

**Application for Letter of Authorization  
for the Non-Lethal Taking of Marine Mammals:**

**bp 2024 Thunder Horse Seismic Survey**

**BOEM G&G Permit: L24-001  
Outer Continental Shelf, Gulf of Mexico**

**Prepared by:**



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**Prepared for:  
bp Exploration & Production Inc.**

**March 2024**



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# Contents

	Page
<b>List of Tables</b> .....	<b>iv</b>
<b>List of Figures</b> .....	<b>v</b>
<b>List of Acronyms and Abbreviations</b> .....	<b>vi</b>
<b>1.0 Description of Proposed Activities</b> .....	<b>1</b>
1.1 PROJECT DESCRIPTION .....	1
1.1.1 Activities Considered in Application.....	3
1.1.2 Acoustic Sources.....	5
<b>2.0 Survey Dates, Duration, and Specific Geographic Region</b> .....	<b>9</b>
2.1 SURVEY ACTIVITY DATES AND DURATION .....	9
2.2 SPECIFIC GEOGRAPHIC REGION .....	9
<b>3.0 Species and Numbers of Marine Mammals</b> .....	<b>10</b>
<b>4.0 Affected Species Status and Distribution</b> .....	<b>11</b>
<b>5.0 Type of Incidental Taking Authorization Requested</b> .....	<b>12</b>
<b>6.0 Take Estimates for Marine Mammals</b> .....	<b>13</b>
6.1 ESTIMATED NUMBERS OF MARINE MAMMALS THAT MIGHT BE TAKEN BY HARASSMENT .....	13
6.1.1 Level B Harassment of Marine Mammals .....	13
6.2 REQUESTED TAKES.....	14
<b>7.0 Effects on Marine Mammal Species or Stocks</b> .....	<b>16</b>
<b>8.0 Minimization of Adverse Effects to Subsistence Uses</b> .....	<b>17</b>
<b>9.0 Anticipated Impacts on Habitat</b> .....	<b>18</b>
<b>10.0 Anticipated Effects of Habitat Impacts on Marine Mammals</b> .....	<b>19</b>
<b>11.0 Mitigation Measures</b> .....	<b>20</b>
<b>12.0 Arctic Plan of Cooperation</b> .....	<b>21</b>
<b>13.0 Monitoring and Reporting</b> .....	<b>22</b>
<b>14.0 Suggested Means of Coordinated Research</b> .....	<b>23</b>
<b>15.0 List of Preparers</b> .....	<b>24</b>
<b>16.0 References</b> .....	<b>25</b>

## List of Tables

<b>Table</b>		<b>Page</b>
1	Primary Gulf of Mexico protraction blocks for the bp 2024 Thunder Horse seismic survey in which survey will occur.....	1
2	Approximate location, duration, and season within which the proposed ocean bottom node (OBN) and distributed acoustic sensing (DAS) survey, optional Gemini 8000 source test, and optional Source Apparition (SA) source test activities used for the analysis in this Application.....	5
3	Survey specifications for the source arrays to be used during the proposed Thunder Horse survey in the U.S. Gulf of Mexico included in this Application.....	8
4	Summary of marine mammals of the northern Gulf of Mexico.....	10
5	Parameters used in the National Marine Fisheries Service (NMFS) exposure estimation tool (NMFS, 2021).....	13
6	Maximum annual Level B exposures for bp’s 2024 Thunder Horse seismic survey estimated using the National Marine Fisheries (NMFS) draft exposure estimation tool (NMFS, 2021).....	14
7	Requested Level B exposures for bp’s 2024 Thunder Horse seismic survey .....	15

## List of Figures

<b>Figure</b>		<b>Page</b>
1	Location of the proposed three-dimensional (3D) ocean bottom node (OBN) and distributed acoustic sensing (DAS) geophysical survey in bp Exploration & Production Inc .....	2
2	Depiction of the Gemini 8000 sound source.....	4
3	Source array configuration for the proposed ocean bottom node (OBN) and distributed acoustic sensing (DAS) survey .....	6

## List of Acronyms and Abbreviations

μPa	micropascal
2D	two-dimensional
3D	three-dimensional
BOEM	Bureau of Ocean Energy Management
bp	bp Exploration & Production Inc.
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulations
DAS	distributed acoustic sensing
dB	decibel
EWG	expert working group
FR	Federal Register
GOMx	Gulf of Mexico
ITR	incidental take regulation
JASCO	JASCO Applied Sciences
LOA	Letter of Authorization
Lpk	peak sound pressure level
MMPA	Marine Mammal Protection Act
NAZ	narrow azimuth
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
NUT	New or Unusual Technology
OBN	ocean bottom node
OCS	Outer Continental Shelf
Lpk	zero-to-peak sound pressure level
PTS	permanent threshold shift
re	referenced to
ROV	remotely operated vehicle
SL	source level
SPL	root-mean-square sound pressure level
WAZ	wide azimuth

## 1.0 Description of Proposed Activities

In accordance with the final incidental take regulation (ITR) published 19 January 2021 (86 *Federal Register* [FR] 5322) and revised 5 January 2023 (88 FR 916), bp Exploration & Production Inc. (bp), hereinafter referred to as the “Applicant”, submits this request for a Letter of Authorization (LOA) for the non-lethal, unintentional taking of small numbers of marine mammals resulting from a three-dimensional (3D) ocean bottom node (OBN) and distributed acoustic sensing (DAS) geophysical surveys, a source test of the Gemini 8000 (Gemini source test), and a Seismic Apparition (SA) source test conducted in the Gulf of Mexico (GOMx). The information provided in this document is submitted in accordance with the final ITR published 19 January 2021 (86 FR 5322), any relevant updates from the 2023 proposed ITR (88 FR 916), and the requirements of 50 Code of Federal Regulations (CFR) § 216.104 to allow for take by incidental harassment of small numbers of marine mammals resulting from geophysical surveys for oil and gas exploration activities.

### 1.1 PROJECT DESCRIPTION

The Applicant proposes to conduct a 3D OBN and DAS survey, with two optional tests: a Gemini source test, and an SA source test within the Thunder Horse bp prospect. Prospect area is located in the Bureau of Ocean Energy Management’s (BOEM’s) Central Planning Area of the GOM that overlaps with ITR assessment zones 5 and 7 (**Figure 1**). The scope is expected to begin no earlier than 25 March 2024.

The prospect areas under consideration are located in the MC and Atwater Valley (AT) lease areas. In 2024, the Applicant anticipates a single 3D OBN/DAS survey within this prospect area; an optional Gemini source test; and an optional SA source test. **Table 1** provides the protraction blocks for the primary boundaries of this prospect. Surrounding blocks may be included in some surveys; however, all blocks involved in the survey will remain in either zone 5 or zone 7.

Table 1. Primary Gulf of Mexico protraction blocks for the bp 2024 Thunder Horse seismic survey in which survey will occur.

Thunder Horse
<u>MC</u> : 514, 515, 516, 517, 518, 519, 520, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 993, 994, 995, 996, 997, 998, 999, 1000, 1001, 1002
<u>AT</u> : 26, 27, 28, 29, 30, 31, 32, 33, 71, 72, 73, 74, 75, 76

AT = Atwater Valley; MC = Mississippi Canyon.

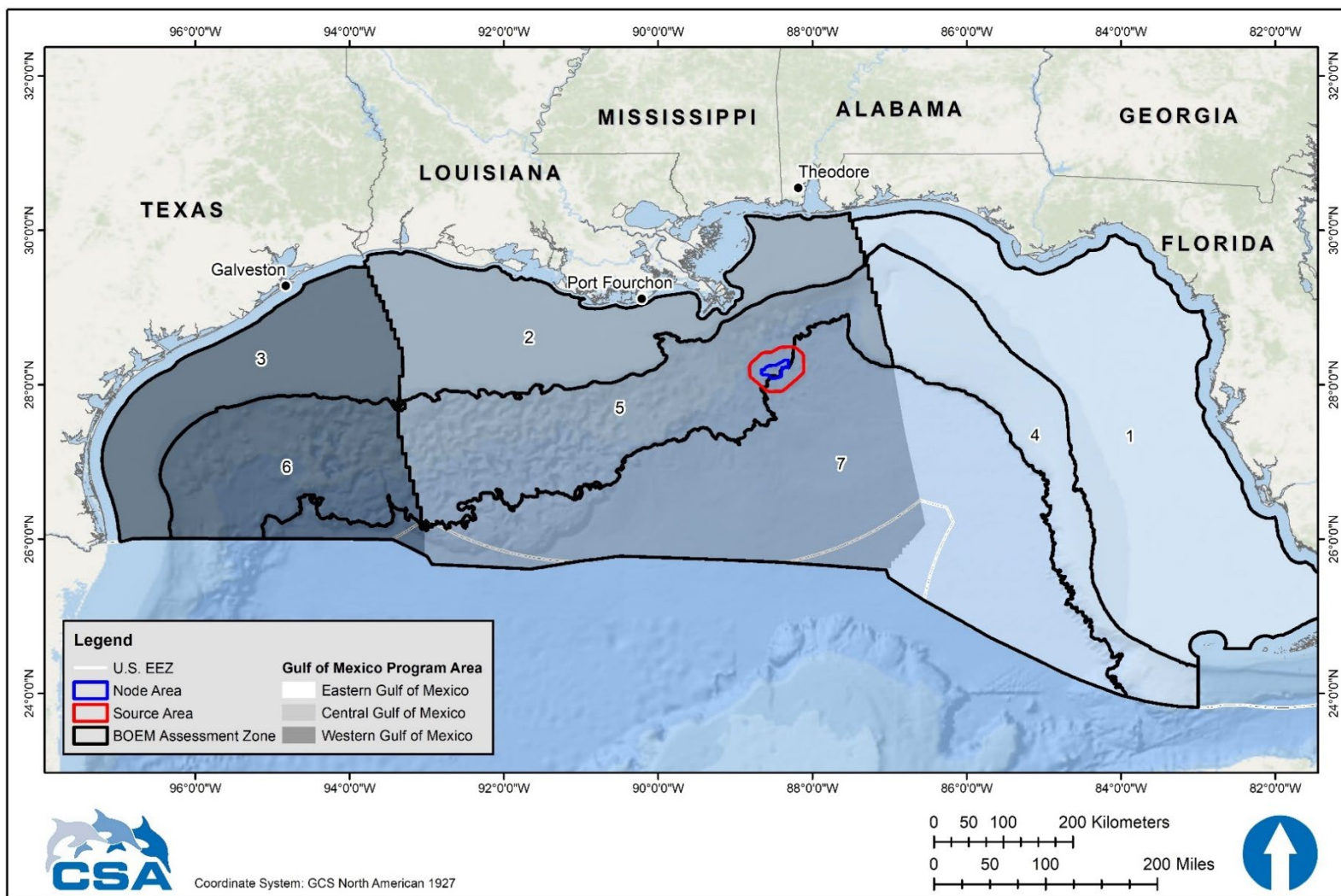


Figure 1. Location of the proposed three-dimensional (3D) ocean bottom node (OBN) and distributed acoustic sensing (DAS) geophysical survey in bp Exploration & Production Inc. Thunder Horse prospect area within the Bureau of Ocean Energy Management’s (BOEM’s) Gulf of Mexico Central Planning Area in relation to the assessment zones identified in the incidental take regulation (ITR) (86 Federal Register (*FR*) 5322). EEZ = exclusive economic zone.



## 1.1.1 Activities Considered in Application

### *OBN and DAS Surveys*

The OBN survey employ bottom-mounted receivers, or “nodes”, used in conjunction with a vessel-towed seismic source array. Seismic receivers (nodes) are deployed from remotely operated vehicles (ROV) within the node areas (**Figure 1**). For the Thunder Horse project, nodes will be deployed using four configurations; a sparse density configuration, a medium density configuration, a high density configuration, and a box wave configuration. The sparse density configuration will have in-line and cross-line spacing of approximately 426 and 369 m; the medium will have 213 and 369 m spacing; the high density configuration will have 213 and 184 m spacing; and the box wave configuration will have 50 and 50 m spacing. In total, the Applicant will deploy up to 6,904 nodes, each with a footprint of approximately 0.26 m<sup>2</sup> which, when fully deployed, will cover approximately 474 km<sup>2</sup> of seafloor for a survey that covers an approximate sea surface area of 3,305 km<sup>2</sup>.

The nodes used for the OBN survey take the place of traditional seismic streamers and allow a tighter survey configuration due to increased maneuverability of the vessels without towed streamers. The acoustic footprint of the proposed OBN survey is best characterized in the ITR modeling as coil surveys due to the relatively small ensonified area when compared to 3D wide (WAZ) or narrow (NAZ) azimuth surveys. The OBN survey is not modeled as part of the ITR; therefore, for modeling comparisons, the coil survey scenario as modeled by Zeddies et al. (2015) was used as the most comparable survey type. The main comparison lies in the “density” of the surveys over single transect lines and the areal coverage of the survey. The longest proposed source line length for this survey is 65 km, more comparable to the 58 km linear component of the coil array (noting that the coil survey consists of concentric circles along that 58 km distance and each of the circular source paths in the coil survey has a total length of about 39.3 km) versus the modeled 3D NAZ/WAZ which incorporated 145 km survey lines. Additionally, the maximum source footprint of the proposed survey is approximately 3,305 km<sup>2</sup> which is closer to the 3,364 km<sup>2</sup> footprint of the modeled coil survey than the other survey types modeled such as 3D NAZ survey with larger footprints up to 6,960 km<sup>2</sup>. The spatial footprint of the survey was the main consideration for selecting a proxy for this take assessment.

The DAS surveys will utilize an optical fiber cable connected between the well and production facility to receive the 3D geophysical information. However, due to the use of the fiber cable as a receiver, the seismic source operations are most comparable to a two-dimensional (2D) seismic survey. The cable is permanently installed in the well and does not emit any sound. The seismic source is then deployed from two source vessels, each towing two source arrays alternately emitting an acoustic pulse.

Both the OBN and DAS surveys will use the same seismic source and will be conducted at the same time. Two dual-source vessels will be used to produce acoustic pulses at regular spatial intervals across the node grid. The source vessels will survey along transect lines that extend through, and 10 km beyond, the node grid on every site. The Thunder Horse scope is anticipated to start 25 March 2024. The survey will occur over approximately 61 operational days.

### ***Optional test 1: Gemini 8000 Source Test***

The Gemini 8000 sound source option is a dual barbell airgun source with a total volume of 8,000 in<sup>3</sup> comprised of two individual BOLT 1500LL airguns operating at 2000 psi, each with a volume of 4,000 in<sup>3</sup> (**Figure 2**). The proposed 8,000 in<sup>3</sup> seismic source is comprised of specially designed, large volume airguns that have a higher air capacity than conventional airguns, but without an increase in source levels. These large-volume airguns are designed to emit lower sound frequencies than conventional airguns, in order to produce higher-quality seismic images beneath salt domes. Because the same air volume is used to operate two very large guns, rather than multiple, smaller airguns, the proposed array produces lower sound levels than an array of equivalent total volume (Grooms et al., 2020).

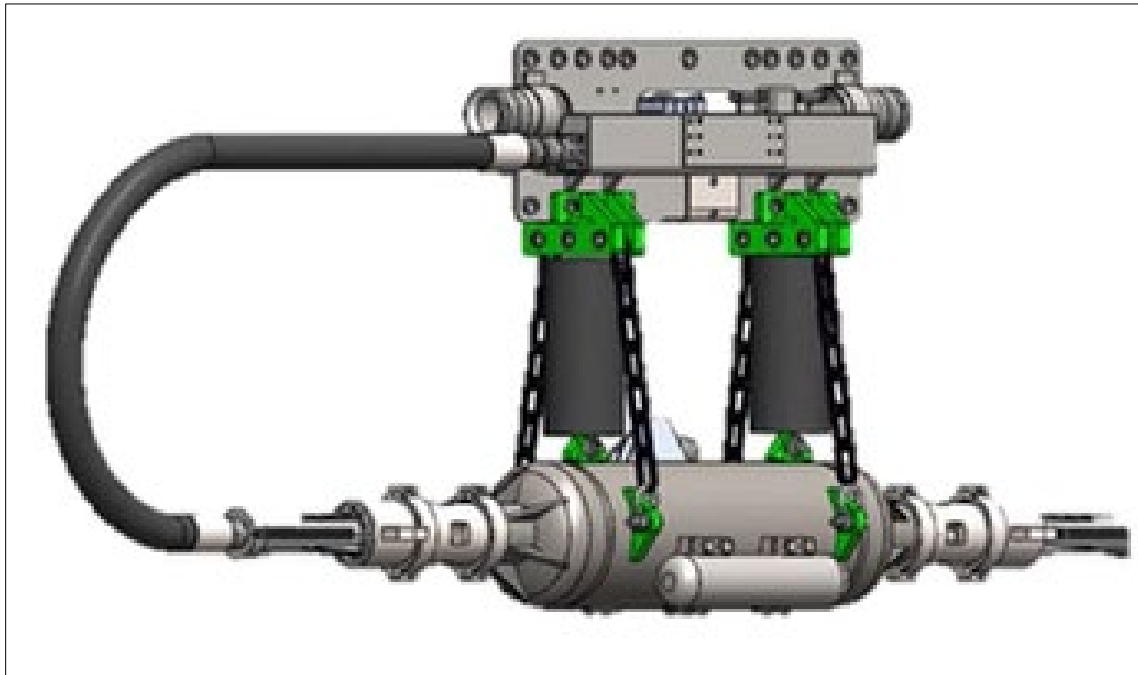


Figure 2. Depiction of the Gemini 8000 sound source.

The Gemini 8000 sound source will be operated within the yellow square depicted in **Figure 1** over three source lines, each 16 km long with a 10 km separation between lines covering a total approximate survey area of 320 km<sup>2</sup>.

**Optional test 2: Seismic Apparition (SA) Source Test**

The SA source test option will utilize traditional airgun equipment but will be testing out the geophysical data collection capabilities of “source densification” in which a greater number of pulses are produced per square kilometer, compared to the OBN/DAS survey. On average, the OBN/DAS seismic survey source will be operated such that 400 pulses are produced per square kilometer whereas for the SA test, approximately 900 pulses are produced per square kilometer. This would increase the number of pulses created per day compared to the OBN/DAS survey; however, this survey would cover a much smaller area of approximately 112 km<sup>2</sup> compared to the 1,751 – 3,305 km<sup>2</sup> survey area covered by the OBN/DAS surveys. As discussed above for the OBN/DAS survey, the ITR modeling includes various survey configurations, and the modeled configuration which covers the smallest area is the coil survey (Zeddies et al. 2015) so this would be the most applicable for the SA source test. Additionally, the coil survey configuration modeled had the highest number of simulated pulses out of the modeled survey configuration (Zeddies et al. 2015) which further makes it an appropriate proxy for this source test. The SA source test is anticipated to produce a total of 101,558 pulses for the full duration of the test, and in comparison the coil survey included 120,000 simulated pulses (compared to 80,000 pulses for the 3D NAZ) (Zeddies et al. 2015).

**Table 2** provides a summary of information used in take estimations employed in this Application for both the main production survey, optional Gemini 8000 source test, and optional Source Apparition (SA) source test. Input parameters for the NMFS Exposure Estimation Tool are provided in **Section 6.1**.

Table 2. Approximate location, duration, and season within which the proposed ocean bottom node (OBN) and distributed acoustic sensing (DAS) survey, optional Gemini 8000 source test, and optional Source Apparition (SA) source test activities used for the analysis in this Application.

Category	Thunder Horse Survey
Bureau of Ocean Energy Management Planning Area	Central
Incidental take regulations (ITR) assessment zone	5 and 7
bp Exploration & Production Inc. prospect area	Thunder Horse
Season in which surveys would occur <sup>1</sup>	Summer
Total survey duration (days)	61

<sup>1</sup>The modeling used in the take assessment of the ITR reflects only two seasons, winter (December–March) and summer (April–November). Therefore, the proposed 61-day survey period between April through October would only occur during the summer season identified in the ITR take assessment so that was the season used in this Application.

**1.1.2 Acoustic Sources**

***OBN and DAS Surveys***

The Applicant intends to use a two air gun source arrays per vessel, each with up to 32 elements and a maximum total volume of 5,110 in<sup>3</sup>. Each source array is made up of three ‘sub-arrays,’ with 7.5-m crossline spacing between each sub-array, each with approximately 10 or 12 air gun elements. Each source array has dimensions of approximately 15 m × 7 m and is composed of elements ranging in size from 90 to 250 in<sup>3</sup> (**Figure 3**).



Figure 3. Source array configuration for the proposed ocean bottom node (OBN) and distributed acoustic sensing (DAS) survey.

Thunder Horse source array will be towed at a depth of 12 m. The survey will employ vessels towing two to three source arrays operating in an alternative manner (i.e., each array alternated with a pulse interval at 12.5 s), such that the volume of the array will never exceed a total volume of 5,110 in<sup>3</sup> irrespective of how many source arrays are towed. Acoustic pulses will be delivered at regular spatial intervals from a source array towed by a surface vessel across the area of interest and extending 10 km per side beyond the receiver pattern. The source level (SL) expressed as a zero-to-peak sound pressure level (L<sub>pk</sub>) of the source array is expected to be approximately 255 decibels (dB) referenced to (re) 1 micropascal (μPa) m. In the ITR assessment (86 FR 5322) and the GOMx exposure estimation tool provided by NMFS (2021) no 5,110 in<sup>3</sup> air gun array was modeled or available for use as a proxy in this Application, only a 4,130 in<sup>3</sup> and an 8,000 in<sup>3</sup> air gun array. However, modeling results for the 4,130 in<sup>3</sup> air gun array in the exposure estimation tool are only available for a subset of the species assessed in this Application (**Section 3.0**) including *Kogia* spp., Rice's whale, beaked whales, bottlenose dolphins, short-finned pilot whales, and sperm whales (NMFS 2021). Additionally, the SL of the 8,000 in<sup>3</sup> air gun array (estimated endfire SL expressed as L<sub>pk</sub> of 255 dB re 1 μPa m) is closer to the SL of the proposed air gun array (**Table 3**); therefore, as a conservative approach for the take assessment in this Application, the 8,000 in<sup>3</sup> array was selected as the proxy in the GOMx exposure estimation tool.

Operating frequencies for the source array are expected to range from 10 to 2,000 Hz, with a peak frequency of 45 Hz. Predicted SLs are based on far-field measurements that are back calculated to approximate the conditions 1 m from a monopole source. This methodology, while widely accepted for estimating SLs, does not fully capture the near-field characteristics of the source. In the case of an air gun array, which is a distributed source in the near-field rather than a monopole source as is assumed, near-field characteristics can have substantial bearing on the propagation of that source. This results in reported SLs that are conservative, often overestimated, and lacking in specific spectral information. The total area covered by the proposed OBN and DAS survey will be approximately 1,255 km<sup>2</sup> (**Table 3**).

### ***Optional test 1: Gemini 8000 Source Test***

As discussed in **Section 1.1.1**, the Gemini 8000 sound source option study will utilize a Gemini 8000 sound source instead of a conventional airgun array. The Gemini 8000 is a dual barbell airgun source with a total volume of 8,000 in<sup>3</sup> comprised of two individual BOLT 1500LL airguns operating at 2000 psi, each with a volume of 4,000 in<sup>3</sup>. The Gemini 8000 will employ a single source vessel towing the source operating at a pulse interval of 25 seconds. Operating frequencies for the Gemini 8000 sound source are expected to range from 300 Hz to 25 kHz, with a peak frequency of approximately 4 Hz (Grooms et al., 2020).

For the purposes of comparison to the ITR and the take estimates presented in **Section 6.0**, the source levels for the Gemini 8000 (**Table 3**) were higher than those for the single airgun so the 8,000 in<sup>3</sup> array (Zeddies et al., 2015), while louder than the Gemini 8000 sound source, were identified as the most applicable from the ITR modeling.

However, it is worth noting for both sources that predicted SLs are often based on far-field measurements that are back calculated to approximate the conditions 1 m from a monopole source. This methodology, while widely accepted for estimating SLs, does not fully capture the near-field characteristics of the source. In the case of an air gun array, which is a distributed source in the near-field rather than a monopole source as is assumed, near-field characteristics can have substantial bearing on the propagation of that source. This results in reported SLs that are conservative, often overestimated, and lacking in specific spectral information.

### ***Optional test 2: Seismic Apparition (SA) Source Test***

The sound source for the SA source test option will utilize a conventional airgun array consisting of a horizontal, planar array of individual compressed air chambers (i.e., air guns) of different sizes towed behind the source vessels. The main characteristics of the pressure signal generated by a single-source element are the strong initial peak and the subsequent bubble pulses. The amplitude of the initial peak depends primarily on the operating pressure and chamber volume of the element, whereas the period and amplitude of the bubble pulses depend on the chamber volume and source array towing depth. Both the volume of the air guns and size of the array are selected based on the needs of the survey. The proposed seismic source array for this study is an airgun array with a total volume of 10,220 in<sup>3</sup> which consists of six sources all firing within a 120 ms time window, and based on six individual sources, two of which comprise a volume of 1,690 in<sup>3</sup> each and the remaining four comprising a volume of 1,170 in<sup>3</sup> each. The SA source test will employ two source vessels each towing six airgun strings operating in an alternative manner (i.e., each array alternated with a pulse interval at 7 s). The two source vessels will operate such that they are separated by a minimum of 2 km at all times so that there is no interference in the seismic acquisitions from the sources.

**Table 3** provides a summary of the acoustic properties of the sources to be used during bp's 2024 Thunder Horse seismic survey included in this Application.

Table 3. Survey specifications for the source arrays to be used during the proposed Thunder Horse survey in the U.S. Gulf of Mexico included in this Application.

Source Information	OBN/DAS Survey	Gemini 8000 Source Test	Seismic Apparition Source Test
Mean Vessel Survey Speed (knots)	4.3	4.5	4.2
Approximate Total Survey Area (km <sup>2</sup> )	3,305 km <sup>2</sup>	320 km <sup>2</sup>	119 km <sup>2</sup>
Array Tow depth (m)	12	8	13
Array Maximum Total Volume (in <sup>3</sup> )	5,110	8,000	10,220
SL (Lpk) in dB re 1 $\mu$ Pa m	255	243	247
SL (SPL) in dB re 1 $\mu$ Pa m	239	220	232
Frequency Range (Hz)	10–2,000	300 Hz–25 kHz	10–2,000 Hz
Peak Frequency (Hz)	45	4	45
Pulse Duration (s)	0.5	1.5	0.5
Pulse Rate (s)	0.08	0.04	0.14

$\mu$ Pa = micropascal; DAS = distributed acoustic sensing; dB = decibel; OBN = ocean bottom node; PK = zero-to-peak sound pressure level; re = referenced to; SL = source level; SPL = root-mean-square sound pressure level.

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## **2.0 Survey Dates, Duration, and Specific Geographic Region**

### **2.1 SURVEY ACTIVITY DATES AND DURATION**

Survey activities considered under this Application will begin 25 March 2024 and will occur over approximately 61 operational days (**Table 2**).

### **2.2 SPECIFIC GEOGRAPHIC REGION**

The Applicant's survey activities will occur within the Thunder Horse proposed prospect area within BOEM's Central Planning Area of the GOMx (**Figure 1**). The proposed prospect area falls within ITR assessment zones 5 and 7.

### 3.0 Species and Numbers of Marine Mammals

Marine mammal species occurring in the U.S. GOMx were identified and provided in the published ITR (86 FR 5322) and updated with new information in the 2023 proposed update (88 FR 916). Information about each species distribution, abundance, and status can be found in that document. A summary of the GOMx species with modeled abundance estimates from the ITR (86 FR 5322; 88 FR 916) is provided in **Table 4**.

Table 4. Summary of marine mammals of the northern Gulf of Mexico.

Common Name	Scientific Name	Stock	ESA/MMPA Stock Status	Modeled Abundance Estimates <sup>2</sup>
Rice's whale <sup>1</sup>	<i>Balaenoptera ricei</i>	Northern Gulf of Mexico	E/S	37
Sperm whale	<i>Physeter macrocephalus</i>	Northern Gulf of Mexico	E/S	3,007
Atlantic spotted dolphin	<i>Stenella frontalis</i>	Northern Gulf of Mexico	NS	1,782 <sup>3</sup>
Beaked whale	<i>Ziphius cavirostris</i> and <i>Mesoplodon</i> spp.	Northern Gulf of Mexico	NS	803 <sup>4</sup>
Common bottlenose dolphin	<i>Tursiops truncatus</i>	Northern Gulf of Mexico	NS	9,672 <sup>5</sup>
Clymene dolphin	<i>Stenella clymene</i>	Northern Gulf of Mexico	NS	4,619
False killer whale	<i>Pseudorca crassidens</i>	Northern Gulf of Mexico	NS	494
Fraser's dolphin	<i>Lagenodelphis hosei</i>	Northern Gulf of Mexico	NS	1,665
Killer whale	<i>Orcinus orca</i>	Northern Gulf of Mexico	NS	267
Melon-headed whale	<i>Peponocephala electra</i>	Northern Gulf of Mexico	NS	6,113
Pantropical spotted dolphin	<i>Stenella attenuata</i>	Northern Gulf of Mexico	NS	67,225
Pygmy killer whale	<i>Feresa attenuata</i>	Northern Gulf of Mexico	NS	613
Risso's dolphin	<i>Grampus griseus</i>	Northern Gulf of Mexico	NS	1,501
Rough-toothed dolphin	<i>Steno bredanensis</i>	Northern Gulf of Mexico	NS	4,853
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	Northern Gulf of Mexico	NS	2,741
Spinner dolphin	<i>Stenella longirostris</i>	Northern Gulf of Mexico	NS	5,548
Striped dolphin	<i>Stenella coeruleoalba</i>	Northern Gulf of Mexico	NS	5,634
<i>Kogia</i> spp.	<i>Kogia breviceps</i> and <i>Kogia sima</i>	Northern Gulf of Mexico	NS	980 <sup>4</sup>

ESA = Endangered Species Act; E = endangered; MMPA = Marine Mammal Protection Act; NS = non-strategic stock; S = strategic stock.

<sup>1</sup>The original 2021 rule (86 FR 5322) referred to the Bryde's whale (*Balaenoptera edeni*), and these whales were subsequently described as a new species, the Rice's whale (Rosel et al. 2021).

<sup>2</sup>Abundance estimates from modeled estimates in the proposed 2023 incidental take regulation (ITR) update (88 FR 916), or the most recent draft 2023 stock assessment report from the National Marine Fisheries Service (NMFS 2024) for species for which the ITR did not have any predicted abundances (i.e., pygmy killer whale, false killer whale, killer whale).

<sup>3</sup>The mean abundance for Atlantic spotted dolphins is based on the oceanic population in the proposed 2023 ITR update (88 FR 916).

<sup>4</sup>Due to difficulty in identifying to species level during visual surveys, *Kogia* spp. and beaked whale species are grouped into guilds and abundance estimates are provided for these guilds rather than each species.

<sup>5</sup>The mean abundance for common bottlenose dolphins is based on the oceanic population in the proposed 2023 ITR update (88 FR 916).



## **4.0 Affected Species Status and Distribution**

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Affected species status and distribution were examined by the National Marine Fisheries Service (NMFS) within the scope of the proposed regulation, and more information can be found in the published ITR (86 FR 5322) and the proposed 2023 update (88 FR 916).

## 5.0 Type of Incidental Taking Authorization Requested

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The Applicant requests an LOA pursuant to Section 101 (a)(5)(D) of the Marine Mammal Protection Act (MMPA) for incidental take by behavioral harassment of small numbers of marine mammals during geophysical surveys conducted as part of oil and gas exploration and production activities within the U.S. GOMx. Proposed activities, as outlined in **Section 1.0**, have the potential to impact marine mammals from sounds generated by the vessel and survey equipment.

The seismic sources used during bp's 2024 Thunder Horse seismic survey produce sound levels that may exceed established acoustic thresholds for marine mammals (Wood et al., 2012; NMFS, 2023). Acoustic thresholds are received sound levels that meet current scientific criteria as sufficient for eliciting the onset of a permanent threshold shift (PTS), termed Level A harassment, or a behavioral response, termed Level B harassment.

Level A harassment is not expected to result from the proposed activities due to the expected source levels and implementation of mitigation measures. Level A takes were assessed but resulting in no calculated takes and therefore are not requested. Level B harassment may occur as a result of proposed activities; therefore, the Applicant is requesting authorization for small numbers of Level B takes of marine mammals. The species potentially taken are described fully in the published ITR and listed in **Table 4** for reference. Each species has a geographic distribution that includes the lease areas in which survey activities may occur.

## 6.0 Take Estimates for Marine Mammals

The maximum number of exposures for each species were estimated in this Application using the GOMx exposure estimation tool provided by NMFS (2021) and developed in May 2021. As discussed in **Section 1.1.2**, estimated SLs for air gun arrays used in propagation modeling often do not fully capture the near-field characteristics of the source that can have substantial bearing on the propagation of that source. This results in reported SLs that are conservative, often overestimated, and lacking in specific spectral information. Additionally, the exposure modeling in the proposed 2023 ITR update (88 FR 916) includes updated marine mammal densities from Litz et al. (2023) and updated species movement and behavior data used in the animal movement model (Weirathmueller et al., 2022) which have not been incorporated into the GOMx exposure estimation tool (NMFS, 2021). Furthermore, mitigation was not accounted for in the exposure estimation tool when calculating potential exposures. Therefore, the number of exposures for each species estimated in this Application should be considered as highly conservative estimates. Requested takes from the Applicant are provided in **Section 6.2**; however, the final number of takes will be determined during the consultation process with NMFS.

### 6.1 ESTIMATED NUMBERS OF MARINE MAMMALS THAT MIGHT BE TAKEN BY HARASSMENT

The parameters used as input into the NMFS (2021) exposure estimation tool to estimate takes which may result from the main production survey and the Gemini 8000 source test activities are provided in **Table 5**.

Table 5. Parameters used in the National Marine Fisheries Service (NMFS) exposure estimation tool (NMFS, 2021).

Parameter	Survey Tool Input
Survey Type	Coil
Survey Days <sup>1</sup>	Zone 5 = 31 Zone 7 = 30

<sup>1</sup>All survey days input into the exposure estimation tool will occur in the summer season as identified in the ITR modeling assessment. Because the survey area of the proposed survey covers both zones 5 and 7 (see Figure 1 of this Application), the total number of operational survey days were split evenly between the two zones.

#### 6.1.1 Level B Harassment of Marine Mammals

Level B exposures were calculated using the NMFS exposure estimation tool (NMFS, 2021) using the parameters provided in **Table 5**.

Exposures in **Table 7** assume bp's 2024 Thunder Horse seismic survey inclusive of the OBN/DAS surveys, the optional Gemini source test, and the optional SA source test, will have a total duration of 61 days as described in **Section 1.1**.

Table 6. Maximum annual Level B exposures for bp’s 2024 Thunder Horse seismic survey estimated using the National Marine Fisheries (NMFS) draft exposure estimation tool (NMFS, 2021).

Common Name	Abundance <sup>2</sup>	Zone 5 Exposures	Zone 7 Exposures	Total Exposures	Maximum Population Affected
Low-frequency cetaceans					
Rice’s whale <sup>1</sup>	37	3	0	3	8%
Mid-frequency cetaceans					
Sperm whale	3,007	345	61	406	14%
Atlantic spotted dolphin <sup>3</sup>	1,782	326	0	326	18%
Beaked whale <sup>4</sup>	803	353	131	484	60%
Common bottlenose dolphin <sup>5</sup>	9,672	791	2	793	8%
Clymene dolphin	4,619	475	165	640	14%
False killer whale	494	123	62	185	37%
Fraser’s dolphin	1,665	55	28	83	5%
Killer whale	267	3	6	9	3%
Melon-headed whale	6,113	332	114	446	7%
Pantropical spotted dolphin	67,225	2153	1640	3793	6%
Pygmy killer whale	613	77	55	132	22%
Risso’s dolphin	1,501	143	28	171	11%
Rough-toothed dolphin	4,853	172	64	236	5%
Short-finned pilot whale	2,741	96	9	105	4%
Spinner dolphin	5,548	577	38	615	11%
Striped dolphin	5,634	185	86	271	5%
High-frequency cetaceans					
<i>Kogia</i> spp. <sup>4</sup>	980	106	30	136	14%

<sup>1</sup>The original 2021 rule (86 FR 5322) referred to the Bryde’s whale (*Balaenoptera edeni*), and these whales were subsequently described as a new species, the Rice’s whale (Rosel et al., 2021).

<sup>2</sup>Abundance estimates from modeled estimates in the proposed 2023 incidental take regulation (ITR) update (88 FR 916), or the most recent draft 2023 stock assessment report from the National Marine Fisheries Service (NMFS 2024).

<sup>3</sup>The mean abundance for Atlantic spotted dolphins is based on the oceanic population in the proposed 2023 ITR update (88 FR 916).

<sup>4</sup>Due to difficulty in identifying to species level during visual surveys, *Kogia* spp. and beaked whale species are grouped into guilds and abundance estimates are provided for these guilds rather than each species.

<sup>5</sup>The mean abundance for common bottlenose dolphins is based on the oceanic population in the proposed 2023 ITR update (88 FR 916).

## 6.2 REQUESTED TAKES

The Level B exposures provided in **Section 6.1.1** were calculated assuming that the largest source array will be used for the entire production survey and an 8,000 in<sup>3</sup> traditional airgun array operating in a coil configuration will be used for the Gemini 8000 source test and the SA source test. Additionally, these calculations assume exposures will occur for the full duration of the survey. In actuality, animals would only be exposed to above-threshold noise for a portion of the survey duration. Additionally, the draft exposure estimation tool (NMFS, 2021) significantly overestimates exposures. Therefore, requested take needs to reflect more realistic exposure estimates. For this reason, takes for beaked whales have been revised to reflect a more realistic percentage of the population that would be taken during the proposed seismic survey activities. Requested takes for these species were adjusted to provide a more realistic expectation of the modeled exposures versus actual takes by harassment. It is understood that an animal can only be taken once in a 24-hour period, and it is unlikely that animals will be taken every day throughout the 61-day survey. The largest mean group size of 3 animals reported in either Barkaszi and

Kelly (2019) or Maze-Foley and Mullin (2006), both of which are referenced in the ITR (86 FR 5322), were used to estimate takes with the assumption that a maximum of two groups per day (i.e., 6 animals) throughout the 61-day survey could potentially receive sound levels above Level B thresholds. Requested takes for OBN and DAS survey are provided in **Table 8**.

Table 7. Requested Level B exposures for bp’s 2024 Thunder Horse seismic survey.

Common Name	Abundance <sup>1</sup>	Total Estimated Level B Exposures	Maximum Population Affected
<b>Low-frequency cetaceans</b>			
Rice’s (Bryde’s) whale <sup>2</sup>	37	3	8%
<b>Mid-frequency cetaceans</b>			
Sperm whale	3,007	406	14%
Atlantic spotted dolphin	1,782	326	18%
Beaked whale <sup>3,4</sup>	803	366	46%
Common bottlenose dolphin	9,672	793	8%
Clymene dolphin	4,619	640	14%
False killer whale	494	185	37%
Fraser’s dolphin	1,665	83	5%
Killer whale	267	9	3%
Melon-headed whale	6,113	446	7%
Pantropical spotted dolphin	67,225	3793	6%
Pygmy killer whale	613	132	22%
Risso’s dolphin	1,501	171	11%
Rough-toothed dolphin	4,853	236	5%
Short-finned pilot whale	2,741	105	4%
Spinner dolphin	5,548	615	11%
Striped dolphin	5,634	271	5%
<b>High-frequency cetaceans</b>			
<i>Kogia</i> spp. <sup>4</sup>	980	136	14%

<sup>1</sup>Abundance estimates from modeled estimates in the proposed 2023 incidental take regulation (ITR) update (88 FR 916), or the most recent draft 2023 stock assessment report from the National Marine Fisheries Service (NMFS 2024).

<sup>2</sup>Data published on 22 January 2021 indicate the whale previously identified as the Bryde’s whale may be a new species of whale, the Rice’s whale, and although official species designation has not yet been made by the National Marine Fisheries Service (NMFS), the new name is included here for reference (Rosel et al., 2021).

<sup>3</sup>Requested takes for beaked whales were revised to reflect takes of two groups of 3 individuals per day throughout the 61-day survey using mean group size from Barkaszi and Kelly (2019); and Maze-Foley and Mullin (2006), providing a more realistic expectation of the modeled exposures versus actual takes by harassment.

<sup>4</sup>Due to difficulty in identifying to species level during visual surveys, *Kogia* spp. and beaked whale species are grouped into guilds and abundance estimates are provided for these guilds rather than each species.

## 7.0 Effects on Marine Mammal Species or Stocks

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Anticipated impacts on marine mammal habitat were examined by NMFS within the scope of the proposed regulation, and more information can be found in the published ITR (86 FR 5322) and proposed 2023 ITR update (88 FR 916).

Effects of proposed seismic survey activities for a period of up to 10 years throughout the U.S. GOMx were assessed in the ITR, following the expert working group (EWG) framework developed by Southall et al. (2014). This framework considers the context within which acoustic exposures will occur, along with the vulnerability of individual marine mammal stocks, to determine the likelihood of stock-related population-level impacts. The results of this analysis found that the total take from proposed activities will have only negligible impacts on all affected GOMx marine mammal stocks. A more detailed explanation can be found in the published ITR (86 FR 5322). Furthermore, the revised 2023 ITR assessment (88 FR 916) also resulted in a negligible impact determination based on the updated information from the revised modeling (Weirathmueller et al. 2022) and marine mammal density information (Litz et al., 2023).

Given that the scope of activities proposed in this Application are less than that of the ITR, both the original (86 FR 5322) and the 2023 proposed update (88 FR 916), both in terms of spatial and temporal extent, the activities in this Application are expected to remain within this finding of only negligible impacts. The take estimates provided in **Section 6.1** represent estimates for the entirety of zones 5 and 7, when in actuality the proposed activities would only cover a maximum of up to 3,305 km<sup>2</sup> during the Thunder Horse survey, reducing the spatial extent of potential marine mammal encounters. All other surveys described in this application would cover a smaller spatial extent. Additionally, the take estimates do not account for mitigation which would be expected to negate any potential for Level A takes and reduce the risk of marine mammals experiencing biologically significant Level B harassment. Therefore, it is reasonable to assume that the project activities would not negatively affect stocks.

## **8.0 Minimization of Adverse Effects to Subsistence Uses**

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This section addresses NMFS' requirement to identify methods to minimize adverse effects of the proposed activity on subsistence uses.

There are no current subsistence hunting areas in the vicinity of any of the proposed lease blocks and there are no activities related to the proposed surveys that may affect the availability of a species or stock of marine mammal for subsistence uses. Consequently, there are no available methods to minimize potentially adverse effects to subsistence uses.

## **9.0 Anticipated Impacts on Habitat**

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Anticipated impacts on marine mammal habitat were examined by NMFS within the scope of the proposed regulation, and more information can be found in the published ITR (86 FR 5322) and the proposed 2023 ITR update (88 FR 916).



## **10.0 Anticipated Effects of Habitat Impacts on Marine Mammals**

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Anticipated effects of habitat impacts on marine mammals were examined by NMFS within the scope of the proposed regulation, and more information can be found in the published ITR (86 FR 5322) and the proposed 2023 ITR update (88 FR 916).

## 11.0 Mitigation Measures

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This section addresses NMFS' LOA requirement to assess the availability and feasibility (economic and technological) of methods and manner of conducting these proposed survey activities that have the least practicable impact upon affected species or stock, their habitat, and their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

The Applicant has demonstrated a strong commitment to minimizing impacts to marine mammal species through a comprehensive and progressive mitigation and monitoring program. The Applicant will follow all monitoring and mitigation measures set forth in the ITR (86 FR 5322) that are applicable to air gun surveys with total source volumes above 1,500 in<sup>3</sup>. These monitoring and mitigation measures were not revised or changed in the proposed 2023 ITR update (88 FR 916), and the only additional measures identified in the 2023 update include a process for adaptive management wherein NMFS, BOEM, the Bureau of Safety and Environmental Enforcement (BSEE), and the operators will participate in the adaptive management process through the annual comprehensive reports required of the LOA holders (detailed further in 88 FR 916).

The mitigation measures will align with those currently required under existing regulations (e.g., BOEM Notice to Lessees and Operators 2016-G02, revised 19 June 2020) as well as additional mitigation outline in the published ITR (86 FR 5322) and the NMFS 2020 Biological Opinion and its appendices (NMFS, 2020), as they apply to the proposed survey activities.

## **12.0 Arctic Plan of Cooperation**

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This requirement is applicable only for activities that occur in Alaskan waters north of 60° N latitude. The proposed survey activities will not take place within the designated region and, therefore, will not have an adverse effect on the availability of marine mammals for subsistence uses. As such, there is no need to form such a plan.

## **13.0 Monitoring and Reporting**

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The Applicant will comply with all monitoring and reporting guidelines provided in the published ITR (86 FR 5322) and the proposed 2023 ITR update (88 FR 916) as they pertain to Protected Species Observer and passive acoustic monitoring data, and reporting injured or dead marine mammal species.

## **14.0 Suggested Means of Coordinated Research**

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Relevant research efforts which may effectively supplement the monitoring and reporting requirements pursuant to issued LOAs are described in detail by NMFS in the published ITR (86 *FR* 5322) and the proposed 2023 ITR update (88 *FR* 916).

## 15.0 List of Preparers

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- Etienne Marc, Principal Seismic Advisor

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