at 22:35 UTC. At the time of the detection, the source was deployed while on a survey line and the visual observers requested a shutdown, which was implemented at 22:29 UTC.

Acoustic detection #503. On 17 July 2024, at 15:43 UTC, delphinid MF click trains were aurally detected and observed on PAMGuard's MF Spectrogram and LF Click Detector. The animals were visually confirmed as short-finned pilot whales by the PSOs. MF whistles were also observed in the MF Spectrogram. The clicks had a frequency ranging between 8.4 to over 60 kHz and a maximum amplitude of 54.4 dB re 1µPa. The regular inter-click interval (ICI) ranged between 1.15 and 1.39 seconds, but at least one pulse was recorded. The click trains were detected at a bearing of 85 degrees. The whistles were upsweep and convex and showed one layer of harmonics, ranged between 10.4 to 17.6 kHz and had a maximum amplitude of 45.7 dB re 1µPa. The closest point of approach was estimated at 15:43 UTC, based on the highest amplitude of both clicks and whistles. Two overlapping clicks and whistles were observed, but the detection was correlated with a visual sighting of six pilot whales. The animals could not be tracked on the map module of PAM Guard, but it is estimated than the whales were beyond 300 meters from the hydrophones, according to the maximum amplitude calibrated with previous acoustic detections on dolphins. The PSOs recorded the animals were 250 meters from the source but it was not specified to what part of the source array. The last acoustic detection occurred at 15:45 UTC. At the time of the detection, the source was deployed while on a survey line and the visual observers requested a shutdown, which was implemented at 15:44 UTC.

Acoustic detection #504. On 17 July 2024, at 16:57 UTC, delphinid MF click trains were aurally detected and observed on PAMGuard's MF Spectrogram and LF Click Detector. The animals were visually confirmed as short-

finned pilot whales. MF whistles were also observed in the MF Spectrogram. The clicks had a frequency ranging between 10.5 to 55 kHz and a maximum amplitude of 107.8 dB re 1µPa. The regular inter-click interval (ICI) ranged between 1.19 and 1.62 seconds, but several pulses were recorded. The click trains were detected at a bearing of 100 degrees. The whistles were upsweep and did not showed harmonics, ranged between 5.5 to 13.7 kHz and had a maximum amplitude of 97.7 dB re 1µPa. The closest point of approach was estimated at 16:59 UTC, based on the highest amplitude of both clicks and whistles. Two overlapping clicks were observed, but the detection was correlated with a visual sighting of ten pilot whales. The animals could not be tracked on the map module of PAMGuard, but the distance to the hydrophone was estimated to be 100 meters given the amplitude recorded. The last acoustic detection occurred at 17:05 UTC. At the time of the detection, the source was deployed but silent and extended and ongoing delay initiated by VD 36.

Acoustic detection #507. On July 24, 2024, at 02:11 UTC, a delay of ramp up was requested due to an acoustic detection of an unidentified dolphin within the BZ. The last detection occurred at 02:22 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 35 minutes, with a production loss estimated at 41 minutes.

Acoustic detection #508. On July 24, 2024, at 07:49 UTC, a delay of ramp up was requested due to an acoustic detection of an unidentified dolphin within the BZ. The last detection occurred at 08:06 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 47 minutes, with a production loss estimated at 01 hour and 54 minutes.

Acoustic detection #509. On July 27, 2024, at 03:18 UTC, a delay of ramp up was requested due to an acoustic detection of an unidentified dolphin within the BZ. The last detection occurred at 03:26 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 38 minutes, with a production loss estimated at 38 minutes.

Acoustic detection #518. On August 08, 2024, at 02:15 UTC delay of ramp up was requested due to an acoustic detection of an unidentified dolphin within the BZ. The last detection occurred at 03:25 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 02 hours and 40 minutes, with a production loss estimated at 02 hours and 57 minutes.

Acoustic detection #520. On August 12, 2024, at 08:40 UTC, a shutdown of a survey line was implemented due to an acoustic detection of a sperm whale within the EZ. The last detection occurred at 08:47 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 41 minutes, with a production loss estimated at 02 hours and 15 minutes.

Acoustic detection #523. On August 26, 2024, at 03:02 UTC a shutdown of a full volume was implemented due to an acoustic detection of a sperm whale within the EZ. The last detection occurred at 04:40 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour and 08 minutes, with a production loss estimated at 01 hour and 55 minutes.

Acoustic detection #524. On August 17, 2024, at 09:32 UTC a shutdown of a survey line was implemented due to an acoustic detection of a sperm whale within the EZ. The last detection occurred at 09:37 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 35 minutes, with a production loss estimated at 02 hours and 02 minutes.

Acoustic detection #530. On September 01, 2024, at 06:19 UTC a delay of ramp up was requested due to an acoustic detection of dolphins within the BZ. The last detection occurred at 07:15 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour 26 minutes, with a production loss estimated at 56 minutes.

Acoustic detection #531. On September 01, 2024, at 23:11 UTC a shutdown of a survey line was implemented due to an acoustic detection of a sperm whale within the EZ. The last detection occurred at 02:14 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 03 hours and 33 minutes, with a production loss estimated at 04 hours and 20 minutes. Detection is correlated with visual sighting # 39.

Acoustic detection #533. On September 2, 2024, at 13:39 UTC, clicks produced by three sperm whales were both visually and aurally detected using PAMGuard's mid-frequency spectrogram. The clicks ranged in frequency from 2 to 23.5 kHz and a maximum amplitude of 107 dB re 1 μPa . The closest point of approach (CPA) to the hydrophones was estimated to be at 13:58 UTC. Considering the nature of sound propagation in water and confirmation from the PSO, it was estimated that the whales were at a minimum distance of 500 meters from the hydrophones. The final acoustic detection was recorded at 14:59- UTC. At the time of detection, the vessel was active on survey line, Report No. E001902

with the seismic source operating at full volume. The detection was first sighted by PSO's who implemented a "shut down" as a mitigation action at the moment of the first detection at 13:39 UTC to reduce potential impacts on the animals.

Acoustic detection #534. On September 02, 2024, ay 17:35 UTC a shutdown of a survey line was implemented due to an acoustic detection of a sperm whale within the EZ. The last detection occurred at 17:40 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 35 minutes, with a production loss estimated at 02 hours and 19 minutes.

Acoustic detection #536. On 4th September 2024 at 22:51 UTC, sperm whale clicks were both visually and aurally detected using PAMGuard's mid-frequency spectrogram and LF click detector. The clicks ranged in frequency from 2.1 to 24 kHz. The CPA to the hydrophones was estimated to be at 22:51 UTC, based on the time when the maximum amplitude of 112 dB re 1  $\mu$ Pa was recorded. Considering the nature of sound propagation in water it was estimated that the whale was at a minimum distance of 440 meters from the hydrophones, The final acoustic detection was recorded at 22:53 UTC. During the time of detection, the seismic source was on silent. A shut down was already implemented during the acoustic detection.

Acoustic detection #538. On September 06, 2024, at 05:50 UTC a shutdown of a survey line was implemented due to an acoustic detection of a sperm whale within the EZ. The last detection occurred at 06:26 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour and 06 minutes, with a production loss estimated at 04 hours and 34 minutes.

Acoustic detection #540. On September 08, 2024, at 05:21 UTC a delay of ramp up was requested due to an acoustic detection of three sperm whales within the BZ. The last detection occurred at 05:42 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 51 minutes, with a production loss estimated at 01 hour and 49 minutes.

Acoustic detection #541. On September 08, 2024, at 07:07 UTC a delay of ramp up was requested due to an acoustic detection of four unidentified dolphins within the BZ. The last detection occurred at 07:57 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour and 20 minutes, with a production loss estimated at 02 hours and 35 minutes.

Acoustic detection #542. On September 10, 2024, at 01:54 UTC a shutdown of a survey line was implemented due to an acoustic detection of three sperm whales within the EZ. The last detection occurred at 02:11 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 47 minutes, with a production loss estimated at 02 hours and 39 minutes.

Acoustic detection #543. On September 10, 2024, at 02:12 UTC a delay of ramp up was requested due to an acoustic detection of eight unidentified dolphins within the BZ. The last detection occurred at 03:32 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour and 50 minutes, with a production loss estimated at 01 hour and 50 minutes.

Acoustic detection #545. On September 13, 2024, at 19:28 UTC a delay of ramp up was requested due to an acoustic detection of three unidentified dolphins within the BZ. The last detection occurred at 19:31 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 33 minutes, with a production loss estimated at 34 minutes.

Acoustic detection #546. On September 13, 2024, at 00:20 UTC a shutdown of a survey line was implemented due to an acoustic detection of sperm whales within the EZ. The last detection occurred at 00:30 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 40 minutes, with a production loss estimated at 02 hours and 38 minutes.

Acoustic detection #547. On September 16, 2024, at 04:49 UTC a shutdown of a survey line was implemented due to an acoustic detection of two sperm whales within the exclusion zone. The last detection occurred at 04:56 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 37 minutes, with a production loss estimated at 03 hours and 24 minutes.

Acoustic detection #548. On September 16, 2024, at 06:22 UTC a delay of soft start was implemented due to an acoustic detection of two sperm whales within the EZ. The last detection occurred at 06:45 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 53 minutes, with a production loss estimated at 01 hour and 51 minutes.

Acoustic detection #549. On September 20, 2024, at 06:22 UTC a shutdown of a survey line was implemented due to an acoustic detection of three sperm whales within the EZ. The last detection occurred at 07:49 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour and 57 minutes, with a production loss estimated at 02 hours and 49 minutes.

Acoustic detection #551. On 27th September at 21:24 UTC, clicks emitted by a unidentified dolphin were visually and aurally detected. Clicks were observed in the PAMGuard's MF spectrogram, HF Spectrogram, and Clip Generator. The clicks had a frequency ranging from 23 kHz to 170 kHz. Post-analysis also revealed pulse bursts. Burst pulses varied from 30.7 kHz to 102 kHz with a peak amplitude of 27.2 dB dB re 1  $\mu$ Pa. The closest approach to the hydrophones was estimated at 21:24 UTC, inferred from the highest amplitude of the clicks. Considering the sound propagation loss in water, it is presumed that the dolphins were approximately 100 meters from the hydrophones. At the time of detection, the sound source was deployed but silent. The final acoustic detection was at 21:27 UTC. This detection correlated with Visual Detection #62, which resulted in a delay called by the PSO team.

Acoustic detections #552 to 557. On September 29, 2024, at 01:05 UTC delay of soft start was implemented due to acoustic detections of unidentified dolphins within the BZ. The last detection occurred at 09:19 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 07 hours and 25 minutes, with a production loss estimated at 07 hours and 34 minutes.

Acoustic detection #558. On September 30, 2024, at 00:46 UTC a shutdown of a survey line was implemented due to an acoustic detection of five *Grampus griseus* within the EZ. The last detection occurred at 09:09 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 08 hours and 53 minutes, with a production loss estimated at 08 hours and 55 minutes.

Acoustic detection #562. On October 01, 2024, at 10:30 UTC a shutdown of soft start was implemented due to an acoustic detection of a sperm whale within the EZ. The last detection occurred at 10:57 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 57 minutes, with a production loss estimated at 02 hours and 37 minutes.

Acoustic detection #564. On October 01, 2024, at 20:35 UTC a delay of ramp up was requested due to an acoustic detection of two unidentified dolphins within the BZ. The last detection occurred at 20:50 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 45 minutes, with a production loss estimated at 01 hour and 06 minutes.

Acoustic detection #566. On October 02, 2024, at 02:01 UTC a shutdown of a survey line was implemented due to an acoustic detection of a sperm whale within the EZ. The last detection occurred at 02:31 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 60 minutes, with a production loss estimated at 01 hour and 41 minutes.

Acoustic detection #567. On October 02, 2024, at 04:23 UTC a delay of ramp up was requested due to an acoustic detection of six Risso's dolphins within the BZ. The last detection occurred at 14:12 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 08 hours 36 minutes, with a production loss estimated at 09 hours and 06 minutes.

Acoustic detection #568. On October 02, 2024, at 06:06 UTC a shutdown of a survey line was implemented due to an acoustic detection of two sperm whales within the EZ. The last detection occurred at 07:16 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour 40 minutes, with a production loss estimated at 01 hour and 40 minutes.

Acoustic detection #569. On October 03, 2024, at 02:15 UTC a shutdown of a survey line was implemented due to an acoustic detection of two sperm whales within the EZ. The last detection occurred at 02:40 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour 10 minutes, with a production loss estimated at 01 hour and 15 minutes.

Acoustic detection #570. On October 03, 2024, at 03:10 UTC a delay of ramp up was requested due to an acoustic detection of four dolphins within the BZ. The last detection occurred at 12:45 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 09 hours 10 minutes, with a production loss estimated at 09 hours and 47 minutes.

Acoustic detection #574. On October 04, 2024, at 00:16 UTC a shutdown of ramp up was implemented due to an acoustic detection of unidentified dolphins within the BZ. The last detection occurred at 00:21 UTC and a 30-minute

clearance search was conducted afterwards. The mitigation time totaled 35 minutes, with a production loss estimated at 50 minutes.

Acoustic detection #578. On October 05, 2024, at 06:57 UTC a delay of ramp up was requested due to an acoustic detection of unidentified dolphins within the BZ. The last detection occurred at 17:46 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour 20 minutes, with a production loss estimated at 01 hour and 22 minutes.

Acoustic detection #584. On October 12, 2024, at 01:17 UTC a delay of ramp up was requested due to an acoustic detection of three unidentified dolphins within the BZ. The last detection occurred at 09:47 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 30 minutes, with a production loss estimated at 01 hour and 38 minutes.

Acoustic detection #585. On October 12, 2024, at 06:49 UTC a shutdown of a survey line was implemented due to an acoustic detection of sperm whale within the EZ. The last detection occurred at 08:05 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour and 46 minutes, with a production loss estimated at 01 hour and 46 minutes.

Acoustic detection #586. On October 12, 2024, at 10:13 UTC a delay of ramp up was requested due to an acoustic detection of two sperm whales within the BZ. The last detection occurred at 10:41 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 58 minutes, with a production loss estimated at 01 hour and 08 minutes.

Acoustic detection #587. On October 13, 2024, at 06:28 UTC a shutdown of a survey line was implemented due to an acoustic detection of false killer whales within the EZ. The last detection occurred at 12:23 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 06 hours and 25 minutes, with a production loss estimated at 06 hours and 51 minutes.

Acoustic detection #590. On October 14, 2024, at 09:28 UTC a shutdown of a survey line was implemented due to an acoustic detection of two sperm whales within the EZ. The last detection occurred at 10:30 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour and 28 minutes, with a production loss estimated at 01 hour and 57 minutes.

Acoustic detection #592. On October 15, 2024, at 04:00 UTC a shutdown of a survey line was implemented due to an acoustic detection of three sperm whales within the EZ. The last detection occurred at 04:16 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 46 minutes, with a production loss estimated at 01 hour and 27 minutes.

Acoustic detection #594. On October 16, 2024, at 00:45 UTC a shutdown of soft start line was implemented due to an acoustic detection of three sperm whales within the EZ. The last detection occurred at 02:04 UTC. The mitigation time totaled 01 hour 20 minutes, with a production loss estimated at 04 hours and 13 minutes.

Acoustic detection #595. On October 21, 2024, at 08:39 UTC a delay of ramp up was requested due to an acoustic detection of unidentified dolphin within the BZ. The last detection occurred at 09:18 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour and 07 minutes, with a production loss estimated at 01 hour and 11 minutes.

Acoustic detection #597. On October 22, 2024, at 00:01 UTC a delay of ramp up was requested due to an acoustic detection of unidentified dolphin within the BZ. The last detection occurred at 00:18 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 47 minutes, with a production loss estimated at 01 hour and 49 minutes.

Acoustic detection #603. On October 25, 2024, at 08:19 UTC a delay of ramp up was requested due to an acoustic detection of spinner dolphin within the BZ. The last detection occurred at 09:36 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour and 17 minutes, with a production loss estimated at 01 hour and 17 minutes.

Acoustic detection #604. On October 25, 2024, at 04:55 UTC a shutdown of a survey line was implemented due to an acoustic detection of two sperm whales within the EZ. The last detection occurred at 08:19 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 03 hours and 24 minutes, with a production loss estimated at 03 hours and 24 minutes.

Acoustic detection #605. On October 25, 2024, at 10:29 UTC a delay of ramp up was requested due to an acoustic detection of unidentified dolphin within the BZ. The last detection occurred at 11:10 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour and 11 minutes, with a production loss estimated at 01 hour and 35 minutes.

Acoustic detection #606. On October 25, 2024, at 12:04 UTC a delay of ramp up was requested due to an acoustic detection of sperm whales within the BZ. The last detection occurred at 12:32 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour and 58 minutes, with a production loss estimated at 01 hour and 49 minutes.

Acoustic detection #607. On 25 October 2024, at 13:53 UTC a delay of ramp up was requested due to an acoustic detection of sperm whales within the buffer zone. The last detection occurred at 14:25 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour and 02 minutes, with a production loss estimated at 01 hour and 50 minutes.

Acoustic detection #609. On October 26, 2024, at 02:57 UTC a delay of ramp up was requested due to an acoustic detection of sperm whales within the BZ. The last detection occurred at 08:03 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 05 hours and 36 minutes, with a production loss estimated at 06 hours and 59 minutes.

Acoustic detection #610. On October 27, 2024, at 03:30 UTC a shutdown of a survey line was implemented due to an acoustic detection of two sperm whales within the EZ. The last detection occurred at 08:19 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 03 hours and 24 minutes, with a production loss estimated at 03 hours and 24 minutes.

Acoustic detection #613. On October 28, 2024, at 02:17 UTC a delay of ramp up was requested due to an acoustic detection of sperm whales within the BZ. The last detection occurred at 02:24 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 37 minutes, with a production loss estimated at 01 hour and 06 minutes.

Acoustic detection #614. On October 28, 2024, at 03:23 UTC a delay of ramp up was requested due to an acoustic detection of sperm whales within the BZ. The last detection occurred at 05:05 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 02 hours and 12 minutes, with a production loss estimated at 02 hours and 14 minutes.

Acoustic detection #619. On October 29, 2024, at 03:58 UTC a shutdown of a survey line was implemented due to an acoustic detection of two sperm whales within the EZ. The last detection occurred at 05:12 UTC and a 30-minute clearance search was conducted afterwards. The mitigation time totaled 01 hour and 44 minutes, with a production loss estimated at 02 hours and 12 minutes.

# 1.2. Sanco Spirit

Visual sighting #4. On July 20, 2024, at 21:20 UTC a pod of approximately 25 bottlenose dolphins, including three calves, were observed at a bearing of 330 degrees surface traveling at a heading of 190 degrees, parallel to the direction of the vessel at 1100 meters from the port bow of the vessel. The closest time of approach was at 21:27 UTC when the pod was observed bow-riding 1 meter from the bow, this behavior lasted for 30 minutes. At 21:41 UTC some of the dolphins started traveling in variable direction, at 21:58 UTC the last of the pod started traveling in and opposite direction of the vessel with a heading of 135 degrees and a bearing of 90 degrees. At 22:00 UTC the dolphins were last observed at a bearing of 90 degrees diving at 90 meters. A shutdown was implemented at 21:25 UTC when the animals entered the exclusion zone while the vessel was in a soft start. A reduction of speed and maintenance course was implemented as vessel strike avoidance measure at 21:26 UTC when the dolphins and calves entered the separation distance. This visual detection resulted in 1:05 minutes of mitigation down time.

Visual sighting #19. On August 4, 2024, at 21:28 a visual sighting consisting of three sperm whales occurred. The initial sighting placed the whale 2000 meters from the stern of the vessel as it blew several times. At 21:30 UTC, a second whale joined the first. The vessel was traveling away from the two whales increasing the distance as they appeared to be stationary. At 21:39 UTC a third whale was observed off the vessel's starboard bow traveling in the opposite direction to the vessel. At 21:40 UTC, the third whale entered the buffer zone, and the survey team was alerted. At 21:41 UTC the third whale was observed 1000 meters off the starboard beam to dive with flukes up. This was the CPA to the vessel (1000m) and the source (900m). The original two whales were still seen blowing outside the buffer zone off the stern till 21:47 UTC when they were lost in the glare. A mitigation action of delay to soft start was called for and initiated when the third whale Report No. E001902

entered the buffer zone and a 30-minute post watch was started from the last time the whale was seen inside the buffer zone. None of the whales entered the vessel separation distance. These three whales could have been the whales from visual sightings 17 and 18. Correlated with PAM detection number 509.

Visual sighting #20. At 12:09 UTC on August 6, 2024, a group of three pantropical spotted dolphins were observed. They were observed swimming slowly to the bow of the ship breaking the surface to breath as they came. The pod swam along the starboard bow for two minutes and was not observed leaving the buffer zone. The last sighting in the buffer zone was 12:12 UTC. The vessel was about to start a soft start of the source at 12:12 UTC and as a result this sighting resulted in a delay of 00:15 minutes. The CPA to the vessel was one meter and 325 meters to the non-active source. Both CPA's occurred at 12:10 UTC. No VSA maneuvers were requested or required as the dolphins' approach to the vessel was voluntarily.

Visual sighting #27. On September 18, 2024, at 13:42 UTC, one adult leatherback sea turtle was observed at a distance of approximately 75 meters off the starboard bow of the vessel with a relative bearing of 75 degrees. The turtle was seen surfacing and slow swimming in the 180 degrees direction, opposite to the vessel. The turtle was seen approximately 100 meters from the seismic source at 13:47 UTC, at which time a turtle pause was called for and immediately implemented. The turtle then dove out of sight and resurfaced at 13:51 UTC approximately 800 meters from the vessel's stern which was the last sighting of the turtle.

Visual sighting #34. On September 20, 2024, at 12:55 UTC, a sperm whale was first detected slowly surfacing at a distance of 800 m away from the vessel at a bearing of 20 degrees. An immediate shutdown of the source was requested as the animals were within the EZ and the source was on full power on a production line. Three animals were detected slowly surfacing for most of the detection until they dove and were no longer seen again. A VSM was also requested to the officer on watch. This was a correlated detection with PAM detection 515.

Visual sighting #36. On September 22, 2024, at 21:05 UTC, one sperm whale was sighted 500m away from the port side bow of the vessel and 900m away from the active source, with a bearing of 340 degrees and a heading of 190 degrees, swimming, blowing and diving crossing ahead to the vessel. Due to the animal was observed inside the EZ a call for shut down was requested at 21:07 UTC, being the guns disable at 21:07 UTC. At 21:28 UTC, the whale was last sighting swimming and blowing at 2500m from the vessel starboard side, and 2100m from the silent source. With a bearing of 140 degrees and a heading of 120 degrees, getting outside the EZ. The detection has a correlation with PAM (AD 517). Keep the course and speed was implemented as VSA maneuvers. No photo was recorded.

Visual sighting #37. On September 23, 2024, at 12:40 UTC, a leatherback sea turtle was observed off the port bow at a distance of approximately 5 meters at a true bearing of 190 degrees. The turtle was seen surfacing and resting below the surface. Due to the vessels speed and the trajectory of the turtle, a turtle pause was requested and immediately implemented at 12:43 UTC and the source was reactivated at 12:44 UTC. The last time of the sighting was at 12:42 UTC, where the turtle was seen 50 meters off the port stern of the vessel heading towards the seismic source.

Visual sighting #38. On September 28, 2024, at 21:22 UTC, a leatherback sea turtle was observed 75m off the port beam of the vessel swimming towards the guns. At the time of detection, the guns were at full power and the vessel was traveling with a heading of 176.3 degrees and a speed of 5.0 knots. The turtle dove at 21:23 UTC and an 8 shot turtle pause was called at 21:23 UTC.

Visual sighting #42. On September 30, 2024, at 15:51 UTC, a leatherback sea turtle was observed approximately 170 meters from the vessel, forward of the starboard beam, swimming toward the vessel. At the time of detection, the guns were at full power and the vessel was traveling with a heading of 352.1 degrees and a speed of 3.7 knots. The turtle dove at 15:51 UTC and a 7 shot turtle pause was called at 15:53 UTC and the pause was completed at 15:54.

Visual sighting #43. On September 30, 2024, at 16:39 UTC, a green sea turtle was observed approximately 45 meters off the starboard bow of the vessel at a true bearing of 70 degrees and heading in the northeast direction. The turtle was seen surfacing and swimming away from the vessel at a slow pace. At 16:40 UTC, the turtle dove and due to the vessel's speed and the turtle's trajectory, an 8 shot turtle pause was requested and implemented from 16:41 UTC to 16:42 UTC. The vessel was at full power and in production during the detection.

Visual sighting #44. On September 30, 2024, at 22:32 UTC, a leatherback sea turtle was first observed approximately 50 meters from the vessel, forward of the port bow, slowly swimming and surfacing going in parallel and opposite direction of the vessel. At the time of detection, the guns were at full power on a production line. When the turtle reached the 100 m EZ, an 8 shot turtle pause was called at 22:34 UTC and completed at 22:35. The turtle then kept the same pattern pf traveling until last seen at 22:39 UTC.

Visual sighting #46. On October 5, 2024, at 16:17 UTC, two sperm whales were observed off the port bow of the vessel at an initial bearing of 190 degrees, approximately 700 meters away and heading in the same direction as the vessel. The Report No. E001902 Revision 1.0 whales were observed logging, surfacing and blowing and where identified by the dorsal hump, the gray coloration and the 45-degree angled blow. Due to the whales being inside the exclusion zone, a shutdown was requested and immediately implemented at 16:18 UTC. The closest point of approach to the seismic source was at 16:25 UTC, at approximately 150 meters. The last time of the detection was at 16:26 UTC, where the whales were seen approximately 300 meters away logging and blowing.

Visual sighting #52. On October 12, 2024, at 22:57 UTC, a sperm whale was first detected at 2500 meters away from the vessel at a bearing of 205 degrees. The whale was seen blowing and occasionally breaching. Two other sperm whales were shortly detected after the initial sighting. The additional two sperm whales were observed traveling slowly, surfacing, blowing and with occasional breaches. The animals continued slowly traveling in parallel and in the opposite direction of the vessel. When they entered the EZ, a shutdown was called and immediately implemented at 23:07 UTC. This was a correlated detection with PAM detection AD 545. The animals were visually last detected at 23:51 UTC inside the EZ and acoustically at 00:06 UTC.

Visual sighting #54. On October 14, 2024, at 13:49 UTC, three sperm whales were seen blowing approximately 1900 meters away, forward the port quarter at a bearing of 335 degrees, slowly heading in the in the direction of the vessel's path while the vessel was at full volume. The whales were seen blowing, surfacing and slow traveling. The whales kept the same behavior of slow traveling, surfacing and blowing as the vessel kept its course and the distance between the whales and the vessel decreased. As the distance between the whales and the vessel continued to decrease, a shutdown was called for at, 13:57 UTC, as the distance was estimated to be approximately 1500m, the requested shutdown was immediately implemented at 13:57 UTC. The closest point of approach to the seismic source was at 13:58 UTC while the source was silent, at approximately 1200 meters. The time of the last detection was at 13:58 UTC, where the whales were seen approximately 1200 meters away from the port beam at the surface and blowing. This was a correlated detection with PAM, acoustic detection 554.

Visual sighting #57. On October 14, 2024, at 23:56 UTC, a leatherback sea turtle was first observed approximately 50 meters from the vessel, forward off the port bow, slowly swimming and surfacing going in parallel and opposite direction of the vessel. At the time of detection, the guns were at full power on a production line. When the turtle reached the 100 m EZ, an 8 shot turtle pause was called at 22:58 UTC and completed at 22:59. The turtle then kept the same pattern pf traveling until last seen at 22:39 UTC.

Visual sighting #58. On October 15, 2024, at 15:54 UTC, a leatherback sea turtle was first observed approximately 10 meters from the vessel, forward of the port bow, swimming fast underwater going in parallel and opposite direction of the vessel. At the time of detection, the guns were at full power on a production line. When the turtle reached the 100 m EZ, an 8 shot turtle pause was called at 15:56 UTC and completed at 15:58.

Visual sighting #58. On October 15, 2024, at 20:57 UTC, a leatherback sea turtle was first observed approximately 10 meters from the vessel, forward of the port bow, slowly swimming underwater going in parallel and opposite direction of the vessel. At the time of detection, the guns were at full power on a production line. When the turtle reached the 100 m EZ, an 8 shot turtle pause was called at 20:59 UTC and completed at 21:00.

Acoustic detection #501. On July 20, 2024, at 21:30 UTC, delphinid whistle signatures appeared visually on the MF spectrogram, shortly after visually observed by the PSOs on watch. Click amplitudes ranged between 72 dB and 114. dB, peaking at 114 dB on the PAMGuard amplitude/time display. Convex, up and down-sweeping signatures indicated at least four dolphins vocalizing between 9.2 kHz and 16.91 kHz, however at least 20 dolphins were confirmed visually bow riding. A frequency of 114 kHz peaked at 21:32 UTC. For the next 30 minutes, sinusoidal whistle signatures sporadically appeared on the MF and HF spectrogram while the PSOs on watch confirmed the dolphins continued to bow ride. No activity was detected after 21:58 UTC concluding this detection by the PAM system. This detection was initially detected by the PSOs on watch, resulting in a shutdown of the acoustic source during a ramp up. PSOs shutdown the source while in soft start at 21:25 UTC. Therefore, at the time of the acoustic detection source was already shutdown. There was a total of 1:05 minutes mitigation downtime counted in PSO logs.

Acoustic detection #508. On August 1, 2024, at 03:02 UTC, faint and continuous click trains (12-24 kHz) were detected on the MF spectrogram followed for sinusoidal and concave delphinid whistle signatures detected on the MF spectrogram, in a range between 08-24 kHz. The click trains were also detected on the MF click detector, were tracked at 570 m from the source. The whistles sequence was audible to the PAM Operator. At 03:05 UTC strongest and continuous click trains were detected on the MF and HF spectrogram (range 12-90 kHz), these were visible and tracked on the HF click detector, being the closes distance of approach of the animals to the source of 114 m at 03:06 UTC. The last signal was detected at 03:14 UTC. At the time of the detection the vessel was performing a line turn with the acoustic source silent, the planned

soft start was around 03:15 UTC, therefore this detection resulted in 30 minutes delay of clearance of the initiation of the acoustic source.

Acoustic detection #515. On September 20, 2024, at 13:05 UTC, a series of MF clicks were detected on the MF spectrogram, with an average upper limit between 04-16 kHz and ICI of approximately 0.60 seconds. Three sperm whales were visually detected (VD 34) on the surface at 12:55 UTC and a shutdown was called; the animals were seen diving at 13:00 UTC and were observed acoustically at 13:05 UTC. During the acoustic detection two distinct sperm whale click trains were visually represented on the LF click detector, confirming the presence of at least two sperm whales (Physeter macrocephalus). The clicks were localized to be in line with the source at a relative bearing of 90/270 degrees and a distance of 270 m. The source was off at the time of the acoustic detection between 13:12 UTC and 13:45 UTC. Navigation crew was notified at 13:12 UTC that the sperm whales were no longer being heard and then again at 13:45 UTC that they had returned. At 13:45 UTC very faint sperm whale click trains were again seen on the MF spectrogram, however at this time it was not possible to localize the sperm whales within the BZ. The last detection was at 13:52 UTC and crew was notified.

Acoustic detection #516 . On September 22, 2024, at 03:19 UTC, HF click trains of unidentified delphinids were detected on the HF click detector module. Initial clicks were observed at a bearing of 90/270 degrees relative to the hydrophone array. Click frequency ranged from 80-220 kHz, with amplitudes ranging between 70-90 dB. Maximum amplitude of 90 dB was recorded at 03:23 UTC which may indicate the time of closest approach to the hydrophones. During this timeframe there was an insufficient number of clicks to localize the animal's distance using PAMGuard software; however, the PAM Operator concluded animals were present within the 1000 m BZ. The last signal was detected at 03:24 UTC. At the time of the detection the vessel was performing a line turn with the acoustic source silent, the planned soft start was 03:39 UTC, therefore this detection resulted in a 15 minute delay of clearance for the initiation of the acoustic source.

Acoustic detection #526. On October 2, 2024, at 00:19 UTC faint and non-continued series of MF and LF clicks signals were detected on the MF spectrogram, with an average upper limit between 02-13 kHz, the clicks sequences had a low signal to noise rate (SNR) and relative ICI of 0.5 seconds. Based on the maximum frequency reached by the signals, the SNR and the pattern in the click signals, the presence of at least one sperm whale (Physeter macrocephalus) was confirmed, however at this point, the animal was not able to be tracked inside the EZ. The survey crew was advising of the presence of the whale. The detection continued with a gradual increment in frequency range of the clicks (02-22 kHz) and the homogenization in the click train groups continuity, being audibles to the PAM Operator at 00:25 UTC. At 00:35 UTC the signals were tracked inside the EZ, in a range of 300 m from the source, the source was in a line production, due to this, a shutdown was immediately requested, the source was silent at 00:35 UTC. The last detection was at 00:42 UTC.

Acoustic detection #529. On October 3, 2024, at 00:52 UTC faint and continuous series of MF and LF clicks signals were detected on the MF spectrogram, with an average upper limit between 06-20 kHz, the clicks sequences had a medium SNR and relative ICI of 0.6 seconds. Based on the maximum frequency reached by the signals, the SNR and the pattern in the click signals, the presence of at least three sperm whales (Physeter macrocephalus) was confirmed, however at this point, the animals were not able to be tracked inside the EZ. The detection continued with a fast increment in frequency range of the clicks (02-30 kHz) and the homogenization in the click train groups continuity, being audible to the PAM Operator at 00:54 UTC. At 00:58 UTC the signals were tracked inside the EZ, in a range of 200 m from the source, and due to the vessel being in a line production, a shutdown was immediately requested, the source was silent at 00:58 UTC. The closest point of approach to the whales to the silent source was 100 m at 01:41 UTC. The last detection was at 01:45 UTC. No VSA action was taken.

Acoustic detection #533. On October 4, 2024, at 05:50 UTC, unidentified delphinid clicks and whistles signals were detected on the MF and HF spectrograms. The whistles were faint, up-sweeping, concave, and ranged in frequency from 09 to 20 kHz. The click trains signals had an average upper limit between 20-80 kHz. Based on the maximum frequency reached by the signals, the SNR and the pattern in the click signals, the presence of at least one individual was estimated to be within the BZ. The detection continued with a fast increment in frequency range of the clicks (08-130 kHz) and the homogenization in the click train groups and whistles continuity, being audibles to the PAM Operator at 05:52 UTC. Along the detection the signals were able to be tracked around the sources in a range of 88-1500 m. The survey crew was informed from the beginning of the detection due to the vessel being doing a change line with the source silent. Due to the presence of the animals tracked inside the BZ the soft start was delayed at 08:31 UTC as a mitigation action. The last sighting was at 10:02 UTC. No VSA action was taken.

Acoustic detection #534. On October 5, 2024, at 03:55 UTC, HF clicks and click trains, indicative of unidentified dolphins, were detected on the HF click detector and HF spectrogram modules. Overlapping vocalization and click trains indicated the presence of at least three individuals. A click train at a bearing 78/285 degrees relative to the hydrophone, with amplitude levels of 90 dB, was tracked to a distance of 30 m from the source. Clicks ranged in frequency from 11 to 123 kHz. At 04:03 UTC, as HF clicks became intermittent, sinusoidal, and up-sweeping whistle signatures with frequency ranges between 9 to 22 kHz were detected aurally as well as on the MF spectrogram display. Final whistles were observed on the MF spectrogram at 04:20 UTC and the last HF clicks were observed on the HF spectrogram at 04:24 UTC, concluding the detection. At the time of detection, the vessel was transiting to the next production line with a planned soft start at 04:42 UTC. The PAM Operator cleared the vessel for soft start at 04:54 UTC, resulting in a delay to soft start with a total mitigation downtime of 12 minutes.

Acoustic detection#539. On October 11, 2024, at 02:48 UTC, clicks indicative of unidentified dolphins were detected across the MF and HF spectrogram modules, as well as the LF click detector. A series of click trains, originating from a bearing of 87/267 degrees relative to the hydrophone, with amplitude levels of 83 dB, was tracked to a distance of 20 m from the source. Overlapping vocalizations suggested the presence of several individuals. The off-shift PAM Operator provided visual confirmation of the animals as rough-toothed dolphins. Approximately 20 individuals, including at least three juveniles, were observed feeding between the stern and the source. Throughout the detection, a wide range of acoustic signals including burst pulses, highly varied whistle signatures, and chirps were aurally detected and observed on the MF spectrogram display. The animals remained within the EZ throughout the detection, which concluded at 09:36 UTC. At the time of detection, the vessel was transiting to the next production line with a planned soft start at 04:18 UTC. The PAM Operator cleared the vessel for soft start at 10:06 UTC, resulting in a mitigation downtime of 05:48 hours as delay to initiation of the source.

Acoustic detection #545. On October 12, 2024, at 23:06 UTC, a series of MF clicks were detected on the MF spectrogram, with an average upper limit between 04-35 kHz and ICI of 0.4-.07 seconds. Immediately the survey crew advised of the presence of whales. Parallelly three sperm whales were visually detected first at 22:57 UTC outside the EZ (VD 45). At 23:07 UTC, the whales were visually detected inside the EZ on the surface at 23:07 UTC and a shutdown was called, the animals were seen diving at 23:56 UTC. Based on the maximum frequency reached by the signals and the SNR, the presence of at least three sperm whales (Physeter macrocephalus) was confirmed. The clicks were localized at 23:08 at 1000 m from the source at a relative bearing of 90/270 degrees. Last detection occurred on the next UTC day at 02:20 UTC. The source was silent at the time of the acoustic detection due to the visual shut-down. The detection was ongoing at 24:00 UTC and the animals were tracked inside the EZ to a distance of 139 m from the source. Final clicks were observed on the MF spectrogram at 02:20 UTC. The vessel was cleared for soft start at 02:50 UTC and this delayed the beginning of a soft start. No VSA actions were applied.

Acoustic detection #546. On October 13, 2024, at 03:06 UTC, faint, MF clicks, characteristic of sperm whales, were detected on the MF spectrogram. Clicks were intermittent and characterized by an ICI of 2.5 seconds, and peak frequencies ranging from 12 to 18 kHz. Clicks were detected intermittently until 03:40 UTC, at which point prominent clicks were detected on the MF spectrogram, followed by aural detection at 03:41 UTC, indicating the whale's likely approach to the hydrophone. Navigation was alerted to the whale likely entering the BZ. At this time, click trains became visible on the LF click detector and a click train was tracked within the BZ to a distance of 60 m from the source at a bearing of 70/290 degrees relative to the hydrophone. Final clicks were observed on the MF spectrogram at 03:50 UTC. At the time of detection, the source was silent as the vessel was transiting to begin soft start with a planned soft start time for 03:30 UTC. The vessel was cleared for soft start at 04:20 UTC, resulting in 00:50 hour delay to initiation of the source.

Acoustic detection #548. On October 13, 2024, at 18:48 UTC, sinusoidal delphinid whistle signatures with a frequency range between 10 and 14 kHz and burst pulses with frequencies between 4 and 11 kHz and ICI of .3 seconds, were viewed on the MF and LF spectrogram displays. The whistle signatures and burst pulses repeated sporadically until 18:55 UTC and then was last seen at 19:00 UTC. The whistle signature was seen crossing only once at 18:45 UTC so it was determined that at least two dolphins were present. Due to the sporadic nature, it was not able to be tracked, an estimation of 500 m of range was considered due to the nature of the signal and audio characteristics and was not audible. The source was off at the time of detection and the vessel was in the pre-clearance period before soft start. PSOs were notified but were not able to visually detect the dolphins so the vessel was told that they would be clear to initiate soft start 30 minutes from the last detection at 19:00 UTC. No VSA actions were applied.

Acoustic detection #551. On October 14, 2024, at 05:56 UTC, a single sinusoidal delphinid whistle signature with a frequency range 12-18 kHz was detected on the MF spectrogram, the signal was not tracked inside the BZ. The survey crew was advised about the presence of the animals. At 06:08 UTC a short series of sinusoidal delphinid whistle signals

were detected and tracked inside the BZ, estimated distance to the source of 100 m. The signals were audible to the PAM Operator. The source was off at the time of detection and the vessel was in the pre-clearance period before soft start, due to the detection inside the BZ the beginning of the soft start was delayed at 06:09 UTC. Last detection at 06:09 UTC. No VSA actions were applied.

Acoustic detection #552. On October 14, 2024, at 06:56 UTC, a single sinusoidal delphinid whistle signature with a frequency range 12-18 kHz was detected on the MF spectrogram, the signal was not tracked inside the BZ. The survey crew was advised about the presence of the animals around. At 07:14 a short series of sinusoidal delphinid whistle signals were detected and tracked inside the BZ at 07:15 UTC, estimated distance to the source of 70 m. The source was off at the time of detection and the vessel was in the pre-clearance period before soft start, due to the detection inside the BZ the beginning of the soft start was delayed at 07:15 UTC. The signals were audible to the PAM operator. At 07:24 strong and continuous click trains were detected in the MF and HF spectrogram, being tracked at 100m from the source at 07:25 UTC. Last detection at 07:51 UTC. No VSA actions were applied.

Acoustic detection #554. On October 14, 2024, at 13:59 UTC following the source shutdown resulting from VD54 of sperm whales (Physeter macrocephalus) observed entering the EZ, three sperm whales click trails were acoustically detected and visible on the LF click detector, MF and LF spectrograms. The click signatures fell within a frequency range of between 1 and 16 kHz and had ICI between .3 and .6 seconds. The click trains were first tracked at 13:59 UTC to a distance of 200 m from the source with individuals present both forward and aft of the source. The whales were later tracked moving aft. The closest tracked approach was observed at 14:01 UTC at a distance of 125m from source. Between 14:04 UTC and 14:05 UTC two separate click trains were tracked to 812 m and 512 m from the source respectively. The last tracked individual was located 1500 m from the source at 14:09 UTC and the click signatures were last observed on the spectrogram at 14:13 UTC.

Acoustic detection #556. On October 15, 2024, at 06:18 UTC, a series of MF clicks were detected on the MF spectrogram, with an average upper limit between 04-20 kHz and ICI of 0.5 seconds. Based on the maximum frequency reached by the signals and the SNR, the presence of at least two sperm whales (Physeter macrocephalus) were confirmed. Immediately the survey crew was advised of the presence of the whale. The signals were audible to the PAM Operator at 06:25 UTC. At 06:28 UTC the clicks were localized outside the EZ at 2700 m from the source with a relative bearing of 90/270 degrees. The detection continued with a gradual increment in frequency range of the click signals (02-38 kHz) and the homogenization in the click train groups continuity. At 06:36 UTC, the click signals were tracked at 300 m from the source, immediately a shutdown was requested, being the source disable at 06:37 UTC. The last detection was at 06:54 UTC. No VSA actions were requested.

Acoustic detection #566. On October 27, 2024, at 09:08 UTC, long, faint, and continuous series of click trains were detected in the MF and HF spectrogram with an average upper limit between 23-46 kHz and ICI of 0.05-0.1 seconds. Based on the maximum frequency reached by the signals and the SNR, the presence of at least three unidentified Delphinidae was confirmed, the signals were not able to be tracked. The survey crew was advised of the presence of dolphins due to the source being active at a soft start routine. The detection continued with a gradual increment in frequency range of the clicks and NBHF signals (21- 187 kHz) and the homogenization in the click train groups continuity, with an ICI range of 0.011-.09 seconds. At 09:13 UTC, a single up-sweeping whistle signature was detected in a range from 8-17 kHz, being audible to the PAM Operator. At 09:14 UTC, the clicks were tracked inside the EZ at 230 m from the source and, immediately a shutdown was requested, the source was turned off, and the soft start routine stopped at 09:15 UTC. The last detection was at 09:22 UTC. No VSA actions were requested.

# 1.3. Artemis Athene

Visual sighting #2. On June 23, 2024, at 17.14 UTC, three short-finned pilot whales were visually sighted 350 m off the starboard side of vessel at a bearing of relative 110 degrees. The initial sighting was one pilot whale breaching. The pilot whale was seen within the 500 m EZ from the sound source, while the sound source was active. A call for a shutdown was conducted and immediately carried out at 17.14 UTC. Four more pilot whales were seen blowing and surfacing, remaining quite stationary for a couple of minutes. The pilot whales were last seen at 14.17 UTC slowly surfacing and moving away from the vessel, with the furthest distance from the vessel at approximately 450 m, and outside of the 500 m EZ.

Visual sighting #14. On July 13, 2024, at 19.11 UTC a juvenile green sea turtle was detected 355 m from the starboard side of the vessel, at a bearing of 280 degrees and a heading of 190 degrees. The turtle was seen swimming at and below the surface at a slow pace travelling parallel in the opposite direction of the vessel. The Report No. E001902 REVISION 1.0

turtle was last seen at 19.14 UTC with a bearing of 210 degrees and a heading of 180 degrees, swimming below surface towards the acoustic source. The vessel was on a production line and the source was active at full volume and considering the heading of the turtle and speed of the vessel, a turtle pause was requested and immediately implemented as a mitigation measure. The source was silent from 19.14 UTC to 19.15 UTC resulting in a 00.01 minute mitigation downtime. The turtle was seen outside the separation distance therefore a VSA action was not necessary. The closest point of approach the turtle made to the source was 50 m at 19.14 UTC when the acoustic source was silent.

Visual sighting #23. On July 21, 2024, at 11.04 UTC, three adult bottlenose dolphins were observed forward of the starboard beam 5 m from the vessel and 445 m from the inactive source, with a bearing of 60 degrees and heading of 280 degrees. The dolphins were first observed to surface near the vessel, traveling fast towards the vessel, and then diving in. The dolphins were last seen at 11.07 UTC approximately 5 m from the vessel, 440 m from the inactive source with a bearing of 60 degrees and heading of 270 degrees. The closest point of approach the dolphins made to the inactive source was at 11.04 UTC at 440 m. At the time of the observation the source was inactive but ramp up was scheduled at the same time as the observation took place. The PSO on watch alerted the PAM Operator that the dolphins had entered the BZ and the ramp-up of the source was delayed for a total of 01 hour and 30 minutes. Since the dolphins were detected inside the 50 m separation distance voluntarily and the vessel was towing equipment, no VSA maneuvers were necessary, however, the vessel maintained steady course and speed under 10 knots throughout the detection. This observation correlates with acoustic detection AD 508.

Visual sighting #24. On July 25, 2024, at 22.03 UTC an unidentified juvenile sea turtle was detected 10 m forward of the port bow of the vessel, at a bearing of 300 degrees and a heading of 190 degrees. The turtle was seen swimming below the surface at a vigorous pace travelling parallel in the opposite direction of the vessel until it was last seen at 22.05 UTC with a bearing of 220 degrees and a heading of 190 degrees, swimming below surface towards the acoustic source. The vessel was on a production line and the source was active at full volume and considering the heading of the turtle and speed of the vessel, a turtle pause was requested and immediately implemented as a mitigation measure. The source was silent from 22.05 UTC to 22.06 UTC resulting in a 00.01 minute mitigation downtime. The turtle was seen inside the separation distance and a VSA action was implemented as the vessel maintained a steady course and speed. The closest point of approach the turtle made to the source was 15 m at 22.05 UTC when the acoustic source was silent.

Visual sighting #25. On July 26, 2024, at 18.33 UTC, a sea turtle was sighted 50 m from the starboard side of the vessel, at a bearing of 30 degrees and heading 180 degrees. The turtle was fast-paced swimming below the surface in the opposite direction of the vessel. The animal was last seen at 18.34 UTC, at a bearing of 120 degrees with a heading of 130 degrees, swimming towards the source. Since the vessel was on a production line and the source was active at full volume, a turtle pause was requested, considering the heading of the turtle and the speed of the vessel. The source was disabled at 18.34 UTC and enabled at 18.35 UTC, resulting in a 00.01 minute of mitigation downtime. The turtle was seen in the limit of the separation distance and since the vessel was towing equipment, the VSA was to keep the course and speed. The turtle's closest point of approach to the source was 10 m at 18.34 UTC, when the source was silent.

Visual sighting #29. On July 29, 2024, at 18.20 UTC, a juvenile sea turtle was sighted 80 m from the starboard side of the vessel, at a bearing of 40 degrees and heading 120 degrees. The turtle was fast-paced swimming below the surface in the opposite direction of the vessel. The animal was last seen at 18.21 UTC, at a bearing of 100 degrees with a heading of 110 degrees, swimming towards the source. Since the vessel was on a production line and the source was active at full volume, a turtle pause was requested considering the heading of the turtle and the speed of the vessel. The source was disabled at 18.20 UTC, when the turtle made its closest approach to the source at 20 m. The source was enabled back at 18.21 UTC, resulting in 00.01 minute of mitigation downtime. The animal was seen outside of the separation distance, so no VSA maneuver needed to be implemented.

Visual sighting #32a. On July 31, 2024, at 13.10 UTC a pod of approximately eight adults and two juvenile false killer whales was observed 900 m off the starboard bow at a bearing of 30 degrees and heading of 360 degrees. The pod was observed surfacing, blowing, slow traveling parallel in the same direction of the vessel and changing to variable headings, and then, the animals were seen changing their heading and swimming parallel in the opposite direction of the vessel, towards the active source. At the moment of the detection the vessel was operating at full volume and considering the trajectory of the animals and the speed of the vessel, a mitigation action was requested and immediately implemented as a shutdown of the source at 13.22 UTC. The pod was seen changing their heading again to crossing astern of the vessel and then continuing parallel in the same direction of the vessel now on the portside, as the vessel was now turning into the line change, the PSO on watch requested to the bridge officer to

maintain a steady course to prevent an approach to the animals. The animals were then seen approaching voluntarily to the vessel and crossing ahead of the bow from port to starboard side and since they were seen entering the relevant separation distance a VSA action was requested and immediately implemented by decreasing the speed. The pod was last seen porpoising and swimming below the surface 60 m away from the vessel's starboard bow at 14.07 UTC with a bearing of 40 degrees and heading of 50 degrees. The animals' closest approach to the active source was 600 m at 13.21 UTC and 100 m to the inactive source at 13.28 UTC. This visual sighting is correlated with visual sighting 32b as it consists of a mixed species pod, and with acoustic detection AD 521.

Visual sighting #32b. On July 31, 2024, at 13.10 UTC a pod of approximately ten adult melon-headed whales observed 900 m off the starboard bow at a bearing of 30 degrees and heading of 360 degrees. The pod was observed surfacing, blowing, slow traveling parallel in the same direction of the vessel and changing to variable headings, and then, the animals were seen changing their heading and swimming parallel in the opposite direction of the vessel, towards the active source. At the moment of the detection the vessel was operating at full volume, and a shutdown mitigation action was already taking place due to visual detection 32a. The pod was seen changing their heading again to crossing astern of the vessel and then continuing parallel in the same direction as the vessel now on the portside, as the vessel was now turning into the line change. The animals were then seen approaching voluntarily to the vessel and crossing ahead of the bow from port to starboard side and since they were seen entering the relevant separation distance a VSA action was requested and immediately implemented by decreasing the speed. The pod was last seen porpoising and swimming below surface 60 m away from the vessel's starboard bow at 14.07 UTC with a bearing of 40 degrees and heading of 50 degrees. The animals' closest point of approach to the active source was 600 m at 13.21 UTC and 100 m to the inactive source at 13.28 UTC. This visual sighting correlates with visual sighting 32a as it consisted of a mixed species pod, and with acoustic detection AD 521.

Visual sighting #33. On July 31, 2024, at 14.31 UTC six adult bottlenose dolphins were observed off the port bow at 10 m with bearing of 330 degrees and heading 120 degrees, 500 m from the inactive source. At first, the dolphins were observed swimming towards the vessel, surfacing, and then bow riding. The animals continued to bow ride until they swam away below the surface and were last observed at 14.44 UTC, approximately 5 m off the vessel's bow at a bearing of 10 degrees and heading of 0 degrees. The dolphin's closest approach to the inactive source was 500 m at 14.32 UTC. At the time of the observation the source was silent due to a recent call for a shutdown and the source ramp up was delayed as the dolphin's detection was observed within the 30-minute pre-watch period and they were not seen exiting the BZ. The source was enabled at 15.40 UTC with mitigation downtime being 1 hour and 9 minutes. Since the dolphins voluntarily entered the 50 m separation distance, the vessel kept course and speed as a VSA action. This visual sighting correlated with acoustic detection AD 522.

Visual sighting #37. On August 2, 2024, at 13.51 UTC one sperm whale was observed 900 m from the vessel's starboard bow with a bearing of 25 degrees and heading of 170 degrees. The sperm whale was swimming parallel in the opposite direction of the vessel at a moderate pace. At 14.05 UTC the sperm whale was last observed 1100 m from the vessel's starboard stern at a bearing of 140 degrees, with a heading of 180 degrees. The closest point of approach of the sperm whale to the vessel was 820 m at 13.56 UTC. The closest point of approach to the inactive source was 700 m at 13.58 UTC. No VSA maneuver was requested because the animal did not come within the designated 100 m separation distance. The source was silent while the vessel was transiting to a production line at the time of the detection. A delay to the source's initiation was implemented and resulted in 01.30 minutes of mitigation downtime.

Visual sighting #38. On August 2, 2024, at 15.50 UTC three unidentified dolphins were observed 600 m from the vessel's starboard beam with a bearing of 100 degrees and heading of 350 degrees. The dolphins were seen surfacing, swimming below surface on variable directions, and showing feeding behavior. At 15.52 UTC the dolphins were last observed 700 m from the vessel's starboard stern at a bearing of 120 degrees, with a heading of 10 degrees. The closest point of approach of the dolphins to the vessel was 600 m at 15.51 UTC. The closest point of approach to the inactive source was 480 m at 15.52 UTC. No VSA maneuver was requested because the animals did not come within the designated 100 m separation distance. At the time of the detection the vessel was on an extended line change due to a delay from visual sighting 37. This detection delayed the source's initiation further and resulted in 01.00 minutes of mitigation downtime.

Visual sighting #43. On August 9, 2024, at 18.22 UTC, a leatherback sea turtle was sighted 400 m off vessel's port bow beam, bearing 340 degrees with an initial heading of 150 degrees. At the beginning of the detection the turtle was swimming slowly towards the vessel. The animal was last seen at 18.26 UTC, with a heading of 270 degrees, swimming fast and away from the vessel at a bearing of 270 degrees. Since the vessel was on a production line and the source was active, a turtle pause was requested, considering the vessel speed and the turtle's heading. At 18.25 UTC, when the turtle made its closest approach to the source at 100 m, the turtle pause was implemented and the source disabled. The source was enabled back at 18.26 UTC, resulting in 00.01 minute of mitigation downtime. Since the turtle was seen in the limit of the separation distance (50 m) and the vessel was towing equipment, the VSA maneuver applied was to keep speed and course. The turtle's closest point of approach to the source was 100 m, when the source was silent.

Visual sighting #46. On August 10, 2024, at 21.23 UTC, an unidentified sea turtle was sighted 10 m off vessel's broad on the starboard bow, at a bearing of 50 degrees with an initial heading of 60 degrees. The turtle was seen swimming slowly away from the vessel and then diving below the surface. The animal was last seen at 21.24 UTC, with a heading of 60 degrees, and a bearing of 70 degrees. Since the vessel was on a production line and the source was active, a turtle pause was requested, considering the vessel speed and the turtle's heading at 21.24 UTC, the turtle pause was implemented and the source was enabled back at 21.25 UTC, resulting in 00.01 minute of mitigation downtime. The turtle's closest point of approach to the active source was at 110 m and 100 m to the inactive source at 21.25 UTC. Since the turtle was seen inside the separation distance and the vessel was towing equipment at the moment of the detection, the VSA maneuver applied was to keep speed and course.

Visual sighting #51. On August 15, 2024, at 15.16 UTC, a green sea turtle was sighted 20 m off vessel's port bow, with a bearing of 350 degrees and a heading of 190 degrees. At the beginning of the detection the turtle was stationary and resting on a sargassum patch. The animal was last seen at 15.18 UTC, at a bearing of 190 degrees and with the same initial heading of 190 degrees. The turtle kept resting on the sargassum patch. Since the vessel was on a production line and the source was active, a turtle pause was requested considering the vessel speed and the turtle's heading. At 15.17 UTC, when the animal entered the EZ the turtle pause was implemented, and the source was disabled. The turtle's closest point of approach to the silent source was 20 m. The source was enabled back at 15.18 UTC, resulting in 00.01 minute of mitigation downtime. Since the turtle was seen inside of the separation distance and the vessel was towing equipment, the VSA maneuver applied was to keep speed and course.

Visual sighting #53. On August 16, 2024, at 13.35 UTC a pod of seven adults and one juvenile bottlenose dolphins was observed 400 m off the vessel's bow, at a bearing of 5 degrees and heading of 180 degrees. The dolphins were observed swimming towards the vessel, performing bow riding, then they were seen swimming at the vessel's port stern in the same direction as the vessel, and then swimming away. The dolphins were last seen at 13.54 UTC, 300 m from the vessel's port stern at a bearing of 210 degrees and a heading of 280 degrees. The closest approach the dolphins made to the vessel was 5 m at 13.37 UTC. The closest approach the dolphins made to the active source was 550 m at 13.36 UTC and to the silent source 15 m at 13.53 UTC. At the moment of the detection the vessel was starting a production line with the source at ramp up, and when the dolphins were seen approaching the EZ, a preventive shutdown was requested and immediately implemented at 13.37 UTC, resulting in 01.12 hours of mitigation downtime. Since the dolphins voluntarily entered the separation distance and the vessel was towing equipment, the VSA maneuver applied was to keep speed and course. This visual sighting was correlated with acoustic detection AD 540.

Visual sighting #54. On August 16,2024 at 14.49 UTC a pod of eight bottlenose dolphins, seven adults and one juvenile, was observed 20 m off the port bow's broad at a bearing of 280 degrees and heading of 65 degrees. The dolphins swam toward the vessel's bow, to start bow riding and surfacing. The dolphins were last seen at 14.53 UTC, 5 m from the vessel's bow at a heading of 5 degrees and bearing of 0 degrees. The closest approach the bottlenose dolphins made to the vessel was 5 m at 14.50 UTC. The closest approach the bottlenose dolphins made to the vessel was 5 m at 14.50 UTC. The closest approach the bottlenose dolphins made to the silent source was 400 m at 14.50 UTC. At the moment of the detection the vessel was on a line change with the source silent preparing for ramp up. A mitigation action was implemented as the ramp up of the source was delayed for 00.06 minutes. Since the bottlenose dolphins voluntarily entered the separation distance of 50 m and the vessel was towing equipment, the VSA maneuver applied was to keep speed and course. This visual sighting was correlated with acoustic detection AD 540.

Visual sighting #55. On August 16, 2024, at 13.35 UTC a pod of 16 adult, two juvenile, and two calves of Atlantic spotted dolphins was observed 200 m off the vessel's bow at a bearing of 330 degrees and heading of 180 degrees. The dolphins were observed swimming towards the vessel, performing bow riding, then they were seen swimming at the vessel's port beam in the same direction as the vessel and then swimming towards the stern and swimming next to the port side door. The dolphins were last seen at 16.47 UTC, 350 m from the vessel's port stern at a bearing of 210 degrees and a heading of 240 degrees. The closest approach the dolphins made to the vessel was 5 m at 16.07 UTC. The closest approach the dolphins made to the inactive source was 5 m at 16.30 UTC. At the moment of the detection the vessel was on a line change with the source silent due to a previous delay from AD 541 and

preparing for ramp up. A mitigation action was implemented as the ramp up of the source was further delayed for 01.54 minutes of mitigation downtime. Since the dolphins voluntarily entered the separation distance and the vessel was towing equipment, the VSA maneuver applied was to keep speed and course.

Visual sighting #59. On August 19, 2024, at 15.24 UTC on August 19, 2024, an unidentified sea turtle was observed 15 m off the port side mid ship of the vessel. This 15 m was the CPA to the vessel. The turtle was observed surfacing and appeared to be eating a jellyfish. The location of the turtle was tracked as it swam in the opposite direction as the vessel was heading till 15.27 UTC when the turtle entered the EZ of 100 m meters to the source and a turtle pause was called for and implemented for a total of 6 shots. The time of 15.27 was also the CPA to source and last observed time of the turtle as it dove. The turtle was inside the separation distance at the beginning of the detection and the VSA measure of maintain course and speed was implemented as the vessel was towing survey gear.

Visual sighting #66. On September 3, 2024, at 13.30 UTC, a sperm whale was observed approximately 1400 m off port bow, and 1800 m from the active acoustic source. The whale bearing was 315 degrees and its heading 270 degrees. The whale was observed blowing and slow traveling in opposite direction to the vessel. At the time of the detection, the vessel was full power on a survey line. At 13.32 UTC, the whale entered the 1500 m EZ, and a shutdown was called. The closet point of approach of the whale to the inactive source was approximately 1400 m at 13.33 UTC. The whale was observed exiting the exclusion zone at 13.35 UTC, it was approximately 1950 m off port stern, and 1600 m from the active acoustic source, and the clearance was given to resume activities. Shutdown resulting in three minutes of mitigation down time. At 13.38 UTC, the whale was last observed approximately 1800 m off port stern, and 2150 m from the inactive acoustic source. The animal did not enter the separation distance to the vessel and no VSA maneuvers were requested.

Visual sighting #67. On September 3rd, 2024, at 18.32 UTC, a group of short-finned pilot whales was observed approximately 2000 m off port bow with a true bearing to the pod of 330 degrees. The vessel was heading north. The pod was slowly crossing ahead of the vessel and heading in a southeast direction. Two groups totaling 12 individuals were confirmed to be consisting of a single juvenile. At 18.37 UTC the whales entered the EZ of 500 m to the active source off the starboard bow of vessel. At this same time of 18.37 UTC, a shutdown was called for and immediately implemented by the survey team. Closest approach to the source was at 18.45 UTC at 300 m. Visual conformation was maintained, and the whales were seen exiting the EZ at 18.47 UTC and the survey team was alerted at this time. Last visual conformation was at 18.49 UTC off the starboard stern. The CPA to the vessel was at 18.45 UTC at 200 m. No VSA maneuver request was made as the pilot whales did not enter the vessel separation distance.

Visual sighting #72. On September 15, 2024, at 15.13 UTC, two sperm whales were observed. The first whale was observed at 15.13 UTC, 1700 m from the port side of the vessel. It was observed to take three breaths when it promptly dove showing its flukes at 13.14 UTC. This whale did not enter the EZ or separation distance. At 15.17 UTC a second sperm whale was observed to surface 600 m from the bow of the vessel. This was 1010 m from the active source and a shutdown was called for and immediately implemented. This second whale was observed slowly swimming away from the vessel in the same direction as the vessel (north) maintaining the 600 m distance from the bow. At 15.19 UTC the whale turned to its left (west) and continued to slowly swim at the surface. At 15.21 UTC the whale dove showing its flukes and was not seen again. This time of 15.21 UTC was the CPA to the vessel at 400 m and the CPA to the source at 800 m. The mitigation request for a shutdown was made and implemented at 15.17 UTC. No VSA request was made or implemented as the whale did not enter the separation distance.

Visual sighting #73. On September 16, 2024, at 21.33 UTC, a juvenile green sea turtle was observed swimming just under the surface of the water away and the opposite direction from the vessel. The turtle was 20 m out from the starboard side at a level of the bridge when first seen. The turtle was tracked till it entered the EZ at 100 m from the active source when a turtle pause was called for and received. This time was also the last sighting of the turtle and the CPA to the source. The vessel-maintained course and speed as a VSA precaution.

Visual sighting #74. On September 17, 2024, at 19.52 UTC, a sperm whale was observed approximately 1600 m off port bow, and 2000 m from the active acoustic source. The whale bearing was at 330 degrees and its heading was stationary relative to the vessel. The whale was observed blowing and the vessel was traveling toward the whale. At the time of the detection, the vessel was at full power on a survey line. At 20.01 UTC, the whale entered the 1500 m EZ, and a shutdown was called. During the same minute, the whale's flukes were observed as a dive took place. Last detection was at 20.01 UTC at 820 m off port bow with 1450 m to the source. CPA to the source was 1450 m and 820 m was the CPA to the vessel. The animal did not enter the separation distance to the vessel and no VSA maneuvers were requested or required.

Visual sighting #75. On September 18, 2024, at 11.46 UTC, a leatherback sea turtle was sighted 15 m off vessel's starboard bow beam, bearing 30 degrees with an initial heading of 180 degrees. At the beginning of the detection the turtle was swimming slowly towards the vessel traveling below the surface. The animal was last seen at 11.47 UTC, with a heading of 180 degrees, diving to an unknown direction at a bearing of 90 degrees. Since the vessel was on a production line and the source was active, a turtle pause was requested, considering the vessel speed and the turtle's heading. At 11.49 UTC, when the turtle made its closest approach to the source at 100 m, the turtle pause was implemented and the source disabled. The source was enabled back at 11.50 UTC, resulting in 00.01 minute of mitigation downtime. Since the turtle was seen in the limit of the separation distance (50 m) and the vessel was towing equipment, the VSA maneuver applied was to keep speed and course. The turtle's closest point of approach to the source was 100 m, when the source was silent.

Visual sighting #80. On September 20, 2024, at 12.56 UTC, two sperm whales were observed 1700 m off the port bow bearing 150 degrees. The whales maintained their position as they were observed taking several breaths. The vessel was on a survey line with source active. When the whales entered the EZ of 1500 m to the active source a shutdown was called for at 13.03 UTC. The CPA to the vessel was at 13.07 UTC at 850 m. The CPA to the not active source was at 13.08 UTC at 800 m. At 13.08 UTC one of the whales dove with flukes shown. At 13.11 UTC, the second whale dove. Both dives were inside the EZ. At 13.18 UTC a whale surfaced inside the EZ at 1200 m to the vessel. The whale then dove at 13.19 UTC at 1250 m. The two whales were seen again to surface at 13.31 UTC at 1700 m form the source and then dive at 13.35 UTC not to be seen again. This was the end of the detection. This detection resulted in a shutdown of the source and no VSA maneuvers were required.

Visual sighting #85. On September 23, 2024, at 21.51 UTC, a single leatherback sea turtle was observed swimming slowly 2 m off the port of the vessel. The turtle was in line with the bridge at first sighting. The turtle was swimming in the same direction as the vessel but at a slower pace. When the animal entered the 100 m EZ at 21.53 UTC to the active source an eight-shot turtle pause was called for and incidentally received. This was also the known CPA to the source and last sighting of the turtle. The CPA to the vessel was at 21.51 UTC and 2 m. The vessel was towing gear and maintained its course and speed as requested for a VSA precaution.

Visual sighting #97. On October 24, 2024, at 22.08 UTC two sperm whales were observed 1300 m off the vessel's starboard bow, at a bearing of 10 degrees and heading of 270 degrees. The whales were seen blowing, swimming at surface crossing ahead of the vessel, and diving in with flukes. At 22.10 UTC the whales surfaced again at 1100 m from the port bow, and 1520 m from the active acoustic source, swimming parallel in the opposite direction of the vessel, and a call for a shutdown was made and immediately implemented as a mitigation measure by the navigation team as the whales were seen entering the EZ. The whales were last observed at 22.28 UTC, 1200 m from the vessel's stern at a bearing of 190 degrees, with a heading of 180 degrees. The closest point of approach of the whales to the vessel was 915 m at 22.25 UTC and to the active acoustic source 800 m at 22.25 UTC. At the time of the observation the vessel was at full volume on a survey line. A VSA maneuver was not necessary since the whales did not enter the separation distance.

Visual sighting #99. On October 25, 2024, at 13.42 UTC a sperm whale was observed 1180 m off the vessel's port bow, at a bearing of 330 degrees and an initial heading of 40 degrees. The whale was seen blowing, swimming at surface towards the heading of the vessel, and diving in with flukes parallel to the vessel. At 13.43 UTC a call for a shutdown was made and immediately implemented as a mitigation measure by the navigation team as the whale was seen entering the EZ. The whale was last observed at 13.46 UTC, 900 m from the vessel's port bow at a bearing of 310 degrees, with a heading of 10 degrees. The closest point of approach of the whales to the vessel was 900 m at 13.46 UTC and to the active acoustic source 1550 m at 13.43 UTC and 1300 m to the inactive source at 13.46 UTC. At the time of the observation the vessel was at full volume on a survey line and a mitigation downtime was recorded for 01.35 hours. A VSA maneuver was not necessary since the whales did not enter the separation distance. This visual sighting was correlated with the acoustic detection AD 555.

Acoustic detection #506. On July 20, 2024, at 13.09 UTC, scattered clicks from an unidentified delphinid were detected on PAMGuard's HF click detector. The PAM Operator radioed the PSO team informing them of the detection at this time, however they did not have a sighting event. The signal was initially detected between the bearings of 22 and 90 degrees relative to the hydrophone array at amplitude 132 to 127 dB. Scattered clicks were seen until 13.14 UTC and overall, the detection lasted five minutes. Maximum amplitude of 132 dB was recorded at 13.10 UTC which may indicate the time of closest approach to the hydrophones. Sound files were analyzed using Raven Lite and HF echolocation clicks were seen ranging from 13 to 75 kHz. PAMGuard and spectrogram data indicated the presence of one individual within the 1000 m BZ. At the time of the detection the vessel was on a line

change with the source silent about starting a ramp up. A delay to the initiation of the source was implemented and resulted in 1 hour and 48 minutes of mitigation downtime.

Acoustic detection #510. On July 23, 2024, at 02.25 UTC click trains from an unidentified delphinid were detected on PAMGuard's HF click detector. The signal was initially detected between the bearings of 0 and 180 degrees relative to the hydrophone array at amplitude 124 to 154 dB. Scattered clicks and click trains were seen until 02.27 UTC between the bearings of 15 and 95 degrees. Maximum amplitude of 160 dB was detected at 02.25 UTC, which may indicate the time of closest approach to the hydrophones. When data from this time frame was analyzed using Target Motion Analysis, clicks were tracked to a distance of 11 m from the hydrophone array and 220 m from the acoustic source. When sound files were analyzed using Raven Lite, HF echolocation clicks were seen ranging from 14 to 220 kHz and burst pulses were detected between 15 and 80 kHz. PAMGuard and spectrogram data indicated the presence of at least five individuals within the 1000 m BZ. At the time of the detection the vessel was on a line change and the source was silent. A delay to the initiation of the source was implemented and resulted in 33 minutes of mitigation downtime.

Acoustic detection #515. On July 27, 2024, at 02.47 UTC, click trains from an unidentified delphinid were detected on PAMGuard's HF click detector. The signal was initially detected between the bearings of 124 to 135 degrees relative to the hydrophone array at amplitude 123 to 135 dB. Scattered clicks and click trains were seen until 02.59 between a bearing of 12 to 180 degrees. Maximum amplitude of 156 dB was detected at 02.56 UTC, which may indicate the time of closest approach to the hydrophones. When data from this time frame was analyzed using Target Motion Analysis, clicks were tracked to 14 m from the hydrophone array and 213 m from the acoustic source. When sound files were analyzed using Raven Lite, HF echolocation clicks were seen ranging from 20 to 190 kHz, whistles were detected between 9-45 kHz, and burst pulses were detected between 25 and 90 kHz. PAMGuard and spectrogram data indicated the presence of at least five individuals within the 1000 m BZ. At the time of detection, the vessel was on a line change and the source was silent. A delay to the initiation of the source was implemented and resulted in 1 hour and 57 minutes of mitigation downtime.

Acoustic detection #516. On July 27, 2024, at 04.39 UTC a faint concave whistle was detected on PAMGuard's MF spectrogram followed by scattered clicks from an unidentified delphinid on the PAMGuard's HF click detector. The signal was initially centered between the bearings of 22 to 83 degrees, relative to the hydrophone array at an amplitude of 97 to 144 dB. Individual and short clicks trains were then intermittently seen until 05.14 UTC between the bearings of 0 and 174 degrees and amplitudes between 118 to 153 dB throughout the event. Maximum amplitude of 147 dB was detected at 04.57 UTC, which may indicate the time of closest approach to the hydrophones. When sound files were analyzed using Raven Lite, HF echolocation clicks were seen ranging from 13 to 120 kHz. PAMGuard and spectrogram data indicated the presence of at least four individuals within 1000 m BZ localized in front of the hydrophones. At the time of the detection the vessel was on a line change and the source was silent. A delay to the initiation of the source was implemented and resulted in 2 hours and 21 minutes of mitigation downtime.

Acoustic detection #520. On July 31, 2024, at 07.40 UTC, clicks from unidentified Delphinids were detected on PAMGuard's HF click detector. Clicks were initially detected between the bearings of 79 to 104 degrees relative to the hydrophone array at amplitude 124 to 147 dB. Scattered clicks and click trains were seen until 07.43 UTC with clicks in the range of 114 to 155 dB. Overall, the detection lasted three minutes. Sound files were analyzed with Raven Lite, and results showed HF clicks in the 8 to 250 kHz range and burst pulses in the 18 to 214 kHz range. PAMGuard and spectrogram data indicated the presence of at least four individuals within the 1000 m BZ. The vessel was in transit to a survey line and the source was silent. A delay to the initiation of the source was implemented and resulted in 35 minutes of mitigation downtime.

Acoustic detection #525. On August 02, 2024, at 04.39 UTC, scattered clicks from an unidentified delphinid were detected on PAMGuard's HF click detector. The signal was initially seen between the bearings of 0 to 180 degrees, relative to the hydrophone array at an amplitude of 112 to 164 dB. Scattered clicks and click trains were seen until 06.51 UTC between the bearings of 0 and 180 degrees throughout the event. Maximum amplitude 164 dB were detected at 04.39 UTC, which may indicate the time of closest approach to the hydrophones. When sound files were analyzed using Raven Lite, HF echolocation clicks were seen ranging from 6 to 250 kHz. Several whistles were also detected ranging from 6 to 22 kHz and burst pulses ranging from 15 to 194 kHz. PAMGuard and spectrogram data indicated the presence of at least five individuals within 1000 m BZ. At the time of the detection the vessel was on a line change and the source was silent. A delay to the initiation of the source was implemented and resulted in 3 hours and 19 minutes of mitigation downtime.
Acoustic detection #526. On August 02, 2024, at 15.21 UTC, scattered clicks from an unidentified delphinid were detected on PAMGuard's HF click detector. The signal was initially detected between the bearings of 80 and 100 degrees relative to the hydrophone array at amplitude 120 to 131 dB. Scattered clicks and click trains were seen until 15.32 UTC between the bearings of 0 and 175 degrees. Maximum amplitude 114 dB was detected at 15.23 UTC, which may indicate the time of closest approach to the hydrophones. When data from this time frame was analyzed using Target Motion Analysis, clicks were tracked to a distance of 300 m from the hydrophone array and 190 m from the acoustic source. When sound files were analyzed using Raven Lite, HF echolocation clicks were seen ranging from 15 to 135 kHz and whistles were seen between 11 and 25 kHz. PAMGuard and spectrogram data indicated the presence of at least six individuals within the 1000 m BZ. At the time of the detection the vessel was on an extended line change due to a delay from VS 37 and the source was silent. This detection delayed operations further and resulted in 29 minutes mitigation downtime.

Acoustic detection #529. On August 03, 2024, at 02.10 UTC, scattered clicks from an unidentified delphinid were detected on PAMGuard's HF click detector. The signal was initially detected between the bearings of 120 and 150 degrees relative to the hydrophone array at amplitude 122 to 138 dB. Scattered clicks and click trains were seen until 02.28 UTC between the bearings of 30 and 175 degrees. Maximum amplitude 158 dB was detected at 02.14 UTC, which may indicate the time of closest approach to the hydrophones. When data from this time frame was analyzed using Target Motion Analysis, clicks were tracked to a distance of 23 m from the hydrophone array and 214 m from the acoustic source. Whistles were also sporadically seen throughout the detection event. When sound files were analyzed using Raven Lite, HF echolocation clicks were seen ranging from 15 to 225 kHz, whistles were seen between 7 and 42 kHz and burst pulses between 34 and 54 kHz. PAMGuard and spectrogram data indicated the presence of at least five individuals within the 1000 m BZ. At the time of the detection the vessel was on a line change and the source was silent. A delay to the initiation of the source was implemented and resulted in 50 minutes of mitigation downtime.

Acoustic detection #531. On August 03, 2024, at 20.51 UTC, single clicks from an unidentified delphinid were detected on PAMGuard's HF click detector. The PAM Operator radioed the PSO team informing them of the detection at this time. The signal was initially detected between the bearings of 85 and 90 degrees relative to the hydrophone array at amplitude 120 to 127 dB. Scattered clicks and click trains were seen until 21.04 UTC between the bearings of 0 and 180 degrees. At 20.56 UTC, the PSO team radioed the PAM Operator informing them of their initial visual detection of the pod (VS 42). Maximum amplitude 165 dB was detected at 20.54 UTC, which may indicate the time of closest approach to the hydrophones. When data from this time frame was analyzed using Target Motion Analysis, clicks were tracked to a distance of 15 m from the hydrophone array and 235 m from the acoustic source. Whistles were also sporadically seen on PAMGuard's MF Spectrogram between 20.55 and 20.57 UTC. The visual detection lasted until 21.07 UTC but the PSO team was not able to make a positive species identification. When sound files were analyzed using Raven Lite, HF echolocation clicks were seen ranging from 15 to 250 kHz. Whistles were seen between 6 and 20 kHz with harmonics visible up to 70 kHz. PAMGuard and spectrogram data indicated the presence of at least 10 individuals within the 1000 m BZ. At the time of the detection the vessel was on a line change and the source was silent. A delay to the initiation of the source was implemented and resulted in 1 hour and 45 minutes of mitigation downtime.

Acoustic detection #541. On August 16, 2024, at 14.55 UTC, clicks from unidentified delphinids were detected on PAMGuard's MF spectrogram, and clicks trains were detected on the HF click detector. Clicks were initially detected between the bearings of 68 to 97 degrees relative to the hydrophone array at amplitude 153 to 143 dB. scattered clicks were detected until 14.56 UTC, when the last detection occurred. Overall, the detection lasted one minute. Overall, click bearings ranged from 68 to 97 degrees relative to the hydrophones, and click amplitude ranged from 153 to 143 dB. Sound files were analyzed with Raven Lite, and results showed clicks in the 9 to 222 kHz range. PAMGuard and spectrogram data indicated the presence of at least three individuals within the 1000 m BZ. At the time of the detection the vessel was silent withing the 30-minute search period prior to resuming the seismic source. A delay to the initiation of the source was implemented and resulted in 1 hour and 11 minutes of mitigation downtime.

Acoustic detection #543. On August 16, 2024, at 18.01 UTC scattered clicks from an unidentified delphinid were detected on PAMGuard's HF click detector as well as whistles were detected on PAMGuard's spectrogram. The PAM Operator radioed the PSO team who confirmed the visual detection of dolphins (VS 56) inside the EZ. The signal was initially detected between the bearings of 56 and 175 degrees relative to the hydrophone array at amplitude 126 to 150 dB. Scattered clicks and click trains were seen until 18.06 UTC between the bearings of 19 and 180 degrees. At 18.11 UTC, PSOs radioed the PAM Operator informing them of their last visual detection.

Maximum amplitude 152 dB was detected at 18.01 UTC, which may indicate the time of closest approach to the hydrophones. When data from this time frame was analyzed using Target Motion Analysis, clicks were tracked to a distance of 18 m from the hydrophone array and 241 m from the acoustic source. When sound files were analyzed using Raven Lite, HF echolocation clicks were seen ranging from 9 to 224 kHz and whistles from 6 to 16 kHz. PAMGuard and spectrogram data indicated the presence of at least five individuals within the 500 m EZ. A shut down mitigation action was called at 18.02 UTC as the vessel was with a soft start in progress. A 40-minute production loss was attributed to the shutdown.

Acoustic detection #547. On September 19, 2024, at 08.19 UTC, upsweeps and downsweeps indicating delphinid whistles were observed on the MF spectrogram. Initial sign was observed at a base of 7 kHz with harmonics shown reaching a maximum of 35 kHz. Using Raven Light, recordings indicated whistles in a range of 7 to 147 kHz and clicks in a 20 to 113 kHz range. Whistles were observed on the spectrogram until 08.23 UTC. Spectrogram analysis indicated the presence of 20 to 50 individuals within 500 m of the hydrophones and within the BZ for Delphinidae. The detection resulted in a delay of 56 minutes, from 08.19 until 9.15 UTC, as soft start clearance was requested just after the beginning of the detection.

Acoustic detection #549. On October 11, 2024, at 08.13 UTC scattered clicks from an unidentified delphinid were detected on PAMGuard's HF click detector. The signal was initially detected between the bearings of 70 and 100 degrees relative to the hydrophone array at amplitude 124 to 138 dB. Scattered clicks and click trains were seen until 08.14 UTC between the bearings of 0 and 100 degrees. Maximum amplitude 138 dB was detected at 08.13 UTC, which may indicate the time of closest approach to the hydrophones. PAMGuard and spectrogram data indicated the presence of one individual within the 500 m EZ. When sound files were analyzed using Raven Lite, HF echolocation clicks were seen ranging from 15 to 200 kHz and a HF burst pulse was seen between 20 and 220 kHz. The vessel was approaching a production line, and the source was firing at reduced volume while conducting a soft start. A shutdown of the source was requested by the PAM Operator at 08.13 UTC and immediately implemented by the seismic team. One hour and 43 minutes of mitigation downtime was attributed to the shutdown.

Acoustic detection #550. On October 14, 2024, at 02.36 UTC scattered clicks from an unidentified delphinid were detected on PAMGuard's HF click detector. The signal was initially detected between the bearings of 0 and 115 degrees relative to the hydrophone array at amplitude 120 to 125 dB. Scattered clicks and click trains were seen until 03.04 UTC between the bearings of 0 and 180 degrees. Maximum amplitude 154 dB was detected at 02.39 UTC, which may indicate the time of closest approach to the hydrophones. Convex and down sweep whistles were also detected on PAMGuard's MF spectrogram between 02.37 and 02.38 UTC. PAMGuard and spectrogram data indicated the presence of three animals within the 1000 m BZ. When sound files were analyzed using Raven Lite, HF echolocation clicks were seen ranging from 5 to 90 kHz, whistles were seen ranging from 8 to 37 kHz and a HF burst pulse was seen between 25 and 40 kHz. The vessel was approaching a production line, and the source was silent. A delay to start of the source was requested by the PAM Operator at 02.36 UTC and immediately implemented by the seismic team. One hour and 34 minutes of mitigation downtime was attributed to the delay.

Acoustic detection #551. On October 17, 2024, at 21.03 UTC faint sperm whale clicks were seen on PAMGuard's MF spectrogram and heard aurally by the PAM Operator. At 21.04 UTC, the signal increased in strength and a single click train was detected on PAMGuard's LF click detector between the bearings of 126 and 135 degrees relative to the hydrophone array at amplitude 125 to 130 dB. Click trains were sporadically seen until 21.14 UTC between the bearings of 70 and 135 degrees. The last detection occurred on PAMGuard's MF spectrogram at 21.15 UTC. Maximum amplitude 140 dB was detected at 21.13 UTC, which may indicate the time of closest approach to the hydrophones. When data from this timeframe was analyzed using Target Motion Analysis, clicks were tracked to a distance of 150 m from the hydrophone array and 275 m from the source. PAMGuard and spectrogram data indicated the presence of two animals within the 1500 m BZ. When sound files were analyzed using Raven Lite, MF echolocation clicks were seen ranging from 10 to 60 kHz with an ICl of 0.77 seconds. The vessel was on a line change approaching a production line, and the source was silent. A delay to the initiation of the source was implemented and resulted in 19 minutes of mitigation downtime.

Acoustic detection #559. On October 28, 2024, at 08.38 UTC sperm whale clicks were seen on PAMGuard's MF spectrogram, heard aurally by the PAM Operator and click trains were detected on PAMGuard's LF click detector. At that time, the PAM Operator called for a shutdown of the source which was immediately implemented by the seismic crew. The signal was initially detected between the bearings of 76 and 140 degrees relative to the hydrophone array at amplitude 115 to 127 dB. Click trains were sporadically seen until 08.45 UTC between the bearings of 76 and 140 degrees. The last detection occurred on PAMGuard's MF spectrogram and PAMGuard's LF click detector at 08.45 UTC. Maximum amplitude 125 dB was detected at 08.42 UTC, which may indicate the time

of closest approach to the hydrophones. PAMGuard and spectrogram data indicated the presence of two animals within the 1500 m EZ. When sound files were analyzed using Raven Lite, MF echolocation clicks were seen ranging from 5 to 115 kHz with an ICI of 0.49 seconds. The vessel was on a production line, and the source was on full volume. The shutdown resulted in 55 minutes of mitigation downtime until AD 560 initiated a further delay to soft start.

Acoustic detection #560. On October 28, 2024, at 09.33 UTC sperm whale clicks were heard aurally by the PAM Operator and a click train was detected on PAMGuard's LF click detector at bearing of 124 degrees relative to the hydrophone array at amplitude 130 to 141 dB. Click trains were sporadically seen until 10.06 UTC between the bearings of 39 and 144 degrees. The last detection occurred on PAMGuard's MF spectrogram and PAMGuard's HF click detector at 10.06 UTC. Maximum amplitude 142 dB was detected at 09.36 UTC, which may indicate the time of closest approach to the hydrophones. PAMGuard and spectrogram data indicated the presence of two animals within the 1500 m BZ. When sound files were analyzed using Raven Lite, MF echolocation clicks were seen ranging from 5 to 120 kHz with an ICI of 0.48 seconds. At the time of the detection the vessel was on a line change and the source was silent after a shutdown previously implemented by the PAM team (AD 559). A delay to the initiation of the source was implemented and resulted in one hour and 32 minutes of mitigation downtime.

#### Appendix F PAM Setup Descriptions

#### 1.1. REM Andes

The PAM station was set up in the Instrument Room. The main and the spare deck leads were both routed above the panels on the ceiling of the Instrument Room and Server Room.



Figure 1. PAM station in instrument room

The deck cable exited out of the aft wall of the server room. The cables were then routed along the cable trays on both port and starboard sides to the stern of the source deck where the tow cables were then coiled up on the deck.



Figure 2. Opening of the source deck

Routing the deck cables through the cable trays between the instrument room and the opening of the source deck was easily done as the ceiling was quite low. Routing the deck cables through the cable trays over the opening in the source deck was achieved using a rope to pull the cables through. Once the cables were routed to the back of the source deck past the opening in the deck, a stepladder was required to continue routing the deck cables through the cable trays in port and starboard side to the tow cables.



Figure 3. Routing of the deck cable

The port side cable was the main one and the starboard side spare cable was ready to use for the initial testing of the source.

In the first deployment for source testing, a set of Chinese fingers was attached 75 m from the end of the tow cable (ITT connector) which was the tow point for the tow cable. When in full operations of the source the Chinese fingers were attached at 175 m from the end of the tow cable.



Figure 4. Routing of the deck cable



Figure 5. Tow cable in the back of source deck

#### 1.2. Sanco Spirit

The 230 m tow cable portion of the array was wound on a hydraulic winch, located on the streamer deck at the vessel's stern. The 25 m six hydrophone array was connected via a subsea connection to the tow cable and remained connected and coiled on deck when not deployed. PAM deployment began with a toolbox by PAM Operator and Sanco source mechanics, followed by crew carefully lowering the array portion of the cable over the rail at the stern of the vessel into the water.



Figure 6. Deck cable connected to the tow cable spooled into the winch onboard the Sanco Spirit

The tow cable and hydrophone array on the *Sanco Spirit* were deployed from a winch on the streamer deck. The winch was located at the center stern of the vessel, approximately 4 m from the stern rail and 6.6 m above the water's surface. The cable and hydrophone array were deployed over the stern rail to approximately 150 m astern of the vessel. To prevent an acute point of tension and chaffing on the tow cable, a braided rope arrangement was positioned at the 150 m mark and secured to a winch on deck after deployment. Subsequently, the tow cable was connected to a 100 m deck cable, the acquisition unit and audio interface were powered on the buffer unit, PAMGuard signal processing starts, and acoustic observations began.

#### 1.3. Artemis Athene

The PAM monitoring station was set up in the Instrument room. Both the main and the spare deck leads were both routed under the floor of the instrument room and server room and out the aft wall of the server room. The cables were then routed along the cable trays to the stern of the streamer deck where the hydrophone cables were set up on winches. At the stern of the streamer deck, both sets of tow and hydrophone cables were spooled onto mechanical winches on the port and starboard sides for quick deployment and retrieval. Throughout the survey both the port and starboard cables were used depending on the needs of the seismic crew.



Figure 7. PAM monitoring station in instrument room

The PAM cable was deployed directly off the stern of the *Artemis Athene* from the streamer deck. When deploying, the 25 m of hydrophone cable were deployed off the stern by hand. The Mechanic then opened the local hydraulic valves to activate and run the winch to deploy the cable to the desired tow length, which for the project was 145 m of tow cable added to the 25 m length of hydrophone cable.



Figure 8. PAM cable deployed off stern

The PAM cable was deployed and retrieved from the streamer deck, but the tow points and tension were set up off the source deck of the *Artemis Athene*. A 10 m rope with a G-link was temporarily attached to the back of the streamer deck near the PAM cable deployment point. The other end of the rope was securely attached to the back of the source deck. At approximately 145 m a set of Chinese fingers with a G-link was attached to the tow cable. Once the cable was deployed up to the Chinese fingers the G-link was attached to the rope/Glink and the remaining 12-15 m of PAM cable was deployed which transfered the tension from the PAM cable and winch to the rope attached to the source deck.



Figure 9. Tension rope attachment on source deck

### Appendix G Other Wildlife

#### 1.1. Birds



Figure 1. Sea birds observed during Engagement 5



Figure 2. Land birds and waterfowl observed during Engagement 5

### 1.2. Fish and invertebrates



Figure 3. Fish and invertebrates observed during Engagement 5

#### Appendix H PAM Calibration Report

### SM.7955 System Frequency Response

This PAM system has been calibrated so that realistic sound level and signal amplitudes values may be displayed in PAM software. The system frequency response of the system when using this hydrophone array is shown below, and calibration settings are provided for use in Pamguard.

Table 2 provides -3 dB and -6 dB points of the system response curves for hydrophones in each group. These points delimit the 'flat' portion of the response curve. Groups H1-H2 and H3-H4 are acquired by the Fireface 800/802 sound card. Group H5-H6 is acquired by the NI USB-6251 DAQ. The frequency response curves are shown in Fig. 14.

Table 2Frequency points for -3 dB and -6 dB sensitivity, for representative hydrophones of each<br/>group.

Hudronhono	Fireface 800,	Fireface 800,	USB-6251,	USB-6251,
нушторлопе	-3 dB	-6 dB	-3 dB	-6 dB
H1	16-25,000 Hz	10-40,000 Hz	-	-
Н3	400-80,000 Hz	250-80,000 Hz	-	-
Н5	-	-	2,500-160,000 Hz	1,600-250,000 Hz



*Fig.* 14 System frequency response curves showing channel sensitivity for representative hydrophones of the H1-H2, H3-H4 and H5-H6 groups.

# Calibration Values for PAM Software

## Pamguard Array Manager

H1 (Ch0, 0.01-24 kHz)	Sensitivity = -196.0 dB re: 1 V/uPa, Preamplifier Gain = +21.0 dB
H2 (Ch1, 0.01-24 kHz)	Sensitivity = -195.5 dB re: 1 V/uPa, Preamplifier Gain = +21.0 dB
H3 (Ch2, 0.2-200 kHz)	Sensitivity = -195.9 dB re: 1 V/uPa, Preamplifier Gain = +39.8 dB
H4 (Ch3, 0.2-200 kHz)	Sensitivity = -195.9 dB re: 1 V/uPa, Preamplifier Gain = +39.8 dB
H5 (Ch4, 2-200 kHz)	Sensitivity = -195.9 dB re: 1 V/uPa, Preamplifier Gain = +39.8 dB
H6 (Ch5, 2-200 kHz)	Sensitivity = -195.7 dB re: 1 V/uPa, Preamplifier Gain = +39.7 dB

## Pamguard Sound Acquisition

### NI USB-6251

	Terminal ConfigurationDifferential
	Input Voltage Range4 V (set as +/- 2 V per channel)
	Additional System Gain0 dB
	ChannelsSW Ch0 / HW Ch4, SW Ch1 / HW Ch5
	Sample Rateup to 500 kHz
	Sample Size16 bit
RM	E Fireface 800
	Line Level Input10 dBV (set in the <u>Fireface Settings</u> utility)
	Input Voltage Range (p-p)2 V (i.e., +/- 1 V)
	Additional System Gain11.3 dB
	ChannelsSW Ch0 / HW Ch0, SW Ch1 / HW Ch1
	SW Ch2 / HW Ch2, SW Ch3 / HW Ch3
	Sample Rate48-192 kHz
	Sample Size24 bit

# Depth Sensor

The array section is terminated with a piezoresistive pressure sensor.

Pressure Sensor Rating	10 bar
Working Depth Range	0-100 m (overpressure limit = 200 m)
ADC	Measurement Computing USB-1208 LS
Range	-2.5 to +2.5 V
Hardware Channel	0
Pamguard Calibration	Depth (m) = 64.8 * Voltage + 67.3 offset

## **Calibration Methods**

#### **Recording Chain Components**

At Seiche Ltd., we measure the gain response of the individual electronic components of our PAM systems as a quality control process, immediately after purchase or manufacture. The same procedure, with slight differences, is followed when measuring the frequency response of preamplifiers, buffer boards, and data-acquisition units (DAQs).

The National Instruments DAQ NI-6251 is at the heart of the calibration approach. Currently, we use two in-house software applications (coded in MATLAB and LabView) to automate the measurement process. Both applications work in a similar way, producing a sequence of short tone bursts of increasing frequency, which are sent to the input of the Device Under Test (DUT) via the NI-6251, and are simultaneously recorded by the NI-6251 from the output of the DUT. The output tones from the DUT's are 'gated' and band-filtered to minimise the effect of contaminating noise. Gain is then calculated as the ratio between the root-mean-squared (RMS) voltage of the band-filtered output and the input at each measured frequency. The frequency response is presented in decibels, as 20 x log<sub>10</sub> voltage gain.

A Faraday cage is used for the calibration of small components, such as preamplifiers and buffer boards, to reduce the contamination from electromagnetic interference. For larger devices, such as DAQ units, band-filtering techniques are most effective.

### Hydrophone at Low Frequency

The low frequency sensitivity of all piezo-electric ceramics is measured before these are 'potted' onto a hydrophone cable using Robnor Resinlab EL225D/Bk. For this purpose, we use a relative *pressure-field* calibration method with a reference transducer, as described in section 10.4.1 of the BSI standard BS EN IEC 60565-2:2019 "Underwater Acoustics – Hydrophones – Calibration of Hydrophones. Part 2: Procedures for low frequency pressure calibration".

The ceramic is housed in an air-tight copper enclosure sealed at the bottom by a loudspeaker. The enclosure comprises two output terminals, connected internally to the ceramic, and an opening for the attachment of a reference microphone. The loudspeaker is driven with a constant low-frequency tone produced by a TTi TG5012A signal generator. A preamplifier is connected to the output terminals of the ceramic to adapt the impedance between the ceramic and the measuring device. The microphone is connected to a WB1372 DeltaTron power supply to polarise the capsule and condition the signal. The outputs from the ceramic and preamplifier, and the reference microphone and power

supply, are connected to an Agilent MSO-X 3024A digital oscilloscope. The RMS voltages from the three outputs are then measured and added into a spreadsheet tool for automatically calculating the sensitivity (in dB re:  $1\mu$ Pa) for the corresponding frequencies. The spreadsheet uses the sensitivity of the reference microphone and the gain of the ceramic's preamplifier to calculate the final sensitivity of the ceramic.

Only six frequencies, from 10 Hz to 200 Hz, are routinely calibrated. Higher frequencies cannot be accurately measured with this method, since the *pressure field* assumption is no longer valid for frequencies comparable or lower than, the largest dimension of the cavity of the enclosure, resulting in an in-homogenous pressure field. Nonetheless, the low-frequency sensitivity of the ceramic remains practically constant at frequencies lower than the mechanical resonance of the ceramic, which is of the order of 50 kHz for our spherical ceramics.

The sensitivity response of 'potted' hydrophones at low frequencies is calculated as the combination of the nominal sensitivity of the ceramic (averaged over 5 measurements from 20 Hz to 200 Hz) and the gain response of the selected preamplifier. The sensitivity response calculated in this way holds relatively high accuracy up to 10 kHz. For frequencies above 10 kHz, a high-frequency calibration approach is required.

#### Hydrophone at High Frequency

When required, the high frequency sensitivity of 'potted' hydrophones is measured using a relative *free-field* method with reference hydrophone, as described in section 10.4.1 of the BSI standard BS EN IEC 60565-1:2020 "Underwater Acoustics – Hydrophones – Calibration of Hydrophones. Part 1: Procedures for free-field calibration of hydrophones".

The hydrophone under test (HUT) is placed in a *pool* or large water tank at a fixed position, depth and orientation. A *projector* or emitting hydrophone is placed at a fixed distance from the HUD. A National Instruments NI-6251 DAQ is used to simultaneously generate and measure a sequence of short tone bursts. The signal sequence is sent to a 50 dB power amplifier, with flat response below the megahertz range, to drive the projector. The voltage from the HUT is measured by the NI-6251. The process is repeated by replacing the HUT with a reference hydrophone of known sensitivity. The individual tones in the sequences measured by the reference hydrophone and HUT are 'gated' and band-filtered before calculating their RMS voltage.

The measurement from the reference hydrophone is used to provide an accurate estimate of the pressure at the HUD for different frequencies. The pressure at the receiver and the measured voltage from the HUT are combined to obtain the sensitivity of the HUT, in dB re:  $1V/\mu$ Pa.

The burst duration, emission period and measurement repeatability are key for the success of this type of calibration. The burst duration must be short enough to ensure that individual tone bursts are not affected by reflections from boundaries in the finite-sized tank, and can then be isolated; the emission period must be long enough to ensure that the reverberant energy from a previous emission is totally dissipated; and test conditions (hydrophone locations, water temperature, cables, etc.) are carefully controlled to ensure repeatability in the results. All free-field measurements are carried out with strict control measurements to guarantee maximum accuracy within the limitations of the calibration approach (see BS EN IEC 60565-1:2020).

## SM.8194 System Frequency Response

This PAM system has been calibrated so that realistic sound level and signal amplitudes values may be displayed in PAM software. The system frequency response of the system when using this hydrophone array is shown below, and calibration settings are provided for use in Pamguard.

Table 2 provides -3 dB and -6 dB points of the system response curves for hydrophones in each group. These points delimit the 'flat' portion of the response curve. Groups H1-H2 and H3-H4 are acquired by the Fireface 800/802 sound card. Group H5-H6 is acquired by the NI USB-6251 DAQ. The frequency response curves are shown in Fig. 14.

Table 2Frequency points for -3 dB and -6 dB sensitivity, for representative hydrophones of each<br/>group.

Hudronhono	Fireface 800,	Fireface 800,	USB-6251,	USB-6251,
нушторлопе	-3 dB	-6 dB	-3 dB	-6 dB
H1	16-25,000 Hz	10-40,000 Hz	-	-
Н3	400-80,000 Hz	250-80,000 Hz	-	-
Н5	-	-	2,500-160,000 Hz	1,600-250,000 Hz



*Fig.* 14 System frequency response curves showing channel sensitivity for representative hydrophones of the H1-H2, H3-H4 and H5-H6 groups.

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H1 (Ch0, 0.01-24 kHz)	Sensitivity = -196.0 dB re: 1 V/uPa, Preamplifier Gain = +21.0 dB
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H4 (Ch3, 0.2-200 kHz)	Sensitivity = -195.9 dB re: 1 V/uPa, Preamplifier Gain = +39.8 dB
H5 (Ch4, 2-200 kHz)	Sensitivity = -195.9 dB re: 1 V/uPa, Preamplifier Gain = +39.8 dB
H6 (Ch5, 2-200 kHz)	Sensitivity = -195.7 dB re: 1 V/uPa, Preamplifier Gain = +39.7 dB

## Pamguard Sound Acquisition

### NI USB-6251

	Terminal ConfigurationDifferential
	Input Voltage Range4 V (set as +/- 2 V per channel)
	Additional System Gain0 dB
	ChannelsSW Ch0 / HW Ch4, SW Ch1 / HW Ch5
	Sample Rateup to 500 kHz
	Sample Size16 bit
RM	E Fireface 800
	Line Level Input10 dBV (set in the <u>Fireface Settings</u> utility)
	Input Voltage Range (p-p)2 V (i.e., +/- 1 V)
	Additional System Gain11.3 dB
	ChannelsSW Ch0 / HW Ch0, SW Ch1 / HW Ch1
	SW Ch2 / HW Ch2, SW Ch3 / HW Ch3
	Sample Rate48-192 kHz
	Sample Size24 bit

# Depth Sensor

The array section is terminated with a piezoresistive pressure sensor.

Pressure Sensor Rating	10 bar
Working Depth Range	0-100 m (overpressure limit = 200 m)
ADC	Measurement Computing USB-1208 LS
Range	-2.5 to +2.5 V
Hardware Channel	0
Pamguard Calibration	Depth (m) = 64.8 * Voltage + 67.3 offset

## **Calibration Methods**

#### **Recording Chain Components**

At Seiche Ltd., we measure the gain response of the individual electronic components of our PAM systems as a quality control process, immediately after purchase or manufacture. The same procedure, with slight differences, is followed when measuring the frequency response of preamplifiers, buffer boards, and data-acquisition units (DAQs).

The National Instruments DAQ NI-6251 is at the heart of the calibration approach. Currently, we use two in-house software applications (coded in MATLAB and LabView) to automate the measurement process. Both applications work in a similar way, producing a sequence of short tone bursts of increasing frequency, which are sent to the input of the Device Under Test (DUT) via the NI-6251, and are simultaneously recorded by the NI-6251 from the output of the DUT. The output tones from the DUT's are 'gated' and band-filtered to minimise the effect of contaminating noise. Gain is then calculated as the ratio between the root-mean-squared (RMS) voltage of the band-filtered output and the input at each measured frequency. The frequency response is presented in decibels, as 20 x log<sub>10</sub> voltage gain.

A Faraday cage is used for the calibration of small components, such as preamplifiers and buffer boards, to reduce the contamination from electromagnetic interference. For larger devices, such as DAQ units, band-filtering techniques are most effective.

### Hydrophone at Low Frequency

The low frequency sensitivity of all piezo-electric ceramics is measured before these are 'potted' onto a hydrophone cable using Robnor Resinlab EL225D/Bk. For this purpose, we use a relative *pressure-field* calibration method with a reference transducer, as described in section 10.4.1 of the BSI standard BS EN IEC 60565-2:2019 "Underwater Acoustics – Hydrophones – Calibration of Hydrophones. Part 2: Procedures for low frequency pressure calibration".

The ceramic is housed in an air-tight copper enclosure sealed at the bottom by a loudspeaker. The enclosure comprises two output terminals, connected internally to the ceramic, and an opening for the attachment of a reference microphone. The loudspeaker is driven with a constant low-frequency tone produced by a TTi TG5012A signal generator. A preamplifier is connected to the output terminals of the ceramic to adapt the impedance between the ceramic and the measuring device. The microphone is connected to a WB1372 DeltaTron power supply to polarise the capsule and condition the signal. The outputs from the ceramic and preamplifier, and the reference microphone and power

supply, are connected to an Agilent MSO-X 3024A digital oscilloscope. The RMS voltages from the three outputs are then measured and added into a spreadsheet tool for automatically calculating the sensitivity (in dB re:  $1\mu$ Pa) for the corresponding frequencies. The spreadsheet uses the sensitivity of the reference microphone and the gain of the ceramic's preamplifier to calculate the final sensitivity of the ceramic.

Only six frequencies, from 10 Hz to 200 Hz, are routinely calibrated. Higher frequencies cannot be accurately measured with this method, since the *pressure field* assumption is no longer valid for frequencies comparable or lower than, the largest dimension of the cavity of the enclosure, resulting in an in-homogenous pressure field. Nonetheless, the low-frequency sensitivity of the ceramic remains practically constant at frequencies lower than the mechanical resonance of the ceramic, which is of the order of 50 kHz for our spherical ceramics.

The sensitivity response of 'potted' hydrophones at low frequencies is calculated as the combination of the nominal sensitivity of the ceramic (averaged over 5 measurements from 20 Hz to 200 Hz) and the gain response of the selected preamplifier. The sensitivity response calculated in this way holds relatively high accuracy up to 10 kHz. For frequencies above 10 kHz, a high-frequency calibration approach is required.

#### Hydrophone at High Frequency

When required, the high frequency sensitivity of 'potted' hydrophones is measured using a relative *free-field* method with reference hydrophone, as described in section 10.4.1 of the BSI standard BS EN IEC 60565-1:2020 "Underwater Acoustics – Hydrophones – Calibration of Hydrophones. Part 1: Procedures for free-field calibration of hydrophones".

The hydrophone under test (HUT) is placed in a *pool* or large water tank at a fixed position, depth and orientation. A *projector* or emitting hydrophone is placed at a fixed distance from the HUD. A National Instruments NI-6251 DAQ is used to simultaneously generate and measure a sequence of short tone bursts. The signal sequence is sent to a 50 dB power amplifier, with flat response below the megahertz range, to drive the projector. The voltage from the HUT is measured by the NI-6251. The process is repeated by replacing the HUT with a reference hydrophone of known sensitivity. The individual tones in the sequences measured by the reference hydrophone and HUT are 'gated' and band-filtered before calculating their RMS voltage.

The measurement from the reference hydrophone is used to provide an accurate estimate of the pressure at the HUD for different frequencies. The pressure at the receiver and the measured voltage from the HUT are combined to obtain the sensitivity of the HUT, in dB re:  $1V/\mu$ Pa.

The burst duration, emission period and measurement repeatability are key for the success of this type of calibration. The burst duration must be short enough to ensure that individual tone bursts are not affected by reflections from boundaries in the finite-sized tank, and can then be isolated; the emission period must be long enough to ensure that the reverberant energy from a previous emission is totally dissipated; and test conditions (hydrophone locations, water temperature, cables, etc.) are carefully controlled to ensure repeatability in the results. All free-field measurements are carried out with strict control measurements to guarantee maximum accuracy within the limitations of the calibration approach (see BS EN IEC 60565-1:2020).

## SM.8292 System Frequency Response

This PAM system has been calibrated so that realistic sound level and signal amplitudes values may be displayed in PAM software. The system frequency response of the system when using this hydrophone array is shown below, and calibration settings are provided for use in Pamguard.

Table 2 provides -3 dB and -6 dB points of the system response curves for hydrophones in each group. These points delimit the 'flat' portion of the response curve. Groups H1-H2 and H3-H4 are acquired by the Fireface 800/802 sound card. Group H5-H6 is acquired by the NI USB-6251 DAQ. The frequency response curves are shown in Fig. 14.

Table 2Frequency points for -3 dB and -6 dB sensitivity, for representative hydrophones of each<br/>group.

Hudronhono	Fireface 800,	Fireface 800,	USB-6251,	USB-6251,
нушторлопе	-3 dB	-6 dB	-3 dB	-6 dB
H1	16-25,000 Hz	10-40,000 Hz	-	-
Н3	400-80,000 Hz	250-80,000 Hz	-	-
Н5	-	-	2,500-160,000 Hz	1,600-250,000 Hz



*Fig.* 14 System frequency response curves showing channel sensitivity for representative hydrophones of the H1-H2, H3-H4 and H5-H6 groups.

# Calibration Values for PAM Software

## Pamguard Array Manager

H1 (Ch0, 0.01-24 kHz)	Sensitivity = -196.0 dB re: 1 V/uPa, Preamplifier Gain = +21.0 dB
H2 (Ch1, 0.01-24 kHz)	Sensitivity = -195.5 dB re: 1 V/uPa, Preamplifier Gain = +21.0 dB
H3 (Ch2, 0.2-200 kHz)	Sensitivity = -195.9 dB re: 1 V/uPa, Preamplifier Gain = +39.8 dB
H4 (Ch3, 0.2-200 kHz)	Sensitivity = -195.9 dB re: 1 V/uPa, Preamplifier Gain = +39.8 dB
H5 (Ch4, 2-200 kHz)	Sensitivity = -195.9 dB re: 1 V/uPa, Preamplifier Gain = +39.8 dB
H6 (Ch5, 2-200 kHz)	Sensitivity = -195.7 dB re: 1 V/uPa, Preamplifier Gain = +39.7 dB

## Pamguard Sound Acquisition

### NI USB-6251

Т	Ferminal Configuration	.Differential
Ir	nput Voltage Range	.4 V (set as +/- 2 V per channel)
А	Additional System Gain	.0 dB
С	Channels	.SW Ch0 / HW Ch4, SW Ch1 / HW Ch5
S	Sample Rate	.up to 500 kHz
S	Sample Size	.16 bit
RME I	Fireface 800	
Li	ine Level Input	10 dBV (set in the <u>Fireface Settings</u> utility)
Ir	nput Voltage Range (p-p)	.2 V (i.e., +/- 1 V)
A	Additional System Gain	11.3 dB
С	Channels	.SW Ch0 / HW Ch0, SW Ch1 / HW Ch1
		.SW Ch2 / HW Ch2, SW Ch3 / HW Ch3
S	Sample Rate	.48-192 kHz
S	Sample Size	.24 bit

# Depth Sensor

The array section is terminated with a piezoresistive pressure sensor.

Pressure Sensor Rating	10 bar
Working Depth Range	0-100 m (overpressure limit = 200 m)
ADC	Measurement Computing USB-1208 LS
Range	-2.5 to +2.5 V
Hardware Channel	0
Pamguard Calibration	Depth (m) = 64.8 * Voltage + 67.3 offset

## **Calibration Methods**

#### **Recording Chain Components**

At Seiche Ltd., we measure the gain response of the individual electronic components of our PAM systems as a quality control process, immediately after purchase or manufacture. The same procedure, with slight differences, is followed when measuring the frequency response of preamplifiers, buffer boards, and data-acquisition units (DAQs).

The National Instruments DAQ NI-6251 is at the heart of the calibration approach. Currently, we use two in-house software applications (coded in MATLAB and LabView) to automate the measurement process. Both applications work in a similar way, producing a sequence of short tone bursts of increasing frequency, which are sent to the input of the Device Under Test (DUT) via the NI-6251, and are simultaneously recorded by the NI-6251 from the output of the DUT. The output tones from the DUT's are 'gated' and band-filtered to minimise the effect of contaminating noise. Gain is then calculated as the ratio between the root-mean-squared (RMS) voltage of the band-filtered output and the input at each measured frequency. The frequency response is presented in decibels, as 20 x log<sub>10</sub> voltage gain.

A Faraday cage is used for the calibration of small components, such as preamplifiers and buffer boards, to reduce the contamination from electromagnetic interference. For larger devices, such as DAQ units, band-filtering techniques are most effective.

### Hydrophone at Low Frequency

The low frequency sensitivity of all piezo-electric ceramics is measured before these are 'potted' onto a hydrophone cable using Robnor Resinlab EL225D/Bk. For this purpose, we use a relative *pressure-field* calibration method with a reference transducer, as described in section 10.4.1 of the BSI standard BS EN IEC 60565-2:2019 "Underwater Acoustics – Hydrophones – Calibration of Hydrophones. Part 2: Procedures for low frequency pressure calibration".

The ceramic is housed in an air-tight copper enclosure sealed at the bottom by a loudspeaker. The enclosure comprises two output terminals, connected internally to the ceramic, and an opening for the attachment of a reference microphone. The loudspeaker is driven with a constant low-frequency tone produced by a TTi TG5012A signal generator. A preamplifier is connected to the output terminals of the ceramic to adapt the impedance between the ceramic and the measuring device. The microphone is connected to a WB1372 DeltaTron power supply to polarise the capsule and condition the signal. The outputs from the ceramic and preamplifier, and the reference microphone and power

supply, are connected to an Agilent MSO-X 3024A digital oscilloscope. The RMS voltages from the three outputs are then measured and added into a spreadsheet tool for automatically calculating the sensitivity (in dB re:  $1\mu$ Pa) for the corresponding frequencies. The spreadsheet uses the sensitivity of the reference microphone and the gain of the ceramic's preamplifier to calculate the final sensitivity of the ceramic.

Only six frequencies, from 10 Hz to 200 Hz, are routinely calibrated. Higher frequencies cannot be accurately measured with this method, since the *pressure field* assumption is no longer valid for frequencies comparable or lower than, the largest dimension of the cavity of the enclosure, resulting in an in-homogenous pressure field. Nonetheless, the low-frequency sensitivity of the ceramic remains practically constant at frequencies lower than the mechanical resonance of the ceramic, which is of the order of 50 kHz for our spherical ceramics.

The sensitivity response of 'potted' hydrophones at low frequencies is calculated as the combination of the nominal sensitivity of the ceramic (averaged over 5 measurements from 20 Hz to 200 Hz) and the gain response of the selected preamplifier. The sensitivity response calculated in this way holds relatively high accuracy up to 10 kHz. For frequencies above 10 kHz, a high-frequency calibration approach is required.

#### Hydrophone at High Frequency

When required, the high frequency sensitivity of 'potted' hydrophones is measured using a relative *free-field* method with reference hydrophone, as described in section 10.4.1 of the BSI standard BS EN IEC 60565-1:2020 "Underwater Acoustics – Hydrophones – Calibration of Hydrophones. Part 1: Procedures for free-field calibration of hydrophones".

The hydrophone under test (HUT) is placed in a *pool* or large water tank at a fixed position, depth and orientation. A *projector* or emitting hydrophone is placed at a fixed distance from the HUD. A National Instruments NI-6251 DAQ is used to simultaneously generate and measure a sequence of short tone bursts. The signal sequence is sent to a 50 dB power amplifier, with flat response below the megahertz range, to drive the projector. The voltage from the HUT is measured by the NI-6251. The process is repeated by replacing the HUT with a reference hydrophone of known sensitivity. The individual tones in the sequences measured by the reference hydrophone and HUT are 'gated' and band-filtered before calculating their RMS voltage.

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#### Appendix I Report Certification



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# **Report Certification**

In accordance with the Letter of Authorization issued for this project, this letter serves as certification that the Lead PSO confirms that the data collected by the offshore observers and information provided within the final report are accurate to the best of their knowledge.

Signature: _	Lorena Marquez	Signature:	
Name:	Lead PSO Lorena Marquez	Name:	Jordan Boliver
Date:	04/16/2025 PDT	Date:	04/16/2025 PDT
Vessel:	REM Andes	Vessel:	Sanco Spirit

Signature:	Signer ID: TODQBHCTXO Lead PSO
Name:	Rachel Rice
Date: _	04/16/2025 PDT

Vessel: Artemis Athene

Registered In Texas, USA. Company Registration No. 801797359 EIN No. 46-3185044. Registered Office 206E, 9<sup>th</sup> Street Suite 1300, Austin, Texas, 78701, USA.

#### Appendix J Vessel Tracklines