

**Application for a Five-Year Programmatic Permit for  
Small Takes of Marine Mammals Incidental to  
Launching of Space Launch Vehicles, Long Range  
Ballistic Target Missiles, and Smaller Missile Systems at  
Pacific Spaceport Complex Alaska, Kodiak Island,  
Alaska**



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## **1 Introduction**

Alaska Aerospace Corporation (AAC), an entity of the State of Alaska, is applying for a five-year programmatic permit for the take of pinnipeds by harassment incidental to rocket launch operations from its Pacific Spaceport Complex - Alaska (PSCA). PSCA occupies 3,717 acres of state-owned lands on the Narrow Cape Peninsula on the eastern side of Kodiak Island, Alaska. Launch operations are authorized under license from the Federal Aviation Administration (FAA), Office of the Associate Administrator for Space Transportation, in accordance with the facility's Environmental Assessment (EA), stipulations in the EA's Finding of No Significant Impact (FAA 1996), and in subsequent licenses (FAA 1998, 2003, and 2005, 2013). The area considered to be affected by the facility and its operations was set in a September 1996 meeting involving AAC, its environmental consultant (The Environment and Natural Resources Institute, University of Alaska, Anchorage), and government agencies including the FAA, the U.S. National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (FWS), and the Alaska Department of Environmental Conservation (ADEC). There are no federally listed terrestrial threatened or endangered species within this six mile radius area, however there are several federally listed marine mammals present in the waters offshore and on haulouts on Ugak Island, which lies about 3.5 miles from the launch pad area. The species of interest using Ugak Island haulouts is the harbor seal (*phoca vitulina*).

## **2 Description of Specified Activity**

*"A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals."*

Orbital and suborbital launch vehicles (i.e. rocket, missiles) are launched from PSCA as part of the aerospace industry. The operation takes years to plan and execute, as well as a large preparation effort lasting for weeks before the launch. In preparation for the launch, launch vehicles are checked, integrated, and erected. During launch, burning fuel from the launch vehicle creates noise and light in the surrounding area that may result in a take on and near Kodiak Island.

A typical launch vehicle is deployed by igniting the vehicle through a controlled means to send it on a very specific flight path. Upon ignition, the fuel begins to burn while the launch vehicle remains on the ground for several seconds. After which the vehicle accelerates rapidly upwards. The sound produced subsides to inaudible within two minutes. Sound levels are different for each type of vehicle and can be found in Table 1.

Spent first stage rocket motors impact the ocean from 11 to more than 300 miles down range, depending on launch vehicle. Sonic booms reach the earth's surface beyond the Outer Continental Shelf (US FAA 1996). Both falling first stage rocket motors and sonic booms are too far from land to take pinnipeds and are not expected to affect whales.

PSCA occupies 3,717 acres of state-owned lands on the Narrow Cape Peninsula on the eastern side of Kodiak Island, Alaska. Ugak Island (where the seal haulouts of concern are located) is roughly 4 miles off-shore to the South-Southeast. The launch pads are located near the Narrow

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Cape shoreline which places them approximately 3.5 miles from the nearest point of Ugak Island and approximately 4.5 miles from its farthest point.

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The vehicles typically launched from PSCA is included in Figure 1. No vehicles launched from PSCA would exceed the sound pressure data limitations provided in Table 1.

Orbital and suborbital vehicles may be launched from several locations on site, however, no launch pads are closer to the haulouts on Ugak Island than Launch Pad 1 (LP1), from which the largest and, therefore, loudest vehicles will be launched.

Table 1 provides motor diameters and representative sound pressures for various launch vehicles, some of which have been launched previously from PSCA. The listed vehicles include various ballistic launch vehicles and the small lift Castor 120 space launch vehicle, as well as smaller target/interceptor systems and tactical rocket systems. All PSCA sound measurements reported in Table 1 were taken at a distance of 3.5 miles from the launch pad at the nearest point of Ugak Island, the location of pinniped haulouts. It is important to note that the Castor 120 (previously launched from PSCA) is the loudest launch vehicle motor expected to be launched from PSCA over the five-year period covered by the requested permit.

### 2.1.1 Peacekeeper Derivatives - Castor 120, Athena, Minotaur IV and V, and Taurus I

The Castor 120 was the base vehicle analyzed in the Environmental Assessment (EA) conducted by the FAA (US FAA 1996) in support of the decision to issue a launch license to AAC. The Castor 120 uses solid fuel and produces about 371,000 pounds of thrust. The motor mass is about 116,000 pounds and the motor is 347 inches long and 93 inches wide. Modeling shows the rocket

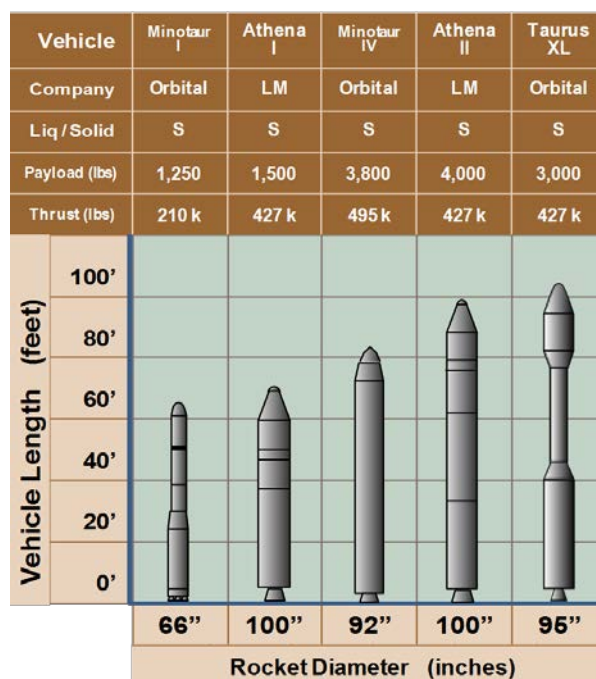


Figure 1. PSCA Launch Vehicle Examples



is about eight miles above the earth's surface when it overflies Ugak Island, and that the sonic boom reaches earth between 21 to 35 miles down range, which is past the Outer Continental Shelf break and over the North Pacific abyss (US FAA 1996). Sound pressure from the Castor 120 at the nearest traditional haulout on Ugak Island was measured to be 101.4 dBA Sound Exposure Level (SEL) (Table 1). None of the vehicles expected to be flown from PSCA over the five-year period covered by this rule is known to be louder than the Castor 120.

**Table 1. Past and Anticipated Launch Vehicles.**

Previously Launched & Recorded at PSCA (also Potentially Launched in Future)							
Launch Designator	Launch Vehicle	Date	Distance to Haulout	Motor Diameter (feet) <sup>1</sup>	SEL (dBA)	Lmax (dBA)	LPeak (dBA)
QRLV		11/5/98	3.5 miles <sup>2</sup>	4.3	88.4	78.2	97.0
QRLV		9/15/99	3.5 miles <sup>2</sup>	4.3	92.2	81.5	101.5
QRLV		3/22/01	3.5 miles <sup>2</sup>	4.3	80.3	73.3	87.2
Athena	Castor 120	9/29/01	3.5 miles <sup>2</sup>	7.75	101.4	90.8	115.9
FT-04-1	Polaris A-3 STARS	2/23/06	4.1 miles	4.5	92.3	86.0	109.0
FTG-02	Polaris A-3 STARS	9/01/06	4.1 miles	4.5	90.1	83.1	105.6
FTG-03a	Polaris A-3 STARS	9/28/07	4.1 miles	4.5	91.4	84.2	107.3
FTX-03	Polaris A-3 STARS	7/18/08	4.1 miles	4.5	89.6	83.0	108.3
-	Minotaur I	-	-	4.5	90+ <sup>2</sup>	-	-
-	C-4 Trident I	-	-	6.1	-	-	-
-	Castor I	-	-	2.6	-	-	-
-	SR19/SR773	-	-	4.3	-	-	-
-	SR19/SR19	-	-	4.3	-	-	-
-	Castor IVB	-	-	3.3	-	-	-
Tactical Vehicles	-	-	-	<1.5	-	-	-

**NOTES:**

1. Motor sound pressures from solid fueled motors, roughly, correlate to motor diameter.
2. Estimated.

### **2.1.2 Minuteman Derivative - Minotaur I**

The Minotaur I is a small lift solid propellant space launch vehicle, the first stage of which is a modified Minuteman II. The first stage motor has a diameter of 4.5 feet. This launch vehicle has not yet been flown from PSCA. Sound pressure monitoring of two Minotaur I launches was accomplished at Vandenberg Air Force Base, California (VAFB). The data were collected 1.4 miles away from the launch point and show sound pressure levels of 104.9 to 107.0 dBA (SEL) at that distance. Sound energy at sea level decreases with the square of the distance, and given that the nearest traditional haulout on Ugak Island is two miles farther away (i.e. the haulout is 3.5 miles from the launch point), the anticipated sound pressure levels from a Minotaur I at the Ugak Island nearest traditional haulout would be less than that of the Castor 120.

### ***2.1.3 Trident Derivatives - C-4 Trident I***

The C-4 is a solid fueled vehicle and its first stage has a diameter of 6.1 feet, which is about 1.5 feet less than the Castor 120. Because it is significantly smaller in diameter than the Castor 120 and uses a similar fuel, it is anticipated that sound pressure levels at the nearest traditional haulout would be less than those of the Castor 120.

### ***2.1.4 Polaris Derivatives - A-3 STARS***

The Strategic Target System (STARS) utilizes the first stage of the Polaris A-3, which is solid fueled and measures 4.5 feet in diameter. Several STARS systems have been flown from PSCA. Recorded sound pressure levels at Ugak Island have ranged from 90.2 to 91.4 dBA (SEL).

### ***2.1.5 Smaller Vehicles and Tactical Rocket Systems***

A number of smaller missile systems, such as tactical or target vehicles, have the possibility of being flown from PSCA. As shown, representative smaller systems range from about a foot in diameter up to about four feet in diameter. Sound pressures from these smaller systems are not available, but will be substantially less than those from the space launch and ballistic vehicles described above and pose little potential for disturbance to marine mammals.

Even smaller systems ranging down in size to several inches in diameter will conceivably be flown as well. Small sounding and research rockets (defined as less than 5,000 pounds in weight) will be excluded from this request, including its mitigations and reporting, as the rockets' small shape and energy are too small to transmit an appreciable sound pressure on Ugak Island, and is expected to be well below the threshold for an active response, as is discussed in Section 8.

### ***2.1.6 Medium Lift Vehicles***

AAC has submitted an Environmental Assessment to the FAA for a third launch pad. The medium lift vehicles are larger in diameter than those described in this document. Medium lift vehicles are not expected within the LOA five-year period and are not included in this request.

## ***3 Dates, Duration, and Specified Geographic Region***

*"The date(s) and duration of such activity and the specified geographical region where it will occur."*

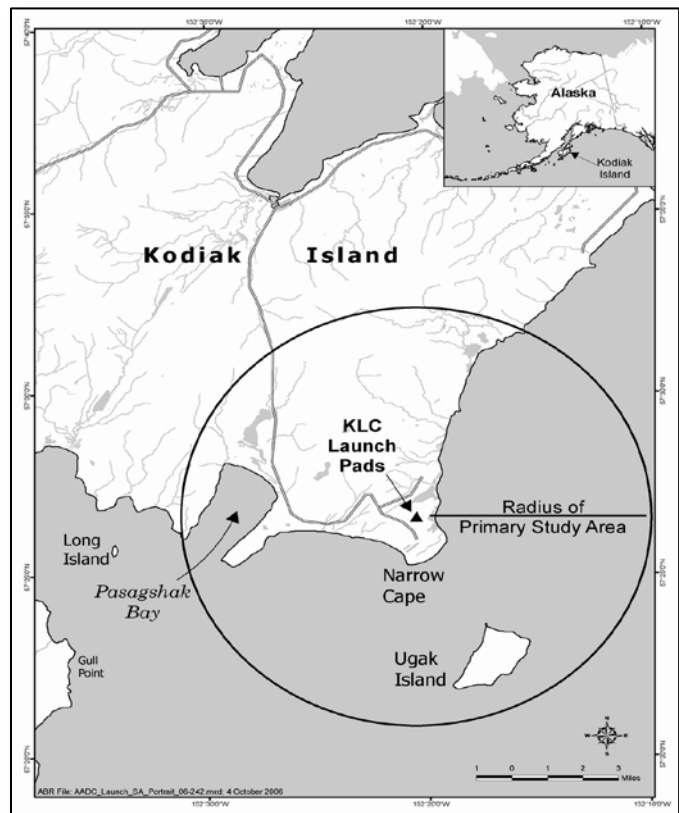
PSCA is located on Kodiak Island, which is an island in the Gulf of Alaska about 99 miles long and 10 to 60 miles wide. PSCA is about 22 air miles from the City of Kodiak, which is the largest settlement on the Kodiak Island. The land occupied by PSCA is owned by the State of Alaska and is administered by AAC under terms of an Interagency Land Management Assignment (ILMA) issued by AAC's sister agency, the Alaska Department of Natural Resources.

The attendees of the September 1996 meeting referenced in Section 1, above, reviewed information on the known effects of rocket operations on the environment and set the expected impact area to be within a six-mile radius of the launch pad area. Figure 2 shows the location of Ugak Island relative to the PSCA launch pad area and the six-mile radius of concern. PSCA has two launch pads, designated as Launch Pad 1 (LP1) and Launch Pad 2 (LP2), at this time. LP1 is capable of launching small lift class vehicles and is 3.5 miles from the nearest point on Ugak

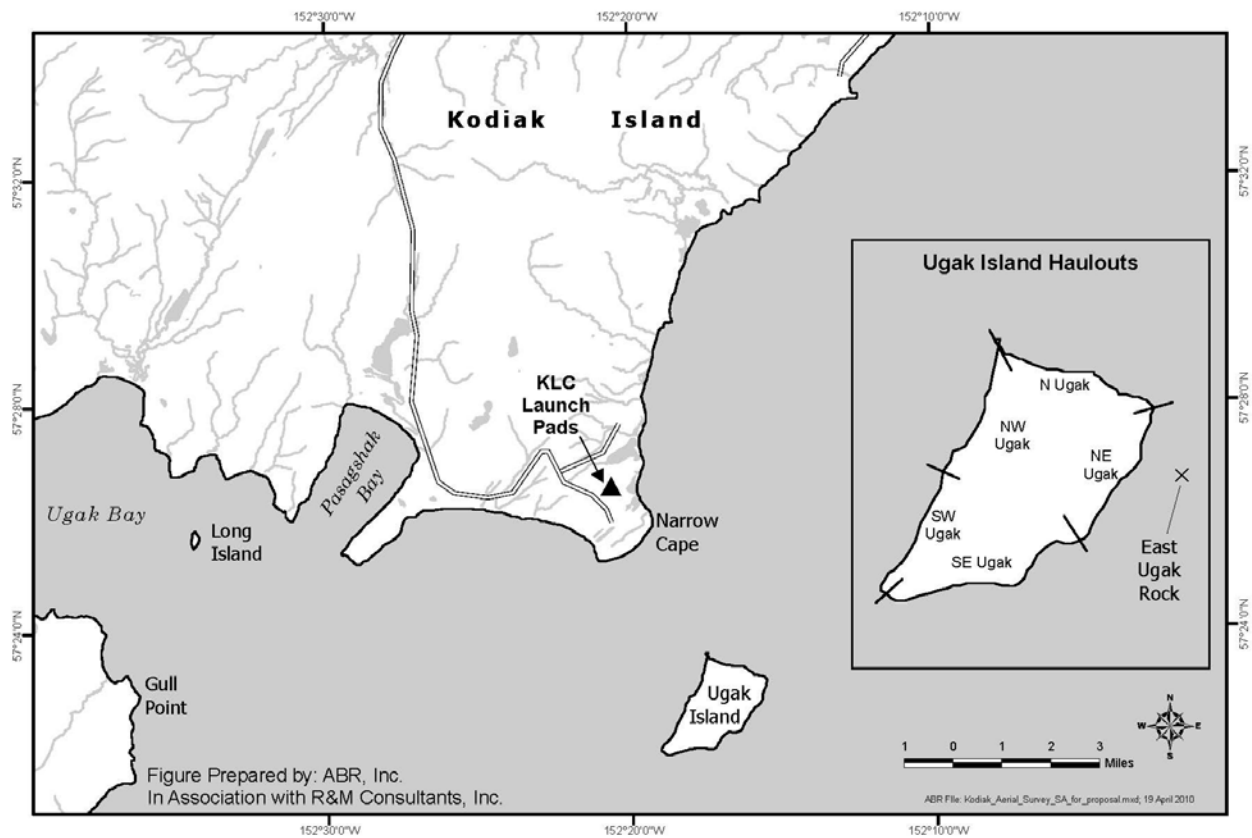
Island. Small lift vehicles are generically categorized as being capable of carrying payloads of up to 4,400 pounds. LP1 has a flame trench that directs exhaust (and much of the sound) horizontally eastward during liftoff, while LP2 is a flat pad. LP1 is larger and better suited for the larger vehicles within our capabilities. The vehicles that produce the most sound in Table 1 are most likely to be launched from LP1.

Launches could occur year round, at any time of day or night, and in most weather during the period to be covered under this application (2/1/2017 through 1/31/2022). PSCA launch azimuths range from 110° to 220°. The eastern most launch azimuth of 110° crosses the extreme eastern edge of Ugak Island where several pinniped haulouts are found. Modeling done of Castor 120 space launches indicates the vehicle is passing through 45,000 feet altitude by the time it reaches the island about 70 seconds following launch (US FAA 1996).

The ILMA also grants AAC authority to restrict public access for safety purposes to an additional 7,000 acres of land abutting PSCA's northern and western boundaries, as well as to all of Ugak Island. Ugak Island's axis trends northeast to southwest. The island is about two miles long by about one mile wide. The land slopes steeply upward from a spit on the island's northern most point, which is the nearest traditionally used haulout (Figure 3 and Figure 4), to the southwest, culminating in cliffs that are approximately 1,000 feet in elevation. These cliffs run the entire length of the island's long axis. Eastward, the narrow Outer Continental Shelf ends about twenty miles offshore, where it plunges precipitously to the North Pacific abyss. Near shore water depths to the immediate south and west of the island range to several hundred feet. Primary haulouts are present mainly on Ugak Island's eastern shores.



**Figure 2. PSCA Vicinity Map.**



**Figure 3. Ugak Island Haulouts.**



**Figure 4. Ugak Island (foreground) as seen from the Southeast.**

AAC's estimate of the total number of vehicles that might be launched from PSCA over the course of the five-year period covered by this request is 45, with an average of nine per year. Few launches are on contract at this time, so a specific distribution cannot be given. Generally, the frequency will be separated by several months; however, there may be limited instances of a rapid succession of launches in the course of hours, or days. Launches can, and do, occur year-round. The duration of the possible disturbance will be at levels that may cause disturbances for only a few seconds tapering off to inaudible in a few minutes.

In addition, launch planning is a dynamic process, and launch delays, which can last from hours to days, can and do occur. Launch delays occur due to variables ranging from technical issues to adverse weather. These factors have controlling influence over the numbers of vehicles by class that are actually launched in any given year from PSCA.

#### 4 **Species and Numbers of Marine Mammals**

*"The species and numbers of marine mammals likely to be found within the activity area."*

Marine mammals that regularly occur in the vicinity of PSCA include the harbor seal, Stellar sea lion, gray whale, humpback whale, and sea otter (Table 2). All are protected under the Marine Mammal Protection Act (MMPA) and the Steller sea lion, humpback whale, and sea otter are listed as threatened or endangered under the Endangered Species Act (ESA). The U.S. Fish and Wildlife Service manages the sea otter, and NMFS does not have jurisdiction to issue takes of this species; therefore, it is not discussed further in this application.

**Table 2. Summary of MMPA Species**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Status</b>	<b>Occurrence</b>	<b>Seasonality</b>	<b>Daily counts</b>
Harbor seal	<i>phoca vitulina</i>	MMPA	Common	Trends toward Summer	32-1500
Stellar Sea Lion	<i>eumetopias jubatus</i>	Endangered	Rare	Trends toward Summer	0-19
Gray Whale	<i>eschrictius robustus</i>	MMPA	Seasonal	Spring and fall	0-32
Humpback Whale	<i>megaptera novaeangliae</i>	Endangered	Seasonal	Summer and fall	0-4

Table 3 presents daily counts, by species, of the MMPA-protected marine mammals that have been observed during launch-related environmental monitoring activities conducted since a previous LOA became active in early 2006. The counts are specific to Ugak Island. These counts provide a data set for the types of marine mammals present. Subsequent data in this report will provide more recent pinniped data.



**Table 3. Marine Mammal Observations during Launch-Related Environmental Monitoring within Six-mile Radius Study Area**

Date	Steller Sea Lion <sup>1</sup>	Harbor Seal <sup>2</sup>	Gray Whale	Humpback Whale	Pre-Launch Survey (# days pre-launch)	Post-Launch Survey (# days post-launch)
2/18/2006		684			Yes (5)	
2/19/2006		519	2		Yes (4)	
2/20/2006		201			Yes (3)	
2/21/2006		405	8		Yes (2)	
2/22/2006		350			Yes (1)	
2/23/2006		211	1			Yes (Same Day)
2/24/2006		270	1			Yes (1)
2/25/2006		58				Yes (2)
8/28/2006	3	495			Yes (3)	
8/29/2006	4	652			Yes (2)	
8/31/2006	8 <sup>3</sup>	901			Yes (1)	
9/1/2006	2	961				Yes (Same Day)
9/2/2006	1	954	2	1		Yes (1)
9/3/2006	1	789		1		Yes (2)
5/23/2007		136	2		Yes (2)	
5/27/2007		402	3			Yes (2)
5/28/2007		224	1			Yes (3)
9/25/2007		381	4		Yes (3)	
9/26/2007	2	265			Yes (2)	
9/27/2007		461	8		Yes (1)	
9/30/2007		686	6			Yes (2)
10/1/2007		748				Yes (3)
7/15/2008	4	700	9		Yes (3)	
7/16/2008	5	611	32		Yes (2)	
7/17/2008	1	853	9		Yes (1)	
7/18/2008	4	840	12			Yes (Same Day)
7/19/2008	4	744	1			Yes (1)
7/20/2008	5	610	5			Yes (2)
7/21/2008	3	1534				Yes (3)
12/7/2008	1	971	5			Yes (2)

**NOTES:**

1. Steller sea lions pup mid-May to mid-July and breed late-May to late-July at rookeries. Molt is late July to early December (Hoover 1988). Haulouts are used for resting. Ugak Island is a haulout not a rookery. The Ugak Haulout has been used in the past between July and October.
2. Harbor seals pup from mid-May to late-June (Jemison and Kelly 2001) and molt from June to October. Both periods contain peaks in haulout attendance.
3. Five individuals observed by aerial survey, eight captured on unmanned video.

The primary monitoring method has involved conducting aerial surveys along set transect lines to observe and count harbor seals and Steller sea lions. Marine mammals other than harbor seals and sea lions, although observed and recorded, were not specifically targeted by the launch-related aerial surveys. Marine mammal abundance and distribution were recorded during aerial surveys

flown in a single-engine fixed-wing airplane with floats. The aerial survey route was designed for harbor seals and sea lions and was flown using a Global Positioning System (GPS) for navigation. All surveys were intended to be flown within two hours of the daytime low tide and during mid-day, when haul out attendance peaks for harbor seals. The aerial survey schedule during the formal monitoring period consisted of daily surveys one day prior to the launch, immediately following the launch (on the launch day), and each day of the three days following the launch date, weather conditions permitting (NMFS 2008). Two additional surveys were often conducted prior to the formal monitoring period at AAC's discretion. The two additional surveys were conducted to balance the pre-launch sample size with the three post-launch surveys to allow calculation of the variance in pre-launch counts for subsequent statistical analysis. The aerial surveys were flown 1000 feet above sea level at 80–90 nautical mph and the flight line was kept  $\geq 0.25$  miles from known haulouts. Digital photographs of groups of pinnipeds (generally greater than 10 pinnipeds) were taken with a Nikon D70 camera (equipped with a 70 to 300 millimeter zoom lens) or a Canon Powershot S5 camera with image stabilized zoom. Images were reviewed on a personal computer and counts of pinnipeds were summarized from sets of overlapping images. All counts of greater than 15 pinnipeds were made from digital images taken from the aircraft, unless the images were blurred or underexposed, in which cases the visual estimates were used.

Foul weather, daylight considerations, launch timing, and timing of tidal flux have all contributed to the difficulty in collecting the data in Table 3. Foul weather precludes aerial surveys primarily due to visibility, excessive turbulence, and other dangerous conditions. In addition, rockets can often be launched during periods of weather that are not conducive to operation of small aircraft. Table 3 does not reflect the aerial surveys that were attempted and aborted or scrubbed. Only successfully completed aerial surveys are listed.

Table 4, below, shows the results of the quarterly aerial surveys during the most recent Rule. Careful review shows that the population trends in the quarterly surveys mirror the results of the launch related survey. Previous rocket launches did not appear to depress the daily attendance of pinnipeds at haulouts on Ugak Island. The number of harbor seals tallied at Ugak Island during the July 2008 FTX-03 surveys reached a record for monitoring surveys, at 1,534 seals (R&M, 2008). Numbers in Table 3 are highest during August and September because they were conducted during the annual molt, when maximal numbers of seals tend to haulout (Calambokidis et al., 1987).

Marine mammals other than harbor seals and sea lions, although observed and recorded, were not specifically targeted by the aerial survey and other monitoring efforts for this launch. A small number of gray whales (5), humpback whales (2), and sea otters (3) were the only other marine mammals observed.

During the most recent Rule, there were 17 quarterly surveys flown, as can be seen in Table 4. Steller sea lions were only spotted one time; while the harbor seals were consistently present (AAC 2016).

**Table 4. Five Year Quarterly Survey Results**

Year	Quarter	Date	Time (local)	# Sea Lions	# Harbor Seals	Notes
2011	2 <sup>nd</sup> (Apr-Jun)	N/A	-	-	-	Source selection for flights
2011	3 <sup>rd</sup> (Jul-Sep)	21-Sep-11	1330-1430	19	462	Only sea lion sighting
2011	4 <sup>th</sup> (Oct-Dec)	5-Dec-11	-	-	-	Postponed twice due to multiple storms
2012	1 <sup>st</sup> (Jan-Mar)	Mar-12	0930-1030	0	32	Results Typical
2012	2 <sup>nd</sup> (Apr-Jun)	N/A	-	-	-	Postponed due to storms
2012	3 <sup>rd</sup> (Jul-Sep)	8-Jul-12	1600-1626	0	747	Results Typical
2012	4 <sup>th</sup> (Oct-Dec)	20-Oct-12	1200-1330	0	975	Results Typical
2013	1 <sup>st</sup> (Jan - Mar)	16-Mar-13	1209-1334	0	823	Results Typical
2013	2 <sup>nd</sup> (Apr-Jun)	16-Jun-13	1342-1408	0	332	Results Typical
2013	3 <sup>rd</sup> (Jul-Sep)	1-Oct-13	1210-1316	0	955	Results Typical
2013	4 <sup>th</sup> (Oct-Dec)	14-Nov-13	N/A-N/A	0	847	Results Typical
2014	1 <sup>st</sup> (Jan-Mar)	21-Jan-14	1115-1230	0	144	Results Typical
2014	2 <sup>nd</sup> (Apr-Jun)	5-Apr-14	1218-1338	0	1133	Results Typical
2014	3 <sup>rd</sup> (Jul-Sep)	3-Jul-14	1110-1239	0	513	Results Typical
2014	4 <sup>th</sup> (Oct-Dec)	30-Oct-14	1100-1207	0	810	Results Typical
2015	1 <sup>st</sup> (Jan-Mar)	26-Jan-15	1100-1200	0	312	Results Typical
2015	2 <sup>nd</sup> (Apr-Jun)	23-Apr-15	1230-1330	0	631	Results Typical
2015	3 <sup>rd</sup> (Jul-Sep)	24-Aug-15	1520-1610	0	726	Results Typical
2015	4 <sup>th</sup> (Oct-Dec)	18-Oct-15	1100-1154	0	609	Results Typical
2016	1 <sup>st</sup> (Jan-Mar)	21-Mar-16	1100-1200	0	898	Results Typical

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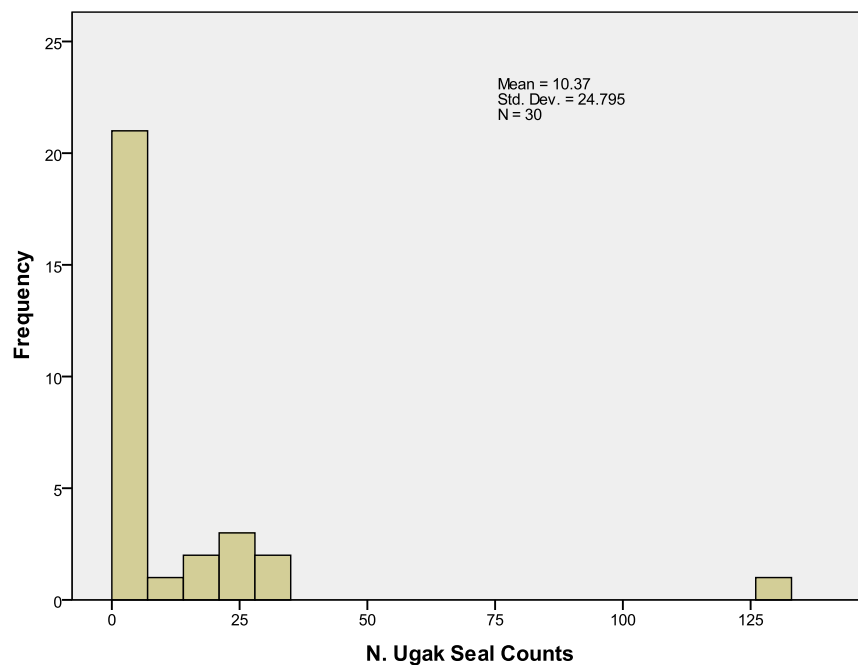
Current estimates for Alaska are at 205,090 (Muto, M. M., et al., 2015). The South Kodiak stock has an estimated abundance of 19,199 (Muto, M. M., et al., 2015), with most of the stock generally



at Tugidak Island, southwest of Kodiak. NMFS does not classify Kodiak as a strategic stock (Moto and Angliss 2016).

Harbor seals are present on Ugak Island year round. Approximately 97% of all individuals are found on the eastern shore, based on aerial survey counts from launch monitoring reports conducted since January 2006. The eastern shore is backed by high steep cliffs that reach up to 1,000 feet above sea level and is approximately 5 miles from LP1. These cliffs form a visual and acoustic barrier to rocket operations, and limit effects on the species. Additionally, sound pressure recordings that showed surf and wind-generated sound pressures at sea level were generally in the greater than 70 dBA (SEL) range on the best weather and surf days (cf. Cuccarese et al. 1999, 2000); while sound pressures at sea level can exceed 100 dBA (SEL) during inclement weather. The remainder of the harbor seals identified during surveys are found at the northwest spit.

Because access to Ugak Island harbor seal haulouts is difficult, little is known of how seals use these habitats. Harbor seals generally breed and molt where they haulout, so it is assumed that both of these activities take place on Ugak Island. This assumption is supported by the fact that young seals have routinely been seen there during aerial surveys. These haulouts are the only haulouts used by harbor seals within the six-mile radius area designated as being affected by launch operations. Pupping in Alaska generally takes place in the May-June time frame; while molting generally occurs from June to October. Total counts on Ugak Island have increased steadily since the 1990s from several hundred (ENRI 1995-1998) up to a peak of about 1,500 in the last ten years (R&M 2008) (Table 3).



**Figure 5. Harbor Seal Count Frequency at the Northwest Spit<sup>1</sup>.**

1. Frequency of harbor seal counts at the northwest spit during 30 aerial surveys conducted during pre- and post-launch aerial surveys, Kodiak Island, 2006–2008. Unpublished data collected by ABR, Inc. in association with R&M Consultants, Inc. Note: no seals were seen at the northwest spit during 19 of 30 surveys.

## 4.2 *Steller sea lion*

The Steller sea lion population is described by two stocks. Those west of 144° West longitude, which includes the PSCA area, are classified as Endangered. The Alaskan portion of the western stock of the Steller sea lions, which includes those found in the Narrow Cape area, has a population estimate of 49,497 (Moto and Angliss 2016). Mature and sub-adult male Steller sea lions have previously used a post-breeding haulout found on a spit on Ugak Island. This spit is on the northwestern most shore of the island within 3.5 miles of the launch pad complex (Figure 3). This spit is also the closest haulout to the launch complex and experiences the highest sound pressures. The historic occupancy period ranged from June to September (post breeding), with peak reported numbers in the few hundred (Sease 1997; ENRI 1995-1998). Numbers of individuals using the spit have declined to zero and this reduction is consistent with the general declines seen in the species throughout Kodiak Island and as a whole. The spit is designated a long term trend count site by NMFS and has been surveyed once yearly, with June as the target, since the 1990s. Counts since 2000 have generally been zero (e.g. AAC 2016, US NMFS 2009; Fritz and Stinchcomb 2005). No Stellar Sea lions have been seen at the spit during our surveys since 2011 (AAC 2016 (TacSat-4)) when 19 were present. Previously, when Stellar sea lions were present during surveys, they have occupied a haulout on a supratidal rock east of Ugak Island, known as East Ugak Rock. East Ugak Rock is 5.2 miles from LP1 and partially shielded by Ugak Island. During one series of aerial surveys, East Ugak Rock was used daily by sea lions during previous monitoring surveys in the June-September timeframe. As a result of the reduction in the use of the nearest haulout by Stellar sea lions, this species is not expected to be affected by launch operations and they are not discussed further in this application.

#### 4.3 *Gray Whale*

The migration path of the gray whale runs past Narrow Cape twice yearly. The area from Cape Chiniak (which is about 15 miles north of Narrow Cape) to Narrow Cape/Ugak Island has been identified by NMFS as a major spring gray whale concentration area and probable feeding area (Consiglieri et al. 1989). PSCA operations do not affect gray whales because airborne noise is generally reflected at the sea surface outside of a 26° cone extending downward from the ascending rocket (Richardson et al. 1995). Little sound energy passes into the sea across the air-water boundary. Submerged animals would have to be directly underneath the rocket to hear it, and given the hypersonic velocity of launch vehicles in the atmosphere, the duration of sounds reaching gray whales would be negligible. Given the limited surface area involved, the very short time a cetacean would be exposed to the noise, and the attenuation that occurs at the air-sea interface, this species is not expected to be affected by launch operations and they are not discussed further within this application.

#### 4.4 *Humpback Whale*

The humpback whale is seasonally present in small numbers in the near shore waters around Narrow Cape. A peak count of thirteen was recorded in 1997 about fifteen miles north of PSCA at Cape Chiniak (ENRI 1995-1998). Sightings around Narrow Cape in the vicinity of the launch complex are sporadic (Table 3) and range from one to four. Humpback whales will not be affected by launch operations from PSCA for the reasons discussed for gray whales in section 4.3, and they will not be discussed further in this application.

## 5 **Affected Species Status and Distribution**

*"A description of the status and distribution, including seasonal distribution (when applicable), of the affected species or stocks of marine mammals likely to be affected by such activities."*

### 5.1 **H a r b o r S e a l**

The harbor seal is widely distributed in the Gulf of Alaska, an area that includes Narrow Cape. Harbor seals have not been listed under the ESA, nor have they been listed as depleted under the MMPA.

In the last five years of 17 quarterly surveys that were commissioned by AAC, there has been an average of 644 seals spotted with a range of 32-1133 and standard deviation of 307. From the first quarter of the calendar year through the fourth, the averages were as follows: 441, 698, 608, and 810, respectively (AAC 2016). As indicated in Section 4.2 above, pupping generally occurs from May to June and molting occurs from June to October.

## 6 **Type of Incidental Taking Authorization Requested**

*"The type of incidental taking authorization that is being requested (i.e., takes by harassment only; takes by harassment, injury, and/or death) and the method of incidental taking."*

There are two types of incidental take. The most likely outcome is pinnipeds might be taken by incidental Level B Harassment (e.g. head lifting, move toward or into the water) as a consequence of rocket motor noise or the sudden visual appearance of a rocket during its ascent from PSCA.

Pinniped responses to launches from VABF, with notes on related observations from Ugak Island are presented in Section 8.

## 7 **Take Estimates for Marine Mammals**

*"By age, sex, and reproductive condition (if possible), the number of marine mammals (by species) that may be taken by each type of taking identified in Section 5, and the number of times such takings by each type of taking are likely to occur."*

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The estimates in Table 5 are based on a maximum of nine launches per year at a frequency not to exceed one per month.

**Table 5. Summary of Estimated Take**

Species	Age Groups	Sex	Annual Level B Takes	Annual Mortality
Harbor seal	All	Both	0-315	0

As discussed in Section 2, durations of light and sound are less than a few minutes with a peak that lasts a few seconds and then subsides quickly to ambient noise.

**Table 6. Harbor Seal Counts pre- and post-Launch Since Rule Was Created in 2006.**

<i>Launch Name/Date</i>	<i>Numbers Pre Launch</i>	<i>Numbers Post Launch</i>
FT-04-1 (02/23/06) <sup>1</sup>	350 <sup>6</sup>	211 <sup>6</sup>
FTG-02 (09/01/06) <sup>2</sup>	901 <sup>7</sup>	961 <sup>7</sup>
FTG-03 (05/27/07) <sup>3</sup>	136 <sup>7,8</sup>	402 <sup>7,8</sup>
FTG-03a (09/28/07) <sup>4</sup>	461 <sup>7</sup>	0 <sup>9</sup>
FTX-03 (07/18/08) <sup>5</sup>	853 <sup>7</sup>	840 <sup>7</sup>

1. R&M et al. 2006. Environmental Monitoring Report FT-04-1 Launch. Report for Alaska Aerospace Development Corporation. Anchorage, Alaska. 28pp + Appendices.
2. R&M et al. 2006. Environmental Monitoring Report FTG-02 Launch. Report for Alaska Aerospace Development Corporation. Anchorage, Alaska. 32pp + Appendices.
3. R&M et al. 2007. Environmental Monitoring Report FTG-03 Launch. Report for Alaska Aerospace Development Corporation. Anchorage, Alaska. 24pp + Appendices.
4. R&M et al. 2007. Environmental Monitoring Report FTG-03a Launch. Report for the Alaska Aerospace Development Corporation. Anchorage, Alaska. 28pp + Appendices.
5. R&M et al. 2008. Environmental Monitoring Report FTX-03 Launch. Report for Alaska Aerospace Development Corporation. Anchorage, Alaska. 29pp + Appendices.
6. Visual count; launch coincided with execution of LOA that requires photographic documentation of seal numbers.
7. Counts from photographs.
8. Data are not representative of launch period. Sole pre-launch survey was done two days prior to launch (weather precluded surveys on launch day), and first post launch survey was done two days after launch due to adverse weather conditions.
9. Survey occurred at high tide when haulouts were flooded.

The total number of harbor seals present on Ugak Island ranges up to a maximum of about 1,500 in the last ten years, and 1,150 in the last five years, approximately 97% are found at the eastern shore haulout where they are sheltered from launch effects by the 1000 ft. cliffs that stand between

this haulout and PSCA. Only about 3% use the northwest spit across from PSCA because of the lack of suitable beaches (See Section 4.2). When present, the majority of counts at the northwest spit were of less than 25 individuals (Figure 5). An exceptional one-time high count of about 125 animals has been made within the last ten years. The mean number of harbor seals present at the northwest spit, however, is roughly 10 with a standard deviation of roughly 25.

A representative Harbor seal population at the northwest spit of 35 (mean plus one standard deviation, see Figure 5) is used for the following take estimates.

Therefore, for a maximum of five launches during the pupping and molting season and assuming all launches are of the Castor 120 and that no habituation occurs, AAC estimates that up to 70 Harbor seal pups (14 pups per launch times 5 launches) could be taken by Level B Harassment per year and that up to 7 Harbor seal pups (1.4 pups per launch times 5 launches) could be taken by Level A Harassment per year.

Further, and assuming that all of the adult Harbor seals expected to be present suffer a Level B Harassment during a launch, that all nine launches are of the Castor 120, and no habituation occurs AAC, estimates that up to 315 harbor seals could be taken by Level B Harassment per year based on the 35 adult Harbor seals expected to be present during a launch. This estimate also assumes that all nine launches occur outside the pupping and molting season, for conservatism.

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No Stellar sea lions will be taken by harassment given the very low likelihood that sea lions will be present at the nearest haulout at Ugak Island during a launch.

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No whales will be taken by harassment given that sound pressures in the range produced by rocket motors generally decouple at the air-sea interface. AAC does not anticipate impacts to whales.

## **8 Anticipated Impact of the Activity**

*"The anticipated impact of the activity to the species or stock of marine mammal."*

Launch activities are generally considered to be subject to the terms of the National Environmental Policy Act (NEPA), as was the issuance of PSCA's Launch Site Operator's License. Consequently, several NEPA processes have been done for launches from PSCA. Pertinent ones are listed in Table 8 below. All have concluded in "Findings of No Significant Impact (FONSI)" or related determinations such as "Records of Environmental Consideration."

**Table 7. Pertinent NEPA Processes Completed for PSCA Operations.**

Purpose	Environmental Assessment FONSI	Environmental Impact Statement FONSI	Record of Environmental Consideration	Analyzed Topic
FAA Site Operator's License	X			Launch of Up to 9 Castor 120s per year
USA STARS	X			Polaris A-3
NMFS LOA Rulemaking	X			Launch Operations Effects on Marine Mammals
USAF OSP	X			Minotaur, All Classes (I through V)
FAA Programmatic Licenses		X		License Rulemaking
GMD ETR EIS		X		C-4 Trident I
FAA Experimental Flight Permits		X		Small Reusable Launch Vehicles
USA Mobile Sensors	X		X	Use of Mobile Sensors

Predicted effects in these NEPA analyses include unequivocal findings of no impact due to sound pressures being below 100 dBA (SEL), which is the general point at which pinnipeds will leave shore for the water (USAF 1997) to possible short term behavioral effects of no long lasting consequence due to expected sound pressures of about 100 dBA (SEL) (US Army 2003). The above documentation shows 100 dBA (SEL) is the threshold at which one can expect to dependably see short term behavioral responses.

Wildlife generally exhibit a startle response to sudden loud, uncommon, short term noises such as occur during a rocket launch. This statement is supported by observations from the Kennedy Space Center in Florida and VAFB (US Army 2003), as well as from PSCA (before 2006). Harbor seals respond to level sounds above 90 dBA (SEL) (NMFS). Once in the water, affected pinnipeds tend to mill around just off the beach in an alert posture, then return to shore within minutes to a few hours following the disturbance (Portor 1997; Kouvacs et al. 1990; Thorson et al. 1999a, b; Perry et al. 2002). Pinnipeds can, and do, habituate to loud sounds, with older adults showing less concern than younger, less experienced ones (Thorson et al. 1999a, b).

Potential launch effects on pinnipeds are limited to disturbance from rocket motor noise (FAA 1996; USAF 1997, 2001, 2006; US Army 2001, 2003). Potential noise effects can be characterized as auditory and non-auditory. Auditory impacts to pinnipeds by definition consist of injury effects such as ruptured ear drums or behavioral impairments such as temporary threshold shift in hearing level. Auditory impacts are associated with exposure to close by explosive events, such as might happen were a rocket to suffer a highly unusual catastrophic failure on ignition. Given the distance from the LP1 to Ugak Island, auditory impacts are not considered further in this request for permit. Non-auditory effects could include stress, behavioral changes, and interference with mating or care of young. Behavioral responses in animals can be highly variable depending on the situation and vary from startle behaviors to flight. Animals can be sensitive to sound pressures of a given level one day and not the next.

The effects of sound pressure on marine mammals are highly variable and were categorized by Richardson et al. 1995 to include: 1) sound pressures that are below the hearing threshold of the species or less than the prevailing ambient noise, 2) sound pressures that are within the audible range of the species but not strong enough to elicit an overt behavioral response, 3) sound pressures that elicit reactions of variable conspicuousness and variable relevance to the wellbeing of an individual, 4) sound pressures for which repeated exposure elicits either diminishing responses (habituation) or persistence of effects, 5) sound pressures strong enough to reduce (mask) the ability of pinnipeds to hear natural sounds at similar frequencies, including calls from conspecifics, and environmental sounds such as surf noise, 6) sound pressures of such magnitude and frequency that they induce physiological stress and affect the wellbeing or reproductive success of individuals, and 7) sound pressures that lead to permanent hearing impairment. With regard to number 7, received sound levels must far exceed an animal's hearing threshold for there to be even temporary threshold shift, and as indicated, any explosive events that might occur would be distant from Ugak Island; thus, they are not considered further in this application. The first six effects listed by Richardson et al. (1995) have varying potentials ranging from likely to unlikely in the vicinity of Ugak Island. For example, numbers 2 through 4 above are likely depending on the vehicle, while numbers 1 and 6 are unlikely.

Southall, et al, proposes an injury criterion of 149 dB sound pressures, 144 dB sound exposure level, in air, to elicit Temporary Threshold Shift (TTS). Vehicle sounds levels at Ugak island are far below that value (101 dBa SEL, Table 1) and, as such, Permanent Threshold Shift (PTS) or TTS are not expected for Steller sea lions or harbor seals (Southall et al. 2007).

Spent rocket motors will fall into the open ocean over deep water, far from Ugak Island and do not pose a threat to seals or sea lions. Similarly, sonic booms will occur well past the edge of the Outer Continental Shelf break over the deep ocean, and do not pose any threat to pinnipeds. Airborne launch sounds outside of a cone of 26° beneath an ascending rocket will not penetrate the water column to an appreciable extent, and of that portion which does, the transitory nature of the event (because of the very swift and rapidly increasing velocity of the rocket) will serve to mitigate effects; sounds that do penetrate the water column will not persist more than a few seconds at a time.

## 8.1 *H a r b o r S e a l s*

Impact on harbor seals is expected to be a behavioral response, a flush to the water, based on documented startle threshold of 90 dBa SEL (Muto, M. M., et al., 2015) if they are at the northwest

spit. AAC's monitoring has little harbor seal data during a launch primarily because most or all are normally at the eastern shore haulout and the monitoring camera was positioned at the northwest spit to focus on Steller sea lions and higher sound levels. During a launch in September of 2011 17-19 harbor seals were observed at the northwest spit and 4-5 of them were observed the next day after a night launch (tidal status was not noted). No injured, killed, or otherwise harassed seals were observed.

It isn't well known how much the sound will dissipate while traveling over to the other side of the island; however, accounting for the ambient noise that ranges from >70 dBa to 100 dBa detailed in section 4.2 combined with some dissipation of sound while it travels over the 1000 ft ridge on Ugak, AAC estimates launches will not meet the harbor seal's 90 dBa threshold for a behavioral response.

Cetaceans and other marine mammals, such as cetaceans, are not expected to be impacted due to the weak transmission of sound from air to water, as previously discussed.

As is discussed in section 2. Spent rocket motors and sonic booms are not expected to impact marine mammals, such cetaceans, as their impact is too far into the open ocean.

## **9 Anticipated Impact on Subsistence Uses.**

*"The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses."*

Several communities on Kodiak Island use harbor seals and Steller sea lions for subsistence uses. The communities closest to Ugak Island are Old Harbor and Kodiak City; each is over 35 sea miles from Ugak Island.

The Alaska Native Harbor Seal Commission quantified the Kodiak area subsistence take of Steller sea lions and harbor seals in a report issued in 2011. Within the last ten years, 2011, 2008, 2007, 2006 were surveyed. Averaged by the years surveyed in the last ten years, Kodiak city took 35.3 harbor seals and Old Harbor took 35.2. Specific locations of take are not mentioned in this document. Harbor seals are found closer to both communities than Ugak Island, some of them are listed as critical habitat in NMFS (58 FR 45269) (e.g. Gull Point is closer to Old Harbor and Long Island is closer to Kodiak City than Ugak Island).

Based on the distance from each community, and the opportunities closer to each community, either small fraction of the averages provided, or no, take can be estimated from each community. It is likely that no Steller sea lions were taken from Ugak Island since none have been noted in AAC surveys in almost five years. It is possible that some fraction of the average of harbor seals taken listed above were taken from Ugak Island specifically, but there is no documentation to support it. Since harbor seals are abundant in the area relative to the subsistence take, AAC Level A Harassments take estimates are less than 10% of the 70 seals taken from each community.

There is no expectation that harbor seals will abandon sealing grounds, based on our launches, as well as the launches of other launch sites (e.g. Vandenberg AFB). In addition, no permanent barriers will be placed between the subsistence hunter and pinnipeds on Ugak Island. There are temporary closures of Ugak Island for a portion of a 24-hour day during each launch.

## **10 Anticipated Impact on Habitat**

*"The anticipated impact of the activity upon the habitat of the marine mammal populations and the likelihood of restoration of the affected habitat."*

There will be no adverse effects on marine mammal habitat as a result of launch operations at PSCA. As discussed in Section 8, literature and AAC derived data has shown that harbor seals flush during a rocket launch, but return to their haulout with a few hours. As such, no impacts are expected to occur to the habitat from a launch vehicle flyover. Furthermore, there is no expectation of impact on marine mammal prey with any of AAC's operations. As discussed in section 4.3, the sound created does not transmit into water well and isn't expected to impact the prey. Spent rocket motors fall to the sea well beyond the edge of the Outer Continental Shelf over the North Pacific abyss (See Section 3).

## **11 Anticipated Impact of Loss of the Habitat on the Marine Mammal Populations Involved.**

*"The anticipated impact of the loss or modification of the habitat on the marine mammal populations involved."*

None.

## **12 Mitigation Measures**

*"The availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance."*

As stated in Section 3, launch operations are controlled by a range of variables. Launch time of day, fly-out direction, duration, and the noise generated are factors that are dictated by the specific mission.

To minimize impacts on pinnipeds at haulout sites, AAC proposes to conduct the following mitigation measures: (1) Security overflights associated with the launch will not approach occupied pinniped haulouts on Ugak Island by closer than 0.25 mile (0.4 km), and will maintain a vertical distance of 1,000 ft (305 m) from the haulouts when within 0.5 miles (0.8 km), unless indications of human presence or activity warrant closer inspection of the area to assure that national security interests are protected in accordance with law and (2) if launch monitoring detects pinniped injury or death, or if long-term trend counts from quarterly aerial surveys indicate that the distribution, size, or productivity of the potentially affected pinniped populations has been affected due to the specified activity, the launch procedures and the monitoring methods will be reviewed, in cooperation with NMFS, and, if necessary, appropriate changes may be made through modifications to a given LOA, prior to conducting the next launch of the same vehicle under that LOA.

Additionally, and as discussed above, all Castor 120 equivalent launches are conducted at LP1 which is equipped with a concrete and water-filled flame trench. The purpose of the flame trench is to direct smoke away from the launch pad and to absorb light and noise at their, respective, peaks (i.e. lift-off). The result is a dramatic reduction in the noise created during each launch.

## **13 Arctic Plan of Cooperation.**

*"Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, you must submit either a plan of cooperation (POC) or information that*

identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses. " (This requirement is applicable only for activities that occur in Alaskan waters north of 60° North latitude.)

Not applicable, PSCA is below 60° North Latitude.

#### **14 Monitoring and Reporting**

*"The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding."*

AAC proposes to purchase and install time-lapsed photographic systems in order to survey each of the haulout locations around Ugak Island. These camera systems will photograph the haulouts and near off-shore areas in order to accurately determine the number of pinnipeds utilizing each haulout on a daily basis as well as takes resulting from a launch. These systems will confirm the continued abundance of the harbor seal population at the haulouts and allow for the more complete surveying for both seal and sea lion activity. The number of camera systems, the equipment capabilities, the placement of the systems to be used, and the daily photo frequency will be determined through a cooperative effort between AAC, NMFS, and field experts. The photographs will be retrieved from the camera systems following each launch for inclusion in a report to NMFS.

AAC also proposes to conduct one pre-launch aerial survey and one post-launch aerial survey for each launch in a fashion similar to that described in Section 4. AAC will conduct a minimum of one aerial survey annually (in the event no launch occurs during a calendar year).

AAC also proposes a correlation study to be conducted jointly by AAC and NMFS. The purpose of the study is to evaluate the effectiveness of the emplaced camera systems (specifically, the accuracy of the photographic surveys) in order to determine the need to continue aerial surveys. The study will be conducted through a minimum of five launches.

#### **15 Suggested Means of Coordination**

*"Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects."*

AAC will continue to publicly announce launch dates through open news media whenever possible. In addition, reports of environmental monitoring activities would continue to be made available to government agencies, other launch sites, or research agencies by request.



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