UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF OCEAN ENERGY MANAGEMENT
GULF OF MEXICO REGIONIONAL OFFICE
NEW ORLEANS, LOUISIANA

SITE-SPECIFIC ENVIRONMENTAL ASSESSMENT

OF

GEOLOGICAL & GEOPHYSICAL SURVEY APPLICATION NO. L20-033 Mod 1

FOR

TGS

January 10, 2022

RELATED ENVIRONMENTAL DOCUMENTS

Gulf of Mexico OCS Proposed Geological and Geophysical Activities
Western, Central, and Eastern Planning Areas, Final Programmatic Environmental Impact Statement
(OCS EIS/EA BOEM 2017-051)

Gulf of Mexico OCS Oil and Gas Lease Sales: 2017-2022
Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261
Final Environmental Impact Statement
(OCS EIS/EA BOEM 2017-009)

Gulf of Mexico OCS Lease Sale, Final Supplemental Environmental Impact Statement 2018
(OCS EIS/EA BOEM 2017-074)

Biological Opinion Oil and Gas Leasing, Exploration, Development, Production, Decommissioning, and All Related Activities in the Gulf of Mexico Outer Continental Shelf
(FWS April 20, 2018)

Biological Opinion of the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico
(NMFS March 13, 2020)

Amended Incidental Take Statement and Revised Appendices to the Programmatic Biological Opinion on the Gulf of Mexico Oil and Gas Program
(NMFS April 26, 2021)

Final Rule Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to Geophysical Surveys Related to Oil and Gas Activities in the Gulf of Mexico
(NMFS January 19, 2021)

FINDING OF NO SIGNIFICANT IMPACT (FONSI)

The Bureau of Ocean Energy Management (BOEM) has prepared a Site-Specific Environmental Assessment (SEA) (No. L20-033 Mod 1) complying with the National Environmental Policy Act (NEPA). NEPA regulations under the Council on Environmental Quality (CEQ) (40 CFR §1501.3 and § 1501.5), the United States Department of the Interior NEPA implementing regulations (43 CFR § 46), and BOEM policy require an evaluation of proposed major federal actions, which under BOEM jurisdiction includes approving a plan for oil and gas exploration or development activity on the Outer Continental Shelf (OCS).

The potential effects or impacts caused by similar actions to that proposed were examined at a basin-wide scale in the Gulf of Mexico (GOM) in the:

- Gulf of Mexico OCS Proposed Geological and Geophysical Activities Western, Central, and Eastern Planning Areas Final Programmatic Environmental Impact Statement (GOM G&G PEIS) (OCS EIS/EA BOEM 2017-051);
- Gulf of Mexico OCS Oil and Gas Lease Sales: 2017-2022 Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261 Final Environmental Impact Statement (Multisale EIS) (OCS EIS/EA BOEM 2017-009);
- Gulf of Mexico Lease Sale Final Supplemental Environmental Impact Statement 2018 (2018 SEIS) (OCS EIS/EA BOEM 2017-074);
- Biological Opinion Oil and Gas Leasing, Exploration, Development, Production, Decommissioning, and All Related Activities in the Gulf of Mexico Outer Continental Shelf (FWS 2018 BO) (Issued by United States Fish and Wildlife Service [FWS] April 20, 2018);
- Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico (NMFS 2020 BO) (Issued by National Marine Fisheries Service [NMFS] March 13, 2020);
- Amended Incidental Take Statement and Revised Appendices to the Programmatic Biological Opinion on the Gulf of Mexico Oil and Gas Program (NMFS 2021 Amended ITS) (Issued by NMFS April 26, 2021);
- Final Rule Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to Geophysical Surveys Related to Oil and Gas Activities in the Gulf of Mexico (Issued by NMFS January 19, 2021); and
- Biological Environmental Background Report for the Gulf of Mexico OCS Region (2021 BEBR).

This SEA tiers from these evaluations and considers the impacts of the proposed action.

Proposed Action: TGS proposes to conduct a 3D full azimuth seismic survey utilizing airgun arrays and ocean bottom nodes (OBN). The OBNs will be placed on the seafloor and recovered using a remote operational vehicle (ROV). TGS is also proposing to place pressure inverted echo sounders (PIES) on the seafloor during the survey. In addition, the Wolfspar seismic source will also be utilized to collect low frequency data. Also, two additional airgun sources, the ION Gemini and the LISS TPS, will be utilized to collect survey data. Four vessels will be utilized for the conventional airguns survey activities. Two vessels will be utilized for for towing the airgun arrays; the *Artemis Arctic*, and the *Artemis Odyssey*. One vessel; the *REM Saltire,* will be utilized to deploy and retrieve the OBNs from the seafloor via the deployment of ROVs. One vessel: the *7-Oceans* will be utilized for support. An additional offshore supply vessel will be utilized to deploy and tow the Wolfspar low frequency source. The proposed activities are located south of Vermilion Parish, Louisiana in the Central and Western Planning Areas of the GOM. The OBNs of the proposed survey will be deployed in 405 Blocks in the Garden Banks and Keathley Canyon Areas of the GOM OCS which includes an additional 35 Blocks of node coverage added by the permit modification. In addition, up to 8 PIES will be deployed in pre-approved OBN locations. The source acquisition area includes, in addition to the OBN areas, blocks in the High Island (East Addition, South Extension), West Cameron (South Addition), East Cameron (South Addition), Vermilion (South Addition), South Marsh Island (South Addition), Green Canyon, Walker Ridge, Alaminos Canyon, and East Breaks Areas. The area of the proposed action is approximately 96 miles (154 kilometers) from the nearest shoreline and in water depths ranging from approximately 262 to 7,644 feet (ft) (80 to 2,330 meters [m]). Site-specific analysis was completed using TGS' description of the proposed operations; however, specific technical

information regarding the G&G activities described in the permit application is proprietary and therefore is not included in this document. The proposed survey is expected to take approximately 9 months to complete.

Factors Considered in this Determination: The impacts from the proposed action are further analyzed at the site-specific level in this Environmental Assessment. The impact analysis for the proposed activity focused on the geological and geophysical activities and the resources that may be potentially impacted. The impact producing factors (IPF) include: (1) active acoustic sound sources, (2) seafloor disturbance, (3) vessel noise, (4) vessel traffic, and (5) marine trash and debris.

In this SEA BOEM has considered three alternatives: (1) No Action; (2) Proposed Action as Submitted; and (3) Proposed Action with Conditions of Approval. BOEM has assessed the impacts of the proposed action on the following resources:

- marine mammals;
- sea turtles;
- fish;
- benthic communities;
- archaeological resources.; and
- other users (i.e., military).

The use of an active acoustic sound source (airgun) is potentially the most disruptive impact for a free-swimming individual or groups of marine mammals, turtles, and fish if they are in proximity to the airgun in operation. The effect of an active acoustic sound source is weighted most heavily out of all other potential impacting factors. Individual animals are vulnerable to injury if hit by the survey vessel from the proposed action. Conditions of approval include the monitoring of an exclusion zone by trained protected species observers and activation of survey shutdown requirements when mammals are observed: (1) within the exclusion zone or in proximity to an active acoustic sound source or (2) near the vessel. The application of passive acoustic monitoring, a visually/acoustically monitored exclusion zone, shutdown criteria, and vessel avoidance are designed to remove the possibility that animals and an operating airgun are located in the same place at the same time. Groups or individuals are therefore not unduly affected by underwater noise, or exposed to being hit by the survey vessel. Impact significance levels are explained in **Chapter 3.1** of this SEA. Impacts from the proposed activities to marine mammals, sea turtles, fish, benthic resources, archaeological resources, and other users have been mitigated to negligible.

Our evaluation in this SEA has selected Alternative 3 and serves as the basis for approving the proposed action. BOEM concludes that no significant impacts are expected to occur to any affected resources by allowing the proposed activities to proceed, provided that the specific conditions of approval and monitoring measures identified below are met by the operator.

- **COMPLIANCE WITH BIOLOGICAL OPINION TERMS AND CONDITIONS AND REASONABLE AND PRUDENT MEASURES:** This approval is conditioned upon compliance with the Reasonable and Prudent Measures and implementing Terms and Conditions of the Biological Opinion issued by the National Marine Fisheries Service on March 13, 2020, and the amendment issued on April 26, 2021. This includes mitigation, particularly any appendices to Terms and Conditions applicable to the plan, as well as record-keeping and reporting sufficient to allow BOEM and BSEE to comply with reporting and monitoring requirements under the BiOp; and any additional reporting required by BOEM or BSEE developed as a result of BiOp implementation. The NMFS Biological Opinion may be found here: (https://www.fisheries.noaa.gov/resource/document/biological-opinion-federally-regulated-oil-and-gas-program-activities-gulf-mexico). The amendment can be found here: https://repository.library.noaa.gov/view/noaa/29355 . The Appendices and protocols may be found here: (https://www.fisheries.noaa.gov/resource/document/appendices-biological-opinion-federally-regulated-oil-and-gas-program-gulf-mexico). The amendment provided updates to Appendices A, C and I which may be found here: https://repository.library.noaa.gov/view/noaa/29355.
- **SUPPORT BASES AND VESSEL TRANSIT ROUTES**: Approval of your plan is conditioned upon your use of the support bases and vessel transit routes as described in your plan. BOEM/BSEE must be notified

at least 15 days prior to any vessel route changes that require transit of the Bryde's Whale area, and you must receive prior approval for that transit from BOEM/BSEE.

- **SEISMIC SURVEY OPERATION, MONITORING, AND REPORTING GUIDELINES**: The applicant will follow the guidance provided under Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols found in the Biological Opinion amendment issued by the National Marine Fisheries Service on April 26, 2021. The guidance can be accessed on NOAA Fisheries internet website at https://repository.library.noaa.gov/view/noaa/29355.
- **MARINE TRASH AND DEBRIS AWARENESS AND ELIMINATION**: The applicant will follow the guidance provided under Appendix B. Gulf of Mexico Marine Trash and Debris Awareness and Elimination Survey Protocols found in the Biological Opinion issued by the National Marine Fisheries Service on March 13, 2020. The guidance can be accessed on NOAA Fisheries internet website at https://www.fisheries.noaa.gov/resource/document/appendices-biological-opinion-federally-regulated-oil-and-gas-program-gulf-mexico.
- **VESSEL-STRIKE AVOIDANCE/REPORTING**: The applicant will follow the protocols provided under Appendix C. Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols found in the Biological Opinion amendment issued by the National Marine Fisheries Service on April 26, 2021. The guidance can be accessed on the NOAA Fisheries internet site at https://repository.library.noaa.gov/view/noaa/29355.
- **SEA TURTLE RESUSCITATION GUIDELINES**: The applicant will follow the guidance provided under Appendix J. Sea Turtle Handling and Resuscitation Guidelines found in the Biological Opinion issued by the National Marine Fisheries Service on March 13, 2020. The guidance can be accessed on the NOAA Fisheries internet site at https://www.fisheries.noaa.gov/resource/document/appendices-biological-opinion-federally-regulated-oil-and-gas-program-gulf-mexico.
- **SLACK-LINE PRECAUTIONS CONDITION OF APPROVAL:** If operations require the use of flexible, small diameter (< 2 inch) lines to support operations (with or without divers), operators/contractors must reduce the slack in the lines, except for human safety considerations, to prevent accidental entanglement of protected species (i.e. species protected under the Endangered Species Act [ESA] and/or Marine Mammal Protection Act [MMPA]). This requirement includes tether lines attached to remotely operated equipment. The requirements below must be followed for any activities entailing use of flexible, small diameter lines that will not remain continuously taut, except when complying with these requirements would put the safety of divers, crew, or the vessel at risk:
    - Operators must utilize tensioning tools and/or other appropriate procedures to reduce unnecessary looseness in the lines and/or potential looping;
    - The lines must remain taut, as long as additional safety risks are not created by this action;
    - A line tender must be present at all times during dive operations and must monitor the line(s) the entire time a diver is in the water; and
    - Should the line tender and/or diver become aware of an entanglement of an individual protected species, the reporting requirements described in the *Reporting Requirements* COA must be followed as soon as safety permits.
- **REPORTING REQUIREMENTS CONDITION OF APPROVAL:** Review of your proposed activities identified use of equipment that has the potential for entanglement and/or entrapment of protected species (i.e. species protected under the Endangered Species Act [ESA] and/or Marine Mammal Protection Act [MMPA]) that could be present during operations. In case of entrapment, procedures and measures for reporting are dependent upon the situation at hand. **These requirements replace those specific to dead and injured species reporting in respective sections of Appendix A (insofar as they relate to geophysical surveys) and Appendix C of the 2020 Biological Opinion on the Bureau of Ocean Energy Management's Oil and Gas Program Activities in the Gulf of Mexico**.

    *Incidents Requiring **Immediate** Reporting*

Certain scenarios or incidents require immediate reporting to Federal agencies; these are described below:

Should any of the following occur at any time, **immediate reporting** of the incident is required after personnel and/or diver safety is ensured:

- Entanglement or entrapment of a protected species (i.e., an animal is entangled in a line or cannot or does not leave a moon pool of its own volition).
- Injury of a protected species (e.g., the animal appears injured or lethargic). Interaction, or contact with equipment by a protected species.
- Any observation of a leatherback sea turtle within a moon pool (regardless of whether it appears injured, or an interaction with equipment or entanglement/entrapment is observed).

1. As soon as personnel and/or diver safety is ensured, report the incident to National Marine Fisheries Service (NMFS) by contacting the appropriate expert for 24-hr response. If you do not receive an immediate response, you must keep trying until contact is made. Any failed attempts should be documented. Contact information for reporting is as follows:
    a. **Marine mammals**: contact **Southeast Region's Marine Mammal Stranding Hotline at 1-877-433-8299.**
    b. **Sea turtles**: contact **Brian Stacy, Veterinary Medical Officer at 352-283- 3370**. If unable to reach Brian Stacy, contact Lyndsey Howell at 301-310- 3061. This includes the immediate reporting of **any observation of a leatherback sea turtle within a moon pool.**
    c. Other protected species (e.g., giant manta ray, oceanic whitetip shark, or Gulf sturgeon): contact the **ESA Section 7 biologist at 301-427-8413 (nmfs.psoreview@noaa.gov)** and report all incidents to takereport.nmfs@noaa.gov.
    d. Minimum reporting information is described below:
        i. Time, date, water depth, and location (latitude/longitude) of the first discovery of the animal;
        ii. Name, type, and call sign of the vessel in which the event occurred;
        iii. Equipment being utilized at time of observation;
        iv. Species identification (if known) or description of the animal involved;
        v. Approximate size of animal;
        vi. Condition of the animal during the event and any observed injury / behavior;
        vii. Photographs or video footage of the animal, only if able; and
        viii. General narrative and timeline describing the events that took place.
2. After the appropriate contact(s) have been made for guidance/assistance as described in 1 above, you may call BSEE at 985-722-7902 (24 hours/day) for questions or additional guidance on recovery assistance needs (if still required) and continued monitoring requirements. You may also contact this number if you do not receive a timely response from the appropriate contact(s) listed in 1. above.
    a) Minimum post-incident reporting includes all information described above (under 1.d.i-viii) in addition to the following:
        i. NMFS liaison or stranding hotline that was contacted for assistance;
        ii. For moon pool observations or interactions:
        iii. Size and location of moon pool within vessel (e.g., hull door or no hull door);

iv. Whether activities in the moon pool were halted or changed upon observation of the animal; and

v. Whether the animal remains in the pool at the time of the report, or if not, the time/date the animal was last observed.

Reporting of Observations of Protected Species within an Enclosed Moon Pool

If a protected species is observed within an enclosed moon pool and does not demonstrate any signs of distress or injury or an inability to leave the moon pool of its own volition, measures described in this section must be followed (only in cases where they do not jeopardize human safety). Although this particular situation may not require immediate assistance and reporting as described under *Incidents Requiring Immediate Reporting* (see above), a protected species could potentially become disoriented with their surroundings and may not be able to leave the enclosed moon pool of their own volition. In order for operations requiring use of a moon pool to continue, the following reporting measures must be followed:

Within 24 hours of any observation, and daily after that for as long as an individual protected species remains within a moon pool (i.e., in cases where an ESA listed species has entered a moon pool but entrapment or injury has not been observed), the following information must be reported to BSEE (protectedspecies@bsee.gov) and BOEM (protectedspecies@boem.gov):

1. For an initial report, all information described under 1.d.i-viii above should be included.
2. For subsequent daily reports:
   a. Describe the animal's status to include external body condition (e.g., note any injuries or noticeable features), behaviors (e.g., floating at surface, chasing fish, diving, lethargic, etc.), and movement (e.g., has the animal left the moon pool and returned on multiple occasions?);
   b. Description of current moon pool activities, if the animal is in the moon pool (e.g., drilling, preparation for demobilization, etc.);
   c. Description of planned activities in the immediate future related to vessel movement or deployment of equipment;
   d. Any additional photographs or video footage of the animal, if possible;
   e. Guidance received and followed from NMFS liaison or stranding hotline that was contacted for assistance;
   f. Whether activities in the moon pool were halted or changed upon observation of the animal; and
   g. Whether the animal remains in the pool at the time of the report, or if not, the time/date the animal was last observed.

- **NON-RECURRING MITIGATION FOR THE PROTECTION OF POTENTIAL ARCHAEOLOGICAL RESOURCES:** The cultural resources review of TGS' application to conduct a 3D FAZ Seismic survey with OBNs and PIES deployed in the Garden Banks and Keathley Canyon areas indicates that potentially significant archaeological resources have been reported in the area of potential effect. Known resources should be avoided by the distances provided in the appended table. However, there are significant portions of the project area within the OCS that have received either limited or no previous archaeological survey, and these areas are likely to contain archaeological materials that may be impacted by the proposed operations. If the applicant discovers man-made debris that appears to indicate the presence of a shipwreck, aircraft, or other man-made structure (e.g., a sonar image or visual confirmation of an iron, steel, or wooden hull, wooden timbers, anchors, concentrations of man-made objects such as bottles or ceramics, piles of ballast rock, or aircraft structures) within or adjacent to the proposed action area during the proposed survey and PIES operations, they will be required to immediately halt operations, take steps to ensure that the site is not disturbed in any way, and contact the BOEM Regional Supervisor for Environment within 48-hours of its discovery. They must cease

all operations within 1,000 feet (305 meters) of the site until the Regional Director instructs you on what steps you must take to assess the site's potential historic significance and what steps you must take to protect it. If a node, ROV, or other activity impacts any submerged object, then the applicant must also submit a report detailing each instance of this activity. This report should include the coordinates of the impact (to DGPS accuracy), a description of the submerged object, any damage that may have resulted from the core placement or retrieval operations, and any photographic or video imagery that is collected. The applicant must submit a copy of any data collected as a result of these investigations.

Please direct any questions or correspondence pertaining to these requirements to Scott Sorset at (504) 736-2999 or scott.sorset@boem.gov or archaeology@boem.gov.

- **NON-RECURRING MITIGATION BENTHIC COMMUNITIES:** BOEM review of geophysical activities proposed in L20-033 Mod 1 identified confirmed and potential sensitive sessile benthic resources within the proposed node area. According to NTL 2009-G40, the minimum separation distance for bottom disturbing activities is 76 m (250 ft.) from any sensitive sessile benthic community (e.g., deepwater coral, chemosynthetic tube worms). Based on the methods described in the application, BOEM authorizes the applicant to deploy nodes with less than 76 m (250 ft) avoidance of high-density deepwater benthic communities contingent upon the applicant adhering to the mitigations described below:

  1. All seafloor disturbances, including nodes, cables, and ROV, must remain a minimum of 5 m (16 ft) from all sensitive sessile benthic communities.
  2. The contractor must photograph the seabed within a 10 m (33 ft) radius of any node placed within 76 m (250 ft.) of a BOEM anomaly (June 2019 dataset, see link below). Photographs of each such location shall be taken: Pre-node deployment, post-node deployment, and post-node retrieval. The photos shall clearly show the geographic location of each node.
  3. If any sessile benthic communities are present at a proposed node location, a new site that allows compliance with the above requirements shall be selected.
  4. The contractor must provide an as-placed GIS shapefile of actual OBN locations to demonstrate compliance. Submit the required photographs and shapefile to the BOEM Regional Supervisor, Office of Resource Evaluation, Data Acquisition and Special Projects Unit, within 90 calendar days after you complete the G&G activity.

  Refer to the following BOEM site for GIS data layers of known 3D seismic water bottom anomalies: https://www.boem.gov/Seismic-Water-Bottom-Anomalies-Map-Gallery/

  The following feature classes have a high probability of supporting sensitive sessile benthic organisms and shall be avoided unless visual inspection and photographic data confirm an absence of high-density deepwater benthic communities:

  1. Anomaly_patchreefs (Shallow Water)
  2. Anomaly_confirmed_patchreefs (Shallow Water)
  3. Seep_anomaly_positives
  4. Seep_anomaly_positives_possible_oil
  5. Seep_anomaly_positives_confirmed_oil
  6. Seep_anomaly_positives_confirmed_gas
  7. Seep_anomaly_confirmed_corals
  8. Seep_anomaly_confirmed_organisms
  9. Seep_anomaly_confirmed_hydrate
  10. Seep_anomaly_confirmed_carbonate
  11. Anomaly_Cretaceous
  12. Anomaly_Cretaceous_talus

- **MILITARY WARNING AREA COORDINATION**: Our review indicates that the routes to be taken by boats in support of your proposed activities are within Military Warning Areas W-602, W-147AB, and

W-59A (see BOEM Internet website at http://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Gulf-of-Mexico-Region/MWA_boundaries-pdf.aspx for a map of the areas). You shall contact the appropriate individual military command headquarters concerning the control of electromagnetic emissions and use of boats in each of the areas before commencing your operations.

Reference: http://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Gulf-of-Mexico-Region/Military-Contacts-pdf.aspx for a list of the contacts.

Conclusion: BOEM has evaluated the potential environmental impacts of the proposed action. Based on SEA No. L20-033 Mod 1, BOEM has determined that the proposed action with conditions of approval would have no significant impact on the marine, coastal, or human environment provided that the avoidance and mitigation measures required through conditions of approval are met by the operator. Therefore, an Environmental Impact Statement will not be required.

PERRY BOUDREAUX

Digitally signed by PERRY BOUDREAUX
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January 11, 2022

Date

Chief, Environmental Operations Section
Office of Environment
Gulf of Mexico Regional Office
Bureau of Ocean Energy Management

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SITE-SPECIFIC ENVIRONMENTAL ASSESSMENT (SEA) PREPARED FOR TGS GEOLOGICAL AND GEOPHYSICAL SURVEY APPLICATION NO. L20-033 MOD 1

1. INTRODUCTION

TGS has submitted a permit application (L20-033 Mod 1) to conduct a geological and geophysical (G&G) survey on the Outer Continental Shelf (OCS) of the Gulf of Mexico (GOM). This Site-Specific Environmental Assessment (SEA) evaluates the specific impacts associated with TGS' proposed G&G survey activities. **Chapter 1.3** of this SEA provides specific details on the G&G activities proposed in TGS' application.

The SEA is tiered from:

- Gulf of Mexico OCS Proposed Geological and Geophysical Activities Western, Central, and Eastern Planning Areas Final Programmatic Environmental Impact Statement (GOM G&G PEIS) (OCS EIS/EA BOEM 2017-051) (USDOI, BOEM, 2017a);
- Gulf of Mexico OCS Oil and Gas Lease Sales: 2017-2022 Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261 Final Environmental Impact Statement (Multisale EIS) (OCS EIS/EA BOEM 2017-009) (USDOI, BOEM, 2017b);
- Gulf of Mexico Lease Sale Final Supplemental Environmental Impact Statement 2018 (2018 SEIS) (OCS EIS/EA BOEM 2017-074) (USDOI, BOEM, 2017c);
- Biological Opinion Oil and Gas Leasing, Exploration, Development, Production, Decommissioning, and All Related Activities in the Gulf of Mexico Outer Continental Shelf (FWS 2018 BO) (Issued by United States Fish and Wildlife Service [FWS] April 20, 2018);
- Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico (NMFS 2020 BO) (Issued by National Marine Fisheries Service [NMFS] March 13, 2020) (USDOC, NMFS, 2020);
- Amended Incidental Take Statement and Revised Appendices to the Programmatic Biological Opinion on the Gulf of Mexico Oil and Gas Program (NMFS 2021 Amended ITS) (Issued by NMFS April 26, 2021) (USDOC, NMFS, 2021c);
- Final Rule Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to Geophysical Surveys Related to Oil and Gas Activities in the Gulf of Mexico (Issued by NMFS January 19, 2021) (*Federal Register*, 2021a); and
- Biological Environmental Background Report for the Gulf of Mexico OCS Region (2021 BEBR) (USDOI, BOEM, 2021).

"Tiering" is provided in the National Environmental Policy Act (NEPA) implementing regulations (40 CFR § 1501.11 and 1508.1 (ff)) and is designed to reduce and simplify the size of environmental assessments by eliminating repetitive discussions of impacts considered in prior NEPA compliance documents, allowing analyses to focus on those site-specific concerns and effects related to the action proposed. Document tiering in the Bureau of Ocean Energy Management (BOEM) is subject to additional guidance under the United States Department of the Interior (DOI) regulations at 43 CFR § 46.140 wherein the site-specific analysis must note which conditions and effects addressed in the programmatic document remain valid and which conditions and effects require additional review.

For this SEA, all of the analyses prepared in the GOM G&G PEIS, Multisale EIS, 2018 SEIS, 2021 BEBR, FWS 2018 BO, NMFS 2020 BO, and NMFS 2021 Amended ITS are sufficiently comprehensive and adequate to support decision making for TGS' proposed activities, with the following exceptions:

- **Active Acoustic Sound Sources and Vessel Noise and Traffic Impacts on Marine Mammals** – the environmental baseline since completion of the programmatic analyses may have experienced slight changes and/or new information has become available;
- **Active Acoustic Sound Sources and Vessel Noise and Traffic Impacts on Sea Turtles** – the environmental baseline since completion of the programmatic analyses may have experienced slight changes and/or new information has become available;
- **Active Acoustic Sound Source Impacts on Fish and Fisheries** – the environmental baseline since completion of the programmatic analyses may have experienced slight changes and/or new information has become available; and
- **Space-Use conflicts with other Users of the OCS** – survey operations have the potential to interfere with ongoing military operations in the area of the proposed action; and
- **Seafloor Disturbance** – site specific analysis is required to assess the impacts on biological features and archaeological resources that were not known during the preparation of the programmatic analyses.

Marine mammals, sea turtles, fish, benthic resources, archaeology, other uses (military), and commercial and recreational fisheries, as indicated in the GOM G&G PEIS, are susceptible to impacts from geophysical activities that may be considered adverse, but not significant. Impacts to fishes and commercial and recreational fisheries from the proposed activities are not expected due to the temporary nature of the operations. This SEA considers the potential for change in the status of resources and the potential for increased sensitivity of those resources to impacts from G&G activities.

Therefore, **Chapter 3** of this SEA will focus on how the new information relative to the cumulative environmental effects of this action. Where applicable, relevant affected environment discussions and impact analyses from the GOM G&G PEIS, Multisale EIS, 2018 SEIS, 2021 BEBR, FWS 2018 BO, NMFS 2020 BO, and NMFS 2021 Amended ITS are summarized and utilized for this site-specific analysis, and are incorporated by reference into this SEA. Relevant conditions of approval and monitoring measures identified in the GOM G&G PEIS, Multisale EIS, 2018 SEIS, 2021 BEBR, FWS 2018 BO, NMFS 2020 BO, and NMFS 2021 Amended ITS have been considered in the evaluation of the proposed action.

1.1. BACKGROUND

BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) are mandated to manage the development of OCS oil, gas, mineral resources, and renewable energy resources while ensuring safe operations and the protection of the human, marine, and coastal environments. One purpose of BOEM's regulatory program is to ensure that the G&G data is obtained in an environmentally safe manner. BOEM and BSEE regulate leasing, exploration, development, production, and decommissioning, and they perform environmental analyses during each of these phases. BOEM's Resource Evaluation Program oversees "speculative" G&G data acquisition and permitting activities pursuant to 30 CFR § 551 and § 580. Specifically, 30 CFR § 551 regulates prelease G&G exploratory operations for oil, gas, and sulfur resources, and 30 CFR § 580 regulates prelease prospecting activities. BOEM's Office of Leasing and Plans oversees "on-lease" or "ancillary" G&G data acquisition pursuant to 30 CFR § 550, which applies to postlease G&G exploratory operations.

The G&G surveys provide information used by industry and government to evaluate the potential for offshore oil and gas resources, renewable energy development, mineral resources exploration and development, and geologic hazards in a particular area. Industry needs accurate data to determine the location, extent, and properties of hydrocarbon resources. Information on shallow geologic hazards and seafloor geotechnical properties assists in the safe and economical exploration, development, production, and transportation of hydrocarbons. Additionally, the results of G&G surveys characterize sea bottom conditions before installing a renewable energy facility or to verify the completion of decommissioning activities.

The scope of the effects on GOM resources from activities proposed in TGS' G&G survey permit application, No. L20-033 Mod 1, were fully discussed and analyzed in the GOM G&G PEIS. Neither the specific location, equipment, nor the duration of this proposal will result in impacts different from those discussed in the GOM G&G PEIS, Multisale EIS, 2018 SEIS, 2021 BEBR, FWS 2018 BO, NMFS 2020

BO, or NMFS 2021 Amended ITS prepared since that time. Existing peer-reviewed literature and environmental monitoring suggests the proposed activity will not result in a different cumulative impact conclusion from what was made in the GOM G&G PEIS, Multisale EIS, 2018 SEIS, 2021 BEBR, FWS 2018 BO, or NMFS 2020 BO (as amended). This information was not available or considered during the preparation of the GOM G&G PEIS. Therefore, this SEA was prepared by BOEM to evaluate the operator's proposed G&G activities in light of any new changes in the baseline and/or new information.

1.2. Purpose of and Need for the Proposed Action

TGS has submitted a permit application L20-033 Mod 1 to conduct a G&G activity on the OCS. The permit application proposes to conduct a 3D full azimuth (FAZ) seismic survey using airguns with ocean bottom nodes (OBN). A low frequency Wolfspar seismic source will also be utilized as part of the proposed activities. TGS is also proposing to place pressure induced echo sounders (PIES) on the seafloor. This information can be utilized to evaluate the potential for, and develop plans for, the development and production of hydrocarbon resources on the OCS, which would help satisfy the Nation's need for energy. Additional information regarding other survey activities can be found in Appendix F of the GOM G&G PEIS.

The need for this action is established by BOEM's responsibility under the Outer Continental Shelf Lands Act (OCSLA) to make OCS lands available for expeditious and orderly development, subject to environmental safeguards, in a manner that is consistent with the maintenance of competition and other national needs. Section 11 of the OCSLA, 43 U.S.C. 1340, requires anyone seeking to conduct such activities to first obtain approval from BOEM. The Secretary of the Interior oversees the OCS oil and gas program, and BOEM and BSEE are the agencies charged with this oversight and regulated management of the permitted or otherwise authorized oil and gas activities. The Secretary is required to balance orderly resource development with protection of the human, marine, and coastal environments while ensuring that the U.S. public receives a fair return for resources discovered on and produced from public lands (43 U.S.C. 1332[3]).

In response to the proposed activities in TGS' application, BOEM has regulatory responsibility, consistent with the OCSLA and other applicable laws, to approve, approve with modifications or conditions of approval, or deny the application. BOEM's regulations provide criteria that BOEM will apply in reaching a decision and providing for any applicable conditions of approval.

1.3. Description of the Proposed Action

TGS proposes to conduct a 3D full azimuth seismic survey utilizing airgun arrays and OBN. The OBNs will be placed on the seafloor and recovered using a remote operational vehicle (ROV). TGS is also proposing to place PIES on the seafloor during the survey. In addition, the Wolfspar seismic source will also be utilized to collect low frequency data. Also, two additional airgun sources, the ION Gemini and the LISS TPS, will be utilized to collect survey data. Four vessels will be utilized for the conventional airguns survey activities. Two vessels will be utilized for for towing the airgun arrays; the *Artemis Arctic*, and the *Artemis Odyssey*. One vessel; the *REM Saltire,* will be utilized to deploy and retrieve the OBNs from the seafloor via the deployment of ROVs. One vessel: the *7-Oceans* will be utilized for support. An additional offshore supply vessel will be utilized to deploy and tow the Wolfspar low frequency source. The proposed activities are located south of Vermilion Parish, Louisiana in the Central and Western Planning Areas of the GOM. The OBNs of the proposed survey will be deployed in 405 Blocks in the Garden Banks and Keathley Canyon Areas of the GOM OCS which includes an additional 35 Blocks of node coverage added by the permit modification. In addition, up to 8 PIES will be deployed in pre-approved OBN locations. The source acquisition area includes, in addition to the OBN areas, blocks in the High Island (East Addition, South Extension), West Cameron (South Addition), East Cameron (South Addition), Vermilion (South Addition), South Marsh Island (South Addition), Green Canyon, Walker Ridge, Alaminos Canyon, and East Breaks Areas.

The area of the proposed action is approximately 96 miles (154 kilometers) from the nearest shoreline and in water depths ranging from approximately 262 to 7,644 feet (ft) (80 to 2,330 meters [m]). Site-specific analysis was completed using TGS' description of the proposed operations; however, specific technical information regarding the G&G activities described in the permit application is proprietary and therefore is

not included in this document. The proposed survey is expected to take approximately 9 months to complete (TGS, 2021).

3D Seismic Survey Using Ocean Bottom Nodes and Pressure Inverted Echosounders

Seismic surveys OBNs as receivers involve the placement of OBNs on the seafloor. The OBNs are typically placed using a ROV from a node handling vessel. After deployment, a source vessel towing an airgun array passes along the receivers. The OBNs may remain deployed for a couple of days to several weeks, depending on the survey's design. After a survey is completed, the sensors are retrieved by an ROV. Each node placement would temporarily affect a small area of the seafloor.

PIES are used for measuring the average speed of sound in the water column. PIES use an up chirp to accurately measure two-way travel-time in the water column. It simultaneously measures pressure at the seafloor. Pressure measurements are converted to depth to find the acoustic distance traveled from the seafloor to the surface and back again. By combining the depth and travel time, the average speed of sound in the water column is calculated (Sonardyne, 2022).

The sound source typically used in most seismic surveys is an airgun array. An airgun array consists of pneumatic devices that produce acoustic output through the rapid release of a volume of compressed air. The airgun array is designed to direct the high energy bursts of low-frequency sound (termed a "shot") downward toward the seafloor. Reflected sounds from below the seafloor are received by an array of sensitive hydrophones on cables (collectively termed "streamers") that are either towed behind a survey vessel, attached to cables/nodes placed on or anchored to the seafloor, or placed within the wellbore during vertical seismic profile surveys. A typical full-scale array produces a source level of 248-255 dB re µPa-m, zero-to-peak (referring to the waveform of the sound pulse). Typical seismic arrays being used in the GOM produce source levels (sound pressure levels) of approximately 240 dB re 1 µPa @ 1 m. While the seismic array pulses are directed toward the ocean bottom, sound can propagate horizontally for several kilometers (Richardson et al., 1995). Measurements of sources at sea (Goold and Fish, 1998; Sodal, 1999) have demonstrated that, although airgun arrays are primarily a source of low-frequency energy, there is also some transmission of energy at higher frequencies. These energies encompass the entire audio frequency range of 20 Hz to 20 kHz (Goold and Fish, 1998) and may extend well into the ultrasonic range up to 50 kHz (Sodal, 1999).

Wolfspar Technology

Airgun arrays commonly used as the sound source to image the subsurface have a limited ability to penetrate certain features, such as salt accumulations, because of the presence in the signal of higher frequencies that reflect off these layers. The BP Wolfspar prototype is designed to use a vibratory technology for creating an acoustic source for acquisition of seismic data. The source is essentially a transducer designed to generate low frequency sound (1 to 17 Hz) in the form of non-linear sweeps (as opposed to pulsed airgun sources). The advantages of this Wolfspar system are thought to be twofold: 1) the elimination of unwanted high frequencies generated by airguns (thought to be as high as 2 kHz), and 2) a better system of imaging in acoustically opaque areas, like the extensive sub-salt areas in the GOM.

2. ALTERNATIVES CONSIDERED

2.1. NO ACTION ALTERNATIVE

Alternative 1 –If this alternative is selected the applicant would not undertake the proposed activity. This alternative might prevent the exploration and development of hydrocarbons, resulting in the potential loss of royalty income and energy resources for the United States.

2.2. PROPOSED ACTION AS SUBMITTED

Alternative 2 – If this alternative is selected the applicant would undertake the proposed activity as requested in the application. No conditions of approval would be required by BOEM.

2.3. PROPOSED ACTION WITH CONDITIONS OF APPROVAL

Alternative 3 – This is BOEM's *Preferred Alternative*. If this alternative is selected the applicant would undertake the proposed activity, as requested in the application, but with the conditions of approval

identified by BOEM, in coordination with NMFS and in accordance with the NMFS 2020 BO, NMFS 2021 Amended ITS, and NMFS 2021 Incidental Take Regulations (listed in **Chapter 2.4** below and described in the effects analyses), to fully address the site- and project-specific impacts of the proposed action.

2.4. SUMMARY AND COMPARISON OF THE ALTERNATIVES

If selected, Alternative 1, the No Action Alternative, would prevent the applicant from acquiring the proper permits and the subsequent collection of seismic data on the OCS. The information would not be available to industry and government to assist in their evaluation of offshore oil and gas resources, geologic hazards, or potential renewable energy sites in a particular area. Alternative 1 would not result in any impacts to the environmental resources analyzed in **Chapter 3**; however, it does not meet the underlying purpose and need.

If selected, Alternative 2 would allow for the collection of seismic data, as requested in the application, but would not include any additional conditions of approval or monitoring measures applied by BOEM or NMFS. Alternative 2 meets the underlying purpose and need of the proposed action but could cause unacceptable impacts to the environmental resources analyzed, as described in **Chapter 3** (e.g., hearing loss in marine mammals, injuries to marine mammals and sea turtles from vessel strikes, potential damages to unknown cultural resources and benthic resources on the seafloor). Alternative 2 would not require the implementation of conditions of approval and monitoring measures developed by BOEM, in coordination with NMFS, to limit the potential for lethal and sublethal impacts to marine mammals and sea turtles.

Alternative 3 is the Preferred Alternative, based on the analysis of potential impacts to resources described in **Chapter 3**, because it meets the underlying purpose and need, and also implements conditions of approval and monitoring measures that adequately limit or negate potential impacts. Implementation of these standard mitigation and monitoring measures was assumed as part of the analysis in the NMFS 2020 Endangered Species Act (ESA) Section 7 Biological Opinion (BO), and NMFS 2021 Amended ITS and BOEM is committed to requiring their implementation. NMFS provided a response to the Step-Down Review of L20-033 Mod 1 on January 5, 2022, in that with implementation of the conditions of approval and monitoring measures below, the proposed action is within the scope of NMFS effects analysis considered for the most recent BO (as amended). The conditions of approval and monitoring measures were identified and will need to be imposed to provide further protection for marine mammals per NMFS 2021 Incidental Take Regulations (*Federal Register*, 2021a) (see **Chapter 3.2**). The G&G activities proposed will provide TGS with sufficiently accurate data to determine the location, extent, and properties of potential hydrocarbon resources. Additionally, the collected data supports BOEM's regulatory and oversight responsibilities while promoting the development of hydrocarbon resources, potentially resulting in increased royalty income as well as energy resources for the United States.

Other alternatives regarding Agency oversight of the G&G permitting program, identified in Chapter 2 of the GOM G&G PEIS, were reviewed with the alternatives listed above chosen as reasonable for the current proposed action.

Conditions of Approval Required under the Preferred Alternative

The need for and utility of the following conditions of approval and monitoring measures are discussed in the relevant impact analysis sections of this SEA. The following conditions of approval and reporting requirements were identified to ensure adequate environmental protection and post-activity compliance:

- **COMPLIANCE WITH BIOLOGICAL OPINION TERMS AND CONDITIONS AND REASONABLE AND PRUDENT MEASURES:** This approval is conditioned upon compliance with the Reasonable and Prudent Measures and implementing Terms and Conditions of the Biological Opinion issued by the National Marine Fisheries Service on March 13, 2020, and the amendment issued on April 26, 2021. This includes mitigation, particularly any appendices to Terms and Conditions applicable to the plan, as well as record-keeping and reporting sufficient to allow BOEM and BSEE to comply with reporting and monitoring requirements under the BiOp; and any additional reporting required by BOEM or BSEE developed as a result of BiOp implementation. The NMFS Biological Opinion may be found here: (https://www.fisheries.noaa.gov/resource/document/biological-opinion-federally-regulated-oil-and-gas-program-activities-gulf-mexico). The amendment can be found here: https://repository.library.noaa.gov/view/noaa/29355 . The Appendices and protocols may be found here: (https://www.fisheries.noaa.gov/resource/document/appendices-biological-opinion-

federally-regulated-oil-and-gas-program-gulf-mexico). The amendment provided updates to Appendices A, C and I which may be found here: https://repository.library.noaa.gov/view/noaa/29355.

- **SUPPORT BASES AND VESSEL TRANSIT ROUTES**: Approval of your plan is conditioned upon your use of the support bases and vessel transit routes as described in your plan. BOEM/BSEE must be notified at least 15 days prior to any vessel route changes that require transit of the Bryde's Whale area, and you must receive prior approval for that transit from BOEM/BSEE.
- **SEISMIC SURVEY OPERATION, MONITORING, AND REPORTING GUIDELINES**: The applicant will follow the guidance provided under Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols found in the Biological Opinion amendment issued by the National Marine Fisheries Service on April 26, 2021. The guidance can be accessed on NOAA Fisheries internet website at https://repository.library.noaa.gov/view/noaa/29355.
- **MARINE TRASH AND DEBRIS AWARENESS AND ELIMINATION**: The applicant will follow the guidance provided under Appendix B. Gulf of Mexico Marine Trash and Debris Awareness and Elimination Survey Protocols found in the Biological Opinion issued by the National Marine Fisheries Service on March 13, 2020. The guidance can be accessed on NOAA Fisheries internet website at https://www.fisheries.noaa.gov/resource/document/appendices-biological-opinion-federally-regulated-oil-and-gas-program-gulf-mexico.
- **VESSEL-STRIKE AVOIDANCE/REPORTING**: The applicant will follow the protocols provided under Appendix C. Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols found in the Biological Opinion amendment issued by the National Marine Fisheries Service on April 26, 2021. The guidance can be accessed on the NOAA Fisheries internet site at https://repository.library.noaa.gov/view/noaa/29355.
- **SEA TURTLE RESUSCITATION GUIDELINES**: The applicant will follow the guidance provided under Appendix J. Sea Turtle Handling and Resuscitation Guidelines found in the Biological Opinion issued by the National Marine Fisheries Service on March 13, 2020. The guidance can be accessed on the NOAA Fisheries internet site at https://www.fisheries.noaa.gov/resource/document/appendices-biological-opinion-federally-regulated-oil-and-gas-program-gulf-mexico.
- **SLACK-LINE PRECAUTIONS CONDITION OF APPROVAL:** If operations require the use of flexible, small diameter (< 2 inch) lines to support operations (with or without divers), operators/contractors must reduce the slack in the lines, except for human safety considerations, to prevent accidental entanglement of protected species (i.e. species protected under the Endangered Species Act [ESA] and/or Marine Mammal Protection Act [MMPA]). This requirement includes tether lines attached to remotely operated equipment. The requirements below must be followed for any activities entailing use of flexible, small diameter lines that will not remain continuously taut, except when complying with these requirements would put the safety of divers, crew, or the vessel at risk:
    - Operators must utilize tensioning tools and/or other appropriate procedures to reduce unnecessary looseness in the lines and/or potential looping;
    - The lines must remain taut, as long as additional safety risks are not created by this action;
    - A line tender must be present at all times during dive operations and must monitor the line(s) the entire time a diver is in the water; and
    - Should the line tender and/or diver become aware of an entanglement of an individual protected species, the reporting requirements described in the *Reporting Requirements* COA must be followed as soon as safety permits.
- **REPORTING REQUIREMENTS CONDITION OF APPROVAL:** Review of your proposed activities identified use of equipment that has the potential for entanglement and/or entrapment of protected species (i.e. species protected under the Endangered Species Act [ESA] and/or Marine Mammal Protection Act [MMPA]) that could be present during operations. In case of entrapment, procedures and measures for reporting are dependent upon the situation at hand. **These requirements replace those specific to dead and injured species reporting in respective sections of Appendix A (insofar as they relate to geophysical surveys) and Appendix C of the 2020 Biological Opinion on the**

Bureau of Ocean Energy Management's Oil and Gas Program Activities in the Gulf of Mexico.

*Incidents Requiring **Immediate** Reporting*

Certain scenarios or incidents require immediate reporting to Federal agencies; these are described below:

Should any of the following occur at any time, **immediate reporting** of the incident is required after personnel and/or diver safety is ensured:

- Entanglement or entrapment of a protected species (i.e., an animal is entangled in a line or cannot or does not leave a moon pool of its own volition).
- Injury of a protected species (e.g., the animal appears injured or lethargic). Interaction, or contact with equipment by a protected species.
- Any observation of a leatherback sea turtle within a moon pool (regardless of whether it appears injured, or an interaction with equipment or entanglement/entrapment is observed).

1. As soon as personnel and/or diver safety is ensured, report the incident to National Marine Fisheries Service (NMFS) by contacting the appropriate expert for 24-hr response. If you do not receive an immediate response, you must keep trying until contact is made. Any failed attempts should be documented. Contact information for reporting is as follows:
    a. **Marine mammals**: contact **Southeast Region's Marine Mammal Stranding Hotline at 1-877-433-8299.**
    b. **Sea turtles**: contact **Brian Stacy, Veterinary Medical Officer at 352-283- 3370**. If unable to reach Brian Stacy, contact Lyndsey Howell at 301-310- 3061. This includes the immediate reporting of **any observation of a leatherback sea turtle within a moon pool.**
    c. Other protected species (e.g., giant manta ray, oceanic whitetip shark, or Gulf sturgeon): contact the **ESA Section 7 biologist at 301-427-8413 (nmfs.psoreview@noaa.gov)** and report all incidents to takereport.nmfs@noaa.gov.
    d. Minimum reporting information is described below:
        i. Time, date, water depth, and location (latitude/longitude) of the first discovery of the animal;
        ii. Name, type, and call sign of the vessel in which the event occurred;
        iii. Equipment being utilized at time of observation;
        iv. Species identification (if known) or description of the animal involved;
        v. Approximate size of animal;
        vi. Condition of the animal during the event and any observed injury / behavior;
        vii. Photographs or video footage of the animal, only if able; and
        viii. General narrative and timeline describing the events that took place.
2. After the appropriate contact(s) have been made for guidance/assistance as described in 1 above, you may call BSEE at 985-722-7902 (24 hours/day) for questions or additional guidance on recovery assistance needs (if still required) and continued monitoring requirements. You may also contact this number if you do not receive a timely response from the appropriate contact(s) listed in 1. above.
    a) Minimum post-incident reporting includes all information described above (under 1.d.i-viii) in addition to the following:
        i. NMFS liaison or stranding hotline that was contacted for assistance;

ii. For moon pool observations or interactions:

iii. Size and location of moon pool within vessel (e.g., hull door or no hull door);

iv. Whether activities in the moon pool were halted or changed upon observation of the animal; and

v. Whether the animal remains in the pool at the time of the report, or if not, the time/date the animal was last observed.

Reporting of Observations of Protected Species within an Enclosed Moon Pool

If a protected species is observed within an enclosed moon pool and does not demonstrate any signs of distress or injury or an inability to leave the moon pool of its own volition, measures described in this section must be followed (only in cases where they do not jeopardize human safety). Although this particular situation may not require immediate assistance and reporting as described under *Incidents Requiring Immediate Reporting* (see above), a protected species could potentially become disoriented with their surroundings and may not be able to leave the enclosed moon pool of their own volition. In order for operations requiring use of a moon pool to continue, the following reporting measures must be followed:

Within 24 hours of any observation, and daily after that for as long as an individual protected species remains within a moon pool (i.e., in cases where an ESA listed species has entered a moon pool but entrapment or injury has not been observed), the following information must be reported to BSEE (protectedspecies@bsee.gov) and BOEM (protectedspecies@boem.gov):

1. For an initial report, all information described under 1.d.i-viii above should be included.
2. For subsequent daily reports:
   a. Describe the animal's status to include external body condition (e.g., note any injuries or noticeable features), behaviors (e.g., floating at surface, chasing fish, diving, lethargic, etc.), and movement (e.g., has the animal left the moon pool and returned on multiple occasions?);
   b. Description of current moon pool activities, if the animal is in the moon pool (e.g., drilling, preparation for demobilization, etc.);
   c. Description of planned activities in the immediate future related to vessel movement or deployment of equipment;
   d. Any additional photographs or video footage of the animal, if possible;
   e. Guidance received and followed from NMFS liaison or stranding hotline that was contacted for assistance;
   f. Whether activities in the moon pool were halted or changed upon observation of the animal; and
   g. Whether the animal remains in the pool at the time of the report, or if not, the time/date the animal was last observed.

- **NON-RECURRING MITIGATION FOR THE PROTECTION OF POTENTIAL ARCHAEOLOGICAL RESOURCES:** The cultural resources review of TGS' application to conduct a 3D FAZ Seismic survey with OBNs and PIES deployed in the Garden Banks and Keathley Canyon areas indicates that potentially significant archaeological resources have been reported in the area of potential effect. Known resources should be avoided by the distances provided in the appended table. However, there are significant portions of the project area within the OCS that have received either limited or no previous archaeological survey, and these areas are likely to contain archaeological materials that may be impacted by the proposed operations. If the applicant discovers man-made debris that appears to indicate the presence of a shipwreck, aircraft, or other man-made structure (e.g., a sonar image or visual confirmation of an iron, steel, or wooden hull, wooden timbers, anchors, concentrations of man-made objects such as bottles or ceramics, piles of ballast rock, or aircraft structures) within or adjacent to the

proposed action area during the proposed survey and PIES operations, they will be required to immediately halt operations, take steps to ensure that the site is not disturbed in any way, and contact the BOEM Regional Supervisor for Environment within 48-hours of its discovery. They must cease all operations within 1,000 feet (305 meters) of the site until the Regional Director instructs you on what steps you must take to assess the site's potential historic significance and what steps you must take to protect it. If a node, ROV, or other activity impacts any submerged object, then the applicant must also submit a report detailing each instance of this activity. This report should include the coordinates of the impact (to DGPS accuracy), a description of the submerged object, any damage that may have resulted from the core placement or retrieval operations, and any photographic or video imagery that is collected. The applicant must submit a copy of any data collected as a result of these investigations.

Please direct any questions or correspondence pertaining to these requirements to Scott Sorset at (504) 736-2999 or scott.sorset@boem.gov or archaeology@boem.gov.

- **NON-RECURRING MITIGATION BENTHIC COMMUNITIES:** BOEM review of geophysical activities proposed in L20-033 Mod 1 identified confirmed and potential sensitive sessile benthic resources within the proposed node area. According to NTL 2009-G40, the minimum separation distance for bottom disturbing activities is 76 m (250 ft.) from any sensitive sessile benthic community (e.g., deepwater coral, chemosynthetic tube worms). Based on the methods described in the application, BOEM authorizes the applicant to deploy nodes with less than 76 m (250 ft) avoidance of high-density deepwater benthic communities contingent upon the applicant adhering to the mitigations described below:

    1. All seafloor disturbances, including nodes, cables, and ROV, must remain a minimum of 5 m (16 ft) from all sensitive sessile benthic communities.
    2. The contractor must photograph the seabed within a 10 m (33 ft) radius of any node placed within 76 m (250 ft.) of a BOEM anomaly (June 2019 dataset, see link below). Photographs of each such location shall be taken: Pre-node deployment, post-node deployment, and post-node retrieval. The photos shall clearly show the geographic location of each node.
    3. If any sessile benthic communities are present at a proposed node location, a new site that allows compliance with the above requirements shall be selected.
    4. The contractor must provide an as-placed GIS shapefile of actual OBN locations to demonstrate compliance. Submit the required photographs and shapefile to the BOEM Regional Supervisor, Office of Resource Evaluation, Data Acquisition and Special Projects Unit, within 90 calendar days after you complete the G&G activity.

    Refer to the following BOEM site for GIS data layers of known 3D seismic water bottom anomalies: https://www.boem.gov/Seismic-Water-Bottom-Anomalies-Map-Gallery/

    The following feature classes have a high probability of supporting sensitive sessile benthic organisms and shall be avoided unless visual inspection and photographic data confirm an absence of high-density deepwater benthic communities:

    1. Anomaly_patchreefs (Shallow Water)
    2. Anomaly_confirmed_patchreefs (Shallow Water)
    3. Seep_anomaly_positives
    4. Seep_anomaly_positives_possible_oil
    5. Seep_anomaly_positives_confirmed_oil
    6. Seep_anomaly_positives_confirmed_gas
    7. Seep_anomaly_confirmed_corals
    8. Seep_anomaly_confirmed_organisms
    9. Seep_anomaly_confirmed_hydrate
    10. Seep_anomaly_confirmed_carbonate
    11. Anomaly_Cretaceous
    12. Anomaly_Cretaceous_talus

- **MILITARY WARNING AREA COORDINATION**: Our review indicates that the routes to be taken by boats in support of your proposed activities are within Military Warning Areas W-602, W-147AB, and W-59A (see BOEM Internet website at http://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Gulf-of-Mexico-Region/MWA_boundaries-pdf.aspx for a map of the areas). You shall contact the appropriate individual military command headquarters concerning the control of electromagnetic emissions and use of boats in each of the areas before commencing your operations.

  Reference: http://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Gulf-of-Mexico-Region/Military-Contacts-pdf.aspx for a list of the contacts.

2.5. ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

A viable alternative is required to be a logical option for carrying out the proposed action, ensure that the purpose of and need can be met, and be feasible under the regulatory directives of the OCSLA and all other applicable guidance. As such, other alternatives regarding Agency oversight of the G&G permitting program, identified in Chapter 2 of the GOM G&G PEIS, were reviewed with the alternatives listed above chosen as reasonable for the current proposed action. Several other alternatives were considered and reviewed during the coordination of the resource reviews, but they were ultimately dismissed and not analyzed further since they did not meet the aforementioned requirements. The following alternative was considered and given review; however, it was not accepted for the reasons discussed below.

Alternative Requiring Shut-Down Conditions for Delphinids

This analysis also considered whether to apply the shutdown conditions to delphinids. From a biological standpoint, the best available information suggests that delphinids are considered mid-frequency specialists (i.e., auditory bandwidth of 150 Hz to 160 kHz) (Southall et al., 2007). Low frequency seismic arrays, such as the one considered for use under this proposed action, generally operate in the frequency range of 20 Hz to 20 kHz (Goold and Fish, 1998) and may extend well into the ultrasonic range up to 50 kHz (Sodal, 1999). Therefore, while the majority of the seismic noise occurs at frequencies below that of delphinids, there are some components that may enter into the hearing range of delphinids (Goold and Fish, 1998). These higher frequency components would be at lower intensity levels (i.e., not as loud). It is unclear, though, from a scientific standpoint whether any of the seismic noise that might be heard by delphinids is in fact disruptive.

Delphinids are known to bow ride on operating seismic vessels. BOEM funded a data synthesis study on the effectiveness of seismic survey mitigation measures and marine mammal observer reports (USDOI, BOEM, 2012) that analyzed protected species observer (PSO) data collected from 2002-2008 in the GOM. Approximately 58 percent of all dolphin sightings occurred within the 500 m exclusion zone, and of these, 33 percent were exhibiting bow-riding behavior.

Looking at these records for a typical year (2009), approximately 400 (~27%) were delphinids within the 500 meter exclusion zone with operating airguns. In that same year, there were 55 records of shut downs for whales within the 500 m exclusion zone. If sources had also been shut down for the 400 sightings of delphinids, this would have resulted in a 7-fold increase in the number of shutdowns. There is little doubt then that a shutdown provision for delphinids within the exclusion zone would have a significant impact on seismic operations, such as those under the proposed action.

BOEM next considered whether a provision could be applied to allow for a reasonable exception for bow riding delphinids. For example, a provision could be considered that would allow PSOs to call for a power down (versus immediate shut down) of the seismic source to the smallest airgun should any delphinid enter, or come close to entering, the 500 meter exclusion zone referenced under Definitions of Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols in the NMFS 2021 Amended ITS. If the delphinids leave the exclusion zone or engage in bow riding behavior then the PSO could call for the immediate return of the array to full power. This would allow for an opportunity for the PSO to determine if the behavior of the animal(s) warranted a shut down and if not would allow the applicant to return to full power more quickly (versus a shut down followed by a 30 minute clearance of the zone and a 20-40 minute ramp up procedure).

Based on the PSO sighting records, it is clear that shut downs for delphinids would result in an impact to industry activities. Unlike other sound producing activities (e.g., sonar), seismic surveys occur on specified tracklines that need to be followed in order to meet the data quality objectives of the survey. In other words, seismic vessels in operation cannot simply divert away from nearby marine mammals without a loss in data quality. As stated above, an analysis of 2009 PSO data (USDOI, BOEM, 2012) indicates that if shut downs for delphinids within the exclusion zone were employed there would have been a 7-fold increase in shut downs of seismic arrays that year. Shut downs of 30 minutes or longer would have required an additional 30 minute observation period to ensure animals have left the exclusion area followed by a 20-40 minute ramp up procedure. In all likelihood, these shut downs would then have required the applicants to return to an earlier point in the track line and resurvey the area again. This not only results in substantially more expense in down time and repositioning of seismic arrays and streamers, but would also likely increase the duration of and amount of total seismic noise for each affected survey area.

Conclusion

Based on the analysis above, BOEM believes it is essential to more fully investigate and vet the application of shut down conditions to delphinids before requiring it as a condition of approval in the GOM (under Alternative 3) or considering it as an additional alternative to the proposed action. It is BOEM's intention, therefore, to fully analyze the application of this condition of approval.

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

3.1. INTRODUCTION

The discussion below will: (1) describe/summarize the pertinent potentially affected resources; (2) determine whether the proposed G&G activities and their impact-producing factors (IPF) will have significant impacts on the marine, coastal, or human environments of the GOM; and (3) identify significant impacts, if any, that may require further NEPA analysis in an EIS. The description of the affected environment and impact analysis are presented together in this section for each resource.

For each potentially affected resource, BOEM staff reviewed and analyzed all currently available peer-reviewed literature and integrated these data and findings into the analyses below. The analyses cite the best available, relevant scientific literature. BOEM performed this analysis to determine whether TGS' proposed survey activities will significantly impact the marine, coastal, or human environments of the GOM. For the impact analysis, resource-specific significance criteria were developed for each category of the affected environment. The criteria for impacts to environmental resources are generally classified into one of the three following levels:

- ***Significant Adverse Impact*** (including those that could be mitigated to nonsignificance);
- ***Adverse but Not Significant Impact;*** or
- ***Negligible Impact.***

Preliminary screening for this assessment was based on a review of this relevant literature; previous SEAs; the GOM G&G PEIS (USDOI, BOEM, 2017a); the Multisale EIS (USDOI, BOEM, 2017b); the 2018 SEIS (USDOI, BOEM, 2017c); the 2021 BEBR (USDOI, BOEM, 2021); the NMFS 2020 BO (USDOC, NMFS, 2020); the NMFS 2021 Amended ITS (USDOC, NMFS, 2021c); and relevant literature pertinent to historic and projected activities. BOEM initially considered the following resources for impact analysis:

- marine mammals (including Endangered Species Act [ESA] listed species and strategic stocks);
- sea turtles (all are ESA listed species);
- fishes (including listed species and ichtyoplankton);
- commercial and recreational fisheries;
- coastal and marine birds (including ESA listed species);
- benthic communities;
- archaeological resources;

- military uses;
- recreational and commercial diving;
- marine transportation;
- geology/sediments; and
- air and water quality.

In the GOM G&G PEIS, the impact analysis focused on a broad group of G&G activities (including other survey types) and resources with the potential for non-negligible impacts. First, a matrix identifies impact agents associated with each type of G&G activity (Chapter 3 of the GOM G&G PEIS; USDOI, BOEM, 2017a). The IPFs include: (1) active acoustic sound sources; (2) vessel and equipment noise; (3) vessel traffic; (4) aircraft traffic and noise; (5) stand-off distance; (6) vessel discharges; (7) trash and debris; (8) seafloor disturbance; (9) drilling discharges; (10) entanglement; and (11) accidental fuel spills. The preliminary analysis in the GOM G&G PEIS considers surveys of the type proposed by TGS as well as impacts to resources by type of activity. To assist with subsequent coordination, the GOM G&G PEIS' analysis further defines the level of impact associated with each interaction as follows:

- **Nominal:** little or no measurable/detectable impact;
- **Minor**: impacts are detectable, short term, extensive or localized, but less than severe;
- **Moderate**: impacts are detectable, short term, extensive, and severe; or impacts are detectable, short term or long lasting, localized, and severe; or impacts are detectable, long lasting, extensive or localized, but less than severe; and
- **Major**: impacts are detectable, long lasting, extensive, and severe.

The GOM G&G PEIS notes that G&G surveys have historically covered a large area of the GOM each year and, when unmitigated, have the greatest potential for "significant" impacts to protected and other sensitive marine species in comparison with other OCSLA-approved activities, including, but not limited to, exploration and development drilling. Further, it acknowledges increasing concerns in the regulatory and scientific communities regarding acoustic impacts on marine life, including marine mammals, turtles, and fishes. Species of particular concern are those whose hearing capabilities (based on vocalization characteristics) fall within the low frequencies introduced into the marine environment by G&G activities. The GOM G&G PEIS provides a comprehensive characterization of biological resources that may be adversely affected by G&G activities. This information is summarized in the various resource-specific descriptions of the affected environment and impact analyses in the chapters that follow.

However, for the purposes of this SEA, BOEM has not included analyses on resource areas that were evaluated and considered under the GOM G&G PEIS as having nominal impacts or determined the resource would not be impacted by the proposed action. Such a procedure is consistent with the NEPA concept of tiering (40 CFR § 1501.11). Additionally, since no expansion or modification of support bases or related vessel construction work are proposed as a result of this activity, socioeconomic effects were not analyzed due to the type, the temporary nature, and employment size of the survey activity. The most recent evaluation of the best available peer-reviewed scientific literature continues to support this conclusion for the following resource categories:

- commercial and recreational fisheries;
- coastal and marine birds (including ESA listed species);
- recreational and commercial diving;
- marine transportation;
- geology/sediments; and
- air and water quality.

For this SEA, BOEM evaluated the potential impacts from the applicant's proposed G&G activities in the GOM on the following resource categories:

- marine mammals (including threatened/endangered and non-ESA listed species);
- sea turtles (all are ESA listed species);

- fish and fisheries (including listed species and ichtyoplankton);
- benthic communities;
- archaeological resources; and
- other users of the OCS (space-use conflicts with military uses).

3.2. MARINE MAMMALS

3.2.1. Description

The marine mammal community is diverse and distributed throughout the northern GOM waters. The GOM's marine mammals are represented by members of the taxonomic order Cetacea, including suborders Mysticeti (i.e., baleen whales) and Odontoceti (i.e., toothed whales), as well as the order Sirenia (i.e., manatee). Twenty-one species of cetaceans and one species of Sirenia regularly occur in the GOM and are identified in the NMFS Stock Assessment Reports (SAR) (Jefferson et al., 2008; Davis et al., 2000; Roberts et al., 2016; Hayes et al., 2018, 2019, 2020, and 2021). A complete description of marine mammals can be found in Chapter 4.2 of the GOM G&G PEIS; Chapter 4.9 of the Multisale EIS and 2018 SEIS; Chapter 3.7 of the 2021 BEBR; the NMFS 2017, 2018, 2019, and 2020 SAR (Hayes et al., 2018, 2019, 2020, and 2021); the NMFS 2020 BO; and the NMFS 2021 Amended ITS; and are incorporated by reference.

Threatened or Endangered Marine Mammal Species

Only two cetaceans, the sperm whale (*Physeter macrocephalus*) and the GOM Rice's whale (*Balaenoptera ricei*) (previously named Bryde's whale [*Balaenoptera edeni*]), regularly occur in the GOM and are listed as endangered under the ESA. On January 8, 2016 (81 FR 999), the United States Fish and Wildlife Service (FWS) issued a proposed rule and notice to reclassify the West Indian manatee from endangered to threatened (*Federal Register*, 2016) which was later issued as a Final Rule (82 FR 16668) on April 5, 2017 (*Federal Register*, 2017). On December 2, 1970, in the Final Rule (35 FR 18319), the sperm whale was listed as endangered throughout its range. The Final Rule (84 FR 15446) to list the GOM Bryde's (Rice's) whale as endangered was issued and became effective on May 15, 2019 (*Federal Register*, 2019). On August 23, 2021, NMFS published a direct final rule in the *Federal Register* (86 FR 47022): Endangered and Threatened Wildlife and Plants; Technical Corrections for the Bryde's Whale (Gulf of Mexico Subspecies). NMFS revises the common name to Rice's whale, the scientific name to *Balaenoptera ricei,* and the description of the listed entity to entire species. The changes to the taxonomic classification and nomenclature do not affect the species' listing status under the ESA or any protections and requirements arising from its listing. This rule is effective October 22, 2021 without further action, unless significant adverse comment is received by September 22, 2021 (*Federal Register*, 2021b).

The only commonly occurring baleen whale in the northern GOM is the Rice's whale. Most sightings have been made in the De Soto Canyon region and off western Florida, although there have been some in the west-central portion of the northeastern GOM. The best estimate of abundance for Rice's whales in the northern GOM is 51 individuals (Hayes et al., 2021). Based on vessel and aerial survey sightings, the primary core habitat of Rice's whale is in the northeastern GOM, centered in De Soto Canyon in water depths between 150 and 410 m (492 and 1,345 ft) (Rosel et al., 2021). Sperm whales in the GOM are not evenly distributed, showing greater densities in areas associated with oceanic features that provide the best foraging opportunities (USDOC, NMFS, 2020).

Non-ESA-Listed Marine Mammal Species

Nineteen toothed cetaceans (including beaked whales and dolphins) regularly occur in the GOM but are not ESA-listed. Despite being non-listed, the Marine Mammal Protection Act (MMPA) of 1972 protects all marine mammals.

Unusual Mortality Events (UME)

An UME is defined under the MMPA as a "stranding that is unexpected, involves a significant die-off of any marine mammal population, and demands immediate response." A list of active and closed UMEs with updated information can be found at the following website: https://www.fisheries.noaa.gov/national/marine-life-distress/active-and-closed-unusual-mortality-events.

2018-2020 Southwest Florida Bottlenose Dolphin UME (UME 66)

Since July 2018, the 2018-2020 Southwest Florida Bottlenose Dolphin UME was issued because of elevated bottlenose dolphin mortalities. Southwest Florida has been experiencing an ongoing severe bloom of a red tide organism since November 2017. The results from several necropsies showed positive findings of red tide toxin (brevetoxin) indicating this UME is related to the bloom. Other species such as fish, sea turtles, and manatees have also been impacted by the algal bloom (USDOC, NMFS, 2021a). This UME is in non-active status with closure pending (USDOC, NMFS, 2021b).

Marine Mammal Hearing

All marine mammals produce and use sound to communicate with another animal of the same species, to navigate and sense their environment, to locate and capture prey, and to detect and avoid predators (Southall et al., 2007 and 2019). The hearing of marine mammals varies based on individuals, absolute threshold of the species, masking, localization, frequency discrimination, and the motivation to be sensitive to a sound (Richardson et al., 1995). Southall et al. (2007) described the frequency sensitivity in five functional hearing groups of marine mammals by combining behavioral and electrophysiological audiograms with comparative anatomy, modeling, and response measured in ear tissues, which has been updated by Southall et al. (2019) to include six proposed hearing groups. For potentially affected marine mammal species in the GOM, the main functional hearing groups include: (1) low-frequency cetaceans with an estimated auditory bandwidth of 7 Hz to 35 kHz; (2) mid-frequency cetaceans with functional hearing of approximately 150 Hz to 160 kHz; and (3) high-frequency cetaceans with functional hearing estimated from 200 Hz to 180 kHz. These hearing sensitivity and frequency ranges are based on audiograms that are obtained by either: (1) behavioral testing on captive, trained animals; or (2) electrophysiological or auditory evoked potential (AEP) methods (Richardson et al., 1995). Currently, there are no behavioral or AEP audiograms for low-frequency cetaceans available. Audiograms, both behavioral and AEP, are available for some mid-frequency and high-frequency cetaceans (Richardson et al., 1995; Nedwell et al., 2004; Southall et al., 2007 and 2019; Au and Hastings, 2008).

3.2.2. Impact Analysis

The IPFs associated with the proposed action that could affect both ESA-listed and non-ESA-listed marine mammals are primarily active acoustic sound sources and vessel noise from survey activities, collisions with seismic survey vessels, and marine trash and debris. Chapter 4.2 of the GOM G&G PEIS contains a discussion of the potential impacts from survey operations on marine mammal resources (USDOI, BOEM, 2017a). Additional information about routine impacts from oil and gas activity on impacts on marine mammals is addressed in Chapter 4.9 of the Multisale EIS and 2018 SEIS, Chapter 4.7 of the 2021 BEBR, the NMFS 2020 BO, and the NMFS 2021 Amended ITS. The discussions are summarized below and are incorporated by reference into this SEA. The best available scientific information also indicates that seismic airgun noise may affect non-ESA-listed marine mammal species (Southall et al., 2007 and 2019).

3.2.2.1. Alternative 1

If Alternative 1, the No Action Alternative, is selected the applicant would not undertake the proposed activities; therefore, the IPFs to marine mammals would not occur. For example, there would be no vessel noise or seismic airgun noise that would result in behavioral change, masking, or non-auditory effects to marine mammals, no long-term or permanent displacement of the animals from preferred habitats, and no destruction or adverse modification of any habitats. In addition, there would be no survey related debris that could result in endangerment to marine mammals and no additional vessel traffic related to the survey activities, there would be no risk of collisions with marine mammals.

3.2.2.2. Alternative 2

If Alternative 2, the Proposed Action as Submitted, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application. Examples of potential impacts to marine mammals without implementation of the above referenced conditions of approval and monitoring measures include, but are not limited to: injury from vessel strikes, hearing loss from seismic noise, disruption of feeding and other behaviors from seismic noise and vessel presence. This Alternative would not adequately limit or negate potential impacts to marine mammals.

3.2.2.3. Alternative 3

If Alternative 3, the Proposed Action with Conditions of Approval, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application; however, the applicant would be required to undertake conditions of approval and monitoring measures as identified by BOEM, in coordination with NMFS and in accordance with the NMFS 2020 BO consultation requirements, the NMFS 2021 Amended ITS, and NMFS 2021 Incidental Take Regulations. For the reasons set forth below, inclusion of these measures under Alternative 3 limits or minimizes potential impacts to marine mammals.

Potential Impacts to Marine Mammals from Active Acoustic Sound Sources

Marine mammals exposed to natural or manmade noise may experience physical and psychological effects, ranging in magnitude from none to severe (Southall et al., 2007 and 2019). Four areas of primary concern for marine mammals exposed to elevated noise levels include the following: (1) permanent hearing loss; (2) temporary hearing loss; (3) behavioral response; and (4) masking (Nowacek et al., 2007). Other literature also suggests that there may be non-auditory effects, such as gas-bubble formation and stress.

Scientific uncertainty remains regarding the nature and magnitude of the actual impacts of seismic noise on the behavior of marine mammals, particularly when it comes to distinguishing between a general behavioral response and a biologically significant one. As noted in Southall et al. (2007 and 2019), some of this uncertainty is related to data suffering from low sample sizes, limited information on received sound levels and background noise, insufficient measurements of all potentially important contextual variables, and/or insufficient controls with most behavioral studies suffering from at least some of these problems. In their 2020 BO (as amended), NMFS noted that harassment or disturbance is not limited to the 160 dB traditionally used as the standard behavioral disturbance, but should consider a number of other sound characteristics, including the frequency content, duration or repetitive nature of the sound, depth of the source, and movement of the source (USDOC, NMFS, 2020).

Permanent Hearing Loss

Permanent hearing loss in a marine mammal (i.e., permanent threshold shift [PTS]) is defined as the deterioration of hearing due to prolonged or repeated exposure to sounds that accelerate the normal process of gradual hearing loss (Kryter, 1985) or the permanent hearing damage due to brief exposure to extremely high sound levels (Richardson et al., 1995). PTS results in a permanent elevation in hearing threshold - that is, an unrecoverable reduction in hearing sensitivity (Southall et al., 2007). Direct physical effects, such as PTS, require relatively intense, received energy that would be expected to occur only at short distances from the seismic survey source (Nowacek et al., 2007; Zimmer and Tyack, 2007). According to Southall et al. (2007), PTS for cetaceans from multiple pulse sources (e.g., using seismic airguns) is established at 230 dB re 1 μPa (peak). In their 2020 BO (as amended), NMFS assumed an 80 percent aversion value to PTS levels of G&G associated sound exposure, which resulted in an estimate of up to 120 individual Rice's whales that could be exposed to PTS sound levels (USDOC, NMFS, 2020) over a 50 year time period without implementation of the proposed closure. The operator does not propose operations or support vessel traffic in the Rice's whale area; therefore, these exposures would be reduced or avoided and as a result impacts to the Rice's whale are expected to be **negligible to minor**. In their 2020 BO (as amended), NMFS determined that adverse impacts of PTS to sperm whales would be discountable (USDOC, NMFS, 2020).

Temporary Hearing Loss

Manmade noise may also cause temporary and reversible hearing loss called a temporary threshold shift (TTS), which may continue for minutes to hours or even days. The duration of TTS depends on a variety of factors, including intensity and duration of the auditory stimulus; and recovery can take minutes, hours, or days as well. Animals suffering from TTS over longer time periods, such as hours or days, may be considered to have a change in a biologically significant behavior, as they could be prevented from detecting sounds that are biologically relevant, including communication sounds, sounds of prey, or sounds of predators (U.S. Navy, 2008a and 2008b).

Behavioral Response

In Southall et al. (2007), an expert panel reviewing available literature on behavioral response to anthropogenic noise were unable to reach a consensus on what level of sound may serve as a threshold for

behavioral reactions in marine mammals. A number of studies document behavioral effects in response to seismic surveys, primarily for mysticetes (Richardson et al., 1995). Mysticetes are considered low-frequency cetaceans with an estimated auditory bandwidth of 7 Hz to 30 kHz. The Rice's whale is included in this low frequency group, though there have been no studies of the response of the Rice's whale to seismic sounds (USDOC, NMFS, 2020). The mysticetes (i.e., baleen whales) have been one of the most studied groups of marine mammals in terms of observations of behavioral changes in response to seismic operations. There is clearly a possible overlap between the expected frequencies of best-hearing sensitivity (low threshold) in mysticetes and maximal airgun output at source. It is generally considered that the auditory abilities of all mysticete species are broadly similar, based upon vocalization frequencies and ear anatomy (Ketten, 1998). Given that no direct audiograms of mysticetes have been obtained, it is impossible to define what level of sound above hearing threshold may cause behavioral effects, which would be expected to be variable, complicated, and dependent upon more than simply the received sound level. The mysticete species found in the GOM (i.e., blue, fin, sei, humpback, and minke whales) are considered rare, extralimital, or uncommon (Würsig et al., 2000), with the exception of the Rice's whale, and their occurrence within the proposed action area being potentially affected by noise is not expected.

Sperm whales are a highly vocal species under natural conditions; they produce echolocation clicks almost continuously during dives. They are considered a mid-frequency cetacean with functional hearing of approximately 150 Hz to 160 kHz. Interruption or cessation of their vocal activity has often been cited as a reaction to manmade noise. Watkins and Schevill (1975) showed that sperm whales interrupted click production in response to pinger (6 to 13 kHz) sounds. Mate et al. (1994) reported temporarily decreased sperm whale abundance in an area of seismic operations in the northeastern GOM. However, acoustic arrays recorded sperm whales producing click sequences during dives within 4 nautical miles of an active, 3D seismic vessel during surveys conducted in 2001. NMFS expects that sperm whales exposed to seismic airgun sounds may cease calling or change their vocal behavior. Codas, or sperm whale communication clicks, are not expected to be affected by seismic survey sound at far distances. As stated in their 2020 BO (as amended), NMFS expects that sperm whales would not come within 18.2 m of an active airgun array, as they would likely hear and see the array and would not come in close proximity. It is also expected that sperm whales in the GOM may have become habituated or become tolerant to airgun sounds, and may not exhibit a behavioral response (USDOC, NMFS, 2020). Further, Weir (2008) found few obvious, visible responses of sperm (and humpback) whales to seismic airgun sounds off Angola, although only overt responses were examined, and subtle or longer range responses may not have been detected. If the whales did come within 500 m (the exclusion zone) of the airgun array, the operator is required to shutdown the airgun, as required under Appendix A in the NMFS 2021 Amended ITS and NMFS 2021 Incidental Take Regulations, and as proposed under Alternative 3. However, whales that go unsighted, are below the surface, or beyond the exclusion zone can still be exposed to airgun sound (USDOC, NMFS, 2020).

From 2002 to 2005, BOEM funded a multiyear, interdisciplinary study on sperm whales in the GOM, called the Sperm Whale Seismic Study. A summary report was produced in 2006 (Jochens et al., 2006) and a synthesis report was released in 2008 (Jochens et al., 2008). These reports provide the following conclusions regarding sperm whales in the GOM and their response to seismic surveys:

- During controlled exposure experiments (CEE), researchers could detect "no horizontal avoidance of the seismic source for exposure levels (RL) of <150 dB re 1 μPa (rms)." Similarly, opportunistic studies detected no apparent horizontal avoidance or displacement of sperm whales associated with operational seismic surveys;
- Although a small sample, the CEE data results did not confirm the assumption that whales swim away from an airgun as it ramps up or approaches the whale at full power;
- In contrast to the lack of avoidance response, the CEE results showed there may be statistically significant changes in the swimming and foraging behavior of sperm whales exposed to the sound of airguns in the exposure range (RL) of 111-147 dB re 1 μPa (rms) (131-164 dB re 1 μPa [peak to peak]; see Table I in Madsen et al., 2006) at distances of approximately 1.4-12.6 km from the sound source; and
- There was the "discovery of a statistically significant 60 percent reduction in foraging for one whale coupled with evidence that other whales are less sensitive…"

Sperm whales are most likely to be acoustically aware of their environment and can exhibit behavioral reactions in a number of ways, including interruption of vocal activity and foraging. However, there are, as yet, insufficient data to assign thresholds for acoustic disturbance to sperm whales. An additional factor to consider is the deep-diving habit of sperm whales. Unlike mysticetes, which may remain close to the surface for long periods, sperm whales spend a small percentage of time at the surface during the course of feeding activity. They surface for longer periods (average 9 minutes) between deeper dives to replenish myoglobin oxygen reserves (Watwood et al., 2006). This means they may be less likely to receive any mitigative effects afforded by sea state and near surface conditions that could buffer or dissipate sound that can occur in some instances. In addition, the sperm whale may dive to a depth where an operating seismic vessel could potentially pass directly over it without visually detecting the sperm whale.

Little is known about the hearing sensitivity of dwarf/pygmy sperm whales. Pulsed sounds with peak frequencies below 13 kHz have been recorded from pygmy sperm whales (Caldwell and Caldwell, 1987), and the anatomical and physiological features of the dwarf sperm whale head have been shown to be consistent with production of echolocation clicks (Cranford et al., 1996; Goold and Clarke, 2000). Audiograms have only recently been obtained for pygmy sperm whales and dwarf sperm whales (Cook et al., 2006; Finneran, 2009; Ridgway and Carder, 2001), but data remain insufficient to ascribe avoidance thresholds. It is possible, however, that these species may, as in the case of sperm whales, be sensitive to a wide range of sound frequencies, including those produced by seismic airgun arrays. This factor, along with their similar deep-diving habits and relatively widespread distributions in the GOM, may warrant concerns for these species from seismic survey activities, similar to those described for the sperm whale.

The Delphinids are also considered mid-frequency cetaceans with functional hearing of approximately 150 Hz to 160 kHz. They represent a diverse group including the true dolphins, killer whales, and pilot whales. There have been few studies of the impact of seismic surveys on species of Delphinidae (e.g., Goold and Fish 1998; Stone and Tasker, 2006; Weir, 2008; Weilgart, 2013). This higher frequency energy must be taken into account when considering seismic interactions with delphinids. Further, and contrary to early perceptions, the high-frequency components of airgun emissions are of sufficient level to exceed the dolphin auditory threshold curve at these low frequencies, even after considerable spreading loss (Goold and Fish, 1998).

Since the delphinid auditory system has a relatively poor response at the low-frequency end (about 110 dB re 1 μPa at 200 Hz; but see Table 2 in Southall et al., 2007) and increases in sensitivity toward the ultrasonic range; there is a clear gradient of increasing sensitivity that exists over a broad frequency range up to the frequency of peak sensitivity. Further, although an airgun pulse will have maximal energy at a few tens of Hertz, with energy decreasing towards the higher frequencies, there is also an increase in dolphin hearing sensitivity in this region. So, although toothed whales specialize in hearing ranges generally outside of the majority of seismic survey impulse sounds, there is still the potential for sounds from these surveys to fall within the acoustic sensitivity of toothed whales.

Masking

Auditory masking occurs when a sound signal that is of importance to a marine mammal (e.g., communication calls, echolocation, and environmental sound cues) is rendered undetectable due to the high noise-to-signal ratio in a frequency band relevant to a marine mammal's hearing range. In other words, noise can cause the masking of sounds that marine mammals need to hear in order to function effectively (Erbe et al., 1999). The presence of the masking noise can make it so that the animal cannot discern sounds of a given frequency. Yet at a given level it would be able to do so in the absence of the masking noise. If sounds used by the marine mammals are masked to the point where they cannot provide the animal with needed information, critical natural behaviors could be disrupted and harm could result (Erbe and Farmer, 1998). In the presence of the masking sounds, the sounds the animal needs to hear must, therefore, be of greater intensity for it to be able to detect and to discern the information in the sound.

In the case of seismic surveys in the GOM, where potential masking noise takes a pulsed form with a low duty cycle (~6-10%, or a 1-s disturbance in the sound field in every 10-15 s of ambient noise), the effect of masking is likely to be low relative to continuous sounds such as ship noise. Some whales are known to continue calling in the presence of seismic pulses. Their calls can be heard between the seismic pulses (e.g., Richardson et al., 1986; McDonald et al., 1995; Nieukirk et al., 2004; Smultea et al., 2004). Although there is one report that sperm whales ceased calling when exposed to pulses from a very distant seismic

ship (Bowles et al., 1994), more recent studies report that sperm whales continued calling in the presence of seismic pulses (Madsen et al., 2002; Tyack et al., 2003; Smultea et al., 2004; Holst et al., 2006; Jochens et al., 2008). Masking of sonar clicks of foraging females could occur, which could decrease the distance over which males can detect females. However, because of their widespread distribution in the GOM, NMFS does not expect the mating success of sperm whales to be adversely affected in the long-term should masking occur (USDOC, NMFS, 2020). The lower frequency range of sounds from G&G activities may interfere with the communication among the Rice's whale, particularly calls from the species to mate (USDOC, NMFS, 2020).

Non-Auditory Effects

The best available scientific information shows that resonance can occur in marine animals but may not necessarily cause injury, and any such injury is not expected to occur below a sound pressure level of 180 dB re 1 μPa. Damage to the lungs and large sinus cavities of cetaceans from air space resonance is not regarded as a likely significant, non-auditory injury because resonance frequencies of marine mammal lungs are generally below that of the Surveillance Towed Active Sonar System-Low Frequency Active (SURTASS LFA) sonar signal (Finneran, 2003); therefore, they are below the seismic survey source signal. Further, biological tissues are heavily damped, and tissue displacement at resonance is predicted to be exceedingly small. Lung tissue damage is generally uncommon in acoustic-related strandings (Southall et al., 2007). Additionally, since there is abundant anatomical evidence that marine mammals have evolved and adapted to dramatic fluctuations in pressure during long, deep dives that seem to exceed their aerobic capacities (Williams et al., 2000), it is very unlikely that significant lung resonance effects could be realized from the proposed seismic survey operations.

Decompression sickness (DCS) may occur as a result of diving to deep depths and then surfacing too quickly, forcing nitrogen bubbles to form in the bloodstream and tissues (Jepson et al., 2003). Historically, there has been much debate on whether marine mammals can suffer from a form of DCS caused by *in vivo* (in the natural body) nitrogen gas-bubble expansion. However, recent pathological findings of two Risso's dolphins (*Grampus griseus*) suggest that, while rare, it is possible as a result of rapid ascent to the surface while struggling with prey during hunting (Fernández et al., 2017). Although more investigation is needed, this study brings to question how exposure to stressful situations, whether from natural (e.g., large prey) or anthropogenic (e.g., military sonar) sources, may affect the diving behavior of marine mammals in order to drive it over a non-reversible condition leading to death. More information is needed to further understand this subject and will require sustained investigation and monitoring. Potential changes in diving behavior as a result of the proposed action are expected to be short-term and temporary. Thus, the proposed action is not likely to cause DCS.

Studies pertaining to the effects of stress and stress responses in mammals, including studies on marine mammals, have been reviewed by Wright et al. (2007) and Curry (1999). The stress studies investigate physiological responses to disturbance (e.g., increase in stress hormones or heart rate) rather than looking for changes in behavior (e.g., avoidance and disruption of foraging). However, in most cases, the biological importance of stress responses in marine mammals (e.g., effects on energetics, survival, reproduction, and population status) remains unknown.

The prey of Rice's whales and sperm whales and the invertebrates that they feed on may exhibit a behavioral response, such as a startle or avoidance response, when exposed to airgun noise. NMFS anticipates a reduction in the availability of prey for sperm whales and the Rice's whales in proximity to an active airgun array; however, NMFS does not expect "a meaningful immediate impact on sperm whales [or] Bryde's (Rice's) whales (USDOC, NMFS, 2020)"

By selecting Alternative 3, the operator is required to follow the conditions of approval and monitoring measures outlined above and in the NMFS 2020 BO, NMFS 2021 Amended ITS, and NMFS 2021 Incidental Take Regulations. With these conditions of approval and monitoring measures in place, the impacts to sperm whales, Rice's whales, and other marine mammals is determined to be **minor**.

Potential Impacts to Marine Mammals from Vessel Noise

The effects of noise produced by moving G&G survey vessels on marine mammals are difficult to assess because of the wide array of reports of their observed behavioral responses, both between and within species. Actual responses of individuals could vary widely and are heavily dependent on context

(Richardson et al., 1995; Southall et al., 2007; Ellison et al., 2011). Vessel noise can have acute effects such as short-term behavioral and stress response. The nature of behavioral response cetaceans exhibit to vessels may depend on vessel speed, size, and distance from the animal, as well as the number and frequency of vessel encounters (USDOC, NMFS, 2020). The dominant source of vessel sound from the proposed action is propeller cavitation, although other ancillary sounds may be produced (Richardson et al., 1995). The intensity of sound from vessels is related to size and speed. Large ships tend to be noisier than small ones and ships underway with a full load or towing/pushing produce more sound than unladen vessels (USDOC, NMFS, 2020). Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from whales and dolphins or mask their sound reception (Tyack, 2008). Vessel noise from the proposed action will produce low levels of noise, generally in the 150 to 170 dB re 1 μPa-m at frequencies below 1,000 Hz. Vessel noise is transitory and generally does not propagate at great distances from the vessel. The NMFS 2020 BO (as amended) concluded that the effects of vessel noise to sperm whales are not likely to adversely affect the species and Rice's whales are likely to be adversely affected from vessel noise (USDOC, NMFS, 2020). However, the proposed activities are located outside of the area where the Rice's whale is likely to be present. The operator does not propose operations or support vessel traffic in the Rice's whale area. The behavioral disruptions potentially caused by noise and the presence of vessel traffic will have **negligible** effects on cetacean populations in the northern GOM.

Potential Impacts to Marine Mammals from Vessel Traffic

Slow-moving cetaceans or those that spend extended periods of time at the surface, and deep-diving species (e.g., sperm whales) while on the surface, might be expected to be the most vulnerable to accidental vessel strike (Vanderlaan and Taggert, 2007). Smaller delphinids often approach vessels that are in transit to bow-ride; however, vessel strikes are less common for these faster moving mammals or are underreported (Wells and Scott, 1997). Florida manatees are commonly found in shallow coastal waters of Florida, but they have been found along the entire northern GOM from Florida to Texas (Fertl et al., 2005), though some recent deepwater sightings have occurred. Vessel strikes are the most common cause of human-induced mortality for manatees (State of Florida, Fish and Wildlife Conservation Commission, 2022), and most manatees bear prop scars from contact with vessels. The vast majority of strikes to manatees result from recreational and fishing vessels, not those related to oil and gas activities.

Worldwide, most vessel strikes of large whales occur when vessels are traveling at speeds greater than approximately 10 knots (Conn and Silber, 2013; Jensen and Silber, 2004; Laist et al., 2001; Vanderlaan and Taggart, 2007). If a vessel strike occurs, the animal may experience no injuries, minor non-serious injuries, serious injuries, or death, which largely depends on the size and speed of the vessel (USDOC, NMFS, 2020). Both GOM Rice's whales and sperm whales are vulnerable to vessel strikes. One confirmed vessel strike to a GOM Rice's whale occurred in 2009. One possible lethal strike occurred in 1990 and a non-lethal strike in 2005, both to sperm whales. Additionally, a sperm whale is believed to have been struck by a U.S. Navy vessel in 2001 (USDOC, NMFS, 2020). Most recently, a seismic survey service vessel returning to shore struck a sperm whale in 2020.

The lack of response by sperm whales to oncoming vessels suggest the whales may not hear or see ships approaching or the whales are habituated to the high level of vessel operation activity in the GOM. The Rice's whale spends much of its' time within 15 m of the water surface and at night on the surface, which makes it more likely to be struck by a vessel. With the Rice's whale vessel strike mitigation measures required by the NMFS 2020 BO, NMFS 2021 Amended ITS, and NMFS 2021 Incidental Take Regulations, and as proposed under Alternative 3, NMFS estimated an annual rate of zero lethal Rice's whale vessel strikes per year from oil and gas vessel traffic greater than 10 knots (USDOC, NMFS, 2020). The proposed activities are located outside of the area where the Rice's whale is likely to be present. The operator has not proposed any service vessels or vessel traffic within the Rice's whale area. Under Alternative 3, the operator is required to notify BOEM 15 days prior to any vessel transit within the Rice's whale area; approval from BOEM is required prior to any vessel transit changes.

In their 2020 BO (as amended), NMFS estimated an annual rate of 0.10 vessel strikes likely to result in no or minor injuries to sperm whales per year from oil and gas activities (USDOC, NMFS, 2020).

By selecting Alternative 3, the operator is required to follow the conditions of approval and monitoring measures in Appendix C: Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols outlined above, in the NMFS 2021 Amended ITS and the NMFS 2021

Incidental Take Regulations. With these conditions of approval and monitoring measures in place, the impacts to sperm whales, Rice's whales, and other marine mammals is determined to be **minor**.

Potential Impacts to Marine Mammals from Marine Trash and Debris

Marine debris is a serious concern in the ocean environment. Plastics, in particular, and from many different sources, pose a threat to the environment and a serious threat to marine mammals. Ingestion of plastic has the potential to cause a digestive blockage which may ultimately lead to the death of a marine mammal (Gall and Thompson, 2015). Entanglement also has the potential to result in injury or mortality for marine mammals (Gall and Thompson, 2015). By selecting Alternative 3, the operator is required to follow the conditions of approval and monitoring measures in Appendix B: Gulf of Mexico Marine Trash and Debris Awareness and Elimination Survey Protocols outlined above and in the NMFS 2020 BO (as amended). With these conditions of approval and monitoring measures in place, the impacts to sperm whales, Rice's whales, and other marine mammals is determined to be **negligible**.

Conclusion

The sections above discuss marine mammal hearing in general and the potential range of effects to marine mammals from seismic noise, including: (1) permanent hearing loss; (2) temporary hearing loss; (3) behavioral response; (4) masking; and (5) non-auditory effects. As described, seismic noise has the potential, individually or cumulatively, to result in any of these potential impacts to marine mammal species commonly found in the GOM and proposed action area. However, BOEM finds that the potential for such effects from the proposed action is unlikely to rise to significant levels for the following reasons:

- Mysticetes, as low-frequency hearing specialists, are the species group most likely to be susceptible to impacts from nonpulse sound (intermittent or continuous) given that their hearing ranges overlap most closely with the noise frequencies produced from drilling (Southall et al., 2007 and 2019). However, most mysticete species that may occur in the GOM (i.e., North Atlantic right, blue, fin, sei, humpback, and minke) are considered either "extralimital," "rare," or "uncommon" within the GOM (Wursig et al., 2000; Hayes et al., 2019). The only commonly occurring baleen whale in the northern GOM is the Rice's whale which is limited in its range. Rice's whales are expected to mostly exhibit avoidance behavior and may alter their vocalizations when exposed to seismic surveys (USDOC, NMFS, 2020). Given the small geographic scope of the proposed action, as well as the operator proposing no survey activity or service vessels through the Rice's whale area, the presence of these species within the action area is unlikely. However, the potential for significant impacts is minimized given the implementation of Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols outlined in the NMFS 2021 Amended ITS and NMFS 2021 Incidental Take Regulations, and under Alternative 3.
- Manatees are typically uncommon in the proposed action area, though some deepwater sightings have occurred. As they predominantly inhabit only coastal marine, brackish, and freshwater areas, they are not expected to occur regularly in the area of the proposed action.
- The remaining marine mammal species in the GOM are considered either mid-frequency hearing specialists (e.g., sperm whales, beaked whales, and dolphins) with hearing ranges that slightly overlap with sound frequencies produced from seismic noise (Southall et al., 2007), or high-frequency specialists (pygmy and dwarf sperm whales). Therefore, the potential for seismic noise produced from this proposed action to cause auditory and non-auditory effects, PTS, TTS, behavioral changes, or masking on these species is further limited although not entirely eliminated.
- To further minimize or reduce the potential for impacts, BOEM requires several conditions of approval and monitoring requirements under Alternative 3 and the NMFS 2020 BO, the NMFS 2021 Amended ITS, and the NMFS 2021 Incidental Take Regulations (Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols) described below. These measures were developed in coordination with NMFS. They are meant to be conservative (i.e., they afford additional protection to the species). These measures, although needing further testing for effectiveness, represent the best available mitigation strategy for seismic surveys. The measures are expected to minimize duration of exposure to sounds above threshold, when implemented in NMFS Incidental Take Authorizations (ITA) under the MMPA. All PSOs must have completed PSO training in accordance with NMFS National Standards for a Protected Species Observer and

Data Management Program: A Model for Seismic Surveys (Baker et al., 2013). The following is a summary of the mitigation and monitoring requirements under Appendix A in the NMFS 2021 Amended ITS and the NMFS 2021 Incidental Take Regulations, applicable for all water depths:

  - Establishment of two exclusion zones. For beaked whales, *kogia* spp., sperm whales, and baleen whales, the exclusion zone encompasses the area at and below the sea surface out to a radius of 1.5 km from the edges of the airgun array. The exclusion zone for all other protected species encompasses the area at and below the sea surface out to a radius of 500-m from the edges of the airgun array (this exclusion zone is then continually monitored for the presence of whales [and sea turtles] by dedicated PSOs).
  - Acoustic monitoring by acoustic PSOs to support visual monitoring.
  - Shut down of the seismic sound source should a PSO observe a whale within or approaching the exclusion zone.
  - Upon implementation of shutdown, the source may be reactivated after the marine mammal(s) have been observed exiting the exclusion zone or following a 30 minute clearance with no further marine mammal(s) observations.
  - Slow ramp-up of seismic sound sources at the start or restart of surveys (e.g., the gradual increase in seismic noise) so as to allow an animal to leave the area before the seismic sound reaches potentially disturbing levels.

- While the proposed activities will not occur within the Rice's whale area, it is possible that the species may travel outside of the habitat closure area, and may still experience impacts from G&G surveys (USDOC, NMFS 2020).

In conclusion, given the scope, timing, and transitory nature of the proposed action and given the conditions of approval and monitoring measures in place, the noise related to the proposed seismic survey is not expected to result in PTS, TTS, behavioral change, masking, or non-auditory effects to marine mammals in the GOM that would rise to the level of significance. The geographic scope of the proposed action is small in relation to the ranges of marine mammals in the GOM. The proposed survey activities are not expected to cause long-term or permanent displacement of the animals from preferred habitats, nor will they result in the destruction or adverse modification of any habitats. Survey activities will involve limited vessel traffic related to the towing of the airgun array that carries some risk of collisions; however, animals may avoid the sound source of the moving vessels, reducing the likelihood of collision. BOEM has adopted requirements from the NMFS 2020 BO and NMFS 2021 Amended ITS to minimize/negate the chance of vessel strike to marine mammals: Appendix C: Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols. Also, BOEM has adopted requirements from the NMFS 2020 BO (as amended) to minimize/negate the chance of marine trash and debris impacts to marine mammals: Appendix B: Gulf of Mexico Marine Trash and Debris Awareness and Elimination Survey Protocols. Vessel strike avoidance and marine trash and debris requirements are also assigned by NMFS through the application of the MMPA rule.

3.2.3. Cumulative Impact Analysis

Chapter 4.2 of the GOM G&G PEIS and Chapter 4.9 of the Multisale EIS and 2018 SEIS address the cumulative impacts on marine mammals as a result of oil and gas leasing, exploration, development and production activities, including G&G activities.

Activities considered under the cumulative scenario which include the GOM oil and gas program and other anthropogenic and natural activities, including the proposed action, may affect protected marine mammals or critical habitat. Marine mammals could be impacted by the degradation of water quality resulting from operational discharges; vessel traffic; noise generated by platforms, drilling rigs, helicopters, vessels, and G&G surveys; explosive structure removals; oil spills; oil-spill-response activities; loss of debris from service vessels and OCS structures; commercial fishing; capture and removal; and pathogens. The cumulative impact on marine mammals is expected to result in a number of chronic and sporadic sublethal effects (i.e., behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may stress and/or weaken individuals of a local group or population and predispose them to infection from natural or anthropogenic sources.

Few deaths are expected from chance vessel collisions, ingestion of plastic material, commercial fishing, and pathogens. Deaths as a result of structure removals are not expected to occur due to conditions of approval and monitoring measures that the operator must adhere to during operations. Disturbance (noise from vessel traffic and drilling operations, etc.) and/or exposure to sublethal levels of toxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them more vulnerable to parasites and diseases that normally would not be fatal. The net result of any disturbance will depend upon the size and percentage of the population likely to be affected, the ecological importance of the disturbed area, the environmental and biological parameters that influence an animal's sensitivity to disturbance and stress, or the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980). Natural phenomena, such as tropical storms and hurricanes, are impossible to predict but do occur in the GOM though impacts remain difficult to quantify.

Conclusion

The effects of the proposed action, when viewed in light of the effects associated with other relevant activities, may impact marine mammals in the GOM. With the implementation of the required conditions of approval and monitoring measures for seismic survey and vessel operations under Alternative 3, as well as the limited scope, timing, and geographic location of the proposed action, effects from the proposed survey activities on marine mammals will be **negligible** (vessel noise, marine trash and debris) to **minor** (acoustic sound, vessel traffic). For animals that may be continuing to experience stress/sublethal impacts from natural or anthropogenic stressors, the additional measures should act to further reduce impacts and provide an abundance of precaution.

3.3. SEA TURTLES

3.3.1. Description

The life history, population dynamics, status, distribution, behavior, and habitat use of sea turtles can be found in Chapter 4.3 and Appendix E of the GOM G&G PEIS, Chapter 4.9 of the Multisale EIS and 2018 SEIS, Chapter 3.6 of the 2021 BEBR, FWS 2018 BO, NMFS 2020 BO, and NMFS 2021 Amended ITS, and are incorporated by reference into this SEA. Of the extant species of sea turtles, five are known to inhabit the waters of the GOM (Pritchard, 1997): the leatherback (*Dermochelys coriacea*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), Kemp's ridley (*Lepidochelys kempii*), and loggerhead (*Caretta caretta*). The loggerhead turtle is the most abundant turtle in the GOM (Dodd, 1988). The leatherback turtle is the most abundant turtle in the northern GOM continental slope (Mullin and Hoggard, 2000). These five species are all highly migratory, and individual animals will migrate into nearshore waters as well as other areas of the North Atlantic Ocean, GOM, and Caribbean Sea.

All five species of sea turtles found in the GOM have been federally listed as endangered or threatened since the 1970's. Critical habitat was designated for the distinct population segment (DPS) of Northwest Atlantic loggerhead turtles on July 10, 2014 in 79 CFR 79 39755 39854 (*Federal Register*, 2014).

In 2007, FWS and NMFS published 5-year status reviews for federally listed sea turtles in the GOM (USDOC, NMFS and USDOI, FWS, 2007a-e). A 5-year review is an ESA-mandated process that is conducted to ensure that the listing classification of a species as either threatened or endangered is still accurate. Both agencies share jurisdiction for federally listed sea turtles and jointly conducted the reviews. After reviewing the best scientific and commercially available information and data, agencies determined that the current listing classification for the five sea turtle species remain unchanged. Updated 5-year reviews for hawksbill and leatherback turtles were published in 2013 that support the current listing status for these species (USDOC, NMFS and USDOI, FWS, 2013a and b).

Sea Turtle Hearing

The anatomy of sea turtle ears and measurements of auditory brainstem responses of green and loggerhead sea turtles demonstrate that sea turtles are sensitive to sounds, with an effective hearing range within low frequencies (Bartol et al., 1999; Lenhardt et al., 1983; Moein et al., 1994; Ridgway et al., 1969). Although external ears are absent, sea turtles have a tympanum composed of layers of superficial tissue over a depression in the skull that forms the middle ear. The tympanum acts as additional mass loading to the ear, allowing for reduction in the sensitivity of sound frequencies and increasing low-frequency, bone-conduction sensitivity (Bartol et al., 1999; Lenhardt et al., 1985). Lenhardt et al. (1983) and Moein et al.

(1993 and 1994) found that bone-conducted hearing appears to be an effective reception mechanism for sea turtles (i.e., loggerhead and Kemp's ridley) with both the skull and shell acting as receiving surfaces for water-borne sounds at frequencies of 250-1,000 Hz. By measuring AEP responses of juvenile green sea turtles to tone pip stimuli, Piniak et al. (2016) found that these turtles have a narrow range of underwater and aerial low frequency hearing. Aerial sound pressure thresholds were lower than those underwater, though they detected a larger frequency range underwater (Piniak et al., 2016). Also, sound intensity level thresholds were lower underwater (Piniak et al., 2016). There is relatively little data on sea turtle hearing, though the current understanding is that sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2.0 kHz (or 2,000 Hz), with a range of maximum sensitivity between 100 to 800 Hz, and a narrower frequency range in air (Bartol et al., 1999; Piniak et al., 2012; Popper et al., 2014). The NMFS 2020 BO (as amended) stated that sea turtles may be affected by sound exposures from airguns and boomers (USDOC, NMFS, 2020). Unlike marine mammals, sea turtles "do not appear to greatly utilize environmental sound, at least at far distances in the open ocean" (USDOC, NMFS, 2007).

3.3.2. Impact Analysis

The diversity of a sea turtle's life history leaves it susceptible to many natural and human impacts, including impacts while it is on land, in the benthic environment, and in the pelagic environment. The IPFs associated with the proposed action that could affect sea turtles include (1) active acoustic sound sources; (2) vessel noise; (3) vessel traffic; and (4) marine trash and debris. Chapter 4.3 of the GOM G&G PEIS contains a discussion of the potential impacts from survey operations on sea turtles (USDOI, BOEM, 2017a). Additional information about routine impacts from oil and gas activity on sea turtles is addressed in Chapter 4.9 of the Multisale EIS and 2018 SEIS, Chapter 4.6 of the 2021 BEBR, FWS 2018 BO, NMFS 2020 BO, and NMFS 2021 Amended ITS. The discussions are summarized below and are incorporated by reference into this SEA.

3.3.2.1. Alternative 1

If Alternative 1, the No Action Alternative, is selected the applicant would not undertake the proposed activities; therefore, the IPFs to sea turtles would not occur. For example, there would be no vessel noise or seismic airgun noise that would result in behavioral change, masking, or non-auditory effects to sea turtles, no long-term or permanent displacement of the animals from preferred habitats, and no destruction or adverse modification of any habitats. Since there would be no vessel traffic related to the towing of the airgun array, there would be no risk of collisions with sea turtles.

3.3.2.2. Alternative 2

If Alternative 2, the Proposed Action as Submitted, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application. Examples of potential impacts to sea turtles without implementation of the above referenced conditions of approval and monitoring measures include, but are not limited to: injury from vessel traffic and disruption of feeding and other behaviors from vessel presence. This Alternative would not adequately limit or negate potential impacts to sea turtles.

3.3.2.3. Alternative 3

If Alternative 3, the Proposed Action with Conditions of Approval, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application; however, the applicant would be required to undertake conditions of approval and monitoring measures as identified by BOEM, in coordination with NMFS and in compliance with the NMFS 2020 BO consultation requirements (i.e., Appendix J: Sea Turtle Handling and Resuscitation Guidelines), and the NMFS 2021 Amended ITS. For the reasons set forth below, inclusion of these measures under Alternative 3 limits or negates potential impacts to sea turtles (e.g., vessel strikes, behavioral disruption from vessel presence).

Potential Impacts to Sea Turtles from Active Acoustic Sound Sources

Although little is known about the effects of anthropogenic noise on sea turtles, potential impacts of G&G surveys may include auditory effects (PTS and TTS) and/or behavioral disturbance. There is limited evidence of TTS in sea turtles. In the 1994 study of juvenile loggerheads, sponsored by the U.S. Dept. of the Army, Corps of Engineers (Moein et al., 1994), sea turtles were contained in a pen in shallow water as they were exposed to pulses from a single airgun. Both behavioral and physiological responses were observed. The turtles avoided airgun pulses at received levels at 175-180 dB re 1 μPa but habituated by the

third presentation of the sounds. In some cases, habituated animals remained close to the airgun as it was operating. In 10-15 percent of the sea turtles exposed to airgun pulses, a temporary shift in auditory responses was measured. Received levels causing the shift are not known.

Additional studies have noted possible reactions to low-frequency noise, such as that associated with the proposed action, including startle responses and rapid swimming (McCauley et al., 2000a) and swimming toward the surface at the onset of the sound (Lenhardt, 1994). Recent investigations reported that green and loggerhead sea turtles increased their swimming activities when exposed to low-frequency noise; these activities become more erratic as the exposure level increases (McCauley et al., 2000a). Weir (2007) did not document obvious behavioral avoidance to airguns but suggested responsive actions by sea turtles to the vessel and towed equipment. Sea turtles may alter their behaviors when a vessel approaches, and thereby suspend feeding, resting, or interacting with conspecifics. Such disruptions are expected to be temporary, however, and should not affect the overall survival and reproduction of individual turtles.

NMFS, in their 2020 BO (as amended), determined PTS to sea turtles to be discountable and that only TTS would occur. Most sea turtles can dive to depths of up to 960 ft (290 m); however, the leatherback sea turtle can dive over 3,000 ft (1,000 m) (Smithsonian, 2018). Should a sea turtle be in close proximity to an airgun, it is expected to move away from sounds produced by an airgun array, and would only experience TTS. Temporary hearing impairment may impact an individual's ability to hear other airgun sounds or approaching vessels, until hearing has returned (USDOC, NMFS, 2020). It is common practice for seismic operators in the GOM to implement a "turtle pause" when a sea turtle is spotted by a PSO. A turtle pause is a voluntary practice during which the visual PSO requests that the operator pause the airgun array for six shots to let the turtle float past the array while it is inactive. This six-shot pause is not considered to produce a loss of data/production and, as a result, operators would not have to re-survey the area. Given the scope, timing, and transitory nature of the proposed action, the implementation of Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols, and that the best available information indicates that sea turtles do not appear to use environmental sound heavily to meet daily needs for survival, the effects to sea turtles from seismic noise are expected to be **negligible**.

Popper et al. (2014) published sound exposure guidelines for fishes and sea turtles. A sea turtle would need to be close to the seismic sound source at 210 dB cum or >207 dB peak to cause mortal injury (Popper et al., 2014). Low frequency sounds can cause moderate TTS in turtles at relatively near or intermediate vicinity to the source. Continuous sounds can cause masking and behavioral effects, though the consequences for survival of sea turtles are unknown (Popper et al., 2014). Observational evidence suggests that sea turtles will exhibit behavioral changes with received sound levels above 175 dB re: 1 μPa (rms) (USDOC, NMFS, 2020).

The prey of sea turtles and the invertebrates that they feed on may exhibit a behavioral response, such as a startle or avoidance response, when exposed to airgun noise. NMFS anticipates a reduction in the availability of prey for sea turtles in proximity to an active airgun array; however, NMFS does not expect "a meaningful immediate impact on . . . sea turtles" (USDOC, NMFS, 2020).

Potential Impacts to Sea Turtles from Vessel Noise

The dominant source of noise from vessels is propeller operation, and the intensity of this noise is largely related to ship size and speed. Vessel noise from the proposed action would produce low levels of noise, generally in the 150 to 170 dB re 1 μPa-m at frequencies below 1,000 Hz. Vessel noise is transitory and generally does not propagate at great distances from the vessel. Also, available information indicates that sea turtles do not greatly utilize environmental sound. The NMFS 2020 BO (as amended) similarly concluded that sound sources associated with vessel movement were not likely to adversely affect sea turtles (USDOC, NMFS, 2020). The Popper et al. (2014) sound exposure guidelines were broad-ranging and provided non-quantified, generalized guidelines for shipping noise as a low risk of impairment, unless the turtle is in the near field range (within tens of meters), which would pose a moderate risk of TTS that can recover over time. The risk for noise to cause masking and behavior effects range from low to high depending on the location of the turtle relative to the noise (Popper et al., 2014). The effects to sea turtles from vessel noise are expected to be **negligible**.

Potential Impacts to Sea Turtles from Vessel Traffic

Sea turtles spend at least 3-6 percent of their time at the surface for respiration and perhaps as much as 26 percent of time at the surface for basking, feeding, orientation, and mating (Lutcavage et al., 1997). There is little data available concerning potential sea turtle impacts from accidental vessel strike due to a lack of studies and/or challenges with detecting such impacts (Nelms et al., 2016). Nonetheless, in the GOM, vessel strike from all types of vessels is known to result in sea turtle mortality and injury, with the associated response depending on the size and speed of the vessel (Lutcavage et al. 1997; Work et al., 2010; Nelms et al., 2016). Although sea turtles can move somewhat rapidly, they are still vulnerable to strikes from vessels that are moving at more than four (4) km per hour, which is common in open water (Hazel et al., 2007; Work et al., 2010). Based on the behavioral observations of turtle avoidance of small vessels, green turtles may be susceptible to vessel strikes at speeds as low as two knots (Hazel et al., 2007). Although there have been hundreds of thousands of vessel trips that have been made in support of offshore operations during the past 40 years of OCS oil and gas operations, there have been no reports of OCS-related vessels having struck sea turtles. This is most likely because a strike with a turtle would probably go undetected by larger vessels or strikes are not reported. Despite the lack of on-water reporting, stranding records show that interactions between vessels and sea turtles in the GOM are quite common (USDOC, NMFS, 2020). Data show that collisions with all types of commercial and recreational vessel traffic are a cause of sea turtle mortality in the GOM (Lutcavage et al., 1997). Both live and dead sea turtles are often found with deep cuts and fractures indicative of collision with a boat hull or propeller (Hazel et al., 2007).

Based on sea turtle density estimates in the GOM, the encounter rates between sea turtles and vessels would be expected to be greater in water depths less than 200 m (656 ft) (USDOC, NMFS, 2007). To further minimize the potential for vessel strikes, BOEM requires operators to implement Appendix C: Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols, which contains vessel strike avoidance measures for sea turtles and other protected species. With implementation of these measures and a PSO on the lookout for sea turtles, the NMFS 2020 BO (as amended) concluded that the risk of collisions between oil/gas-related vessels (including those for G&G, drilling, production, decommissioning, and transport) and sea turtles is appreciably reduced, but strikes may still occur. The NMFS 2020 BO (as amended) then grants BOEM an Incidental Take Statement that includes a set number of allowable takes of sea turtles by vessel strikes (USDOC, NMFS, 2020). As per the required reporting under the NMFS 2021 Amended ITS Appendix C: Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols, BOEM monitors for any takes that have occurred as a result of vessel strikes and also requires that any operator immediately report the striking of any animal (see requirements under Appendix C). To date, there have been no reported strikes of sea turtles by G&G survey vessels. Given the scope, timing, and transitory nature of the proposed action and with these established conditions of approval and monitoring measures, effects to sea turtles from vessel collisions is expected to be **minor**.

Potential Impacts to Sea Turtles from Marine Trash and Debris

A variety of trash and debris, which comes from land-based and ocean sources, is commonly observed in the GOM. Turtles may become entangled in drifting debris and ingest fragments of synthetic materials (Gregory, 2009; Gall and Thompson, 2015; Schuyler, 2016). Once entangled, turtles may drown, incur impairment to forage or avoid predators, sustain wounds and infections from the abrasive or cutting action of attached debris, or exhibit altered behavior that threaten their survival (Gall and Thompson, 2015). By selecting Alternative 3, the operator is required to follow the conditions of approval and monitoring measures in Appendix B: Gulf of Mexico Marine Trash and Debris Awareness and Elimination Survey Protocols outlined above and in the NMFS 2020 BO (as amended). With these conditions of approval and monitoring measures in place, the impacts to sea turtles is determined to be **negligible**.

Conclusion

The sections above discuss sea turtle hearing in general and the potential range of effects to sea turtles from the proposed action, including: (1) active acoustic sound sources; (2) vessel noise; (3) vessel traffic; and (4) marine trash and debris. As described, effects of seismic noise on sea turtles will not rise to the level of significance for the following reasons:

- The best available scientific information indicates that sea turtles do not greatly use sound in the environment for survival; therefore, disruptions in environmental sound would have little effect.
- To further minimize or reduce the potential for impacts, BOEM instituted several key mitigation and monitoring requirements under Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols. These measures were developed in coordination with NMFS. They are meant to be conservative (i.e., they afford additional protection to the species). The measures are expected to minimize duration of exposure to sounds above threshold.
- The scope, timing, and transitory nature of the proposed action will produce limited amounts of seismic noise in the environment.

As described, effects of vessel noise on sea turtles are considered "discountable" (USDOC, NMFS, 2007 and 2020). The risk of impacts from marine trash and debris would not rise to the level of significance given that BOEM requires compliance with Appendix B: Gulf of Mexico Marine Trash and Debris Awareness and Elimination Survey Protocols. The risk of collisions between sea turtles and vessels associated with the proposed action exist but would not rise to the level of significance given:

- BOEM requires compliance with Appendix C: Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols, which provides guidelines on monitoring programs to minimize the risk of vessel strikes to sea turtles and other protected species and the reporting of any observations of injured or dead protected species.
- The NMFS 2020 BO (as amended) recognizes that these measures should appreciably reduce the potential for vessel strikes. The NMFS 2020 BO (as amended) determined vessel strikes are likely to adversely affect sea turtles related to the proposed actions and granted a limited number of ITAs to BOEM for sea turtle mortalities by vessel strikes. BOEM continues to assess activity for any strikes to ensure this authority is not exceeded. To date, there have been no reported strikes of sea turtles by G&G survey vessels.
- The scope, timing, and transitory nature of the proposed action will result in limited opportunity for sea turtles and vessel strikes.

3.3.3. Cumulative Impact Analysis

Chapter 4.3 of the GOM G&G PEIS and Chapter 4.9 of the Multisale EIS and 2018 SEIS address the cumulative impacts on sea turtles as a result of oil and gas leasing, exploration, development and production activities, including G&G activities. The information from these documents is incorporated by reference in this SEA.

Activities considered under the cumulative scenario which include the GOM oil and gas program and other anthropogenic and natural activities, including the proposed action, may affect protected sea turtles or critical habitat. Sea turtles may be impacted by the degradation of water quality resulting from operational discharges, vessel traffic, noise generated by platforms, drilling rigs, helicopters and vessels, G&G surveys, explosive structure removals, oil spills, oil-spill-response activities, loss of debris from service vessels and OCS structures, commercial fishing, capture and removal, and pathogens. The cumulative impact of these ongoing OCS activities on sea turtles is expected to result in a number of chronic and sporadic sublethal effects (i.e., behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may stress and/or weaken individuals of a local group or population and that may predispose them to infection from natural or anthropogenic sources. Through a systematic review, policy comparison, and stakeholder analysis, Nelms et al. (2016) found that potential impacts of seismic surveys on sea turtles vary (i.e., hearing damage, entanglement, and critical habitat exclusion) and can be obscure due to the lack of research. Thus, understanding the impacts on individuals and populations can be challenging, and additional research is needed (Nelms et al., 2016).

Few deaths are expected from chance collisions with OCS service vessels, ingestion of plastic material, commercial fishing, and pathogens. Few deaths as a result of OCS structure removals may occur but would be minimal due to requisite conditions of approval and monitoring measures. Disturbance (noise from vessel traffic and drilling operations, etc.) and/or exposure to sublethal levels of toxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them more vulnerable to parasites and diseases that normally would not be fatal. The net result of any disturbance depends upon the

size and percentage of the population likely to be affected, the ecological importance of the disturbed area, the environmental and biological parameters that influence an animal's sensitivity to disturbance and stress, or the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980). A condition of approval is in place to reduce vessel strike mortalities (i.e., Appendix C: Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols).

Natural disturbances such as hurricanes can cause significant destruction of nests and topography of nesting beaches (Pritchard, 1980; Ross and Barwani, 1982; Witherington, 1986). Tropical storms and hurricanes are a normal occurrence in the GOM and along the Gulf Coast. Generally, the impacts have been localized and infrequent; however, few areas of the Gulf Coast did not suffer some damage in 2004, 2005, 2017, and 2020. Some impacts of the hurricanes, such as loss of beach habitat, continue to impact sea turtles that would have otherwise used those areas as nesting beaches. Increases or decreases in beach armoring and other structures may impact all nesting sea turtles in the areas affected. Hurricanes and tropical activity may temporarily remove some of these barriers to suitable nesting habitat.

Incremental injury effects from the proposed action on sea turtles are expected to be **negligible** for seismic and vessel noise and marine trash and debris and **minor** for vessel collisions but not rise to the level of significance. This is mainly because of the limited scope, duration, and geographic area of the proposed action and the requirements under the NMFS 2020 BO and NMFS 2021 Amended ITS, such as Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols, B: Gulf of Mexico Marine Trash and Debris Awareness and Elimination Survey Protocols, C: Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols, and J: Sea Turtle Handling and Resuscitation Guidelines.

Conclusion

The effects of the proposed action, when viewed in light of the effects associated with other relevant activities, may affect sea turtles occurring in the GOM. With the implementation of the required conditions of approval and monitoring measures for seismic survey and vessel operations (Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols; B: Gulf of Mexico Marine Trash and Debris Awareness and Elimination Survey Protocols; and C: Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols) and the scope of the proposed action, incremental effects from the proposed seismic activities on sea turtles will be **negligible** (acoustic and vessel noise, marine trash and debris) to **minor** (vessel strikes). The best available scientific information indicates that sea turtles do not greatly use sound in the environment for survival; therefore, disruptions in environmental sound would have little effect.

3.4. Fish Resources and Essential Fish Habitat

3.4.1. Description

The life history, population dynamics, status, distribution, behavior, and habitat use of fish and essential fish habitat can be found in Chapter 4.4 and Appendix E of the GOM G&G PEIS, Chapter 4.7 of the Multisale EIS and 2018 SEIS, Chapter 3.5 of the 2021 BEBR, the NMFS 2020 BO, the NMFS 2021 Amended ITS, and are incorporated by reference into this SEA.

Threatened or Endangered Species

Four GOM fish species, the Gulf sturgeon, smalltooth sawfish, giant manta ray, and Nassau grouper are protected under the ESA. One species of elasmobranch, the oceanic whitetip shark is also protected under the ESA. The Gulf sturgeon (*Acipenser oxyrinchus*) was listed as threatened October 30, 1991 (56 CFR §49653, September 30, 1991). Gulf sturgeon is predominantly distributed in the nearshore waters of the northeastern GOM, and currently, the smalltooth sawfish is predominantly distributed in the nearshore waters of south Florida (USDOI, FWS and Gulf States Marine Fisheries Commission, 1995; USDOC, NMFS, 2009). In their 2020 BO (as amended), NMFS determined that smalltooth sawfish and their designated critical habitat are not likely to be adversely affected by BOEM's oil and gas program (USDOC, NMFS, 2020). The oceanic whitetip shark (*Carcharhinus longimanus*) was listed as threatened January 30, 2018 under the ESA (83 FR 4153). The essential fish habitat (EFH) for the oceanic whitetip shark in the project area includes localized areas in the central GOM and Florida Keys. The giant manta ray (*Manta birostris*) was listed as threatened January 22, 2018 under the ESA (83 FR 2916). Although no EFH

or critical habitat has been designated, the giant manta rays are widespread in the GOM. Giant manta rays occupy tropical, subtropical, and temperate oceanic waters and productive coastlines and are commonly found offshore in oceanic waters, but are sometimes found feeding in shallow waters (less than 10 m [33 ft]) during the day (Miller and Klimovich, 2016).

Non-ESA-Listed Species

Approximately 1,540 species of fishes are recorded in the GOM and Florida Keys (McEachran, 2009). NOAA, working with the South Atlantic and Gulf of Mexico Fishery Management Councils, manage 71 and 40 fish and crustacean species, respectively, within the Federal waters of the GOM. Distinctive fish assemblages are recognized within broad habitat classes including demersal (soft bottom and hard bottom), coastal pelagic, and oceanic pelagic (epipelagic and midwater) species. Fish are also classified by their movement patterns. Billfishes (marlins and sailfish), swordfish, tuna, and many shark species are considered highly migratory, as they are widely distributed geographically and occur from coastal waters seaward into the open ocean. Highly migratory species move vertically in the water column to feed, usually on a daily basis, and move great geographic distances for feeding or reproduction (USDOC, NMFS, 2006). An example is the Atlantic bluefin tuna, which are known to use the GOM in the spring for spawning grounds (Teo et al., 2007a and 2007b; Teo and Block, 2010).

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (MFCMA), as amended in 1996 by the Sustainable Fisheries Act, mandates that the regional Fishery Management Councils, through Fishery Management Plans, describe and identify EFH for each federally managed species, minimize adverse effects on such habitat caused by fishing, and identify other actions that encourage the conservation and enhancement of such habitats. Almost the entire GOM is within a designated EFH. Further, the GOM regional Fishery Management Council amended their GOM plans (referred to as Generic Amendment Number 3, 2005) to more specifically designate that habitats less than 100 fathoms (600 ft) are identified and described as EFH.

Fish Hearing

All fish species have hearing and skin-based mechanosensory systems (inner ear and lateral line) used to detect sound in their environment (Fay and Popper, 2000; Popper, 2003). These sounds may be produced by other fish, other organisms (e.g., snapping shrimp, marine mammals), or other naturally occurring sounds such as waves breaking on the shore, rain on the water surface, etc. Many Gulf fish species are known to actively use sound to mediate specific behaviors (e.g., spawning). Anthropogenic (human-generated) sounds may affect fishes through auditory masking, behavioral modification, temporary hearing loss, or physiological injury. Masking of important environmental sounds or social signals could potentially reduce foraging success, increase predation, or disrupt reproduction. Studies suggest responses to anthropogenic sound can vary, even among members of a species. However, startle responses generally include avoidance behaviors away from adverse conditions. Responses may also vary with duration and frequency of exposure to a given signal. Fishes in close proximity to intense sound sources may experience temporarily reduced hearing sensitivity or TTS. These effects depend upon the type of sound, duration of sound, distance of sound, and fish species (Popper and Hastings, 2009). Injury to fishes as a result of rapid changes in pressure (barotrauma) may occur in close proximity to an intense sound source.

Hearing mechanisms in fishes have been studied extensively (Fay and Popper, 2000; Ladich and Popper, 2004; Webb et al., 2008), but the specific capabilities of species and the received-sound levels where potentially adverse impacts may occur are not well known. Furthermore, Popper and Fay (2011) suggest the broad designation of fishes as "hearing specialists" and "hearing generalists" is not sufficient to classify the hearing abilities of fishes. They recommend that the range of hearing capabilities across species is more like a continuum that includes the relative contributions of hydrostatic pressure to the overall hearing capabilities of a species. Although studies have investigated physiological impacts (McCauley et al., 2000c; McCauley et al., 2003) and behavioral response (Skalski et al., 1992; Engas et al., 1996; Slotte et al., 2004; Lokkeborg et al., 2012; Fewtrell and McCauley, 2012) in several species, results are generally inconclusive and cannot be applied at the population level (National Science Foundation, 2011). However, information gaps are widely recognized (Hawkins et al., 2014; Popper et al., 2014) and broad guidance has been developed to minimize potential impacts to fishes and sea turtles resulting from anthropogenic sound

exposure. The sections below provide a synopsis of the available information relevant to the effects on fish from exposure to seismic and other anthropogenic sound.

3.4.2. Impact Analysis

Distinctive fish assemblages can be found within a broad range of habitats in continental shelf and oceanic waters. The IPFs associated with the proposed action that could affect fish include (1) active acoustic sound sources; (2) vessel noise; and (3) vessel traffic. Chapter 4.4 of the GOM G&G PEIS contains a discussion of the potential impacts from survey operations on fish resources (USDOI, BOEM, 2017a). Additional information about routine impacts from oil and gas activity on fish is addressed in Chapter 4.7 of the Multisale EIS and 2018 SEIS, Chapter 4.5 of the 2021 BEBR, the NMFS 2020 BO, and the NMFS 2021 Amended ITS. The discussions are summarized below and are incorporated by reference into this SEA.

3.4.2.1. Alternative 1

If Alternative 1, the No Action Alternative, is selected the applicant would not undertake the proposed activities; therefore, the IPFs to fish would not occur. For example, there would be no seismic airgun noise that would result in behavioral change, masking, or non-auditory effects to the animals, no long-term or permanent displacement of the animals from preferred habitats, and no destruction or adverse modification of any habitats.

3.4.2.2. Alternative 2

If Alternative 2, the Proposed Action as Submitted, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application. As described in the analyses below, impacts to fish from the proposed action (e.g., hearing loss or behavioral disruption from seismic noise), are expected to be short-term, localized and not lead to significant impacts. Although the conditions of approval and monitoring measures outlined in **Chapter 2.4** and discussed in the marine mammal and sea turtle sections are requisite for permit approval, their implementation will not increase or decrease the potential for effects to fish from the proposed action.

3.4.2.3. Alternative 3

If Alternative 3, the Proposed Action with Conditions of Approval, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application; however, the applicant would be required to undertake conditions of approval and monitoring measures as identified by BOEM, in coordination with NMFS and in compliance with the NMFS 2020 BO consultation requirements, and the NMFS 2021 Amended ITS. As described in the analyses below, impacts to fish from the proposed action (e.g., hearing loss or behavioral disruption from seismic noise), are expected to be short-term, localized and not lead to significant impacts. Although the conditions of approval and monitoring measures outlined in **Chapter 2.4** would be included, their implementation would not increase or decrease the potential for effects to fish from the proposed action.

Potential Impacts to Fish from Active Acoustic Sound Sources

Fish ears respond to changes in pressure and particle motions (van Bergeijk, 1967; Schuijf, 1981; Kalmijn, 1988 and 1989; Schellert and Popper, 1992; Hawkins, 1993; Fay, 2005). Fish exposed to natural or manmade sound may experience physical and behavioral effects, ranging in magnitude from negligible to severe. The four areas of primary concern for fish exposed to elevated noise levels include: (1) hearing loss; (2) behavioral response; (3) masking; and (4) non-auditory effects.

Hearing Loss

To result in hearing loss, a sound must exceed the specific hearing threshold of that fish for a certain period of time (Popper, 2005). The consequences of temporary or permanent hearing loss in individual fish or a fish population is largely unknown. However, it likely depends upon the number of individuals affected and whether critical behaviors involving sound (e.g., predator avoidance, prey capture, orientation and navigation, and reproduction) are adversely affected.

McCauley et al. (2003) found that caged pink snapper exposed to airgun sounds (600 pulses with peak-to-peak source levels of approximately 223 dB re 1 μPa) experienced observable anatomical damage to the auditory structures and that this damage did not repair 58 days after exposure. The damage as quantified

by missing hair cells was relatively low, but the potential for impaired function in the remaining cells and the wider implications of potentially reduced fitness were not tested. Popper et al. (2005) documented TTS of northern pike and lake chub in the Mackenzie River Delta but found that broad whitefish receiving a source level of 177 dB re 1 μPa^2 s showed no TTS. In both cases, the repetitive exposure to sound was greater than is expected in a typical seismic survey. Fishes involved in the study by Popper et al. (2005) were examined for damage to the sensory cells of the inner ear as a result of exposure to seismic sound, and no damage was observed (Song et al., 2008).

Behavioral Response

Behavioral effects from seismic noise on fishes can include changes in distribution, migration, mating, and ability to be caught. In general, any adverse effects on fish behavior or fisheries due to G&G surveys may depend on the species in question and the nature of the fishery (i.e., season, duration, and fishing method). Responses may also depend on the age of the fish, motivational state, size, and numerous unknown factors that are difficult, if not impossible, to quantify. Studies investigating the effects of sound (including seismic survey sound) on fish behavior were conducted on both uncaged and caged individuals (Chapman and Hawkins, 1969; Pearson et al., 1992; Santulli et al., 1999; Wardle et al., 2001; Hassel et al., 2003; Boeger et al., 2006) noted that fish typically exhibited a sharp "startle" response at the onset of a sound, followed by a return to normal behavior after the sound ceased. Investigation by Jorgenson and Gyselman (2009) indicated that behavioral characteristics of Arctic riverine fishes were generally unchanged by exposure to airgun sound.

Disturbance to fish population structures and distributions could result in reduced catch. An example would be temporary displacement of fish from traditional fishing grounds. Hirsh and Rodhouse (2000) reviewed studies investigating the hypothesis that seismic survey sounds have a deleterious effect on (usually commercial) fishing success. In most cases, these studies (e.g., Skalski et al., 1992; Engås et al., 1996) found that fishing catch of one or more target species declined with the onset of seismic survey operations and remained depressed throughout this activity and for days after. These effects, as reviewed in Boertmann et al. (2010), depend on species, fishing gear, and other environmental parameters. Further, reduced catch rates have been reported in some marine fisheries during seismic surveys; in several cases the findings are confounded by other sources of disturbance (Dalen and Raknes, 1985; Dalen and Knutsen, 1986; Løkkeborg, 1991; Skalski et al., 1992; Engås et al., 1996). No change was determined in catch-per-unit-effort of fish when airgun pulses were emitted, particularly in the immediate vicinity of the seismic survey (Pickett et al., 1994; La Bella et al., 1996; Wardle et al., 2001). For certain species, reductions in catch may have resulted from a change in behavior of the fish, such as a change in vertical or horizontal distribution (Slotte et al., 2004) and simply coincided with the seismic work.

Masking

Masking is defined as the effect of an acoustic source interfering with the reception and detection of an acoustic signal or other sound of biological importance to a receiver. Any sound within an animal's hearing range can mask relevant sounds. Theoretically, the airguns or airgun arrays and vessel sound could contribute minimally to localized, short-term, and transitory masking of sound detection by some marine fishes, at least those species whose sound detection capacities are in the frequency range of the seismic survey sound source(s). However, there have been no documented studies concluding that seismic surveys resulted in the masking of any biologically relevant sounds for any fish species. This is most likely due to the roving nature of the G&G surveys or the limited exposure area where survey-related energy can be found. For example, some surveying technologies (e.g., vibroseis) may have operational frequencies or cycles that present an increased potential for locally masking biologically relevant sounds. For a discussion of the biological relevance of ambient and signal sounds to fish, see Fay and Popper (2000).

Non-Auditory Effects

Existing research suggests there is a potential for non-auditory injury or mortality of fish in the immediate vicinity of a high-energy acoustic source. Airguns and airgun arrays may potentially injure or kill fishes within several meters at the time of discharge (Kostyvchenko, 1973; Dalen and Knutsen, 1986; Booman et al., 1996; Dalen et al., 1996). The potential for injury is greater among fishes with trapped gas pockets or swim bladders that expand and contract with the ambient pressure changes. There are few studies that specifically investigate the effects of airgun sound on fish larvae and eggs, but existing research suggests

these life stages are no more vulnerable to intense sound than adult fishes. Other studies document no egg, larvae, or fish mortality resulting from exposure to seismic sources (Falk and Lawrence, 1973; Holliday et al., 1987; La Bella et al., 1996; Santulli et al., 1999; McCauley et al., 2000b and 2000c; Thomsen, 2002; Hassel et al., 2003; McCauley et al., 2003; Popper, 2005; Payne et al., 2009).

Physiological effects may also include cellular and/or biochemical responses by fish to acoustic stress. Such stress potentially affects fish by increasing mortality or reducing reproductive success. However, primary and secondary stress responses of fish after exposure to seismic survey sound appear temporary (Sverdrup et al., 1994; McCauley et al., 2000b and 2000c). The periods necessary for these biochemical changes to return to normal are variable and depend on numerous aspects of the biology of the species and of the sound stimulus. The effects to fish from acoustic sound sources are expected to be **negligible**.

Potential Impacts to Fish from Vessel Noise

The proposed action is not within Gulf sturgeon habitat; however, Gulf sturgeon may be exposed to vessel noise when support vessels transit across their habitat. While the Gulf sturgeon may be able to detect passing vessels, they are not expected to be affected by the sound. According to the NMFS 2020 BO (as amended), the effects of vessel noise would be insignificant to the Gulf sturgeon (USDOC, NMFS, 2020). Therefore, the effects to fish from vessel noise are expected to be **negligible**.

Potential Impacts to Fish from Vessel Traffic

In the last five year NMFS species review, vessel strikes were identified as an emerging threat for Gulf sturgeon. The NMFS 2020 BO (as amended) Effects Analysis for Gulf sturgeon estimated one nonlethal and 21 lethal vessel strikes would occur over 50 years as a result of vessels associated with the proposed action. The effects to giant manta rays and oceanic white tip sharks from vessel strikes are discountable (USDOC, NMFS 2020). The operator is required to adhere with the mitigation and monitoring measures provided in the NMFS 2021 Amended ITS under Appendix C: Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols. Compliance with the regulations as clarified in the NMFS 2021 Amended ITS should reduce or avoid impacts from vessel strikes under this alternative. With these conditions of approval and monitoring measures in place, the impacts to the Gulf sturgeon and other fish species is **negligible.**

Conclusion

Noise from the proposed action could potentially result in acute injury and mortality of a minimal number of individuals of some species of fish, their larvae, and/or eggs when in very close proximity to a high-energy acoustic source. The proposed action may result in short-term, localized behavioral reactions. Highly migratory species like the bluefin tuna are found in the proposed action area at certain times of the year. However, given the small area and timeframe exposed to seismic noise under the proposed action, the transience of the moving seismic source relative to the GOM, and the small number of fish potentially within this localized area, the chance of non-auditory injury or mortality would be limited to an insignificant number of individuals. Seismic effects on such a small number of individuals would be insignificant at the population scale and considerably smaller than the natural mortality rate. Therefore, based on the limited best available science, seismic surveys are not expected to result in significant auditory or non-auditory injury or mortality on marine fish at the population scale. Finally, the frequency range of some G&G survey equipment (e.g., airguns) overlaps with the likely hearing range of the ESA-listed fish species; however, neither of these species are found routinely beyond state waters.

3.4.3. Cumulative Impact Analysis

Cumulative impacts on fish and EFH that result from oil and gas leasing, exploration, development, and production activity including G&G activities are discussed in Chapter 4.4 of the GOM G&G PEIS and Chapter 4.7 of the Multisale EIS and 2018 SEIS. The information from these documents is incorporated by reference in this SEA.

Activities considered under the cumulative scenario include the GOM oil and gas program and other anthropogenic and natural activities, including the proposed action, may affect fish and fisheries. Degradation of water quality from multiple human activities as described in the GOM G&G PEIS, Multisale EIS, and 2018 SEIS will continually affect fish and fisheries species. The cumulative impact of these ongoing OCS activities on fish and fisheries is expected to result in a number of chronic and sporadic lethal

and sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) effects that may stress and/or weaken individuals of a local group or population and predispose them to infection from natural or anthropogenic sources. Finally, non-anthropogenic sources such as red tides and tropical storms may add to the cumulative impacts on fish resources in the northern GOM. The proposed action is a short-term event in a portion of the GOM; therefore, the effects from the proposed action will be slight in regards to these ongoing impacts.

The net result of any disturbance depends upon the size and percentage of the population likely to be affected, the ecological importance of the disturbed area, the environmental and biological parameters that influence an animal's sensitivity to disturbance and stress, and the accommodation time in response to prolonged stress.

Conclusion

The effects of the proposed action, when viewed in light of the effects associated with other relevant activities, may impact fish and fisheries occurring in the GOM. However, given the scope of the proposed action, incremental effects from the proposed seismic activities on fish and fisheries will be **negligible**.

3.5. Benthic Communities

3.5.1. Description

For purposes of OCS activity impact analyses, BOEM defines "deepwater benthic communities," to include chemosynthetic and deepwater coral communities in the GOM as those typically found in water depths of 984 ft (300 m) and greater (USDOI, BOEM, 2017b and c).

A description of chemosynthetic and deepwater coral communities in the GOM region can be found in Chapter 4.5 of the GOM G&G PEIS, Chapter 4.4 of the Multisale EIS and 2018 SEIS, and Chapter 3.4 of the 2021 BEBR. The following information is a summary of the descriptions in the EISs, and it is incorporated by reference into this SEA.

The continental slope in the GOM extends from the edge of the continental shelf at a depth of about 656 ft (200 m) to a water depth of approximately 9,840 ft (3,000 m) (USDOI, BOEM, 2017b and c). The vast majority of the GOM has a soft, muddy bottom in which burrowing infauna are the most abundant invertebrates. The proposed survey area generally falls into this category as the water depth of the proposed activity ranges from 262 – 7,644 ft (80 – 2,330 m).

A remarkable assemblage of invertebrates is found in association with hydrocarbon seeps in the GOM. Chemosynthetic communities can occur at or near hydrocarbon seeps and are defined as persistent, largely sessile assemblages of marine organisms dependent upon symbiotic chemosynthetic bacteria as their primary food source (MacDonald, 1992). Invertebrate taxa in these communities include tube worms and bivalves, among others. Symbiotic chemosynthetic bacteria live within specialized cells in the invertebrate organisms and are supplied with oxygen and chemosynthetic compounds (methane and sulfides) by the host via specialized blood chemistry (Fisher, 1990). Chemosynthetic bacteria, which live on mats, in sediment, and in symbiosis with chemosynthetic invertebrates, use a carbon source independent of photosynthesis to make sugars and amino acids. The host, in turn, lives off the organic products subsequently released by the chemosynthetic bacteria and may even feed on the bacteria themselves. Chemosynthetic communities can become established when a hard substrate is available for colonization at or near a seep. Depending on the situation, sessile benthic invertebrates can settle on and colonize carbonate substrate. These organisms form additional structure upon the seafloor, increasing the complexity of the habitat that may provide support to a variety of deepwater corals, invertebrates and fishes.

Some deepwater corals form communities occurring at or near hydrocarbon seeps, or on exposed outcrops, and may be found in association with chemosynthetic communities. Deepwater coral communities are also found on shipwrecks, and deepwater oil and gas infrastructure. These coral communities are distinctive and provide three-dimensional habitat for a range of fishes and invertebrates. Hard-bottom habitats in deep water include communities dominated by *Lophelia pertusa*, with other corals such as the bamboo coral (*Keratoisis flexibilis*) and zigzag coral (*Madrepora oculata*). Numerous other invertebrates are also associated with these benthic habitats (Sulak et al., 2008; Cordes et al., 2008; Fisher et al., 2007; Schroeder et al., 2005).

Hydrocarbon seep communities in the GOM have been reported to occur at water depths greater than 300 m (984 ft) (USDOI, BOEM, 2017b and c). To date, there are over 300 deepwater benthic communities comprised of chemosynthetic organisms and/or deepwater corals. Once thought rare, research suggests that deepwater faunal communities are regularly associated with seafloor features commonly found in the vicinity of the primary geophysical signatures of the seabed for hydrocarbon migration to the seafloor. These areas include those where hydrocarbons percolate through sediments or where hydrocarbons move along faults that reach the seafloor. More than 23,000 positive anomalies have been identified from seismic survey data and each may represent a habitat where a hard substrate and a deepwater community may be found. However, until an anomaly has been visited and confirmed, it is unknown if hard substrates are exposed and capable of supporting deepwater benthic communities.

To map areas of probable habitat for deepwater benthic communities, scientists at BOEM analyzed decades of three-dimensional seismic data to classify seafloor returns exhibiting anomalously high or low reflectivity. The areas of high reflectivity represent patches of anomalous seafloor returns that likely indicate patches of hard seafloor that would provide substrate for deepwater benthic communities. Most confirmed hard bottoms in the deepwater GOM were created by the precipitation of calcium carbonate substrate by chemosynthetic bacterial activity and are capable of supporting deepwater benthic communities. However, non-biogenic hard bottoms are also found at escarpments, seafloor-reaching faults, or where salt formations reach the surface. Investigations of the seafloor at patches of high reflectivity indicate that chemosynthetic and coral communities are much more common in the deepwater GOM than previously known (USDOI, BOEM, 2017b and c). Also, areas of low reflectivity (negative anomalies) can be indicative of gassy sediments and mud volcanoes with a high flux of hydrocarbons from the seafloor. Although uncommon, chemosynthetic bivalves may be found in areas with a high flux of hydrocarbons.

3.5.2. Impact Analysis

A detailed impact analysis of the routine, accidental, and cumulative impacts of the proposed activities on chemosynthetic communities and deepwater coral communities can be found in Chapter 4.5 of the GOM G&G PEIS, Chapter 4.4 of the Multisale EIS and 2018 SEIS, and Chapter 4.4 of the 2021 BEBR. The following information is a summary of the impact analyses in the GOM G&G PEIS, Multisale EIS, 2018 SEIS, and 2021 BEBR, and are incorporated by reference into this SEA.

Any hard substrate communities located in deep water would be particularly sensitive to impacts from OCS activities resulting in bottom disturbances and increased turbidity. Such impacts to these habitats could permanently prevent recolonization by similar organisms requiring hard substrate. The IPF associated with the proposed activities in the Garden Banks and Keathley Canyon Areas that could affect deepwater benthic communities include physical impacts from placement and recovery of OBNs and PIES.

3.5.2.1. Alternative 1

If Alternative 1, the No Action Alternative, is selected the applicant would not undertake the proposed activities. Therefore, the IPF to deepwater benthic communities would not occur. For example, there would be no bottom impacts that could result in physical damage to the deepwater benthic communities or their substrates.

3.5.2.2. Alternative 2

If Alternative 2, the Proposed Action as Submitted, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application. Examples of potential impacts to deepwater benthic communities without implementation of the conditions of approval and monitoring measures noted in **Chapter 2.4** and the following analysis include, but are not limited to, damage from the proposed survey activities. The operator proposes seismic survey activities with OBNs as receivers at sites that are located near potential and/or confirmed deepwater benthic communities which, without additional measures, may lead to potential impacts to those sites.

3.5.2.3. Alternative 3

If Alternative 3, the Proposed Action with Conditions of Approval, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application; however, the applicant would be required to undertake conditions of approval and monitoring measures as identified by BOEM, in coordination with NMFS and in compliance with the NMFS 2020 BO consultation requirements, and NMFS 2021 Amended ITS. The mitigation and monitoring measures from the NMFS 2020 BO and NMFS 2021Amended ITS do not address this resource. The measures outlined in **Chapter 2.4** are expected to decrease or negate the potential for impact to deepwater benthic communities from the proposed action. For the reasons set forth below, inclusion of these measures under Alternative 3 further limits or negates potential impacts to deepwater benthic communities.

Potential Impacts on Deepwater Benthic Communities from Bottom Disturbances

As described in **Chapter 2** of this SEA, the applicant proposes to conduct seismic survey activities that will involve the placement of OBNs and PIES, disturbing the seafloor in the area of the proposed action. If the OBNs or PIES are deployed near or atop a confirmed or potential deepwater benthic community, impacts to these sensitive habitats could permanently prevent recolonization by similar organisms.

If a high-density deepwater benthic community is subjected to impacts by bottom-disturbing activities, potentially severe or catastrophic impacts could occur due to direct impingement by a receiver or partial to complete burial due to resuspension of sediments. The severity of such an impact could be immediate loss of the community or incremental losses of productivity, reproduction, community relationships, leading to degradation of the overall ecological functions of the community and incremental damage to surrounding communities.

However, the offsets to OBN and PIES positioning proposed by BOEM will allow for deployment of the required OBNs and PIES within the demonstrated capability of the operator and provides for buffering of the seafloor disturbances caused by deployment. This condition of approval ensures the potential for impacts resulting from the proposed survey activities are minimal. The effects to benthic communities from bottom disturbances are expected to be **negligible**.

Conclusion

Features capable of supporting deepwater benthic communities are located within the survey area. If the proposed bottom positioned receivers were to contact one of the sites, it would have the potential to destroy any sessile organisms that may be present or cause destruction of underlying carbonate structures on which organisms rely for substrate as well as dispersion of hydrocarbon sources. These impacts could be severe in the immediate area; with recovery times as long as 200 years for mature tube-worm communities and with some corals aged at over 2,000 years (Prouty et al., 2011), there is the possibility a community may never recover. The same geophysical conditions associated with the potential presence of chemosynthetic communities can also result in hard carbonate substrate upon which deepwater corals can attach. The proposed activities may impact the ecological function, biological productivity, or distribution of hard-bottom deepwater benthic (both chemosynthetic and deepwater coral) communities. Burial or disruption of the organisms from redistribution of bottom sediment or increased turbidity from resuspended sediment may foul or otherwise interfere with filter-feeding organs.

Recruitment of new organisms from nearby communities and settlement of organisms in areas with exposed hard ground may take years to decades to become established, if ever. With this in mind, BOEM uses conditions of approval and monitoring measures applied to permits to preserve such undisturbed areas. The conditions of approval and monitoring measures outlined in **Chapter 2.4** would help assure sources for colonizing larvae and protect existing habitat. Impacts to hard-bottom communities are expected to be avoided as a consequence of compliance with existing BOEM regulations and adherence by the operator to the conditions of approval and monitoring measures.

Sensitive sessile benthic resources could occur in the vicinity of the proposed activities; with operator adherence to the measures in **Chapter 2.4**, the proposed activities are not expected to impact either known or probable areas of deepwater benthic communities.

3.5.3. Cumulative Impact Analysis

Considering the location of these habitats, the operator's proposed activities would constitute the primary effect on the resources that may exist in the area of the proposed action. As such, the potential cumulative impacts from all other GOM activities would be identical to the effects described above. Given the negligible impacts on deepwater benthic communities, because of the application of BOEM avoidance criteria as described in NTL No. 2009-G40, the cumulative impacts are also **negligible.**

Conclusion

The effects of the proposed action, when viewed in light of the effects associated with other relevant activities, may impact deepwater benthic communities in the GOM. However, given the scope of the proposed action and conservative nature of the applied conditions of approval, incremental effects from the proposed survey activities on deepwater benthic communities will be **negligible**.

The proposed activities are expected to have negligible impacts on the ecological function, abundance, productivity, and/or distribution of deepwater benthic communities given adherence to distancing requirements found in NTL No. 2009-G40. The operator's plan proposes compliance with the regulations as clarified by NTL No. 2009-G40. Bottom disturbances from nodal placement would be sited away from any sensitive deepwater benthic communities. Any sediments or fluids that could come in contact with the organisms would be diluted to a concentration where the impact to the deepwater benthic community would be **negligible**.

3.6. Archaeological Resources

3.6.1. Description

Archaeological resources are any material remains of human life or activities that are at least 50 years of age and that are of archaeological interest (30 CFR § 551.1). As obligated under OCSLA regulations (30 CFR § 551.6 (a) (5)), applicants are not allowed to disturb archaeological resources while conducting their survey activities. The description of archaeological resources (prehistoric and historic) can be found in Chapter 4.11 of the GOM G&G PEIS and Chapter 4.13 of the Multisale EIS and 2018 SEIS. The following information is a summary of these descriptions and is incorporated by reference into this SEA.

Prehistoric

Geographic features that have a high probability for associated prehistoric sites in the northwestern and north central Gulf (from Texas to Alabama) include barrier islands and back barrier embayments, river channels and associated floodplains and terraces, and salt dome features. Also, a high probability for prehistoric resources may be found landward of a line which roughly follows the 60 m bathymetric contour, which represents the Pleistocene shoreline during the last glaciation some 12,000 years ago when the coastal area of Texas and Louisiana is generally considered to have been populated. BOEM is currently reviewing evidence to determine if a change in the currently accepted area of prehistoric site probability is warranted.

Historic

Historic archaeological resources on the OCS include shipwrecks and a single light house (Ship Shoal Light). Historic research has identified over 4,000 potential shipwreck locations in the Gulf, nearly 1,500 of which occur on the OCS (Garrison et al., 1989). The historic record, however, is by no means complete, and the current ability to predict potential sites has proven inaccurate. As demonstrated by several studies (Pearson et. al., 2003; Lugo-Fernandez et al., 2007; Krivor et al., 2011; Rawls and Bowker-Lee, 2011), many more shipwrecks are likely to exist on the seafloor than have been accounted for in available historic literature. Currently a high-resolution remote sensing survey is the most reliable method for identifying and avoiding historic archaeological resources.

A 2003 study recommended including some deepwater areas, primarily on the approach to the Mississippi River, among those lease areas requiring archaeological investigation. With this in mind, BOEM revised its guidelines for conducting archaeological surveys in 2005 and added about 1,200 lease blocks to the list of blocks requiring an archaeological survey and assessment in advance of oil and gas industry activities. Archaeological survey blocks were further expanded in 2011 and current requirements are posted on the BOEM website under NTL No. 2005-G07 and Joint NTL No. 2011-G01. At present, high-resolution

geophysical, ROV, and/or diver survey is required for all new bottom disturbing activities by the oil and gas industry. Historic shipwrecks have, with the exception of three significant vessels found by treasure salvers, been primarily discovered through oil industry sonar surveys in water depths up to 9,000 ft (2,743 m). In fact, in the last five years, over four dozen potential shipwrecks have been located and several of these ships have been confirmed visually as historic vessels. Many of these wrecks were not previously suspected to exist in these areas, based on the historic record. The preservation of historic wrecks found in deep water has been outstanding because of a combination of environmental conditions and limited human access.

3.6.2. Impact Analysis

The IPF associated with the proposed action that could affect archaeological resources is seafloor disturbance from the placement and recovery of OBNs and PIES. The historically-available literature is not sufficient to identify historic shipwreck losses in the area of the proposed action as historic records of losses occurring this far offshore are not location-specific (Pearson et al., 2003; Krivor et al., 2011; Rawls and Bowker-Lee, 2011). However, if a historic resource exists in the survey area, direct physical contact with a shipwreck site could destroy fragile materials, such as hull remains or artifacts, and could disturb the site context (Atauz et al., 2006; Church and Warren, 2008).

The IPF that could be associated with accidental events include seafloor disturbances from jettisoned/lost debris. Similar to routine impacts, discarded/lost material that falls to the seabed has the potential to damage and/or disturb archaeological resources.

Chapter 4.11 of the GOM G&G PEIS contains a discussion of the potential impacts from survey operations on archaeological resources (USDOI, BOEM, 2017a). Additional information about routine impacts from oil and gas activity on archaeological resources is addressed in Chapter 4.13 of the Multisale EIS and 2018 SEIS. The following information is a summary of the impact analyses and is incorporated by reference into this SEA.

3.6.2.1. Alternative 1

If Alternative 1, the No Action Alternative, is selected the applicant would not undertake the proposed activities; therefore, the IPF to archaeological resources would not occur. For example, there would be no bottom impacts from OBN or PIES placement that could result in potential loss of any known or unknown historic archaelogical resource.

3.6.2.2. Alternative 2

If Alternative 2, the Proposed Action as Submitted, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application. Examples of potential impacts to archaeological resources would include, but are not limited to, damage to potential archaeological resources from the proposed survey activities. The operator proposes seismic survey activities with OBNs as receivers and PIES at sites that are located near potential and/or confirmed archaeological resources which, without additional conditions of approval and monitoring measures, may lead to potential impacts to those sites.

3.6.2.3. Alternative 3

If Alternative 3, the Proposed Action with Conditions of Approval, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application; however, the applicant would be required to undertake conditions of approval and monitoring measures as identified by BOEM. The mitigation and monitoring measures from the NMFS 2020 BO consultation and NMFS 2021 Amended ITS in Alternative 3 do not address this resource. The conditions of approval and monitoring measures outlined in **Chapter 2.4** are expected to decrease or negate the potential for impact to archaeological resources from the proposed action. For the reasons set forth below, inclusion of these measures under Alternative 3 further limits or negates potential impacts to archaeological resources.

Routine Activities

Historic modeling assumes that shipwrecks would be found closest to shore along the Federal/State boundary or within ten mi (16 km) of their reported loss location. However high-resolution geophysical data acquired by oil and gas industry remote sensing surveys now indicate that this model is too limited.

For example, several vessel casualties from World War II with historically reported coordinates were later discovered well over ten mi (16 km) outside the 9-mi^2 area assumed to be their location by the model (Irion, 2002). An early nineteenth century steamship lost off the Texas coast was found by treasure salvers over 120 mi (193 km) from the area of its presumed loss in the Minerals Management Service model (Irion, Official Communication, 2011). These situations, coupled with the fact that no confirmed historic shipwreck sites had been found in any of the designated historic high probability area in 20 years, led to a study released in 2003 (Pearson et al., 2003) to reassess the high-probability model. Some of the recommendations of this study were implemented in July 2005 with the revision of NTL No. 2005-G07, *Archaeological Resource Surveys and Reports*, which added 1,802 lease blocks, mostly in deepwater areas in Mississippi Canyon (MC), Green Canyon (GC), and Viosca Knoll (VK) areas, to the "high-probability" block list requiring archaeological surveys.

The addition of the new blocks, the current requirement that all new bottom disturbing activity by the oil and gas industry be cleared by high-resolution geophysical, ROV, and/or diver survey, industry's resultant survey data, and the subsequent increase in the number of shipwrecks discovered further suggests that the potential distribution of significant historic resources is wider than originally thought.

The Western and Central Gulf was traversed extensively by shipping throughout the 19th and 20th centuries as new ports developed along the Texas coast, such as Galveston (est. 1825) and Brazos Santiago (1848). With the advent of steam, oil screw, and gasoline or diesel-propelled vessels and improved navigational instruments, sailors' options to set a course irrespective of prevailing winds and currents greatly increased expanding even further the potential for a shipwreck to have occurred in the area of the proposed action.

Impacts to a historic site could result from direct physical contact with an OBN or PIES causing irreversible damage. The undisturbed provenience of archaeological data (i.e., the 3-dimensional location of archaeological artifacts) allows archaeologists to accumulate a record of where every item is found, and to develop a snapshot as to how artifacts relate to other items or the site as a whole. The analysis of artifacts and their provenience is one critical element used to make a determination of eligibility to the National Register of Historic Places and is essential in understanding past human behavior and ways of life. Impacts from the proposed operations could alter the provenience and destroy fragile remains, such as the hull, wood, glass, ceramic artifacts and possibly even human remains, or information related to the operation or purpose of the vessel. The destruction and loss of this data eliminates the ability of the archaeologist to fully and accurately detail activity areas found at the site, variation and technological advances lost to history, the age, function, and cultural affiliation of the vessel, and its overall contribution to understanding and documenting the maritime heritage and culture of the region. Under Alternative 3, the operator is required to avoid known archaeological resources and cease operations should the operator discover an unknown, potential archaeological resource. With the conditions of approval and monitoring measures in place under Alternative 3, the effects to archaeological resources are expected to be **negligible**.

Accidental Events

An IPF that could result from an accidental event is from the loss of debris from the survey and support vessels during survey operations. Debris such as structural components (i.e., grating, wire, tubing, etc.), boxes, pallets, and other loose items can become dislodged during heavy seas or storm events and fall to the seabed. Similar to the impacts noted under Routine Activities, if debris were to fall onto an unknown archaeological resource, damage could destroy fragile materials, such as hull remains and artifacts, and could disturb the site's context and associated artifact assemblage. Additionally, lost material could result in the masking of actual archaeological resources or the introduction of false targets that could be mistaken in the remote sensing record as historic resources.

3.6.3. Cumulative Impact Analysis

Cumulative impacts on unknown archaeological resources that may be present in the area of the proposed action could result from other GOM activities. Since the water depth of the proposed activity ranges from approximately 262 – 7,644 ft (80 – 2,330 m)and the area of the proposed action is over 96 mi (154 km) from shore, those activities would be limited to commercial fishing, marine transportation, and adjacent oil and gas exploration, development, and production operations.

During adjacent oil and gas operations, commercial fishing, and maritime transportation activities, there is associated loss or discard of debris that could result in the masking of archaeological resources or the

introduction of false targets that could be mistaken in the remote sensing record as historic resources. Future exploration, development, and production operations and/or any related infrastructure support could lead to bottom disturbances in the area of the proposed action; however, no additional activities have been proposed or are under review at this time.

Any known or unknown archaeological resources that may be present in the proposed survey area could be impacted by contact with oil from a blowout or spill from adjacent oil and gas operations. Similarly, cumulative impacts from accidental oil spills and remediation efforts for adjacent oil and gas operations are not expected because of the water depth at the proposed site and the historically low probability of a loss of well control/blowout.

Considering the potential cumulative impacts from all other GOM activities, the operator's proposed activities would constitute the primary effect, if any, on any known or unknown archaeological resource that may exist in the area of the proposed action.

Conclusion

Based on the previous information, study conclusions, and the number of confirmed wrecks recently found in similar water depths, there is reason to believe that archaeological resources could be present in the area of the proposed action. Impacts may include damage and/or disturbance to the potential resources from OBN and PIES placement. Impacts from accidental events related to the proposed action such as debris lost from the survey and support vessels could lead to impacts similar to those expected from routine impacts. If the operator's seabed disturbing activities make contact with these targets, it might have a significant impact on the resources. The site specific review of the proposed activity indicates that there are potential archaeological targets within the vicinity of the proposed OBN and PIES deployments. Based on the review findings, it is likely that submerged archaeological resources could exist in the area of the proposed action as targets have been identified in pre-existing survey data. Without necessary avoidance conditions of approval and monitoring measures, selecting Alternative 3 should not result in significant impacts to archaeological resources; the effects are expected to be **negligible**.

3.7. Other Users of the OCS

BOEM is required to consider the impact of the proposed action on other users of the GOM OCS; one of the most prevalent users is the U.S. military. All military activities in the GOM OCS occur within military warning areas designated by the Federal Aviation Administration in coordination with the U.S. Department of Defense. Space-use conflicts related to military activities were addressed in Chapter 4.12 of the GOM G&G PEIS (USDOI, BOEM, 2017a); potential impacts related to military warning areas were determined to be **negligible**. Lessees and permittees conducting G&G operations within these warning areas are required to coordinate with the appropriate military command.

The survey operations and routes to be taken by vessels in support of TGS' proposed survey will operate within Military Warning Areas (MWA) W-602, W-147AB, and W-59A. BOEM's website contains a map of the MWAs and EWTAs in the GOM and contact information:

- http://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Gulf-of-Mexico-Region/MWA_boundaries-pdf.aspx
- http://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Gulf-of-Mexico-Region/Military-Contacts-pdf.aspx

Using this information, the coordination condition of approval has proven effective over many years to reduce the risk of interrupting planned military or geophysical activities.

3.8. Other Considerations

A discussion of the other resources considered but not analyzed under this SEA is found in Chapter 5 of the GOM G&G PEIS (USDOI, BOEM, 2017a) and Chapter 3 of the Multisale EIS and 2018 SEIS (USDOI, BOEM, 2017b and c).

4. CONSULTATION AND COORDINATION

The information in this SEA was developed by BOEM subject matter experts and in consultation with other Federal agencies, the private sector, and academia personnel found in Chapter 6 of the GOM G&G PEIS and Chapter 5 of the Multisale EIS and 2018 SEIS (USDOI, BOEM, 2017a, b, and c).

The ESA establishes a national policy designed to protect and conserve threatened and endangered species and the ecosystems upon which they depend. Section 7(a)(2) of the ESA requires each Federal agency to ensure that any action that they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the adverse modification of designated critical habitat. On April 20, 2018, the FWS issued its 10-year programmatic BO (FWS 2018 BO) for BOEM and BSEE's oil and gas activities in the GOM. The FWS 2018 BO does not include any terms and conditions for the protection of endangered species that the Bureaus, lessees, or operators must implement. The FWS 2018 BO also noted that any future consultations may be informal, dependent upon the likelihood of take.

On March 13, 2020, NMFS issued a Programmatic BO (NMFS 2020 BO) and related terms and conditions for oil and gas activities in the GOM for the protection of these species, including holding lease sales. The NMFS 2020 BO and NMFS 2021 Amended ITS address any future lease sales and any approvals issued by BOEM and BSEE, under both existing and future OCS oil and gas leases in the GOM, over a 10-year period. Applicable terms and conditions and reasonable and prudent measures from the NMFS 2020 BO and NMFS 2021 Amended ITS will be applied at the lease sale stage; other specific conditions of approval will also be applied to post-lease approvals. The NMFS 2020 BO may be found here:

https://www.fisheries.noaa.gov/resource/document/biological-opinion-federally-regulated-oil-and-gas-program-activities-gulf-mexico.

The Appendices and protocols may be found here:

https://www.fisheries.noaa.gov/resource/document/appendices-biological-opinion-federally-regulated-oil-and-gas-program-gulf-mexico.

In November 2020, BOEM and BSEE in the spirit of adaptive management and in agreement with NMFS, submitted revised procedures for the NMFS 2020 BO (as amended), in that, some activities previously requiring step-down review by NMFS to not be continued and apply programmatic standardized mitigation measures to protect resources. On April 26, 2021, the NMFS 2020 BO was amended (NMFS 2021 Amended ITS) to incorporate adaptive management for step-down review, MMPA Rulemaking, and revised Appendices A, C, and I.

BOEM petitioned NMFS for rulemaking under the MMPA, to assist industry in obtaining incidental take coverage for marine mammals due to oil and gas and G&G surveys in the GOM. NMFS issued a final rule as a result of the petition on January 19, 2021 (86 FR 5322) with an effective date of April 19, 2021. The rule will be in place for five years. For G&G activity, the operator would need to obtain a Letter of Authorization (LOA) under the Incidental Take Regulation (ITR) to have any expected take of marine mammals authorized under the MMPA, and for ESA-listed species under the NMFS 2020 BO (as amended), authorized under the ESA. Any applicable mitigations would generally already be applied via the NMFS 2020 BO (as amended).

BOEM completed consultation with NOAA's NMFS regarding the MFCMA on July 10, 2017, by the receipt of a comment letter from NMFS. The NMFS letter acknowledged their receipt of the EFH Assessment and the supporting 2017-2022 Multisale Lease NEPA document, provided a determination that the Programmatic Consultation was an appropriate mechanism to evaluate EFH impacts and confirmed the adoption of the BOEM/BSEE mitigation measures outlined in the June 8, 2016 BOEM EFH Assessment to ensure adverse impacts are avoided, minimized, and offset. This consultation remains in effect for 2017-2022 activities or earlier but not if modifications are made to the BOEM/BSEE programs that would result in changes to potential adverse effects on EFH which would trigger additional consultation.

In accordance with the National Historic Preservation Act (54 U.S.C. §§ 300101 *et seq.*), Federal agencies are required to consider the effects of their undertakings on historic properties. The implementing regulations for Section 106 of the National Historic Preservation Act, issued by the Advisory Council on Historic Preservation (36 CFR § 800), specify the required review process. In accordance with 36 CFR § 800.8(c), BOEM intends to use the NEPA substitution process and documentation for preparing an

EIS/ROD or an EA/FONSI to comply with Section 106 of the National Historic Preservation Act in lieu of 36 CFR § 800.3-800.6.

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