investigation within 65 days after the date on which the Department initiated the investigation. However, in accordance with 19 CFR 351.205(e), if the petitioner makes a timely request for an extension, section 703(c)(1)(A) of the Act allows the Department to postpone the preliminary determination until no later than 130 days after the date on which the Department initiated the investigation. Under 19 CFR 351.205(e), a petitioner must submit a request for postponement 25 days or more before the scheduled date of the preliminary determination and must state the reason for the request. The Department will grant the request unless it finds compelling reasons to deny the request.[3]

On March 14, 2016, the petitioner[4] in this investigation submitted a timely request pursuant to section 703(c)(1)(A) of the Act and 19 CFR 351.205(e) to postpone the preliminary determination due to the number and nature of subsidy programs under investigation.[5]

The record does not present any compelling reasons to deny the petitioner's request. Therefore, in accordance with section 703(c)(1)(A) of the Act, we are fully postponing the due date for the preliminary determination to not later than 130 days after the day on which the investigation was initiated. As a result, the deadline for completion of the preliminary determination is now June 27, 2016. In accordance with section 705(a)(1) of the Act and 19 CFR 351.210(b)(1), the deadline for the final determinations of this investigation will continue to be 75 days after the date of the preliminary determination, unless postponed at a later date.

This notice is issued and published pursuant to section 703(c)(2) of the Act and 19 CFR 351.205(f)(1).

Dated: March 24, 2016.

Paul Piquado,

Assistant Secretary for Enforcement and Compliance.

[FR Doc. 2016–07314 Filed 3–30–16; 8:45 am]

BILLING CODE 3510–DS–P

[3] *See* 19 CFR 351.205(e).

[4] The United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union, AFL–CIO–CLC (collectively, the petitioner).

[5] *See* Letter from the petitioner, entitled ''Truck and Bus Tires From People's Republic of China: Petitioner's Request To Extend the Deadline for the Preliminary Determination,'' dated March 14, 2016.

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XE443

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Boost-Backs and Landings of Rockets at Vandenberg Air Force Base

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed incidental harassment authorization; request for comments.

SUMMARY: NMFS has received a request from Space Explorations Technology Corporation (SpaceX), for authorization to take marine mammals incidental to boost-backs and landings of Falcon 9 rockets at Vandenberg Air Force Base in California, and at a contingency landing location approximately 30 miles offshore. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an incidental harassment authorization (IHA) to SpaceX to incidentally take marine mammals, by Level B Harassment only, during the specified activity.

DATES: Comments and information must be received no later than May 2, 2016.

ADDRESSES: Comments on the application should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service. Physical comments should be sent to 1315 East-West Highway, Silver Spring, MD 20910 and electronic comments should be sent to *ITP.Carduner@noaa.gov.*

Instructions: Comments sent by any other method, to any other address or individual, or received after the end of the comment period, may not be considered by NMFS. Comments received electronically, including all attachments, must not exceed a 25-megabyte file size. Attachments to electronic comments will be accepted in Microsoft Word or Excel or Adobe PDF file formats only. All comments received are a part of the public record and will generally be posted for public viewing on the Internet at *www.nmfs.noaa.gov/pr/permits/incidental/* without change. All personal identifying information (*e.g.,* name, address), confidential business information, or otherwise sensitive information submitted voluntarily by the sender will be publicly accessible.

FOR FURTHER INFORMATION CONTACT: Jordan Carduner, Office of Protected Resources, NMFS, (301) 427–8401.

SUPPLEMENTARY INFORMATION:

Availability

An electronic copy of SpaceX's IHA application and supporting documents, as well as a list of the references cited in this document, may be obtained by visiting the Internet at *www.nmfs.noaa.gov/pr/permits/incidental/.* In case of problems accessing these documents, please call the contact listed under **FOR FURTHER INFORMATION CONTACT.**

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce to allow, upon request by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified area, the incidental, but not intentional, taking of small numbers of marine mammals, providing that certain findings are made and the necessary prescriptions are established.

The incidental taking of small numbers of marine mammals may be allowed only if NMFS (through authority delegated by the Secretary) finds that the total taking by the specified activity during the specified time period will (i) have a negligible impact on the species or stock(s) and (ii) not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant). Further, the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such taking must be set forth.

The allowance of such incidental taking under section 101(a)(5)(A), by harassment, serious injury, death, or a combination thereof, requires that regulations be established. Subsequently, a Letter of Authorization may be issued pursuant to the prescriptions established in such regulations, providing that the level of taking will be consistent with the findings made for the total taking allowable under the specific regulations. Under section 101(a)(5)(D), NMFS may authorize such incidental taking by harassment only, for periods of not more than one year, pursuant to requirements and conditions contained within an IHA. The establishment of these prescriptions requires notice and opportunity for public comment.

NMFS has defined ''negligible impact'' in 50 CFR 216.103 as ''. . . an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.'' Except with respect to certain activities not pertinent here, section 3(18) of the MMPA defines ''harassment'' as: ''. . . any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].''

Summary of Request

On July 28, 2015, we received a request from SpaceX for authorization to take marine mammals incidental to Falcon 9 First Stage recovery activities, including in-air boost-back maneuvers and landings of the First Stage of the Falcon 9 rocket at Vandenberg Air Force Base (VAFB) in California, and at a contingency landing location approximately 50 km (31 mi) offshore of VAFB. SpaceX submitted a revised version of the request on November 5, 2015. This revised version of the application was deemed adequate and complete. Acoustic stimuli, including sonic booms (overpressure of high-energy impulsive sound), landing noise, and possible explosions, resulting from boost-back maneuvers and landings of the Falcon 9 First Stage have the potential to result in take, in the form of Level B harassment, of six species of pinnipeds. NMFS is proposing to authorize the Level B harassment of the following marine mammal species/stocks, incidental to SpaceX's proposed activities: Pacific harbor seal (*Phoca vitulina richardii*), California sea lion (*Zalophus californianus*), Steller sea lion (eastern Distinct Population Segment, or DPS) (*Eumetopias jubatus*), northern elephant seal (*Mirounga angustirostris*), northern fur seal (*Callorhinus ursinus*), and Guadalupe fur seal (*Arctocephalus townsendi*).

Description of the Specified Activity

Overview

The Falcon 9 is a two-stage rocket designed and manufactured by SpaceX for transport of satellites and SpaceX's Dragon spacecraft into orbit. SpaceX currently operates the Falcon Launch Vehicle Program at Space Launch Complex 4E (SLC–4E) at VAFB. SpaceX proposes regular employment of First Stage recovery by returning the Falcon 9 First Stage to SLC–4 West (SLC–4W) at VAFB for potential reuse up to six times per year. The reuse of the Falcon 9 First Stage will enable SpaceX to efficiently conduct lower cost launch missions from VAFB in support of commercial and government clients. First Stage recovery includes an in-air boost-back maneuver and the landing of the First Stage of the Falcon 9 rocket.

Although SLC–4W is the preferred landing location, SpaceX has identified the need for a contingency landing action that would only be exercised if there were critical assets on South VAFB that would not permit an over-flight of the First Stage, or if other reasons such as fuel constraints did not permit landing at SLC–4W. The contingency action is to land the First Stage on a barge in the Pacific Ocean at a landing location 50 km (31 miles) offshore of VAFB.

Dates and Duration

SpaceX plans to conduct their proposed activities during the period from June 30, 2016 to June 29, 2017. Up to six Falcon 9 First Stage recovery activities would occur per year. Precise dates of Falcon 9 First Stage recovery activities are not known. Falcon 9 First Stage recovery activities may take place at any time of year and at any time of day.

Specific Geographic Region

Falcon 9 First Stage recovery activities will originate at VAFB. Areas affected include VAFB and areas on the coastline surrounding VAFB; the Pacific Ocean offshore VAFB; and the Northern Channel Islands (NCI). VAFB operates as a missile test base and aerospace center, supporting west coast space launch activities for the U.S. Air Force (USAF), Department of Defense, National Aeronautics and Space Administration, and commercial contractors. VAFB is the main west coast launch facility for placing commercial, government, and military satellites into polar orbit on expendable (unmanned) launch vehicles, and for testing and evaluating intercontinental ballistic missiles and sub-orbital target and interceptor missiles.

VAFB occupies approximately 99,100 acres of central Santa Barbara County, California (see Figure 1–1 in SpaceX's IHA application), approximately halfway between San Diego and San Francisco. The Santa Ynez River and State Highway 246 divide VAFB into two distinct parts: North Base and South Base. SLC–4W is located on South Base, approximately 0.5 miles (0.8 km) inland from the Pacific Ocean (see Figure 1–2 in SpaceX's IHA application). SLC–4E, the launch facility for SpaceX's Falcon 9 program, is located approximately 427 m to the east of SLC–4W, the proposed landing site for the Falcon 9 First Stage (see Figure 1–2, inset, in SpaceX's IHA application).

Although SLC–4W is the preferred landing location, SpaceX has identified the need for a contingency landing action that would be exercised if there were critical assets on South VAFB that would not permit an over-flight of the First Stage or if other reasons (*e.g.* fuel constraints) prevented a landing at SLC–4W. The contingency action is to land the First Stage on a barge in the Pacific Ocean at a landing location 31 miles (50 km) offshore of VAFB (see Figure 1–5 in SpaceX's IHA application for the proposed location of the contingency landing location). Thus the waters of the Pacific Ocean between VAFB and the area approximately 50 km offshore shown in Figure 1–5 in SpaceX's IHA application are also considered part of the project area for the purposes of this proposed authorization.

The NCI are four islands (San Miguel, Santa Rosa, Santa Cruz, and Anacapa) located approximately 50 km (31 mi) south of Point Conception, which is located on the mainland approximately 6.5 km south of the southern border of VAFB (see Figure 2–1 and 2–2 in the IHA application). All four islands are inhabited by pinnipeds, with San Miguel Island being the most actively used among the four islands for pinniped rookeries. All four islands in the NCI are part of the Channel Islands National Park, while the Channel Islands National Marine Sanctuary encompasses the waters 11 km off the islands. The closest part of the NCI (Harris Point on San Miguel Island) is located more than 55 km south-southeast of SLC–4E, the launch facility for the Falcon 9 rocket. Pinnipeds hauled out on beaches of the NCI may be affected by sonic booms associated with the proposed action, as described later in this document.

Detailed Description of Activities

The Falcon 9 is a two-stage rocket designed and manufactured by SpaceX for transport of satellites and SpaceX's Dragon spacecraft into orbit. The First Stage of the Falcon 9 is designed to be reusable, while the second stage is not reusable. The proposed action includes up to six Falcon 9 First Stage recoveries, including in-air boost-back maneuvers and landings of the First Stage, at VAFB and/or at a contingency landing location 50 km offshore over the course of one year.

Boost-back and Landing Maneuvers

After launch of the Falcon 9, the boost-back and landing sequence begins when the rocket's First Stage separates from the second stage and the Merlin engines of the First Stage cut off. After First Stage engine cutoff, rather than dropping the First Stage in the Pacific Ocean, exoatmospheric cold gas thrusters would be triggered to flip the First Stage into position for retrograde burn. The First Stage would then descend back toward earth. During descent, a sonic boom would be generated when the First Stage reaches a rate of travel that exceeds the speed of sound. Sound from the sonic boom would have the potential to result in harassment of marine mammals, as described below. The sonic boom's overpressure would be directed at either the coastal area south of SLC–4 or at the ocean surface no less than 50 km off the coast of VAFB, depending on the targeted landing location. Three of the nine First Stage Merlin engines would be restarted to conduct the retrograde burn in order to reduce the velocity of the First Stage in the correct angle to land. Once the First Stage is in position and approaching its landing target, the three engines would be cut off to end the boost-back burn. The First Stage would then perform a controlled descent using atmospheric resistance to slow the stage down and guide it to the landing site. The landing legs on the First Stage would then deploy in preparation for a final single engine burn that would slow the First Stage to a velocity of zero before landing. Please see Figure 1–3 in the IHA application for a graphical depiction of the boost-back and landing sequence, and see Figure 1–4 in the IHA application for an example of the boost-back trajectory of the First Stage and the second stage trajectory.

Contingency Landing Procedure

As a contingency action to landing the Falcon 9 First Stage on the SLC–4W landing pad at VAFB, SpaceX proposes to return the Falcon 9 First Stage booster to a barge. The barge is specifically designed to be used as a First Stage landing platform and will be located at least 50 km off VAFB's shore (See Figure 1–5 in the IHA application). The contingency landing location would be used if conditions prevented a landing at SLC–4W, as described above. The maneuvering and landing process described above for a pad landing would be the same for a barge landing. Three vessels would be required to support a barge landing, if it were required: A barge/landing platform (300 ft long and 150 ft wide); a support vessel (165 ft long research vessel); and an ocean tug (120 ft long open water commercial tug). In the event of an unsuccessful barge landing, the First Stage would explode upon impact with the barge; the explosion would not be expected to result in take of marine mammals, as described below. The explosive equivalence with maximum fuel and oxidizer is 503 pounds of trinitrotoluene (TNT) which is capable of a maximum projectile range of 384 m (1,250 ft) from the point of impact. Approximately 25 pieces of debris are expected to remain floating in the water and expected to impact less than 0.46 km^2 (114 acres), and the majority of debris would be recovered. All other debris is expected to sink. These 25 pieces of debris are primarily made of Carbon Over Pressure Vessels (COPVs), the LOX fill line, and carbon fiber constructed legs. During previous landing attempts in other locations, SpaceX has performed successful debris recovery. All of the recovered debris would be transported back to Long Beach Harbor for proper disposal. Most of the fuel (estimated 50–150 gallons) is expected to be released onto the barge deck at the location of impact.

In the event that a contingency landing action is required, SpaceX has considered the likelihood of the First Stage missing the barge and landing instead in the Pacific Ocean, and has determined that the likelihood of such an event is so unlikely as to be considered discountable. This is supported by three previous attempts by SpaceX at Falcon 9 First Stage barge landings, none of which have missed the barge. Therefore, NMFS does not propose to authorize take of marine mammals incidental to landings of the Falcon 9 First Stage in the Pacific Ocean, and the potential effects of landings of the Falcon 9 First Stage in the Pacific Ocean on marine mammals are not considered further in this proposed authorization.

NMFS has previously issued regulations and Letters of Authorization (LOA) that authorize the take of marine mammals, by Level B harassment, incidental to launches of up to 50 rockets per year (including the Falcon 9) from VAFB (79 FR 10016). The regulations, titled ''*Taking of Marine Mammals Incidental to U.S. Air Force Launches, Aircraft and Helicopter Operations, and Harbor Activities Related to Vehicles from Vandenberg Air Force Base, California,*'' published February 24, 2014, are effective from March 2014 to March 2019. The activities proposed by SpaceX are limited to Falcon 9 First Stage recovery events (Falcon 9 boost-back maneuvers and landings); launches of the Falcon 9 rocket are not part of the proposed activities, and incidental take (Level B harassment) resulting from Falcon 9 rocket launches from VAFB is already authorized in the above referenced LOA. As such, NMFS does not propose to authorize take of marine mammals incidental to launches of the Falcon 9 rocket; incidental take resulting from Falcon 9 rocket launches is therefore not analyzed further in this document. The LOA application (USAF 2013a), and links to the **Federal Register** notice of the final rule (79 FR 10016) and the **Federal Register** notice of issuance of the LOA (79 FR 18528), can be found on the NMFS Web site at: *http://www.nmfs.noaa.gov/pr/permits/incidental.*

Description of Marine Mammals in the Area of the Specified Activity

There are six marine mammal species with expected occurrence in the project area (including at VAFB, on the NCI, and in the waters surrounding VAFB, the NCI and the contingency landing location) that are expected to be affected by the specified activities. These include the Steller sea lion (*Eumetopias jubatus*), northern fur seal (*Callorhinus ursinus*), northern elephant seal (*Mirounga angustirostris*), Guadalupe fur seal (*Arctocephalus townsendi*), California sea lion (*Zalophus californianus*), and Pacific harbor seal (*Phoca vitulina richardsi*). There are an additional 28 species of cetaceans with expected or possible occurrence in the project area. However, despite the fact that the ranges of these cetacean species overlap spatially with SpaceX's proposed activities, we have determined that none of the potential stressors associated with the proposed activities (including exposure to debris strike, rocket fuel, and visual and acoustic stimuli, as described further in ''Potential Effects of the Specified Activity on Marine Mammals'') are likely to result in take of cetaceans. As we have concluded that the likelihood of a cetacean being taken incidentally as a result of SpaceX's proposed activities is so low as to be discountable, cetaceans are not considered further in this proposed authorization. Please see Table 3–1 in the IHA application for a complete list of species with expected or potential occurrence in the project area.

We have reviewed SpaceX's detailed species descriptions, including abundance, status, distribution and life history information, for accuracy and completeness; this information is summarized below and may be viewed in detail in the IHA application, available on the NMFS Web site at *http://www.nmfs.noaa.gov/pr/permits/incidental.* Additional information on these species is available in the NMFS stock assessment reports (SARs), which can be viewed online at *http://www.nmfs.noaa.gov/pr/sars/.* Generalized species accounts are also available on NMFS' Web site at *www.nmfs.noaa.gov/pr/species/mammals.*

Table 1 lists the marine mammal species with expected potential for occurrence in the vicinity of the project during the project timeframe that are likely to be affected by the specified activities, and summarizes key information regarding stock status and abundance. Please see NMFS' Stock Assessment Reports (SAR), available at *www.nmfs.noaa.gov/pr/sars,* for more detailed accounts of these stocks' status and abundance.

TABLE 1—MARINE MAMMALS EXPECTED TO BE PRESENT IN THE VICINITY OF THE PROJECT LOCATION THAT ARE LIKELY TO BE AFFECTED BY THE SPECIFIED ACTIVITIES

Species	Stock	ESA Status/MMPA Status; strategic (Y/N)[1]	Stock abundance[2]	Occurrence in project area
Order Carnivora—Superfamily Pinnipedia				
Family Otariidae (eared seals and sea lions)				
Steller sea lion	Eastern U.S. DPS	–/D; Y	60,131	Rare.
California sea lion	U.S. stock	–/–; N	296,750	Common.
Family Phocidae (earless seals)				
Harbor seal	California stock	–/–; N	30,968	Common.
Northern elephant seal	California breeding stock	–/–; N	179,000	Common.
Northern fur seal	California stock	–/–; N	12,844	Common.
Guadalupe fur seal	n/a	T/D; Y	[3] 7,408	Rare.

[1] ESA status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). A dash (–) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR or is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.

[2] For certain stocks of pinnipeds, abundance estimates are based upon observations of animals (often pups) ashore multiplied by some correction factor derived from knowledge of the species (or similar species) life history to arrive at a best abundance estimate.

[3] Abundance estimate for this stock is greater than ten years old and is therefore not considered current. We nevertheless present the most recent abundance estimate, as this represents the best available information for use in this document.

In the species accounts provided here, we offer a brief introduction to the species and relevant stock as well as available information regarding population trends and threats, and describe any information regarding local occurrence.

Pacific Harbor Seal

Pacific harbor seals are the most common marine mammal inhabiting VAFB, congregating on multiple rocky haulout sites along the VAFB coastline. Harbor seals are local to the area, rarely traveling more than 50 km from haul-out sites. There are 12 harbor seal haul-out sites on south VAFB; of these, 10 sites represent an almost continuous haul-out area which is used by the same animals. Virtually all of the haul-out sites at VAFB are used during low tides and are wave-washed or submerged during high tides. Additionally, the Pacific harbor seal is the only species that regularly hauls out near the VAFB harbor. The main harbor seal haul-outs on VAFB are near Purisima Point and at Lion's Head (approximately 0.6 km south of Point Sal) on north VAFB and between the VAFB harbor north to South Rocky Point Beach on south VAFB (ManTech 2009). This south VAFB haul-out area is composed of several sand and cobblestone coves, rocky ledges, and offshore rocks. The Rocky Point area, located approximately 1.6 km north of the VAFB harbor, is used as breeding habitat (ManTech 2009).

Pups are generally present in the region from March through July. Within the affected area on VAFB, a total of up to 332 adults and 34 pups have been recorded, at all haulouts combined, in monthly counts from 2013 to 2015 (ManTech 2015). During aerial pinniped surveys of haulouts located in the Point Conception area by NOAA Fisheries in May 2002 and May and June of 2004, between 488 to 516 harbor seals were recorded (M. Lowry, NOAA Fisheries, unpubl. data). Harbor seals also haul out, breed, and pup in isolated beaches and coves throughout the coasts of San Miguel, Santa Rosa, and Santa Cruz Islands (Lowry 2002). During aerial surveys conducted by NOAA Fisheries in May 2002 and May and June of 2004, between 521 and 1,004 harbors seals were recorded at San Miguel Island, between 605 and 972 at Santa Rosa Island, and between 599 and 1,102 Santa Cruz Island (M. Lowry, NOAA Fisheries, unpubl. data).

The harbor seal population at VAFB has undergone an apparent decline in recent years (USAF 2013). This decline has been attributed to a series of natural landslides at south VAFB, resulting in the abandonment of many haulout sites. These slides have also resulted in extensive down-current sediment deposition, making these sites accessible to coyotes, which are now regularly seen in the area. Some of the displaced seals have moved to other sites at south VAFB, while others likely have moved to Point Conception, about 6.5 km south of the southern boundary of VAFB.

Pacific harbor seals frequently use haul-out sites on the NCI, including San Miguel, Santa Rosa, Santa Cruz; and Anacapa. On San Miguel Island, they occur along the north coast at Tyler Bight and from Crook Point to Cardwell Point. Additionally, they regularly breed on San Miguel Island. On Santa Cruz Island, they inhabit small coves and rocky ledges along much of the coast. Harbor seals are scattered throughout Santa Rosa Island and also are observed in small numbers on Anacapa Island.

California Sea Lions

California sea lions are not listed as threatened or endangered under the Endangered Species Act, nor are they categorized as depleted under the

Marine Mammal Protection Act. The estimated population of the U.S. stock is approximately 296,750 (Carretta *et al.* 2015). California sea lion breeding areas are on islands located in southern California, in western Baja California (Mexico), and the Gulf of California. During the breeding season, most California sea lions inhabit southern California and Mexico. Rookery sites in southern California are limited to the San Miguel Islands and the southerly Channel Islands of San Nicolas, Santa Barbara, and San Clemente (Carretta *et al.,* 2015). Males establish breeding territories during May through July on both land and in the water. Females come ashore in mid-May and June where they give birth to a single pup approximately four to five days after arrival and will nurse pups for about a week before going on their first feeding trip. Adult and juvenile males will migrate as far north as British Columbia, Canada while females and pups remain in southern California waters in the non-breeding season. In warm water (El Niño) years, some females are found as far north as Washington and Oregon, presumably following prey. Elevated strandings of California sea lion pups have occurred in Southern California since January 2013. This event has been declared an Unusual Mortality Event (UME), and is confined to pup and yearling California sea lions.

California sea lions are common offshore of VAFB and haul out on rocks and beaches along the coastline of VAFB. At south VAFB, California sea lions haul out on north Rocky Point, with numbers often peaking in spring. They have been reported at Point Arguello and Point Pedernales (both on south VAFB) in the past, although none have been noted there over the past several years. Individual sea lions have been noted hauled out throughout the VAFB coast; these were transient or stranded specimens. California sea lions occasionally haul out on Point Conception itself, south of VAFB. They regularly haul out on Lion Rock, north of VAFB and immediately south of Point Sal. In 2014, counts of California sea lions at haulouts on VAFB increased substantially, ranging from 47 to 416 during monthly counts. Despite their prevalence at haulout sites at VAFB, California sea lions rarely pup on the VAFB coastline (ManTech 2015); no pups were observed in 2013 or 2014 (ManTech 2015) and 1 pup was observed in 2015 (VAFB, unpubl. data).

Pupping occurs in large numbers on San Miguel Island at the rookeries found at Point Bennett on the west end of the island and at Cardwell Point on the east end of the island (Lowry 2002). Sea lions haul out at the west end of Santa Rosa Island at Ford Point and Carrington Point. A few California sea lions have been born on Santa Rosa Island, but no rookery has been established. On Santa Cruz Island, California sea lions haul out from Painted Cave almost to Fraser Point, on the west end. Fair numbers haul out at Gull Island, off the south shore near Punta Arena. Pupping appears to be increasing there. Sea lions also haul out near Potato Harbor, on the northeast end of Santa Cruz. California sea lions haul out by the hundreds on the south side of East Anacapa Island.

During aerial surveys conducted by NOAA Fisheries in February 2010 of the Northern Channel Islands, 21,192 total California sea lions (14,802 pups) were observed at haulouts on San Miguel Island and 8,237 total (5,712 pups) at Santa Rosa Island (M. Lowry, NOAA Fisheries, unpubl. data). During aerial surveys in July 2012, 65,660 total California sea lions (28,289 pups) were recorded at haulouts on San Miguel Island, 1,584 total (3 pups) at Santa Rosa Island, and 1,571 total (zero pups) at Santa Cruz Island (M. Lowry, NOAA Fisheries, unpubl. data).

Northern Elephant Seal

Northern elephant seals are not listed as threatened or endangered under the Endangered Species Act, nor are they categorized as depleted under the Marine Mammal Protection Act. The estimated population of the California breeding stock is approximately 179,000 animals (Carretta et al. 2015). Northern elephant seals range in the eastern and central North Pacific Ocean, from as far north as Alaska and as far south as Mexico. They spend much of the year, generally about nine months, in the ocean. They spend much of their lives underwater, diving to depths of about 1,000 to 2,500 ft (330–800 m) for 20- to 30-minute intervals with only short breaks at the surface, and are rarely seen at sea for this reason. While on land, they prefer sandy beaches.

Northern elephant seals breed and give birth in California and Baja California (Mexico), primarily on offshore islands, from December to March (Stewart et al. 1994). Adults return to land between March and August to molt, with males returning later than females. Adults return to their feeding areas again between their spring/summer molting and their winter breeding seasons.

Northern elephant seals haul out sporadically on rocks and beaches along the coastline of VAFB; monthly counts in 2013 and 2014 recorded between 0 and 191 elephant seals within the affected area (ManTech 2015). However, northern elephant seals do not currently pup on the VAFB coastline. Observations of young of the year seals from May through November at VAFB have represented individuals dispersing later in the year from other parts of the California coastline where breeding and birthing occur. The nearest regularly used haul-out site on the mainland coast is at Point Conception. Eleven northern elephant seals were observed during aerial surveys of the Point Conception area by NOAA Fisheries in February of 2010 (M. Lowry, NOAA Fisheries, unpubl. data). In December 2012, an immature male elephant seal was observed hauled out on the sandy beach west of the breakwater at the VAFB harbor (representing the first documented instance of an elephant seal hauled out at the VAFB harbor). There has been no verified breeding of northern elephant seals on VAFB.

Point Bennett on the west end of San Miguel Island is the primary northern elephant seal rookery in the NCI, with another rookery at Cardwell Point on the east end of San Miguel Island (Lowry 2002). They also pup and breed on Santa Rosa Island, mostly on the west end. Northern elephant seals are rarely seen on Santa Cruz and Anacapa Islands. During aerial surveys of the NCI conducted by NMFS in February 2010, 21,192 total northern elephant seals (14,802 pups) were recorded at haulouts on San Miguel Island and 8,237 total (5,712 pups) were observed at Santa Rosa Island (M. Lowry, NOAA Fisheries, unpubl. data). None were observed at Santa Cruz Island (M. Lowry, NOAA Fisheries, unpubl. data).

Steller Sea Lion

The eastern DPS of Steller sea lion is not listed as endangered or threatened under the ESA, nor is it categorized as depleted under the MMPA. The species as a whole was ESA-listed as threatened in 1990 (55 FR 49204). In 1997, the species was divided into western and eastern DPSs, with the western DPS reclassified as endangered under the ESA and the eastern DPS retaining its threatened listing (62 FR 24345). On October 23, 2013, NMFS found that the eastern DPS has recovered; as a result of the finding, NMFS removed the eastern DPS from ESA listing. Only the eastern DPS is considered in this proposed authorization due to its distribution and the geographic scope of the action. Steller sea lions are distributed mainly around the coasts to the outer continental shelf along the North Pacific rim from northern Hokkaido, Japan through the Kuril Islands and Okhotsk Sea, Aleutian Islands and central Bering

Sea, southern coast of Alaska and south to California (Loughlin *et al.,* 1984).

Prior to 2012, there were no records of Steller sea lions observed at VAFB. In April and May 2012, Steller sea lions were observed hauled out at North Rocky Point on VAFB, representing the first time the species had been observed on VAFB during launch monitoring and monthly surveys conducted over the past two decades (Marine Mammal Consulting Group and Science Applications International Corporation 2013). Since 2012, Steller sea lions have been observed frequently in routine monthly surveys, with as many as 16 individuals recorded. In 2014, up to five Steller sea lions were observed in the affected area during monthly marine mammal counts (ManTech 2015) and a maximum of 12 individuals were observed during monthly counts in 2015 (VAFB, unpublished data). However, up to 16 individuals were observed in 2012 (SAIC 2012). Steller sea lions once had two small rookeries on San Miguel Island, but these were abandoned after the 1982–1983 El Niño event (DeLong and Melin 2000; Lowry 2002); these rookeries were once the southernmost colonies of the eastern stock of this species. In recent years, between two to four juvenile and adult males have been observed on a somewhat regular basis on San Miguel Island (pers. comm. Sharon Melin, NMFS Alaska Fisheries Science Center, to J. Carduner, NMFS, Feb 11, 2016). Steller sea lions are not observed on the other NCI.

Northern Fur Seal

Northern fur seals are not ESA listed and are not categorized as depleted under the MMPA. Northern fur seals occur from southern California north to the Bering Sea and west to the Okhotsk Sea and Honshu Island, Japan. Two stocks of northern fur seals are recognized in U.S. waters: An eastern Pacific stock and a California stock (formerly referred to as the San Miguel Island stock). Only the California stock is considered in this proposed authorization due to its geographic distribution.

Due to differing requirements during the annual reproductive season, adult males and females typically occur ashore at different, though overlapping, times. Adult males occur ashore and defend reproductive territories during a 3-month period from June through August, though some may be present until November (well after giving up their territories). Adult females are found ashore for as long as 6 months (June-November). After their respective times ashore, fur seals of both sexes spend the next 7 to 8 months at sea (Roppel 1984). Peak pupping is in early July and pups are weaned at three to four months. Some juveniles are present year-round, but most juveniles and adults head for the open ocean and a pelagic existence until the next year. Northern fur seals exhibit high site fidelity to their natal rookeries.

Northern fur seals have rookeries on San Miguel Island at Point Bennett and on Castle Rock. Comprehensive count data for northern fur seals on San Miguel Island are not available. San Miguel Island is the only island in the NCI on which Northern fur seals have been observed. Although the population at San Miguel Island was established by individuals from Alaska and Russian Islands during the late 1960s, most individuals currently found on San Miguel nowadays are considered resident to the island. No haul-out or rookery sites exist for northern fur seals on the mainland coast. The only individuals that do appear on mainland beaches are stranded animals.

Guadalupe Fur Seal

Guadalupe fur seals are listed as threatened under the ESA and are categorized as depleted under the MMPA. The population is estimated at 7,408 animals; however, this estimate is over 20 years old (Carretta *et al.* 2015). The population is considered to be a single stock. Guadalupe Fur Seals were abundant prior to seal exploitation, when they were likely the most abundant pinniped species on the Channel Islands. They are found along the west coast of the United States, but are considered uncommon in Southern California. They are typically found on shores with abundant large rocks, often at the base of large cliffs (Belcher and Lee 2002). Increased strandings of Guadalupe fur seals started occurring along the entire coast of California in early 2015. Strandings were eight times higher than the historical average, peaking from April through June 2015, and have since lessened. This event has been declared a marine mammal UME.

Comprehensive survey data on Guadalupe fur seals in the NCI is not readily available. On San Miguel Island, one to several male Guadalupe fur seals had been observed annually between 1969 and 2000 (DeLong and Melin 2000) and juvenile animals of both sexes have been seen occasionally over the years (Stewart *et al.* 1987). The first adult female at San Miguel Island was seen in 1997. In June 1997, she gave birth to a pup in rocky habitat along the south side of the island and, over the next year, reared the pup to weaning age. This was apparently the first pup born in the California Channel Islands in at least 150 years. Since 2008, individual adult females, subadult males, and between one and three pups have been observed annually on San Miguel Island. There are estimated to be approximately 20–25 individuals that have fidelity to San Miguel, mostly inhabiting the southwest and northwest ends of the island. A total of 14 pups have been born on the island since 2009, with no more than 3 born in any single season (pers. comm., S. Melin, NMFS National Marine Mammal Laboratory, to J. Carduner, NMFS, Aug. 28, 2015). Thirteen individuals and two pups were observed in 2015 (NMFS 2016). No haul-out or rookery sites exist for Guadalupe fur seals on the mainland coast, including VAFB. The only individuals that do appear on mainland beaches are stranded animals.

Potential Effects of the Specified Activity on Marine Mammals

This section includes a summary and discussion of the ways that components of the specified activity may impact marine mammals. The ''Estimated Take by Incidental Harassment'' section later in this document will include a quantitative analysis of the number of individuals that are expected to be taken by this activity. The ''Negligible Impact Analysis'' section will include the analysis of how this specific activity will impact marine mammals and will consider the content of this section, the ''Estimated Take by Incidental Harassment'' section, the ''Proposed Mitigation'' section, and the ''Anticipated Effects on Marine Mammal Habitat'' section to draw conclusions regarding the likely impacts of this activity on the reproductive success or survivorship of individuals and from that on the affected marine mammal populations or stocks.

Debris Strike

Under the contingency barge landing action, in the event of an unsuccessful barge landing, the First Stage booster is expected to explode upon impact with the barge. The maximum estimated remaining fuel and oxidizer onboard the booster when it explodes would be the equivalent a net explosive weight of 503 lbs. of TNT. The resulting explosion of the estimated onboard remaining fuel would be capable of scattering debris a maximum estimated range of approximately 384 m from the landing point and thus spread over a radial area of 0.46 km^2 as an impact area (ManTech 2015). Based on engineering analysis collected during a flight anomaly that occurred during a Falcon 9 test at SpaceX's Texas Rocket Development Facility, debris could impact 0.000706 km² of the total 0.46 km² impact area. Debris impacting an individual marine mammal, though highly unlikely as discussed below, would have the potential to cause injury and potential mortality.

Using a statistical probability analysis for estimating direct air strike impact developed by the U.S. Navy (Navy 2014), the probability of impact of debris with a marine mammal (*P*) can be estimated for individual marine mammals of each species that may occur in the impact footprint area (*I*) (0.000706 km²). For this analysis, SpaceX assumed a dynamic scenario with broadside collision, in which the width of the impact footprint is enhanced by a factor of five (5) to reflect forward momentum created by an explosion (Navy 2014). Forward momentum typically accounts for five object lengths, thus the applied factor of five (5) area (Navy 2014).

The probability of impact with a single animal (*P*) is calculated as the likelihood that an animal footprint area (*A,* defined as the adult length [L_a] and width [W_a] for each species) intersects the impact footprint area (*I*) within the overall ''testing area'' (*R*). Note that to calculate (*P*) it is assumed that the animal is in the testing area and is at or near the ocean surface, thus the model is overly conservative since cetaceans spend the majority of time submerged. For the purposes of this model, *R* was estimated as the maximum range of debris spread as a result of the First Stage explosion at the landing location (0.46 km²). The probability impact with a single animal (*P*) depends on the degree of overlap of *A* and *I.* To calculate this area of overlap (A_{tot}), a buffer distance is added around *A* that is equal to one-half of the impact area (0.5*I). This buffer accounts for an impact with the center of the object anywhere within the combined area of overlap (A_{tot}) would result in an impact with the animal. A_{tot} is then calculated as $(L_a + 2*W_i)*(W_a + (1 + 5)*L_i)$, where W_i and L_i are the length and width of the impact area (*I*). We assumed that $W_a = W_i$ = square root of *I.* The single animal impact probability (*P*) for each species is then calculated as the ratio of total area (A_{tot}) to testing area (*R*): $P = A_{tot}/R$. This single animal impact probability (*P*) is then multiplied by the number of animals expected in the testing area (*N* = density * *R*) to estimate the probability of impacting an individual for each species per event (*T*).

SpaceX proposes to conduct up to six contingency offshore landings per year, which may result in between zero and six explosions of the First Stage annually (as recovery actions continue, SpaceX expects to assess each incident, refine methodology and ultimately reduce the risk or explosion for the purpose of First Stage recovery and re-use). In the model presented in the IHA application, SpaceX assumed that the maximum of six events per year would result in an explosion. This is a conservative estimate, since the actual number of contingency landing events resulting in the First Stage explosion may be less than six. In addition, the model conservatively utilized the highest estimated at-sea individual densities for each species within the geographic area of potential impact. Please see Table 6–1 of the IHA application for results of the debris strike analysis.

Even with the intentionally conservative estimates of parameters and assumptions in the model as described above, the results indicate that it is highly unlikely that debris would strike any individual of any marine mammal species, including cetaceans and pinnipeds. For all 34 marine mammal species that occur in the project area, including pinnipeds and cetaceans, the maximum probability of debris strike, for a single debris impact event, was 0.0222 for California sea lion (see Table 6–1 in the IHA application). The modeled probabilities are sufficiently low as to be considered discountable. Therefore, we have concluded that the likelihood of take of marine mammals from debris strike following the explosion of the Falcon 9 First Stage is negligible. As such, debris strike is not analyzed further in this proposed authorization as a potential stressor to marine mammals.

Floating Debris

As described above, in the event of an unsuccessful landing attempt at the contingency landing location, the Falcon 9 First Stage would explode upon impact with the barge. SpaceX has experience performing recovery operations after water and unsuccessful barge landings for previous Falcon 9 First Stage landing attempts. This experience, in addition to the debris catalog that identifies all floating debris, has revealed that approximately 25 pieces of debris remain floating after an unsuccessful barge landing. The surface area potentially impacted with debris would be less than 0.46 km², and the vast majority of debris would be recovered. All other debris is expected to sink to the bottom of the ocean.

The approximately 25 pieces of debris expected to be floating after an unsuccessful barge landing are primarily made up of Carbon Over Pressure Vessels (COPVs), the LOX fill line, and carbon fiber constructed landing legs. SpaceX has performed successful recovery of all of these floating items during previous landing attempts. An unsuccessful barge landing would result in a very small debris field, making recovery of debris relatively straightforward and efficient. All debris recovered offshore would be transported back to Long Beach Harbor.

Since the area impacted by debris is very small, the likelihood of adverse effects to marine mammals is very low. Denser debris that would not float on the surface is anticipated to sink relatively quickly and is composed of inert materials which would not affect water quality or bottom substrate potentially used by marine mammals. The rate of deposition would vary with the type of debris; however, none of the debris is so dense or large that benthic habitat would be degraded. Also, the area that would be impacted per event by sinking debris is only a maximum of 0.17 acres (0.000706 km²), a relatively small portion of the total 0.46 km² potential impact area, based on a maximum range of 384 m that a piece of debris would travel following an explosion.

We have determined that the likelihood of debris from an unsuccessful barge landing that enters the ocean environment approximately 50 km offshore of VAFB resulting in the incidental take of a marine mammal to be so small as to be discountable. Therefore the potential effects of floating debris on marine mammals as a result of the proposed activities are not considered further in this proposed authorization.

Spilled Rocket Propellant

As described above, in the event of an unsuccessful landing attempt at the contingency landing location, the Falcon 9 First Stage would explode upon impact with the barge. At most, the First Stage would contain 400 gallons of rocket propellant (RP–1 or ''fuel'') on board. In the event of an unsuccessful barge landing, most of this fuel would be consumed during the subsequent explosion. Residual fuel after the explosion (estimated to be between 50 and 150 gallons) would be released into the ocean. Final volumes of fuel remaining in the First Stage upon impact may vary, but are anticipated to be below this high range estimate. The fuel used by the First Stage, RP–1, is a Type 1 ''Very Light Oil'', which is characterized as having low viscosity, low specific gravity, and is highly volatile. Clean-up following a spill of very light oil is usually not possible, particularly with such a small quantity of oil that would enter the ocean in the event of an unsuccessful barge landing (U.S. Fish and Wildlife Service 1998). Therefore, SpaceX would not attempt to boom or recover RP–1 fuel from the ocean.

In relatively high concentrations, exposure to very light oils can have a range of effects to marine mammals including skin and eye irritation, increased susceptibility to infection, respiratory irritation, gastrointestinal inflammation, ulcers, bleeding, diarrhea, damage to organs, immune suppression, reproductive failure, and death. The effects of exposure primarily depend on the route (internal versus external) and amount (volume and time) of exposure. Although the U.S. Environmental Protection Agency has established exposure levels for kerosene and jet fuel (RP–1 is a type of kerosene) for toxicity in mammals and the environment (U.S. Environmental Protection Agency 2011), in reality it is difficult to predict exposure levels, even with a known amount of fuel released. This is because exposure level is dependent not only on the amount of fuel in the spill area, but also on unpredictable factors, including the behavior of the animal and the amount of fuel it contacts, ingests, or inhales.

However, precluding these factors is the overall risk of a marine mammal being within the fuel spill area before the RP–1 dissipates. This risk depends primarily on how quickly RP–1 dissipates in the environment and the area affected by the spill. Since RP–1 is lighter than water and almost completely immiscible (*i.e.* very little will dissolve into the water column), RP–1 would stay on top of the water's surface. Due to its low viscosity, it would rapidly spread into a very thin layer (several hundred nanometers) on the surface of water and would continue to spread as a function of sea surface, wind, current, and wave conditions. This spreading rapidly reduces the concentration of RP–1 on the water surface at any one location and exposes more surface area of the fuel to the atmosphere, thus increasing the amount of RP–1 that is able to evaporate.

RP–1 is highly volatile and evaporates rapidly when exposed to the air (U.S. Fish and Wildlife Service 1998). The evaporation rate for jet fuel (a kerosene similar to RP–1) on water, can be determined by the following equation from Fingas (2013): $\%EV = (0.59 + 0.13T)/t$, where $\%EV$ is the percent of mass evaporated within a given time in minutes (t) at a given temperature in °C (T). Using an assumed air temperature of 50 °F (10 °C), the percent of mass evaporated versus time can be determined (see Figure 14 in the IHA application). Although it would require one to two days for the RP–1 to completely dissipate, over 90 percent of its mass would evaporate within the first seven minutes and 99 percent of its mass would evaporate within the first hour (see Figure 14 in the IHA application). In the event of adverse ocean conditions (*e.g.,* large swells, large waves) and weather conditions (*e.g.,* fog, rain, high winds) RP-1 would be volatilized more rapidly due to increased agitation and thus dissipate even more quickly and further reduce the likelihood of exposure.

Since RP–1 would remain on the surface of the water, in order for a marine mammal to be directly exposed to RP–1, it would have to surface within the spill area very soon after the spill occurred (on the order of minutes). Given the relatively small volume of RP–1 that would be spilled (50 to 150 gallons), the exposure area would be relatively small and thus it would be unlikely that a marine mammal would be within the exposure area. Based on the thinness of the layer of RP–1 on the water surface, spreading on the surface (thus rapidly reducing concentration), and rapid evaporation (further reducing concentration), a marine mammal would need to be at the surface within the layer of RP–1 and be exposed to a toxic level within a very short period of time (minutes) after the spill to be affected. Similarly, since RP–1 would be a very thin, rapidly evaporating layer on the water's surface, we do not expect that fish or other prey species would be negatively impacted to any significant degree.

We therefore have determined that the likelihood that spilled RP–1, as a result of an unsuccessful barge landing that enters the ocean environment approximately 50 km from shore, would have an effect on marine mammal species is so low as to be discountable. Therefore the potential effects of spilled rocket propellant are not considered further in this proposed authorization.

Visual Stimuli

Visual disturbances resulting from Falcon 9 First Stage landings have the potential to cause pinnipeds to lift their heads, move towards the water, or enter the water. Pinnipeds hauled out at VAFB would potentially be able to see the Falcon 9 First Stage landing at SLC–4W. However, SpaceX has determined that the trajectory of the return flight includes a nearly vertical descent to the SLC–4W landing pad (see Figure 1–4 in the IHA application) and the contingency landing location (see Figure 1–5 in the IHA application). As a result, there would be no significant visual disturbance expected as the descending Falcon 9 First Stage would either be shielded by coastal bluffs (for a SLC–4W landing) or too far away to cause significant stimuli (in the case of a barge landing). Further, the visual stimulus of the Falcon 9 First Stage would not be coupled with the sonic boom, since the First Stage will be at significant altitude when the overpressure is produced (described further below), further decreasing the likelihood of a behavioral response. Therefore we have determined that the possibility of marine mammal harassment from visual stimuli associated with the proposed activities is so low as to be considered discountable. Therefore visual stimuli associated with the proposed activities are not considered further in this proposed authorization.

Acoustic Stimuli

In the following discussion, we provide general background information on sound and marine mammal hearing before considering potential effects to marine mammals from sound produced by the proposed activities.

Description of Sound Sources

Acoustic sources associated with SpaceX's proposed activities are expected to include: sonic booms; Falcon 9 First Stage landings; and potential explosions as a result of unsuccessful Falcon 9 First Stage landing attempts at the contingency landing location. Sounds produced by the proposed activities may be impulsive, due to sonic boom effects and possible explosions, and non-pulse (but short-duration) noise, due to combustion effects of the Falcon 9 First Stage.

Pulsed sound sources (*e.g.,* sonic booms, explosions, gunshots, impact pile driving) produce signals that are brief (typically considered to be less than one second), broadband, atonal transients (ANSI, 1986; Harris, 1998; NIOSH, 1998; ISO, 2003; ANSI, 2005) and occur either as isolated events or repeated in some succession. Pulsed sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features.

Non-pulsed sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or non-continuous (ANSI, 1995; NIOSH, 1998). Some of these non-pulsed sounds can be transient signals of short duration but without the essential properties of pulses (*e.g.,* rapid rise time). Examples of non-pulsed sounds include those produced by rocket launches and landings, vessels, aircraft, machinery operations such as drilling or dredging, and vibratory pile driving. The duration of such sounds, as received at a distance, can be greatly extended in a highly reverberant environment.

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in hertz (Hz) or cycles per second. Wavelength is the distance between two peaks of a sound wave; lower frequency sounds have longer wavelengths than higher frequency sounds and attenuate (decrease) more rapidly in shallower water. Amplitude is the height of the sound pressure wave or the 'loudness' of a sound and is typically measured using the decibel (dB) scale. A dB is the ratio between a measured pressure (with sound) and a reference pressure (sound at a constant pressure, established by scientific standards). It is a logarithmic unit that accounts for large variations in amplitude; therefore, relatively small changes in dB ratings correspond to large changes in sound pressure. When referring to sound pressure levels (SPLs; the sound force per unit area), sound is referenced in the context of underwater sound pressure to 1 microPascal (μPa). One pascal is the pressure resulting from a force of one newton exerted over an area of one square meter. The source level (SL) represents the sound level at a distance of 1 m from the source (referenced to 1 μPa). The received level is the sound level at the listener's position. Note that all underwater sound levels in this document are referenced to a pressure of 1 μPa and all airborne sound levels in this document are referenced to a pressure of 20 μPa.

Root mean square (rms) is the quadratic mean sound pressure over the duration of an impulse, and is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick, 1983). Rms accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper, 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals, and exposure to sound can have deleterious effects. To appropriately assess these potential effects, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.,* Richardson *et al.,* 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on measured or estimated hearing ranges on the basis of available behavioral data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. The lower and/or upper frequencies for some of these functional hearing groups have been modified from those designated by Southall *et al.* (2007). The functional groups and the associated frequencies are indicated below (note that these frequency ranges do not necessarily correspond to the range of best hearing, which varies by species):

- Low-frequency cetaceans (mysticetes): functional hearing is estimated to occur between approximately 7 Hz and 25 kHz (extended from 22 kHz; Watkins, 1986; Au *et al.,* 2006; Lucifredi and Stein, 2007; Ketten and Mountain, 2009; Tubelli *et al.,* 2012);
- Mid-frequency cetaceans (larger toothed whales, beaked whales, and most delphinids): Functional hearing is estimated to occur between approximately 150 Hz and 160 kHz;
- High-frequency cetaceans (porpoises, river dolphins, and members of the genera *Kogia* and *Cephalorhynchus;* now considered to include two members of the genus *Lagenorhynchus* on the basis of recent echolocation data and genetic data (May-Collado and Agnarsson, 2006; Kyhn *et al.* 2009, 2010; Tougaard *et al.* 2010): Functional hearing is estimated to occur between approximately 200 Hz and 180 kHz; and
- Pinnipeds: Functional hearing for pinnipeds underwater is estimated to occur between approximately 75 Hz to 100 kHz for Phocidae (true seals) and between 100 Hz and 48 kHz for Otariidae (eared seals), with the greatest sensitivity between approximately 700 Hz and 20 kHz. Functional hearing for pinnipeds in air is estimated to occur between 75 Hz and 30 kHz. The pinniped functional hearing group was modified from Southall *et al.* (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä *et al.,* 2006; Kastelein *et al.,* 2009; Reichmuth *et al.,* 2013).

Acoustic Effects on Marine Mammals

The effects of sounds from the proposed activities might result in one or more of the following: Temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, and masking (Richardson *et al.,* 1995; Gordon *et al.,* 2004; Nowacek *et al.,* 2007; Southall *et al.,* 2007). The effects of sounds on marine mammals are dependent on several factors, including the species, size, behavior (feeding, nursing, resting, etc.), and depth (if underwater) of the animal; the intensity and duration of the sound; and the sound propagation properties of the environment.

Impacts to marine species can result from physiological and behavioral responses to both the type and strength of the acoustic signature (Viada *et al.,* 2008). The type and severity of behavioral impacts are more difficult to define due to limited studies addressing the behavioral effects of sounds on marine mammals. Potential effects from impulsive sound sources can range in severity from effects such as behavioral disturbance or tactile perception to physical discomfort, slight injury of the internal organs and the auditory system, or mortality (Yelverton *et al.,* 1973).

Hearing Impairment and Other Physical Effects—Marine mammals exposed to high intensity sound repeatedly or for prolonged periods can experience hearing threshold shift (TS), which is the loss of hearing sensitivity at certain frequency ranges (Kastak *et al.,* 1999; Schlundt *et al.,* 2000; Finneran *et al.,* 2002, 2005). TS can be permanent (PTS), in which case the loss of hearing sensitivity is not recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall *et al.,* 2007). Marine mammals depend on acoustic cues for vital biological functions, (*e.g.,* orientation, communication, finding prey, avoiding predators); thus, TTS may result in reduced fitness in survival and reproduction. However, this depends on the frequency and duration of TTS, as well as the biological context in which it occurs. TTS of limited duration, occurring in a frequency range that does not coincide with that used for recognition of important acoustic cues, would have little to no effect on an animal's fitness. Repeated sound exposure that leads to TTS could cause PTS. PTS constitutes injury, but TTS does not (Southall *et al.,* 2007). The following subsections discuss TTS, PTS, and non-auditory physical effects in more detail.

Temporary Threshold Shift—TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises, and a sound must be stronger in order to be heard. In terrestrial mammals, TTS can last from minutes or hours to days (in cases of strong TTS). For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the sound ends. Available data on TTS in marine mammals are summarized in Southall *et al.* (2007).

Permanent Threshold Shift—When PTS occurs, there is physical damage to the sound receptors in the ear. In severe cases, there can be total or partial deafness, while in other cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985). There is no specific evidence that exposure to pulses of sound can cause PTS in any marine mammal. However, given the possibility that mammals close to a sound source might incur TTS, there has been further speculation about the possibility that some individuals might incur PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS.

Relationships between TTS and PTS thresholds have not been studied in marine mammals but are assumed to be similar to those in humans and other terrestrial mammals. PTS might occur at a received sound level at least several decibels above that inducing mild TTS if the animal were exposed to strong sound pulses with rapid rise time. Based on data from terrestrial mammals, a precautionary assumption is that the PTS threshold for impulse sounds is at least 6 dB higher than the TTS threshold on a peak-pressure basis and probably greater than 6 dB (Southall *et al.,* 2007). On an SEL basis, Southall *et al.* (2007) estimated that received levels would need to exceed the TTS threshold by at least 15 dB for there to be risk of PTS. Thus, for cetaceans, Southall *et al.* (2007) estimate that the PTS threshold might be an M-weighted SEL (for the sequence of received pulses) of approximately 198 dB re 1 μPa^2-s (15 dB higher than the TTS threshold for an impulse). Given the higher level of sound necessary to cause PTS as compared with TTS, it is considerably less likely that PTS could occur.

Captive bottlenose dolphins and beluga whales exhibited changes in behavior when exposed to strong pulsed sounds (Finneran *et al.,* 2000, 2002, 2005). The animals tolerated high received levels of sound before exhibiting aversive behaviors. Experiments on a beluga whale showed that exposure to a single watergun impulse at a received level of 207 kPa (30 psi) p-p, which is equivalent to 228 dB p-p, resulted in a 7 and 6 dB TTS in the beluga whale at 0.4 and 30 kHz, respectively. Thresholds returned to within 2 dB of the pre-exposure level within four minutes of the exposure (Finneran *et al.,* 2002). In order for marine mammals to experience TTS or PTS, the animals must be close enough to be exposed to high intensity sound levels for a prolonged period of time. The likelihood of PTS or TTS resulting from exposure to the proposed activities is considered discountable due to the short duration of the sounds generated by the proposed activities and the data available on marine mammal responses to the stressors associated with the proposed activities, which indicate that PTS and TTS are not likely (as described below).

Non-auditory Physiological Effects—Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to intense sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox *et al.,* 2006; Southall *et al.,* 2007). Studies examining such effects are limited and many of these impacts result from exposure to underwater sound and therefore are not relevant to the proposed activities. In general, little is known about the potential for sonic booms to cause non-auditory physical effects in marine mammals. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. The likelihood of non-auditory physiological effects resulting from exposure to the proposed activities is considered discountable due to data available on marine mammal responses to the stressors associated with the proposed activities (as described below).

Disturbance Reactions

Disturbance includes a variety of effects, including subtle changes in behavior, more conspicuous changes in activities, and displacement. Behavioral responses to sound are highly variable and context-specific and reactions, if any, depend on species, state of maturity, experience, current activity, reproductive state, auditory sensitivity, time of day, and many other factors (Richardson *et al.,* 1995; Wartzok *et al.,* 2003; Southall *et al.,* 2007).

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al.,* 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. Behavioral state may affect the type of response as well. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (Richardson *et al.,* 1995; NRC, 2003; Wartzok *et al.,* 2003).

Controlled experiments with captive marine mammals have shown pronounced behavioral reactions, including avoidance of loud underwater sound sources (Ridgway *et al.,* 1997; Finneran *et al.,* 2003). Observed responses of wild marine mammals to loud pulsed sound sources (typically seismic guns or acoustic harassment devices) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds, 2002; Thorson and Reyff, 2006; see also Gordon *et al.,* 2004; Wartzok *et al.,* 2003; Nowacek *et al.,* 2007).

The onset of noise can result in temporary, short term changes in an animal's typical behavior and/or avoidance of the affected area. These behavioral changes may include (Richardson *et al.,* 1995): Reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior; avoidance of areas where sound sources are located; and/or flight responses.

The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, the consequences of behavioral modification could potentially be biologically significant if the change affects growth, survival, or reproduction. The onset of behavioral disturbance from anthropogenic sound depends on both external factors (characteristics of sound sources and their paths) and the specific characteristics of the receiving animals (hearing, motivation, experience, demography) and is difficult to predict (Southall *et al.,* 2007).

Auditory Masking

Natural and artificial sounds can disrupt behavior by masking, or interfering with, a marine mammal's ability to hear other sounds. Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher levels. Chronic exposure to excessive, though not high-intensity, sound could cause masking at particular frequencies for marine mammals that utilize sound for vital biological functions. Masking can interfere with detection of acoustic signals such as communication calls, echolocation sounds, and environmental sounds important to marine mammals. Therefore, under certain circumstances, marine mammals whose acoustical sensors or environment are being severely masked could also be impaired from maximizing their performance fitness in survival and reproduction. If the coincident (masking) sound were man-made, it could be potentially harassing if it disrupted hearing-related behavior. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs during the sound exposure. Because masking (without resulting in TS) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect. The likelihood of masking resulting from exposure to sound from the proposed activities is considered discountable due to the short duration of the sounds generated by the proposed activities (as described below).

Acoustic Effects, Airborne

Marine mammals that occur in the project area could be exposed to airborne sounds associated with Falcon 9 First Stage recovery activities, including sonic booms, landing sounds, and potentially explosions, that have the potential to cause harassment, depending on the animal's distance from the sound. Airborne sound could potentially affect pinnipeds that are hauled out. Most likely, airborne sound would cause behavioral responses similar to those discussed above in relation to underwater sound. For instance, anthropogenic sound could cause hauled out pinnipeds to exhibit changes in their normal behavior, such as reduction in vocalizations, or cause them to temporarily abandon their habitat and move further from the source. Hauled out pinnipeds may flush into the water, which can potentially result in pup abandonment or trampling of pups. Studies by Blackwell *et al.* (2004) and Moulton *et al.* (2005) indicate a tolerance or lack of response to unweighted airborne sounds as high as 112 dB peak and 96 dB rms.

Acoustic Effects of the Proposed Activities

As described above, the sound sources associated with the proposed activities that have the potential to result in harassment of marine mammals include: Sonic booms; landing noise; and potential explosions associated with unsuccessful barge landing attempts. We describe each of these sources separately and in more detail below.

Explosion Resulting From Unsuccessful Barge Landing Attempt

In the event of an unsuccessful barge landing, the Falcon 9 First Stage would likely explode. Noise resulting from such an explosion would introduce impulsive sound into both the air and the water. This sound would be in the audible range of most marine mammals, even if the duration is expected to be very short (likely less than a second). The spacing of the landing attempts (no more than six over one year) would likely reduce the potential for long-term auditory masking. However, because of its intensity, the direct sound from an explosion has the potential to result in behavioral or physiological effects in marine mammals. The intensity of the explosion would likely vary depending on the amount of fuel remaining in the Falcon 9 First Stage, but for our analysis we assumed a worst-case scenario: That the largest possible amount of fuel would be left in the First Stage upon impact.

Noise resulting from an unsuccessful barge landing would be expected to generate an in-air impulsive sound pressure level up to 180 dB rms re 20μPa (ManTech 2015). NMFS's current acoustic criteria for in-air acoustic impacts assumes Level B harassment of non-harbor seal pinnipeds occurs at 100 dB rms re 20μPa, with Level B harassment of harbor seals occurring at 90 dB rms re 20μPa (Table 2). No threshold for Level A harassment for in-air noise has been established. To determine whether harassment of pinnipeds was likely to occur as a result of in-air noise from explosion of the Falcon 9 First Stage at the contingency landing location, SpaceX performed modeling to determine the distance at which the sound level from such an explosion would attenuate to 90 dB rms re 20μPa (the lowest NMFS threshold for pinniped harassment, as described above).

TABLE 2—NMFS CRITERIA FOR ACOUSTIC IMPACTS TO MARINE MAMMALS

Criterion	Criterion definition	Threshold
In-Water Acoustic Thresholds		
Level A	PTS (injury) conservatively based on TTS	190 dB_{rms} for pinnipeds 180 dB_{rms} for cetaceans.
Level B	Behavioral disruption for impulsive noise	160 dB_{rms}.
Level B	Behavioral disruption for non-pulse noise	120 dB_{rms}.
In-Air Acoustic Thresholds		
Level A	PTS (injury) conservatively based on TTS	None established.
Level B	Behavioral disruption for harbor seals	90 dB_{rms}.
Level B	Behavioral disruption for non-harbor seal pinnipeds	100 dB_{rms}.

The explosion would generate an in-air impulsive noise that would propagate in a radial fashion away from the barge. Based on the size of the anticipated explosion, Sadovsky equations were used to calculate peak received pressures (received levels are a function of charge weight and distance from source) at sound pressure contour lines. Since the sound pressure levels were peak levels, the approximate RMS values were estimated by converting peak to RMS (peak pressure value * 0.707). Then, these values were converted into dB re 20 µPa to determine distances to defined contour levels and in-air acoustic threshold levels for marine mammal harassment (see Figure 2–7 in the IHA application). To generate realistic sound pressure contour lines, atmospheric attenuation was included in the model. Calculations for atmospheric attenuation included the following assumptions: The explosion was assumed to be 250 hertz or less, relative humidity was assumed to be 30 percent and air temperature was assumed to be 50 °F (10 °C). This model does not take into account additional factors that would be expected to attenuate the blast wave further, including: Sea surface roughness, changes in atmospheric pressure, frontal systems, precipitation, clouds, and degradation when encountering other sound pressure waves. Thus, the area of exposure is likely to be conservative. Results indicated that an impulsive in-air noise resulting from a Falcon 9 First Stage explosion at the barge would attenuate to 90 dB rms re 20µPa at a radius of 26.5 km from the contingency landing location (ManTech 2015). There are no pinniped haulouts located within this area (See Figure 2–7 in the IHA application); therefore in-air noise generated by an explosion of the Falcon 9 First Stage during an unsuccessful barge landing would not result in Level B harassment of marine mammals.

Explosions near the water's surface can introduce loud, impulsive, broadband sounds into the marine environment. These sounds can potentially be within the audible range of most marine mammals, though the duration of individual sounds is very short. The direct sound from an explosion would last less than a second. Furthermore, events are dispersed in time, with maximum of six barge landing attempts occurring within the time period that the proposed IHA would be valid. If an explosion occurred on the barge, as in the case of an unsuccessful barge landing, some amount of the explosive energy would be transferred through the ship's structure and would enter the water and propagate away from the ship. There is very little published literature on the ratio of explosive energy that is absorbed by a ship's hull versus the amount of energy that is transferred through the ship into the water. However, based on the best available information, we have determined that exceptionally little of the acoustic energy from the explosion would transmit into the water (Yagla and Stiegler 2003). An explosion on the barge would create an in-air blast that propagates away in all directions, including toward the water's surface; however the barge's deck would act as a barrier that would attenuate the energy directed downward toward the water (Yagla and Stiegler 2003). Most sound enters the water in a narrow cone beneath the sound source (within 13 degrees of vertical). Since the explosion would occur on the barge, most of this sound would be reflected by the barge's surface, and sound waves would approach the water's surface at angles higher than 13 degrees, minimizing transmission into the ocean. An explosion on the barge would also send energy through the barge's structure, into the water, and away from the barge. This effect was investigated in conjunction with the measurements described in Yagla and Steigler (2003). The energy transmitted through a ship to the water for the firing of a typical 5-inch round was approximately six percent of that from the air blast impinging on the water (Yagla and Stiegler 2003). Therefore, sound transmitted from the blast through the hull into the water was a minimal component of overall firing noise, and would likewise be expected to be a minimal component of an explosion occurring on the surface of the barge.

Depending on the amount of fuel remaining in the booster at the time of the explosion, the intensity of the explosion would likely vary. As indicated above, the explosive equivalence of the First Stage with maximum fuel and oxidizer is 503 lb. of TNT. Explosion shock theory has proposed specific relationships for the peak pressure and time constant in terms of the charge weight and range from the detonation position (Pater 1981; Plotkin *et al.* 2012). For an in-air explosion equivalent to 500 lb. of TNT, at 0.5 feet the explosion would be approximately 250 dB re 20µPa. Based on the assumption that the structure of the barge would absorb and reflect approximately 94 percent of this energy, with approximately six percent of the energy from the explosion transmitted into the water (Yagla and Stiegler 2003), the amount of energy that would be transmitted into the water would be far less than the lowest threshold for Level B harassment for both pinnipeds and cetaceans based on NMFS's current acoustic criteria for in-water explosive noise (see Table 3). As a result, the likelihood of in-water sound generated by an explosion of the Falcon 9 First Stage during an unsuccessful barge landing attempt resulting in take of marine mammals is considered so low as to be discountable.

TABLE 3—NMFS ACOUSTIC CRITERIA FOR IMPACTS TO MARINE MAMMALS FROM EXPLOSIVES

Group	Species	Level B		Level A			Mortality
		Behavioral (for ≥2 pulses/24 hours)	TTS	PTS	Gastro-intestinal tract injury	Lung injury	
Low-Frequency Cetaceans.	Mysticetes	167 dB SEL	172 dB SEL or 224 dB peak SPL.	187 dB SEL or 230 dB peak SPL.	237 dB SPL/104 psi.	39.1 $M^{1/3}$ (1+[D_{Rm}/10.081]$^{1/2}$ Pa-sec Where: M = mass of the animal in kg D_{Rm} = depth of the receiver in meters.	91.4 $M^{1/3}$ (1+[D_{Rm}/10.081]$^{1/2}$ Pa-sec Where: M = mass of the animal in kg D_{Rm} = depth of the receiver in meters.
Mid-Frequency Cetaceans.	Most delphinids, medium & large toothed whales.	167 dB SEL	172 dB SEL or 224 dB peak SPL.	187 dB SEL or 230 dB peak SPL.			

TABLE 3—NMFS ACOUSTIC CRITERIA FOR IMPACTS TO MARINE MAMMALS FROM EXPLOSIVES—Continued

Group	Species	Level B		Level A			Mortality
		Behavioral (for ≥2 pulses/24 hours)	TTS	PTS	Gastro-intestinal tract injury	Lung injury	
High-Frequency Cetaceans.	Porpoises and *Kogia* spp.	141 dB SEL	146 dB SEL or 195 dB peak SPL.	161 dB SEL or 201 dB peak SPL.			
Phocids	Elephant & harbor seal.	172 dB SEL	177 dB SEL or 212 dB peak SPL.	192 dB SEL or 218 Db peak SPL.			
Otariids	Sea lions & fur seals.	195 dB SEL	200 dB SEL or 212 Db peak SPL.	215 dB SEL or 218 Db peak SPL.			

As we have determined that neither in-air noise nor underwater noise associated with potential explosions from an unsuccessful Falcon 9 First Stage landing attempt at the contingency landing location would result in take of marine mammals, explosions as a result of unsuccessful landing attempts at the contingency landing location are not considered further in this proposed authorization. The likelihood of a Falcon 9 First Stage completely missing the barge during a landing attempt, and directly impacting the surface of the water, is considered to be so low as to be discountable; therefore this scenario is not analyzed in terms of its potential to result in take of marine mammals. Likewise, the likelihood of a Falcon 9 First Stage landing failure at VAFB, resulting in an explosion of the First Stage on the SLC–4W landing pad, is considered to be so low as to be discountable; therefore this scenario is not analyzed in terms of its potential to result in take of marine mammals.

Landing Noise

A final engine burn during the landing of the Falcon 9 First Stage, lasting approximately 17 seconds, would generate non-pulse in-air noise that could potentially result in hauled out pinnipeds alerting, moving away from the noise, or flushing into the water. SpaceX determined that the landing noise would generate non-pulse in-air noise of between 70 and 110 dB re 20 μPa centered on SLC–4W, but affecting an area up to 22.5 km offshore of VAFB (see Figure 2–5 in the IHA application) (ManTech 2015). Engine noise would also be produced during Falcon 9 First Stage landings at the contingency landing location; the potential area of influence for barge landings was estimated by extrapolating the landing noise profile from a SLC–4W landing (see Figure 2–5 in the IHA application). Engine noise during the barge landing is also expected to be between 70 and 110 dB re 20 μPa non-pulse in-air noise affecting a radial area up to 22.5 km around the contingency landing location (see Figure 2–6 in the IHA application).

As described above, NMFS's current acoustic criteria for in-air acoustic impacts assumes Level B harassment of non-harbor seal pinnipeds occurs at 100 dB rms re 20μPa, with Level B harassment of harbor seals occurring at 90 dB rms re 20μPa (Table 2). No threshold for Level A harassment for in-air noise has been established. Based on SpaceX's modeling of the propagation of noise from a Falcon 9 First Stage landing, there are no pinniped haulouts within the area modeled to be impacted by landing noise at 90 dB or greater, for either a landing at VAFB (see Figure 2–5 in the IHA application) or a contingency barge landing (see Figure 2–6 in the IHA application) (ManTech 2015). Therefore we believe it is unlikely that hauled out pinnipeds will be harassed by the noise associated with Falcon 9 First Stage landings, either at VAFB or at the contingency landing location. The noise associated with Falcon 9 First Stage landings would not be expected to have an effect on submerged animals or those that spend a considerable amount of time submerged, such as cetaceans. Therefore the likelihood of take resulting from noise from a Falcon 9 First Stage landing, either at VAFB or at the contingency landing location, is considered so low as to be discountable. As such, landing noise is not considered further in this proposed authorization.

Sonic Boom

During descent when the First Stage is supersonic, a sonic boom (overpressure of high-energy impulsive sound) would be generated. During a landing event at SLC–4W, the sonic boom would be directed at the coastal area south of SLC–4W (see Figure 2–1 in the IHA application). Acoustic modeling was performed to estimate the area of expected impact and overpressure levels that would be created during the return flight of the Falcon 9 First Stage (Wyle, Inc. 2015). The boom footprint was computed using PCBoom (Plotkin and Grandi 2002; Page et al. 2010). The vehicle is a cylinder generally aligned with the velocity vector, descending engines first (see Figure 1–3 in the IHA application). It was modeled via PCBoom's drag-dominated blunt body mode (Tiegerman 1975), which has been validated for entry vehicles (Plotkin et al. 2006). Drag is determined by vehicle weight and the kinematics of the trajectory. Kinematics include the effect of the retro burn. The model results predict that sonic overpressures would reach up to 2.0 pounds per square foot (psf) in the immediate area around SLC–4W (Figures 2–1 and 2–2) and an overpressure between 1.0 and 2.0 psf would impact the coastline of VAFB from approximately 8 km north of SLC–4 to approximately 18 km southeast of SLC–4W (see Figures 2–1 and 2–2 in the IHA application). A significantly larger area, including the mainland, the Pacific Ocean, and the NCI, would experience an overpressure between 0.1 and 1.0 psf (see Figure 2–1 in the IHA application). In addition, San Miguel Island and Santa Rosa Island may experience an overpressure up to 3.1 psf and the west end of Santa Cruz Island may experience an overpressure up to 1.0 psf (see Figures 2–1 and 2–3 in the IHA application).

During a contingency barge landing event, an overpressure would also be generated while the first-stage booster is supersonic. The overpressure would be directed at the ocean surface no less than 50 km off the coast of VAFB. The SLC–4W pad-based landing overpressure modeling was roughly extrapolated to show potential noise impacts for landing 50 km to the west of VAFB (see Figure 2–4 in the IHA application). An overpressure of up to 2.0 psf would impact the Pacific Ocean at the contingency landing location approximately 50 km offshore of VAFB. San Miguel Island and Santa Rosa Island would experience a sonic boom between 0.1 and 0.2 psf. Sonic boom overpressures on the mainland would be between 0.2 and 0.4 psf.

Behavioral Responses of Pinnipeds to Sonic Booms

The USAF has monitored pinniped responses to rocket launches from VAFB for nearly 20 years. Though rocket launches are not part of the proposed activities (as described above), the acoustic stimuli (sonic booms) associated with launches is expected to be substantially similar to those expected to occur with Falcon 9 boost-backs and landings; therefore, we rely on observational data on responses of pinnipeds to sonic booms associated with rocket launches from VAFB in making assumptions about expected pinniped responses to sound associated with Falcon 9 boost-backs and landings.

Observed reactions of pinnipeds at the NCI to sonic booms have ranged from no response to heads-up alerts, from startle responses to some movements on land, and from some movements into the water to occasional stampedes (especially involving California sea lions on the NCI). We therefore assume sonic booms generated during the return flight of the Falcon 9 First Stage may elicit an alerting or other short-term behavioral reaction, including flushing into the water if hauled out. NMFS considers pinnipeds behaviorally reacting to stimuli by flushing into the water, moving more than 1 meter but not into the water; becoming alert and moving more than 1 meter; and changing direction of current movements as behavioral criteria for take by Level B harassment. As such, SpaceX has requested, and we propose to authorize, take of small numbers of marine mammals by Level B harassment incidental to Falcon 9 boost-backs and landings associated with sonic booms.

Data from launch monitoring by the USAF on the NCI has shown that pinniped reactions to sonic booms are correlated with the level of the sonic boom. Low energy sonic booms (<1.0 psf) have resulted in little to no behavioral responses, including head raising and briefly alerting but returning to normal behavior shortly after the stimulus (Table 4). More powerful sonic booms have resulted in pinnipeds flushing from haulouts. No pinniped mortalities have been associated with sonic booms. No sustained decreases in numbers of animals observed at haulouts have been observed after the stimulus. Table 4 presents a summary of monitoring efforts at the NCI from 1999 to 2011. These data show that reactions to sonic booms tend to be insignificant below 1.0 psf and that, even above 1.0 psf, only a portion of the animals present have reacted to the sonic boom. Time-lapse video photography during four launch events revealed that harbor seals that reacted to the rocket launch noise but did not leave the haul-out were all adults.

Data from previous monitoring also suggests that for those pinnipeds that flush from haulouts in response to sonic booms, the amount of time it takes for those animals to begin returning to the haulout site, and for numbers of animals to return to pre-launch levels, is correlated with sonic boom sound levels. Pinnipeds may begin to return to the haul-out site within 2–55 min of the launch disturbance, and the haulout site usually returned to pre-launch levels within 45–120 min. Monitoring data from launches of the Athena IKONOS rocket from VAFB, with ASELs of 107.3 and 107.8 dB recorded at the closest haul-out site, showed seals that flushed to the water on exposure to the sonic boom began to return to the haul-out approximately 16–55 minutes post-launch (Thorson *et al.,* 1999a; 1999b). In contrast, in the cases of Atlas rocket launches and several Titan II rocket launches with ASELs ranging from 86.7 to 95.7 dB recorded at the closest haul-out, seals began to return to the haul-out site within 2–8 minutes post-launch (Thorson and Francine, 1997; Thorson *et al.,* 2000).

Monitoring data has consistently shown that reactions among pinnipeds vary between species, with harbor seals and California sea lions tending to be more sensitive to disturbance than northern elephant seals and northern fur seals (Table 4). Because Steller sea lions and Guadalupe fur seals occur in the project area relatively infrequently, no data has been recorded on their reactions to sonic booms. At VAFB, harbor seals generally alert to nearby launch noises, with some or all of the animals going into the water. Usually the animals haul out again from within minutes to two hours or so of the launch, provided rising tides or breakers have not submerged the haul-out sites. Post-launch surveys often indicate as many or more animals hauled out than were present at the time of the launch, unless rising tides, breakers or other disturbances are involved (SAIC 2012). When launches occurred during high tides at VAFB, no impacts have been recorded because virtually all haul-out sites were submerged. At San Miguel Island, California sea lions react more strongly to sonic booms than most other species. Pups may react more than adults, either because they are more easily frightened or because their hearing is more acute. Although California sea lions on San Miguel Island tend to react to sonic booms, most disturbances are minor and temporary in nature (USAF 2013b). Harbor seals also appear to be more sensitive to sonic booms than other pinnipeds, often startling and fleeing into the water. Northern fur seals often show little or no reaction. Northern elephant seals generally exhibit no reaction at all, except perhaps a heads-up response or some stirring, especially if sea lions in the same area react strongly to the boom. Post-launch monitoring generally reveals a return to normal patterns within minutes up to an hour or two of each launch, regardless of species (SAIC 2012).

Table 4 summarizes monitoring efforts at San Miguel Island during which acoustic measurements were successfully recorded and during which pinnipeds were observed. During more recent launches, night vision equipment was used. The table shows only launches during which sonic booms were heard and recorded. The table shows that little or no reaction from the four species usually occurs when overpressures are below 1.0 psf. In general, as described above, elephant seals do not react unless other animals around them react strongly or if the sonic boom is extremely loud, and northern fur seals seem to react similarly. Not enough data exist to draw conclusions about harbor seals, but considering their reactions to launch noise at VAFB, it is likely that they are also sensitive to sonic booms (SAIC 2012).

TABLE 4—PINNIPED REACTIONS TO SONIC BOOMS AT SAN MIGUEL ISLAND

Launch event	Sonic boom level (psf)	Location	Species & associated reaction
Athena II (27 April 1999)	1.0	Adams Cove	Calif. sea lion—866 alerted; 232 flushed into water northern elephant seal—alerted but did not flush northern fur seal—alerted but did not flush.
Athena II (24 September 1999).	0.95	Point Bennett	Calif. sea lion—600 alerted; 12 flushed into water northern elephant seal—alerted but did not flush northern fur seal—alerted but did not flush.
Delta II 20 (November 2000)	0.4	Point Bennett	Calif. sea lion—60 flushed into water; no reaction from rest Northern elephant seal—no reaction.
Atlas II (8 September 2001)	0.75	Cardwell Point	Calif. sea lion—no reaction northern elephant seal—no reaction harbor seal—2 of 4 flushed into water.
Delta II (11 February 2002)	0.64	Point Bennett	Calif. sea lion—no reaction northern fur seal—no reaction northern elephant seal—no reaction.
Atlas II (2 December 2003)	0.88	Point Bennett	Calif. sea lion—40% alerted; several flushed to water northern elephant seal—no reaction.
Delta II (15 July 2004)	1.34	Adams Cove	Calif. sea lion—10% alerted.
Atlas V (13 March 2008)	1.24	Cardwell Point	northern elephant seal—no reaction.
Delta II (5 May 2009)	0.76	West of Judith Rock	Calif. sea lion—no reaction.
Atlas V (14 April 2011)	1.01	Cuyler Harbor	northern elephant seal—no reaction.
Atlas V (3 April 2014)	0.74	Cardwell Point	harbor seal—1 of ~25 flushed into water; no reaction from others.
Atlas V (12 December 2014)	1.16	Point Bennett	Calif. sea lion—5 of ~225 alerted; none flushed.

Physiological Responses to Sonic Booms

To determine if harbor seals experience changes in their hearing sensitivity as a result of sounds associated with rocket launches (including sonic booms), Auditory Brainstem Response (ABR) testing was conducted on 14 harbor seals following four launches of the Titan IV rocket, one launch of the Taurus rocket, and two launches of the Delta IV rocket from VAFB, in accordance with NMFS scientific research permits. ABR tests have not yet been performed following Falcon 9 rocket landings nor launches, however results of ABR tests that followed launches of other rockets from VAFB are nonetheless informative as the sound source (sonic boom) is expected to be the same as that associated with the activities proposed by SpaceX.

Following standard ABR testing protocol, the ABR was measured from one ear of each seal using sterile, sub-dermal, stainless steel electrodes. A conventional electrode array was used, and low-level white noise was presented to the non-tested ear to reduce any electrical potentials generated by the non-tested ear. A computer was used to produce the click and an 8 kilohertz (kHz) tone burst stimuli, through standard audiometric headphones. Over 1,000 ABR waveforms were collected and averaged per trial. Initially the stimuli were presented at SPLs loud enough to obtain a clean reliable waveform, and then decreased in 10 dB steps until the response was no longer reliably observed. Once response was no longer reliably observed, the stimuli were then increased in 10 dB steps to the original SPL. By obtaining two ABR waveforms at each SPL, it was possible to quantify the variability in the measurements.

Good replicable responses were measured from most of the seals, with waveforms following the expected pattern of an increase in latency and decrease in amplitude of the peaks, as the stimulus level was lowered. Detailed analysis of the changes in waveform latency and waveform replication of the ABR measurements for the 14 seals showed no detectable changes in the seals' hearing sensitivity as a result of exposure to the launch noise. The delayed start (1.75 to 3.5 hours after the launches) for ABR testing allows for the possibility that the seals may have recovered from a TTS before testing began. However, it can be said with confidence that the post-launch tested animals did not have permanent hearing changes due to exposure to the launch noise from the sonic booms associated with launches of the rockets from VAFB (SAIC 2013).

NMFS also notes that stress from long-term cumulative sound exposures can result in physiological effects on reproduction, metabolism, and general health, or on the animals' resistance to disease. However, this is not likely to occur as a result of the proposed activities because of the infrequent nature and short duration of the noise (up to six sonic booms annually). Research indicates that population levels at these haul-out sites have remained constant in recent years (with decreases only noted in some areas because of the increased presence of coyotes), giving support to this conclusion.

Anticipated Effects on Marine Mammal Habitat

Impacts on marine mammal habitat are part of the consideration in making a finding of negligible impact on the species and stocks of marine mammals. Habitat includes rookeries, mating grounds, feeding areas, and areas of similar significance. We do not anticipate that the proposed activities would result in any temporary or permanent effects on the habitats used by the marine mammals in the proposed area, including the food sources they use (*i.e.* fish and invertebrates). Behavioral disturbance caused by in-air acoustic stimuli may result in marine mammals temporarily moving away from or avoiding the exposure area but are not expected to have long term impacts, as supported by over two decades of launch monitoring studies on the Northern Channel Islands by the U.S. Air Force (MMCG and SAIC 2012).

Effects on Potential Prey and Foraging Habitat

The proposed activities would not result in in-water acoustic stimuli that would cause significant injury or mortality to prey species and would not create barriers to movement for marine mammal prey. In the event of an unsuccessful barge landing and a resulting explosion of the Falcon 9 First Stage, up to 25 pieces of debris would likely remain floating (see Section 6.5.1 in the IHA application for further details). SpaceX would recover all floating debris. Denser debris that would not float on the surface is anticipated to sink relatively quickly and would be composed of inert materials. The area of benthic habitat impacted by falling debris would be very small (approximately 0.000706 km^2) (ManTech 2015) and all debris that would sink are composed of inert materials that would not affect water quality or bottom substrate potentially used by marine mammals. None of the debris would be so dense or large that benthic habitat would be degraded. As a result, debris from an unsuccessful barge landing that enters the ocean environment approximately 50 km offshore of VAFB would not have a significant effect on marine mammal habitat.

In summary, since the acoustic impacts associated with the proposed activities are of short duration and infrequent (up to six events annually), the associated behavioral responses in marine mammals are expected to be temporary. Therefore, the proposed activities are unlikely to result in long term or permanent avoidance of the exposure areas or loss of habitat. The proposed activities are also not expected to result in any reduction in foraging habitat or adverse impacts to marine mammal prey. Thus, any impacts to marine mammal habitat are not expected to cause significant or long-term consequences for individual marine mammals or their populations.

Proposed Mitigation

In order to issue an IHA under section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses.

SpaceX's IHA application contains descriptions of the mitigation measures proposed to be implemented during the specified activities in order to effect the least practicable adverse impact on the affected marine mammal species and stocks and their habitats. The proposed mitigation measures include the following:

- Unless constrained by other factors including human safety or national security concerns, launches will be scheduled to avoid, whenever possible, boost-backs and landings during the harbor seal pupping season of March through June.

We have carefully evaluated SpaceX's proposed mitigation and considered their likely effectiveness relative to implementation of similar mitigation measures in previously issued incidental take authorizations to preliminarily determine whether they are likely to affect the least practicable impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another:

(1) The manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals;

(2) The proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and

(3) The practicability of the measure for applicant implementation.

Any mitigation measure(s) we prescribe should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the general goals listed below:

(1) Avoidance or minimization of injury or death of marine mammals wherever possible (goals 2, 3, and 4 may contribute to this goal).

(2) A reduction in the number (total number or number at biologically important time or location) of individual marine mammals exposed to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing takes by behavioral harassment only).

(3) A reduction in the number (total number or number at biologically important time or location) of times any individual marine mammal would be exposed to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing takes by behavioral harassment only).

(4) A reduction in the intensity of exposure to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing the severity of behavioral harassment only).

(5) Avoidance or minimization of adverse effects to marine mammal habitat, paying particular attention to the prey base, blockage or limitation of passage to or from biologically important areas, permanent destruction of habitat, or temporary disturbance of habitat during a biologically important time.

(6) For monitoring directly related to mitigation, an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation.

Based on our evaluation of SpaceX's proposed measures, we have preliminarily determined that the proposed mitigation measures provide the means of effecting the least practicable impact on marine mammal species or stocks and their habitat. While we have determined preliminarily that the proposed mitigation measures presented in this document will affect the least practicable adverse impact on the affected species or stocks and their habitat, we will consider all public comments to help inform our final decision.

Proposed Monitoring and Reporting

In order to issue an IHA for an activity, section 101(a)(5)(D) of the MMPA states that NMFS must set forth ''requirements pertaining to the monitoring and reporting of such taking.'' The MMPA implementing regulations at 50 CFR 216.104(a)(13) indicate that requests for incidental take authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area.

Any monitoring requirement we prescribe should accomplish one or more of the following general goals:

1. An increase in the probability of detecting marine mammals, both within defined zones of effect (thus allowing for more effective implementation of the mitigation) and in general to generate more data to contribute to the analyses mentioned below;

2. An increase in our understanding of how many marine mammals are likely to be exposed to stimuli that we associate with specific adverse effects, such as behavioral harassment or hearing threshold shifts;

3. An increase in our understanding of how marine mammals respond to stimuli expected to result in incidental take and how anticipated adverse effects on individuals may impact the population, stock, or species (specifically through effects on annual rates of recruitment or survival) through any of the following methods:

- Behavioral observations in the presence of stimuli compared to observations in the absence of stimuli (need to be able to accurately predict pertinent information, *e.g.,* received level, distance from source);
- Physiological measurements in the presence of stimuli compared to observations in the absence of stimuli (need to be able to accurately predict pertinent information, *e.g.,* received level, distance from source); and

• Distribution and/or abundance comparisons in times or areas with concentrated stimuli versus times or areas without stimuli.

4. An increased knowledge of the affected species; or

5. An increase in our understanding of the effectiveness of certain mitigation and monitoring measures.

SpaceX submitted a monitoring plan as part of their IHA application. SpaceX's proposed marine mammal monitoring plan was created with input from NMFS and was based on similar plans that have been successfully implemented by other action proponents under previous authorizations for similar projects, specifically the USAF's monitoring of rocket launches from VAFB. The plan may be modified or supplemented based on comments or new information received from the public during the public comment period.

Proposed monitoring protocols vary according to modeled sonic boom intensity and season. Sonic boom modeling will be performed prior to all boost-back events. PCBoom, a commercially available modeling program, or an acceptable substitute, will be used to model sonic booms. Launch parameters specific to each launch will be incorporated into each model. These include direction and trajectory, weight, length, engine thrust, engine plume drag, position versus time from initiating boost-back to additional engine burns, among other aspects. Various weather scenarios will be analyzed from NOAA weather records for the region, then run through the model. Among other factors, these will include the presence or absence of the jet stream, and if present, its direction, altitude and velocity. The type, altitude, and density of clouds will also be considered. From these data, the models will predict peak amplitudes and impact locations.

Marine Mammal Monitoring

Marine mammal monitoring procedures will consist of the following:

• Should sonic boom model results indicate that a peak overpressure of 1.0 psf or greater is likely to impact VAFB, then acoustic and biological monitoring at VAFB will be implemented.

• If it is determined that a sonic boom of 1.0 psf or greater is likely to impact one of the Northern Channel Islands between 1 March and 30 June; a sonic boom greater than 1.5 psf between 1 July and 30 September, and a sonic boom greater than 2.0 psf between 1 October and 28 February, then monitoring will be conducted at the haulout site closest to the predicted sonic boom impact area.

• Monitoring would commence at least 72 hours prior to the boost-back and continue until at least 48 hours after the event.

• Monitoring data collected would include multiple surveys each day that record the species; number of animals; general behavior; presence of pups; age class; gender; and reaction to booms or other natural or human-caused disturbances. Environmental conditions such as tide, wind speed, air temperature, and swell would also be recorded.

• If the boost-back is scheduled for daylight; video recording of pinnipeds on NCI would be conducted during the boost-back in order to collect required data on reaction to launch noise.

• For launches during the harbor seal pupping season (March through June), follow-up surveys will be conducted within 2 weeks of the boost-back/landing.

Acoustic Monitoring

Acoustic measurements of the sonic boom created during boost-back at the monitoring location would be recorded to determine the overpressure level.

Reporting

SpaceX will submit a report within 90 days after each Falcon 9 First Stage recovery event that includes the following information:

• Summary of activity (including dates, times, and specific locations of Falcon 9 First Stage recovery activities)

• Summary of monitoring measures implemented

• Detailed monitoring results and a comprehensive summary addressing goals of monitoring plan, including:

○ Number, species, and any other relevant information regarding marine mammals observed and estimated exposed/taken during activities;

○ Description of the observed behaviors (in both presence and absence of activities);

○ Environmental conditions when observations were made; and

○ Assessment of the implementation and effectiveness of monitoring measures.

In addition to the above post-activity reports, a draft annual report will be submitted within 90 calendar days of the expiration of the proposed IHA, or within 45 calendar days prior to the effective date of a subsequent IHA (if applicable). The annual report will summarize the information from the post-activity reports, including but not necessarily limited to: (a) Numbers of pinnipeds present on the haulouts prior to commencement of Falcon 9 First Stage recovery activities; (b) numbers of pinnipeds that may have been harassed as noted by the number of pinnipeds estimated to have entered the water as a result of Falcon 9 First Stage recovery noise; (c) for pinnipeds that entered the water as a result of Falcon 9 First Stage recovery noise, the length of time(s) those pinnipeds remained off the haulout or rookery; and (d) any behavioral modifications by pinnipeds that likely were the result of stimuli associated with the proposed activities.

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner not authorized by the proposed IHA (if issued), such as a Level A harassment, or a take of a marine mammal species other than those proposed for authorization, SpaceX would immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources. The report would include the following information:

• Time, date, and location (latitude/longitude) of the incident;

• Description of the incident;

• Status of all Falcon 9 First Stage recovery activities in the 48 hours preceding the incident;

• Description of all marine mammal observations in the 48 hours preceding the incident;

• Species identification or description of the animal(s) involved;

• Fate of the animal(s); and

• Photographs or video footage of the animal(s) (if equipment is available).

Activities would not resume until NMFS is able to review the circumstances of the prohibited take. NMFS would work with SpaceX to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. SpaceX would not be able to resume their activities until notified by NMFS via letter, email, or telephone.

In the event that SpaceX discovers an injured or dead marine mammal, and the lead MMO determines the cause of the injury or death is unknown and the death is relatively recent (*i.e.,* in less than a moderate state of decomposition), SpaceX would immediately report the incident to mailto: The Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the NMFS West Coast Region Stranding Coordinator.

The report would include the same information identified in the paragraph above. Authorized activities would be able to continue while NMFS reviews the circumstances of the incident.

NMFS would work with SpaceX to determine whether modifications in the activities are appropriate.

In the event that SpaceX discovers an injured or dead marine mammal, and the lead MMO determines the injury or death is not associated with or related to the activities authorized in the IHA (*e.g.,* previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), SpaceX would report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and NMFS West Coast Region Stranding Coordinator, within 24 hours of the discovery. SpaceX would provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network.

Estimated Take by Incidental Harassment

Except with respect to certain activities not pertinent here, section 3(18) of the MMPA defines ''harassment'' as: ''. . . any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].''

SpaceX has requested, and NMFS proposes, authorization to take harbor seals, California sea lions, northern elephant seals, Steller sea lions, northern fur seals, and Guadalupe fur seals, incidental to Falcon 9 First Stage recovery activities. All anticipated takes would be by Level B harassment only, resulting from noise associated with sonic booms and involving temporary changes in behavior. Estimates of the number of harbor seals, California sea lions, northern elephant seals, Steller sea lions, northern fur seals, and Guadalupe fur seals that may be harassed by the proposed activities is based upon the number of potential events associated with Falcon 9 First Stage recovery activities (maximum 6 per year) and the average number of individuals of each species that are present in areas that will be exposed to the activities at levels that are expected to result in Level B harassment.

In order to estimate the potential incidents of take that may occur incidental to the specified activity, we must first estimate the extent of the sound field that may be produced by the activity and then incorporate information about marine mammal density or abundance in the project area. We first provide information on applicable thresholds for determining effects to marine mammals before describing the information used in estimating the sound fields, the available marine mammal density or abundance information, and the method of estimating potential incidences of take. It should be noted that estimates of Level B take described below are not necessarily estimates of the number of individual animals that are expected to be taken; a smaller number of individuals may accrue a number of incidences of harassment per individual than for each incidence to accrue to a new individual, especially if those individuals display some degree of residency or site fidelity and the impetus to use the site (*e.g.,* because of foraging opportunities) is stronger than the deterrence presented by the harassing activity.

Sound Thresholds

Typically NMFS relies on the acoustic criteria shown in Table 2 to estimate the extent of take by Level A and/or Level B harassment that is expected as a result of an activity. If we relied on the acoustic criteria shown in Table 2, we would assume harbor seals exposed to airborne sound at levels at or above 90 dB rms re 20 μPa, and non-harbor seal pinnipeds exposed to airborne sound at levels at or above 100 dB rms re 20 μPa, would experience Level B harassment. However, in this case we have the benefit of more than 20 years of observational data on pinniped responses to the stimuli associated with the proposed activity that we expect to result in harassment (sonic booms) in the particular geographic area of the proposed activity (VAFB and the NCI). Therefore, we consider these data to be the best available information in regard to estimating take based on modeled exposures among pinnipeds to sounds associated with the proposed activities. These data suggest that pinniped reactions to sonic booms are dependent on the species, the age of the animal, and the intensity of the sonic boom (see Table 4).

As described above, data from launch monitoring by the USAF on the NCI and at VAFB have shown that pinniped reactions to sonic booms are correlated to the level of the sonic boom. Low energy sonic booms (< 1.0 psf) have resulted in little to no behavioral responses, including head raising and briefly alerting but returning to normal behavior shortly after the stimulus. More powerful sonic booms have flushed animals from haulouts (but not resulted in any mortality or sustained decreased in numbers after the stimulus). Table 4 presents a summary of monitoring efforts at the NCI from 1999 to 2011. These data show that reactions to sonic booms tend to be insignificant below 1.0 psf and that, even above 1.0 psf, only a portion of the animals present react to the sonic boom. Therefore, for the purposes of estimating the extent of take that is likely to occur as a result of the proposed activities, we assume that Level B harassment occurs when a pinniped (on land) is exposed to a sonic boom at or above 1.0 psf. Therefore the number of expected takes by Level B harassment is based on estimates of the numbers of animals that would be within the area exposed to sonic booms at levels at or above 1.0 psf.

The data recorded by USAF at VAFB and the NCI over the past 20 years has also shown that pinniped reactions to sonic booms vary between species. As described above, little or no reaction has been observed in harbor seals, California sea lions, northern fur seals and northern elephant seals when overpressures were below 1.0 psf (data on responses among Steller sea lions and Guadalupe fur seals is not available). At the NCI sea lions have reacted more strongly to sonic booms than most other species. Harbor seals also appear to be more sensitive to sonic booms than most other pinnipeds, often resulting in startling and fleeing into the water. Northern fur seals generally show little or no reaction, and northern elephant seals generally exhibit no reaction at all, except perhaps a heads-up response or some stirring, especially if sea lions in the same area mingled with the elephant seals react strongly to the boom. No data is available on Steller sea lion or Guadalupe fur seal responses to sonic booms.

Exposure Area

As described above, SpaceX performed acoustic modeling to estimate overpressure levels that would be created during the return flight of the Falcon 9 First Stage (Wyle, Inc. 2015). The predicted acoustic footprint of the sonic boom was computed using the computer program PCBoom (Plotkin and Grandi 2002; Page et al. 2010). Modeling was performed for a landing at VAFB and separately for a contingency barge landing (see Figures 2–1, 2–2, 2–3 and 2–4 in the IHA application).

The model results predicted that sonic overpressures would reach up to 2.0 pounds psf in the immediate area around SLC–4W (see Figures 2–1 and 2–2 in the IHA application) and an overpressure between 1.0 and 2.0 psf would impact the coastline of VAFB from approximately 8 km north of SLC–4W to approximately 18 km southeast of SLC–4W see (Figures 2–1 and 2–2 in the IHA application). A substantially larger area, including the mainland, the Pacific Ocean, and the NCI would experience an overpressure between 0.1 and 1.0 psf (see Figure 2–1 in the IHA application). In addition, San Miguel Island and Santa Rosa Island may experience an overpressure up to 3.1 psf and the west end of Santa Cruz Island may experience an overpressure up to 1.0 psf (see Figures 2–1 and 2–3 in the IHA application). During a contingency barge landing event, an overpressure of up to 2.0 psf would impact the Pacific Ocean at the contingency landing location approximately 50 km offshore of VAFB. San Miguel Island and Santa Rosa Island would experience a sonic boom between 0.1 and 0.2 psf, while sonic boom overpressures on the mainland would be between 0.2 and 0.4 psf.

SpaceX assumes that actual sonic booms that occur during the proposed activities will vary slightly from the modeled sonic booms; therefore, when estimating take based on areas anticipated to be impacted by sonic booms at or above 1.0 psf, haulouts within approximately 8.0 km (5 miles) of modeled contour lines for sonic booms at or above 1.0 psf were included to be conservative. Therefore, in estimating take for a VAFB landing, haulouts were included from the areas of Point Arguello and Point Conception, all of San Miguel Island, the north western half of Santa Rosa Island, and northwestern quarter of Santa Cruz Island (see Figure 2–2 and 2–3 in the IHA application). For a contingency landing event, sonic booms are far enough offshore so that only haulouts along the northwestern edge of San Miguel Island may be exposed to a 1.0 psf or greater sonic boom (see Figure 2–4 in the IHA application). As modeling indicates that substantially more haulouts would be impacted by a sonic boom at or above 1.0 psf in the event of a landing at VAFB versus a landing at the contingency landing location, estimated takes are substantially higher in the event of a VAFB landing versus a barge landing.

Description of Take Calculation

The take calculations presented here rely on the best data currently available for marine mammal populations in the project location. Data collected from marine mammal surveys represent the best available information on the occurrence of the six pinniped species in the project area. The quality of information available on pinniped abundance in the project area is varies depending on species; some species, such as California sea lions, are surveyed regularly at VAFB and the NCI, while for others, such as northern fur seals, survey data is largely lacking. See Table 5 for total estimated incidents of take. Take estimates were based on ''worst case scenario'' assumptions, as follows:

- All six proposed Falcon 9 First Stage recovery actions are assumed to result in landings at VAFB, with no landings occurring at the contingency barge landing location. This is a conservative assumption as sonic boom modeling indicates landings at VAFB are expected to result in a greater number of exposures to sound resulting in Level B harassment than would be expected for landings at the contingency landing location offshore. Some landings may ultimately occur at the contingency landing location; however, the number of landings at each location is not known in advance.
- All pinnipeds estimated to be in areas ensonified by sonic booms at or above 1.0 psf are assumed to be hauled out at the time the sonic boom occurs. This assumption is conservative as some animals may in fact be in the water with heads submerged when a sonic boom occurs and would therefore not be exposed to the sonic boom at a level that would result in Level B harassment.
- Actual sonic booms that occur during the proposed activities are assumed to vary slightly from the modeled sonic booms; therefore, when estimating take based on areas expected to be impacted by sonic booms at or above 1.0 psf, an additional buffer of 8.0 km (5 miles) was added to modeled sonic boom contour lines. Thus haulouts that are within approximately 8.0 km (5 miles) of modeled sonic booms at 1.0 psf and above were included in the take estimate. This is a conservative assumption as it expands the area of ensonification that would be expected to result in Level B harassment.

California sea lion—California sea lions are common offshore of VAFB and haul out on rocks and beaches along the coastline of VAFB, though pupping rarely occurs on the VAFB coastline. They haulout in large numbers on the NCI and rookeries exist on San Miguel and Santa Cruz islands. Based on modeling of sonic booms from Falcon 9 First Stage recovery activities, Level B harassment of California sea lions is expected to occur both at VAFB and at the NCI. Estimated take of California sea lions at VAFB was calculated using the largest count totals from monthly surveys of VAFB haulout sites from 2013–2015. These data were compared to the modeled sonic boom profiles. Counts from haulouts that were within the area expected to be ensonified by a sonic boom above 1.0 psf, plus the buffer of 8 km as described above, were included in take estimates; those haulouts outside the area expected to be ensonified by a sonic boom above 1.0 psf, plus the buffer of 8 km, were not included in the take estimate. The estimated number of California sea lion takes on the NCI and at Point Conception was derived from aerial survey data collected from 2002 to 2012 by the NOAA Southwest Fishery Science Center (SWFSC). The estimates are based on the largest number of individuals observed in the count blocks that fall within the area expected to be ensonified by a sonic boom above 1.0 psf plus a radius of 8 km, based on sonic boom modeling. Estimates of Level B harassment for California sea lions are shown in Table 5.

Harbor Seal—Pacific harbor seals are the most common marine mammal inhabiting VAFB, congregating on several rocky haul-out sites along the VAFB coastline. They also haul out, breed, and pup in isolated beaches and coves throughout the coasts of the NCI. Based on modeling of sonic booms from Falcon 9 First Stage recovery activities, Level B harassment of harbor seals is expected to occur both at VAFB and at the NCI. Estimated take of harbor seals at VAFB was calculated using the largest count totals from monthly surveys of VAFB haulout sites from 2013–2015. These data were compared to the modeled sonic boom profiles. Counts from haulouts that were within the area expected to be ensonified by a sonic boom above 1.0 psf plus a radius of 8 km were included in take estimates; those haulouts outside the area expected to be ensonified by a sonic boom above 1.0 psf plus a radius of 8 km were not included in the take estimate. The estimated number of harbor seal takes on the NCI and at Point Conception was derived from aerial survey data collected from 2002 to 2012 by the NOAA SWFSC. The estimates are based on the largest number of individuals observed in the count blocks that fall within the area expected to be ensonified by a sonic boom above 1.0 psf plus a radius of 8 km, based on sonic boom modeling.

It should be noted that total take estimates shown in Table 5 represent incidents of exposure to sound resulting in Level B harassment from the proposed activities, and not estimates of the number of individual harbor seals exposed. As described above, harbor seals display a high degree of site fidelity to their preferred haulout sites, and are non-migratory, rarely traveling more than 50 km from their haulout sites. Thus, while the estimated abundance of the California stock of Pacific harbor seals is 30,968 (Carretta et al. 2015), a substantially smaller number of individual harbor seals is expected to occur within the project area. The number of harbor seals expected to be taken by Level B harassment, per Falcon 9 First Stage recovery action, is 2,157 (Table 5). We expect that, because of harbor seals' site fidelity to haulout locations at VAFB and the NCI, and because of their limited ranges, the same individuals are likely to be taken repeatedly over the course of the proposed activities (six Falcon 9 First Stage recovery actions). Estimates of Level B harassment for harbor seals are shown in Table 5.

Steller Sea Lion—Steller sea lions occur in small numbers at VAFB (maximum 16 individuals observed at any time) and on San Miguel Island (maximum 4 individuals recorded at any time). They have not been observed on the Channel Islands other than San Miguel Island and they not currently have rookeries on the NCI or at VAFB. Estimated take of Steller sea lions at VAFB was calculated using the largest count totals from monthly surveys of VAFB from 2013–2015. These data were compared to the modeled sonic boom profiles. Counts from haulouts that were within the area expected to be ensonified by a sonic boom above 1.0 psf plus a radius of 8 km were included in take estimates; those haulouts outside the area expected to be ensonified by a sonic boom above 1.0 psf plus a radius of 8 km were not included in the take estimate. Estimates of Level B harassment for Steller sea lions are shown in Table 5.

Northern elephant seal—Northern elephant seals haul out sporadically on rocks and beaches along the coastline of VAFB and at Point Conception, but they do not currently breed or pup at VAFB or at Point Conception. Northern elephant seals have rookeries on San Miguel Island and Santa Rosa Island. They are rarely seen on Santa Cruz Island and Anacapa Island. Based on modeling of sonic booms from Falcon 9 First Stage recovery activities, Level B harassment of harbor seals is expected to occur both at VAFB and at the NCI.

Estimated take of northern elephant seals at VAFB was calculated using the largest count totals from monthly surveys of VAFB haulout sites from 2013–2015. These data were compared to the modeled sonic boom profiles. Counts from haulouts that were within the area expected to be ensonified by a sonic boom above 1.0 psf plus a radius of 8 km were included in take estimates; those haulouts outside the area expected to be ensonified by a sonic boom above 1.0 psf plus a radius of 8 km were not included in the take estimate. The estimated number of northern elephant seal takes on the NCI and at Point Conception was derived from aerial survey data collected from 2002 to 2012 by the NOAA SWFSC. The estimates are based on the largest number of individuals observed in the count blocks that fall within the area expected to be ensonified by a sonic boom above 1.0 psf plus a radius of 8 km, based on sonic boom modeling.

As described above, monitoring data has shown that reactions to sonic booms among pinnipeds vary between species, with northern elephant seals consistently showing little or no reaction (Table 4). USAF launch monitoring data shows that northern elephant seals have never been observed responding to sonic booms. No elephant seal has been observed flushing to the water in response to a sonic boom. Because of the data showing that elephant seals consistently show little to no reaction to the sonic booms, we conservatively estimate that 10 percent of northern elephant seal exposures to sonic booms at or above 1.0 psf will result in Level B harassment. Estimates of Level B harassment for northern elephant seals are shown in Table 5.

Northern fur seal—Northern fur seals have rookeries on San Miguel Island, the only island in the NCI on which they have been observed. No haulout or rookery sites exist for northern fur seals at VAFB or on the mainland coast, thus take from sonic booms is only expected on San Miguel Island and not on the mainland. Comprehensive count data for northern fur seals on San Miguel Island are not available. Estimated take of northern fur seals was derived from northern fur seals pup and bull census data (Testa 2013), and personal communications with subject matter experts based at the NMFS National Marine Mammal Laboratory. Northern fur seal abundance on San Miguel Island varies substantially depending on the season, with a maximum of 6,000–8,000 seals hauled out on the western end of the island and at Castle Rock (~1 km northwest of San Miguel Island) during peak pupping season in July; the number of seals on San Miguel Island then decreases steadily from August until November, when very few seals are present. The number of seals on the island does not begin to increase again until the following June (pers. comm., T. Orr, NMFS NMML, to J. Carduner, NMFS, 2/27/16). As the dates of Falcon 9 First Stage recovery activities are not known, the activities could occur when the maximum number or the minimum number of fur seals is present, depending on season. We therefore estimated an average of 5,000 northern fur seals would be present in the area affected by sonic booms above 1.0 psf.

As described above, monitoring data has shown that reactions to sonic booms among pinnipeds vary between species, with northern fur seals consistently showing little or no reaction (Table 4). As described above, launch monitoring data shows that northern fur seals sometimes alert to sonic booms but have never been observed flushing to the water in response to sonic booms. Because of the data showing that fur seals consistently show little to no reaction to sonic booms, we conservatively estimate that 10 percent of northern fur seal exposures to sonic booms at or above 1.0 psf will result in Level B harassment. Estimates of Level B harassment for northern fur seals are shown in Table 5.

Guadalupe fur seal—There are estimated to be approximately 20–25 individual Guadalupe fur seals that have fidelity to San Miguel Island. The highest number of individuals observed at any one time on San Miguel Island is thirteen. No haul-out or rookery sites exist for Guadalupe fur seals on the mainland coast, including VAFB. Comprehensive survey data on Guadalupe fur seals in the NCI is not readily available. The estimated number of takes of Guadalupe fur seals was based the maximum number of Guadalupe fur seals observed at any one time on San Miguel Island (pers. comm., J. LaBonte, ManTech, to J. Carduner, NMFS, Feb 29, 2016). Estimates of Level B harassment for Guadalupe fur seals are shown in Table 5.

As described above, the take estimates shown in Table 5 are considered reasonable estimates of the number of marine mammal exposures to sound resulting in Level B harassment that are likely to occur over the course of the project, and not necessarily the number of individual animals exposed.

TABLE 5—NUMBER OF POTENTIAL INCIDENTAL TAKES OF MARINE MAMMALS, AND PERCENTAGE OF STOCK ABUNDANCE, AS A RESULT OF THE PROPOSED ACTIVITIES

Species	Geographic location	Estimated takes per Falcon 9 First Stage recovery action	Total estimated takes over the duration of the proposed IHA^	Percentage of stock abundance estimated taken
Harbor Seal	VAFB [a]	366	12,942	7% *
	Pt. Conception [b]	488.		
	San Miguel Island [b]	752.		
	Santa Rosa Island [b]	412.		
	Santa Cruz Island [b]	139.		
California Sea Lion	VAFB [a]	416	56,496	19%
	Pt. Conception	n/a.		
	San Miguel Island [c]	9,000.		
	Santa Rosa Island [c].			
	Santa Cruz Island [c].			
Northern Elephant Seal	VAFB [a]	19	960	0.5%
	Pt. Conception [d]	1.		
	San Miguel Island [c].			
	Santa Rosa Island [c]	150.		
	Santa Cruz Island [c].			
Steller Sea Lion	VAFB [a]	16	120	0.2%
	Pt. Conception	n/a.		
	San Miguel Island	4.		
	Santa Rosa Island	n/a.		
	Santa Cruz Island	n/a.		
Northern Fur Seal	VAFB	n/a	3,000	23%
	Pt. Conception	n/a.		
	San Miguel Island [c]	500.		
	Santa Rosa Island	n/a.		
	Santa Cruz Island	n/a.		
Guadalupe Fur Seal	VAFB	n/a	18	0.2%
	Pt. Conception	n/a.		
	San Miguel Island [e]	3.		
	Santa Rosa Island	n/a.		
	Santa Cruz Island	n/a.		

[a] VAFB monthly marine mammal survey data 2013–2015 (ManTech SRS Technologies, Inc. 2014, 2015 and VAFB, unpubl. data).
[b] NOAA Fisheries aerial survey data June 2002 and May 2004 (M. Lowry, NOAA Fisheries, unpubl. data).
[c] Testa 2013; USAF 2013; pers. comm., T. Orr, NMFS NMML, to J. Carduner, NMFS, Feb 27, 2016.
[d] NOAA Fisheries aerial survey data February 2010 (M. Lowry, NOAA Fisheries, unpubl. data).
[e] DeLong and Melin 2000; J. Harris, NOAA Fisheries, pers. comm.
^ Based on six Falcon 9 First Stage recovery actions, with SLC–4W landings, per year.
* For harbor seals, estimated percentage of stock abundance taken is based on estimated number of individuals taken versus estimated total exposures.

Analyses and Preliminary Determinations

Negligible Impact Analysis

NMFS has defined ''negligible impact'' in 50 CFR 216.103 as ''. . . an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.'' A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.,* population-level effects). An estimate of the number of Level B harassment takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be ''taken'' through behavioral harassment, we consider other factors, such as the likely nature of any responses (*e.g.,* intensity, duration), the context of any responses (*e.g.,* critical reproductive time or location, migration), as well as the number and nature of estimated Level A harassment takes, the number of estimated mortalities, and effects on habitat.

To avoid repetition, the discussion of our analyses applies to all the species listed in Table X, given that the anticipated effects of this activity on these different marine mammal stocks are expected to be similar. There is no information about the nature or severity of the impacts, or the size, status, or structure of any of these species or stocks that would lead to a different analysis for this activity.

Activities associated with the proposed Falcon 9 First Stage recovery project, as outlined previously, have the potential to disturb or displace marine mammals. Specifically, the specified activities may result in take, in the form of Level B harassment (behavioral disturbance) only, from in-air sounds generated from sonic booms. Potential takes could occur if marine mammals are hauled out in areas where a sonic boom above 1.0 psf occurs, which is considered likely given the modeled acoustic footprint of the proposed activities and the occurrence of pinnipeds in the project area. Effects on individuals that are taken by Level B harassment, on the basis of reports in the literature as well as monitoring from similar activities that have received incidental take authorizations from NMFS, will likely be limited to reactions such as alerting to the noise, with some animals possibly moving toward or entering the water, depending on the species and the psf associated with the sonic boom. Repeated exposures of individuals to levels of sound that may cause Level B harassment are unlikely to result in hearing impairment or to significantly disrupt foraging behavior. Thus, even repeated Level B harassment of some small subset of the overall stock is unlikely to result in any significant realized decrease in fitness to those individuals, and thus would not result in any adverse impact to the stock as a whole. Level B harassment will be reduced to the level of least practicable impact through use of mitigation measures described above.

If a marine mammal responds to a stimulus by changing its behavior (*e.g.,* through relatively minor changes in locomotion direction/speed), the response may or may not constitute taking at the individual level, and is unlikely to affect the stock or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on animals or on the stock or species could potentially be significant (*e.g.,* Lusseau and Bejder, 2007; Weilgart, 2007). Flushing of pinnipeds into the water has the potential to result in mother-pup separation, or could result in stampede, either of which could potentially result in serious injury or mortality and thereby could potentially impact the stock or species. However, based on the best available information, no serious injury or mortality of marine mammals is anticipated as a result of the proposed activities.

Even in the instances of pinnipeds being behaviorally disturbed by sonic booms from rocket launches at VAFB, no evidence has been presented of abnormal behavior, injuries or mortalities, or pup abandonment as a result of sonic booms (SAIC 2013). These findings came as a result of more than two decades of surveys at VAFB and the NCI (MMCG and SAIC, 2012). Post-launch monitoring generally reveals a return to normal patterns within minutes up to an hour or two of each launch, regardless of species. For instance, eight space vehicle launches occurred from north VAFB, near the Spur Road and Purisima Point haul-out sites, during the period 7 February 2009 through 6 February 2014. Of these eight Delta II and Taurus launches, three occurred during the harbor seal pupping season. The continued use of the Spur Road and Purisima Point haulout sites indicates that it is unlikely that these rocket launches (and associated sonic booms) resulted in long-term disturbances of pinnipeds using the haulout sites. Moreover, adverse cumulative impacts from launches were not observed at this site. San Miguel Island represents the most important pinniped rookery in the lower 48 states, and as such extensive research has been conducted there for decades. From this research, as well as stock assessment reports, it is clear that VAFB operations (including associated sonic booms) have not had any significant impacts on San Miguel Island rookeries and haulouts (SAIC 2012). Based on this extensive record, we believe the likelihood of serious injury or mortality of any marine mammal as a result of the proposed activities is so low as to be discountable. Thus we do not anticipate Level A harassment will occur as a result of the proposed activities and do not propose to authorize take in the form of Level A harassment.

The activities analyzed here are substantially similar to other activities that have received MMPA incidental take authorizations previously, including Letters of Authorization for USAF launches of space launch vehicles at VAFB, which have occurred for over 20 years with no reported injuries or mortalities to marine mammals, and no known long-term adverse consequences to marine mammals from behavioral harassment. As described above, several cetacean species occur within the project area, however no cetaceans are expected to be affected by the proposed activities.

In summary, this negligible impact analysis is founded on the following factors:

1. The possibility of injury, serious injury, or mortality may reasonably be considered discountable;
2. The anticipated incidences of Level B harassment consist of, at worst, temporary modifications in behavior (*i.e.,* short distance movements and occasional flushing into the water with return to haulouts within at most two days), which are not expected to adversely affect the fitness of any individuals;
3. The considerable evidence, based on over 20 years of monitoring data, suggesting no long-term changes in the use by pinnipeds of rookeries and haulouts in the project area as a result of sonic booms; and
4. The presumed efficacy of planned mitigation measures in reducing the effects of the specified activity to the level of least practicable impact.

In combination, we believe that these factors, as well as the available body of evidence from other similar activities, demonstrate that the potential effects of the specified activity will be short-term on individual animals. The specified activity is not expected to impact rates of recruitment or survival and will therefore not result in population-level impacts. Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, we preliminarily find that the total marine mammal take from SpaceX's Falcon 9 First Stage recovery activities will have a negligible impact on the affected marine mammal species or stocks.

Small Numbers Analysis

The numbers of proposed authorized takes would be considered small relative to the relevant stocks or populations (23 percent for northern fur seals; 19 percent for California sea lions; 7 percent for Pacific harbor seals; less than 1 percent each for northern elephant seals, Guadalupe fur seals and Steller sea lions). But, it is important to note that the number of expected takes does not necessarily represent of the number of individual animals expected to be taken. Our small numbers analysis accounts for this fact. Multiple exposures to Level B harassment can accrue to the same individuals over the course of an activity that occurs multiple times in the same area (such as SpaceX's proposed activity). This is especially likely in the case of species that have limited ranges and that have site fidelity to a location within the project area, as is the case with Pacific harbor seals.

As described above, harbor seals are non-migratory, rarely traveling more than 50 km from their haul-out sites. Thus, while the estimated abundance of the California stock of Pacific harbor seals is 30,968 (Carretta *et al.* 2015), a substantially smaller number of individual harbor seals is expected to occur within the project area. We expect that, because of harbor seals' site fidelity to locations at VAFB and the NCI, and because of their limited ranges, the same individuals are likely to be taken repeatedly over the course of the proposed activities (maximum of six Falcon 9 First Stage recovery actions). Therefore the number of exposures to Level B harassment over the course of proposed authorization (the total number of takes shown in Table 5) is expected to accrue to a much smaller number of individuals. The maximum number of harbor seals expected to be taken by Level B harassment, per Falcon 9 First Stage recovery action, is 2,157. As we believe the same individuals are likely to be taken repeatedly over the course of the proposed activities, we use the estimate of 2,157 individual animals taken per Falcon 9 First Stage recovery activity for the purposes of estimating the percentage of the stock abundance likely to be taken.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the mitigation and monitoring measures, we preliminarily find that small numbers of marine mammals will be taken relative to the populations of the affected species or stocks.

Impact on Availability of Affected Species for Taking for Subsistence Uses

Potential impacts resulting from the proposed activities will be limited to individuals of marine mammal species located in areas that have no subsistence requirements. Therefore, no impacts on the availability of marine mammal species or stocks for subsistence use are expected.

National Environmental Policy Act (NEPA)

The U.S. Air Force has prepared a Draft Environmental Assessment (EA) in accordance with NEPA and the regulations published by the Council on Environmental Quality. It will be posted on the NMFS Web site (at *www.nmfs.noaa.gov/pr/permits/incidental/)* concurrently with the publication of this proposed IHA. NMFS will independently evaluate the EA and determine whether or not to adopt it. We may prepare a separate NEPA analysis and incorporate relevant portions of USAF's EA by reference. Information in SpaceX's application, the EA, and this notice collectively provide the environmental information related to proposed issuance of the IHA for public review and comment. We will review all comments submitted in response to this notice as we complete the NEPA process, including a decision of whether to sign a Finding of No Significant Impact (FONSI), prior to a final decision on the IHA request.

Endangered Species Act (ESA)

There is one marine mammal species (Guadalupe fur seal) listed under the ESA with confirmed occurrence in the area expected to be impacted by the proposed activities. The NMFS West Coast Region Protected Resources Division has determined that the NMFS Permits and Conservation Division's proposed authorization of SpaceX's Falcon 9 First Stage recovery activities are not likely to adversely affect the Guadalupe fur seal. Therefore, formal ESA section 7 consultation on this proposed authorization is not required.

Proposed Authorization

As a result of these preliminary determinations, we propose to issue an IHA to SpaceX, to conduct the described Falcon 9 First Stage recovery activities at Vandenberg Air Force Base, in the Pacific Ocean offshore Vandenberg Air Force Base, and at the Northern Channel Islands, California, from June 30, 2016 through June 29, 2017, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. The proposed IHA language is provided next.

This section contains a draft of the IHA itself. The wording contained in this section is proposed for inclusion in the IHA (if issued).

1. This Incidental Harassment Authorization (IHA) is valid from June 30, 2016 through June 29, 2017.

(a) This IHA is valid only for Falcon 9 First Stage recovery activities at Vandenberg Air Force Base, in the Pacific Ocean offshore Vandenberg Air Force Base, and at the Northern Channel Islands, California.

2. General Conditions

(a) A copy of this IHA must be in the possession of SpaceX, its designees, and work crew personnel operating under the authority of this IHA.

(b) The species authorized for taking are the Pacific harbor seal (*Phoca vitulina richardii*), California sea lion (*Zalophus californianus*), Steller sea lion (eastern Distinct Population Segment, or DPS) (*Eumetopias jubatus*), northern elephant seal (*Mirounga angustirostris*), northern fur seal (*Callorhinus ursinus*), and Guadalupe fur seal (*Arctocephalus townsendi*).

(c) The taking, by Level B harassment only, is limited to the species listed in condition 3(b). See Table 5 in the proposed IHA authorization for numbers of take authorized.

(d) The taking by injury (Level A harassment), serious injury, or death of any of the species listed in condition 3(b) of the Authorization or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA.

3. Mitigation Measures

The holder of this Authorization is required to implement the following mitigation measure:

(a) Unless constrained by other factors including human safety or national security concerns, launches will be scheduled to avoid, whenever possible, boost-backs and landings during the harbor seal pupping season of March through June.

4. Monitoring

The holder of this Authorization is required to conduct marine mammal and acoustic monitoring as described below.

(a) SpaceX must notify the Administrator, West Coast Region, NMFS, by letter or telephone, at least 2 weeks prior to activities possibly involving the taking of marine mammals;

(b) To conduct monitoring of Falcon 9 First Stage recovery activities, SpaceX must designate qualified, on-site individuals approved in advance by NMFS;

(c) If sonic boom model results indicate that a peak overpressure of 1.0 psf or greater is likely to impact VAFB, then acoustic and biological monitoring at VAFB will be implemented.

(d) If sonic boom model results indicate that a peak overpressure of 1.0 psf or greater is predicted to impact the Channel Islands between March 1 and June 30, greater than 1.5 psf between July 1 and September 30, and greater than 2.0 psf between October 1 and February 28, monitoring of haulout sites on the Channel Islands will be implemented. Monitoring will be conducted at the haulout site closest to the predicted sonic boom impact area;

(e) Monitoring will be conducted for at least 72 hours prior to any planned Falcon 9 First Stage recovery and continue until at least 48 hours after the event;

(f) For launches during the harbor seal pupping season (March through June), follow-up surveys will be conducted within 2 weeks of the Falcon 9 First Stage recovery to monitor for any long-term adverse effects on marine mammals;

(g) If Falcon 9 First Stage recovery is scheduled during daylight, time-lapse photography or video recording will be used to document the behavior of marine mammals during Falcon 9 First Stage recovery activities;

(h) Monitoring will include multiple surveys each day that record the species, number of animals, general behavior, presence of pups, age class, gender and reaction to noise associated with Falcon 9 First Stage recovery, sonic booms or other natural or human caused disturbances, in addition to recording environmental conditions such as tide, wind speed, air temperature, and swell; and

(i) Acoustic measurements of the sonic boom created during boost-back at the monitoring location will be recorded to determine the overpressure level.

5. Reporting

The holder of this Authorization is required to:

(a) Submit a report to the Office of Protected Resources, NMFS, and the West Coast Regional Administrator, NMFS, within 60 days after each Falcon

9 First Stage recovery action. This report must contain the following information:

(1) Date(s) and time(s) of the Falcon 9 First Stage recovery action;

(2) Design of the monitoring program; and

(3) Results of the monitoring program, including, but not necessarily limited to:

(i) Numbers of pinnipeds present on the haulout prior to the Falcon 9 First Stage recovery;

(ii) Numbers of pinnipeds that may have been harassed as noted by the number of pinnipeds estimated to have moved more than one meter or entered the water as a result of Falcon 9 First Stage recovery activities;

(iii) For pinnipeds estimated to have entered the water as a result of Falcon 9 First Stage recovery noise, the length of time pinnipeds remained off the haulout or rookery;

(v) Any other observed behavioral modifications by pinnipeds that were likely the result of Falcon 9 First Stage recovery activities, including sonic boom; and

(vi) Results of acoustic monitoring including comparisons of modeled sonic booms with actual acoustic recordings of sonic booms.

(b) Submit an annual report on all monitoring conducted under the IHA. A draft of the annual report must be submitted within 90 calendar days of the expiration of this IHA, or, within 45 calendar days of the renewal of the IHA (if applicable). A final annual report will be prepared and submitted within 30 days following resolution of comments on the draft report from NMFS. The annual report will summarize the information from the 60-day post-activity reports, including but not necessarily limited to:

(1) Date(s) and time(s) of the Falcon 9 First Stage recovery action;

(2) Design of the monitoring program; and

(3) Results of the monitoring program, including, but not necessarily limited to:

(i) Numbers of pinnipeds present on the haulout prior to the Falcon 9 First Stage recovery;

(ii) Numbers of pinnipeds that may have been harassed as noted by the number of pinnipeds estimated to have entered the water as a result of Falcon 9 First Stage recovery activities;

(iii) For pinnipeds estimated to have moved more than one meter or entered the water as a result of Falcon 9 First Stage recovery noise, the length of time pinnipeds remained off the haulout or rookery;

(v) Any other observed behavioral modifications by pinnipeds that were likely the result of Falcon 9 First Stage recovery activities, including sonic boom;

(vi) Any cumulative impacts on marine mammals as a result of the activities, such as long term reductions in the number of pinnipeds at haulouts as a result of the activities; and

(vii) Results of acoustic monitoring including comparisons of modeled sonic booms with actual acoustic recordings of sonic booms.

(c) Reporting injured or dead marine mammals:

(1) In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by this IHA (as determined by the lead marine mammal observer), such as an injury (Level A harassment), serious injury, or mortality, SpaceX will immediately cease the specified activities and report the incident to the Office of Protected Resources, NMFS, and the West Coast Regional Stranding Coordinator, NMFS. The report must include the following information:

A. Time and date of the incident;

B. Description of the incident;

C. Status of all Falcon 9 First Stage recovery activities in the 48 hours preceding the incident;

D. Description of all marine mammal observations in the 48 hours preceding the incident;

E. Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, and visibility);

F. Species identification or description of the animal(s) involved;

G. Fate of the animal(s); and

H. Photographs or video footage of the animal(s).

Activities will not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with SpaceX to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. SpaceX may not resume their activities until notified by NMFS via letter, email, or telephone.

(2) In the event that SpaceX discovers an injured or dead marine mammal, and the lead observer determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.,* in less than a moderate state of decomposition), SpaceX will immediately report the incident to the Office of Protected Resources, NMFS, and the West Coast Regional Stranding Coordinator, NMFS.

The report must include the same information identified in 6(c)(i) of this IHA. Activities may continue while NMFS reviews the circumstances of the incident and makes a final determination on the cause of the reported injury or death. NMFS will work with SpaceX to determine whether additional mitigation measures or modifications to the activities are appropriate.

(3) In the event that SpaceX discovers an injured or dead marine mammal, and the lead observer determines that the injury or death is not associated with or related to the activities authorized in the IHA (*e.g.,* previously wounded animal, carcass with moderate to advanced decomposition, scavenger damage), SpaceX will report the incident to the Office of Protected Resources, NMFS, and the West Coast Regional Stranding Coordinator, NMFS, within 24 hours of the discovery. SpaceX will provide photographs or video footage or other documentation of the stranded animal sighting to NMFS. The cause of injury or death may be subject to review and a final determination by NMFS.

6. Modification and suspension

(a) This IHA may be modified, suspended or withdrawn if the holder fails to abide by the conditions prescribed herein, or if NMFS determines that the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals.

Request for Public Comments

We request comment on our analysis, the draft authorization, and any other aspect of this Notice of Proposed IHA for SpaceX Falcon 9 First Stage recovery activities. Please include with your comments any supporting data or literature citations to help inform our final decision on SpaceX's request for an MMPA authorization.

Dated: March 25, 2016.

Donna S. Wieting,

Director, Office of Protected Resources, National Marine Fisheries Service.

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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

United States Global Change Research Program

AGENCY: Office of Oceanic and Atmospheric Research (OAR), National Oceanic and Atmospheric Administration (NOAA), Department of Commerce (DOC).

ACTION: Request for Public Nominations for Technical Contributors.