DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 218

RIN 0648–AW80

Taking and Importing Marine Mammals; U.S. Naval Surface Warfare Center Panama City Division Mission Activities

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

ACTION: Proposed rule; request for comments.

SUMMARY: NMFS has received a request from the U.S. Navy (Navy) for authorization to take marine mammals incidental to Naval Surface Warfare Center Panama City Division (NSWC PCD) Research, Development, Test, and Evaluation (RDT&E) mission activities for the period of July 2009 through July 2014. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is proposing regulations to govern that take and requesting information, suggestions, and comments on these proposed regulations.

DATES: Comments and information must be received no later than June 1, 2009.

ADDRESSES: You may submit comments, identified by 0648–AW80, by any one of the following methods:

- *Electronic Submissions:* Submit all electronic public comments via the Federal eRulemaking Portal *http://www.regulations.gov*
- Hand delivery or mailing of paper, disk, or CD–ROM comments should be addressed to Michael Payne, Chief, Permits, Conservation and Education Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910–3225.

Instructions: All comments received are a part of the public record and will generally be posted to *http://www.regulations.gov* without change. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

NMFS will accept anonymous comments (enter N/A in the required fields if you wish to remain anonymous). Attachments to electronic comments will be accepted in Microsoft Word, Excel, WordPerfect, or Adobe PDF file formats only.

FOR FURTHER INFORMATION CONTACT: Shane Guan, Office of Protected Resources, NMFS, (301) 713–2289, ext. 137.

SUPPLEMENTARY INFORMATION:

Availability

A copy of the Navy's application may be obtained by writing to the address specified above (See **ADDRESSES**), telephoning the contact listed above (see **FOR FURTHER INFORMATION CONTACT**), or visiting the internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm.* The Navy's Draft Environmental Impact Statement (DEIS) for the NSWC PCD mission activities was published on April 4, 2008, and may be viewed at *http://nswcpc.navsea.navy.mil/Environment-Documents.htm.* NMFS participated in the development of the Navy's DEIS as a cooperating agency under the National Environmental Policy Act (NEPA).

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce (Secretary) to allow, upon request, the incidental, but not intentional taking of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) during periods of not more than five consecutive years each if certain findings are made and regulations are issued or, if the taking is limited to harassment, notice of a proposed authorization is provided to the public for review.

Authorization shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses, and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such taking are set forth. 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.

The National Defense Authorization Act of 2004 (NDAA) (Public Law 108–136) removed the ''small numbers'' and ''specified geographical region'' limitations and amended the definition of ''harassment'' as it applies to a ''military readiness activity'' to read as follows (Section 3(18)(B) of the MMPA):

> (i) Any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].

Summary of Request

On April 1, 2008, NMFS received an application, which was subsequently amended on February 12, 2009 with additional information, from the Navy requesting authorization for the take of 10 species of cetaceans incidental to the NSWC PCD RDT&E mission activities over the course of 5 years. These RDT&E activities are classified as military readiness activities. The Navy states that these RDT&E activities may cause various impacts to marine mammal species in the proposed action area (e.g., mortality, Level A and B harassment). The Navy requests an authorization to take individuals of these cetacean species by Level B Harassment. Further, the Navy requests authorization to take 2 bottlenose dolphins, 2 Atlantic spotted dolphins, 1 pantropical spotted dolphin, and 1 spinner dolphin per year by Level A harassment (injury), as a result of the proposed mission activities. Please refer to Tables 6–3, 6–4, 6–6, 6–7, 6–8, and 6–9 of the Letter of Authorization (LOA) Addendum for detailed information of the potential marine mammal exposures from the NSWC PCD mission activities per year. However, due to the proposed mitigation and monitoring measures, NMFS estimates that the take of marine mammals is likely to be lower than the amount requested. Although the Navy requests authorization to take marine mammals by mortality, NMFS does not expect any animals to be killed, and NMFS is not proposing to authorize any mortality incidental to the Navy's NSWC PCD mission activities.

Background of Navy Request

The purpose of the proposed action is to enhance NSWC PCD's capability and capacity to meet littoral and expeditionary warfare requirements by providing RDT&E and in service engineering for expeditionary maneuver warfare, operations in extreme environments, mine warfare, maritime operations, and coastal operations.

The need for the proposed action is for the Navy to successfully meet current and future national and global defense challenges by developing a robust capability to research, develop, test, and evaluate systems within the NSWC PCD Study Area. This capability allows the Navy to meet its statutory mission to deploy worldwide naval forces equipped to meet existing and emergent threats and to enhance its ability to operate jointly with other components of the armed forces. NSWC PCD was established on the current site maintained by the Naval Support Activity Panama City (NSA PC) after a thorough site selection process in 1942. The Navy considered locations along the east coast and in the Gulf of Mexico (GOM). NSWC PCD provides:

- Accessibility to deep water
- Tests in clear water
- Conducive sand bottom
- Available land and sheltered areas, and
- Average good weather (year-round testing).

In addition to these requirements for testing, the area was selected based on the moderate cost of living, the availability of personnel, and the low level of crowding from industries and development. In 1945, the station was re-commissioned as the U.S. Navy mine countermeasure station after its turnover as a section base for amphibious forces in 1944. The factors identified in 1942 during the selection process solidified the decision.

NSWC PCD provides the greatest number of favorable circumstances needed to conduct RDT&E, in particular mine countermeasure exercises. Many of the other locations have large amounts of vessel traffic, rough waters and windy conditions, and closure of waterways seasonally due to water level. NSWC PCD has the established infrastructure, equipment, and personnel as well as the conditions required to fulfill the Proposed Action.

The proposed mission activities involving sonar, ordnance and line charges, and projectile firing would occur in the NSWC PCD Study Area, which includes St. Andrew Bay (SAB) and military warning areas (areas within the Gulf of Mexico (GOM) subject to military operations) W–151 (includes Panama City Operating Area), W–155 (includes Pensacola Operating Area), and W–470 (see Figures 2–1 and 2–2 of the LOA application). The NSWC PCD Study Area includes a Coastal Test Area, a Very Shallow Water Test Area, and Target and Operational Test Fields. The NSWC PCD RDT&E activities may be conducted anywhere within the existing military operating areas and SAB from the mean high water line (average high tide mark) out to 222 km (120 nm) offshore (see Figures 2–1 and 2–2 of the LOA application). The locations and environments include:

- Test area control sites adjacent to NSWC PCD.
- Wide coastal shelf 97 km (52 nm) distance offshore to 183 m (600 ft), including bays and harbors.
- Water temperature range of 27 °C (80 °F) in summer to 10 °C (50°F) in winter.
- Typically sandy bottom and good underwater visibility.
- Seas less than 0.91 m (3 ft) 80 percent of the time (summer) and less than 0.91 m (3 ft) 50 percent of the time (winter).

Description of the Specified Activities

The purpose of the proposed action is to improve NSWC PCD's capabilities to conduct new and increased mission operations for the Department of the Navy (DON). NSWC PCD provides RDT&E and in-service support for expeditionary maneuver warfare, operations in extreme environments, mine warfare, maritime (ocean-related) operations, and coastal operations. A variety of naval assets, including vessels, aircraft, and underwater systems support these mission activities for eight primary test operations that occur within or over the water environment up to the high water mark. These operations include air, surface, and subsurface operations, sonar, electromagnetic energy, laser, ordnance, and projectile firing. Among these activities, surface operations, sonar, ordnance, and projectile firing may result in the incidental take of a marine mammal species or population stock, and are the focus of the Navy's LOA application and LOA Addendum. A detailed description of these operations is provided below.

Surface Operations

The proposed NSWC PCD mission activities include up to 7,443 hours of surface operations per year in the NSWC PCD Study Area. Four subcategories make up surface operations.

The first subcategory is support activities which are required by nearly all of the testing missions within the NSWC PCD Study Area. The size of these vessels varies according to test requirements and vessel availability. Often multiple surface crafts are required to support a single test event. Acting as a support platform for testing, these vessels are utilized to carry test equipment and personnel to and from the test sites and are also used to secure and monitor the designated test area. Normally, these vessels remain on site and return to port following the completion of the test; occasionally, however, they remain on-station throughout the duration of the test cycle for guarding sensitive equipment in the water. Testing associated with these operational capabilities may include a single test event or a series of test events spread out over consecutive days or as one long test operation that requires multiple days to complete.

The remaining subcategories of additional support include tows, deployment and recovery of equipment, and systems development. Tows are also conducted from vessels at NSWC PCD to test system functionality. Tow tests of this nature involve either transporting the system to the designated test area where it is deployed and towed over a pre-positioned inert minefield or towing the system from NSWC PCD to the designated test area. Surface vessels are also utilized as a tow platform for systems that are designed to be deployed by helicopters. Surface craft are also used to perform the deployment and recovery of underwater unmanned vehicles (UUVs), sonobuoys, inert mines, mine-like objects, versatile exercise mine systems, and other test systems. Surface vessels that are used in this manner normally return to port the same day. However, this is test dependent, and under certain circumstances (e.g., endurance testing), the vessel may be required to remain on site for an extended period of time. Finally, RDT&E activities also encompass testing of new, alternative, or upgraded hydrodynamics, and propulsion, navigational, and communication software and hardware systems.

Sonar Operations

NSWC PCD sonar operations involve the testing of various sonar systems in the ocean and laboratory environment as a means of demonstrating the systems' software capability to detect, locate, and characterize mine-like objects under various environmental conditions. The data collected is used to validate the sonar system's effectiveness and capability to meet its mission.

Based on frequency, the Navy has characterized low, mid, or high frequency sound sources as follows:

- Low frequency: Below 1 kHz
- Mid-frequency: From 1 to 10 kHz
- High frequency: Above 10 kHz

Low frequency sonar is not proposed to be used during NSWC PCD operations. The various sonar systems proposed to be tested within the NSWC PCD Study Area range in frequencies of 1 kHz to 5 megahertz (MHz) (5,000 kHz). The source levels associated with NSWC PCD sonar systems that require analysis in this document based on the systems' parameters range from between 118 dB to 235 dB re 1 microPa at 1 m. The sonar systems tested are typically part of a towed array or hull mounted to a vessel. Additionally, subsystems associated with an underwater unmanned vehicle (UUV) or surf zone crawler operation are included. A detailed description of the frequency class and the reporting metric for each sonar system used at NSWC PCD can be found in Table A–1 of Appendix A, Supplemental Information for Underwater Noise Analysis, of the Navy's LOA application. Tables 1A and 1B present an overview of the number of operating hours annually for each of these sonar systems in territorial and non-territorial waters, respectively.

TABLE 1A—HOURS OF SONAR OPERATIONS BY REPRESENTATIVE SYSTEM FOR TERRITORIAL WATER PER YEAR

System	Annual operating hours
AN/SQS–53/56 Kingfisher	3
Sub-bottom profiler (2–9 kHz)	21
REMUS SAS–LF	12
REMUS Modem	25
Sub-bottom profiler (2–16 kHz)	24
AN/SQQ–32	30
REMUS–SAS–LF	20
SAS–LF	35
AN/WLD–1 RMS–ACL	33.5
BPAUV Sidescan	25
TVSS	15
F84Y	15
BPAUV Sidescan	25
REMUS–SAS–HF	10
SAS–HF	11.5
AN/AQS–20	545
AN/WLD–11 RMS Navigation	15
BPAUV Sidescan	30

TABLE 1B—HOURS OF SONAR OPERATIONS BY REPRESENTATIVE SYSTEM FOR NON-TERRITORIAL WATER PER YEAR

System	Annual operating hours
AN/SQS–53/56 Kingfisher	1
Sub-bottom profiler (2–9 kHz)	1
REMUS SAS–LF	0
REMUS Modem	12
Sub-bottom profiler (2–16 kHz)	1
AN/SQQ–32	1
REMUS–SAS–LF	0
SAS–LF	15
AN/WLD–1 RMS–ACL	5
BPAUV Sidescan	38
TVSS	16.5
F84Y	15
BPAUV Sidescan	0
REMUS–SAS–HF	25
SAS–HF	15
AN/AQS–20	15
AN/WLD–11 RMS Navigation	0
BPAUV Sidescan	25

Table 2 provides an overall summary of the total tempos associated with the proposed action. The table includes number of hours of operation per year for mid-frequency and high-frequency sonar testing activities for territorial and non-territorial waters, respectively. The ranges for the operations are given in the column, where appropriate. For example, sonar operations are divided into mid-frequency and high-frequency ranges. The three columns to the left of the double vertical line contain the amount of operations for each subcategory conducted in territorial waters of the NSWC PCD Study Area. The values to the right of this demarcation, except those contained in the last column of the table, indicate the number of hours and/or operations that would occur in the non-territorial waters. The final column provides the total number of hours per year and/or operations in the NSWC PCD Study Area (or tempo in the territorial waters plus tempo in the non-territorial waters).

Table 2. Description of NSWC PCD Proposed Action

	Territorial Waters							Non-Territorial Waters							Total
Sonar Ops (hrs/yr)	Mid (1-10 kHz)				High (>10 kHz)			Mid (1-10 kHz)					High (>10 kHz)		Hrs/yr
	73				822			4					455		1,354*
Ordnance Ops (dets/yr) (line/yr)	Detonations							Detonations							Item/yr
	Range 1 (0-10 lb) (dets/yr)		Range 2 (11-75 lb) (dets/yr)		Range 3 (76-600 lb) (dets/yr)			Range 1 (0-10 lb) (dets/yr)		Range 2 (11-75 lb) (dets/yr)		Range 3 (76-600 lb) (dets/yr)			Item/yr
	51		3		0			0		0		16			70
	Line charges**							Line charges**							Item/yr
	3							0							3
Projectile firing (rnds/yr)	5 in	40 mm	30 mm	20 mm	76 mm	25 mm	Small arms	5 in	40 mm	30 mm	20 mm	76 mm	25 mm	Small arms	Item/yr
	0	0	0	0	0	0	0	60	480	600	2,967	240	525	6,000	10,872

dets = detonations; hrs = hours; lb = pounds; rnds = rounds; ops = operations; yr = year; kHz = kilohertz; kg = kilogram

*An additional 150 hours (144 territorial hrs/6 non-territorial hours) for jamming and mechanical minesweeping devices occurring over broad frequency ranges are not included in this estimate. These systems were not included in the analysis because no power source is used to generate the acoustic output and the mechanical device generates the acoustic output similar to Navy vessels. Movement of vessels through the water is not associated with acoustic impact on marine mammals; mechanical devices would not affect marine mammals.

**Line charges = 794 kg (1,750 lb) net explosive weight, which is evenly distributed along a 107-m (350-ft) detonation cord.

Ordnance Operations

Ordnance operations include live testing of ordnance of various net explosive weights and line charges. The following subsections provide an overview of the events for ordnance and line charges, respectively.

1. Ordnance

Live testing is only conducted after a system has successfully completed inert testing and an adequate amount of data has been collected to support the decision for live testing. Testing with live targets or ordnance is closely monitored and uses the minimum number of live munitions necessary to meet the testing requirement. Depending on the test scenario, live testing may occur from the surf zone out to the outer perimeter of the NSWC PCD Study Area. The Navy must develop its capability to conduct ordnance operations in shallow water to clear surf zone areas for sea-based expeditionary operations. The size and weight of the explosives used varies from 0.91 to 272 kg (2 to 600 lb) trinitrotoluene (TNT) equivalent net explosive weight (NEW) depending on the test requirements. For this document, ordnance was analyzed based on three ranges of NEW: 0.45 to 4.5 kg (1 to 10 lb), 5 to 34 kg (11 to 75 lb), and 34.5 to 272 kg (76 to 600 lb). Detonation of ordnance with a NEW less than 34.5 kg (76 lb) is conducted in territorial waters (with the exception of line charges and because of the need to use higher amounts of NEW to clear surf zone areas) and detonation of ordnance with a NEW greater than 34.5 kg (76 lb) is conducted in non-territorial waters.

2. Line Charges

Line charges consist of a 107 m (350 ft) detonation cord with explosives lined from one end to the other end in 2 kg (5 lb) increments and total 794 kg (1,750 lb) of NEW. The charge is considered one explosive source that has multiple increments that detonate at one time. The energy released from line charges is comprised of a series of small detonations exploding sequentially rather than one simultaneous, large explosion. Therefore, they are treated as a series of small explosives rather than a large detonation. The Navy proposes to conduct up to three line charge events in the surf zone annually. Line charge testing would only be conducted in the surf zone along the portion of Santa Rosa Island that is part of Eglin Air Force Base (AFB). The Navy must develop its capability to safely clear surf zone areas for sea-based expeditionary operations. To that end, NSWC PCD occasionally performs testing on various surf zone clearing systems that use line charges to neutralize mine threats. These tests are typically conducted from a surface vessel (e.g., Landing Craft Air Cushion [LCAC]) and are deployed using either a single or dual rocket launch scenario. This is a systems development test and only assesses the in-water components of testing.

Table 2 also provides an overview of ordnance testing at NSWC PCD.

Projectile Firing

Current projectile firing includes 50 rounds of 30-mm ammunition each year within the NSWC PCD Study Area. The ability to utilize gunfire during test operations was identified as a future requirement. Rounds (individual shots) identified include 5 inch, 20 mm, 25 mm, 30 mm, 40 mm, 76 mm, and various small arms ammunition (i.e., standard target ammo). Projectiles associated with these rounds are mainly armor-piercing projectiles. The 5-in round is a high explosive (HE) projectile containing approximately 3.63 kg (8 lbs) of explosive material. Current projectile firing includes 50 rounds of 30-mm ammunition each year within the NSWC PCD Study Area. The preferred alternative would provide for increases in the number of 30-mm rounds as well as for expansion of projectile firing operations to 5 in, 20 mm, 40 mm, 76 mm, 25 mm, and small arms ammunition. All projectile firing would occur over non-territorial waters.

Description of Marine Mammals in the Area of the Specified Activities

There are 30 marine mammal species with possible or confirmed occurrence in the NSWC PCD Study Area. As indicated in Table 3, there are 29 cetacean species (7 mysticetes and 22 odontocetes) and one sirenian species. Table 3 also includes the federal status of these marine mammal species. Seven marine mammal species listed as federally endangered under the Endangered Species Act (ESA) occur in the study area: The humpback whale, North Atlantic right whale, sei whale, fin whale, blue whale, sperm whale, and West Indian manatee. Of these 30 species with occurrence records in the NSWC PCD Study Area, 22 species regularly occur here. These 22 species are: Bryde's whale, sperm whale, pygmy sperm whale, dwarf sperm whale, Cuvier's beaked whale, Gervais' beaked whale, Sowerby's beaked whale, Blainville's beaked whale, killer whale, false killer whale, pygmy killer whale, short-finned pilot whale, Risso's dolphin, melon-headed whale, rough-toothed dolphin, bottlenose dolphin, Atlantic spotted dolphin, pantropical spotted dolphin, striped dolphin, spinner dolphin, Clymene dolphin, and Fraser's dolphin. The remaining 8 species (i.e., North Atlantic right whale, humpback whale, sei whale, fin whale, blue whale, minke whale, True's beaked whale, and West Indian manatee) are extralimital and are excluded from further consideration of impacts from the NSWC PCD testing mission.

TABLE 3—MARINE MAMMAL SPECIES FOUND IN THE NSWC PCD STUDY AREA

Family and scientific name	Common name	Federal status
Order Cetacea		
Suborder Mysticeti (baleen whales)		
Eubalaena glacialis	North Atlantic right whale	Endangered.
Megaptera novaeangliae	Humpback whale	Endangered.
Balaenoptera acutorostrata	Minke whale	
B. brydei	Bryde's whale	
B. borealis	Sei whale	Endangered.
B. physalus	Fin whale	Endangered.
B. musculus	Blue whale	Endangered.
Suborder Odontoceti (toothed whales)		
Physeter macrocephalus	Sperm whale	Endangered.
Kogia breviceps	Pygmy sperm whale	
K. sima	Dwarf sperm whale	
Ziphius cavirostris	Cuvier's beaked whale	
Mesoplodon europaeus	Gervais' beaked whale	
M. Mirus	True's beaked whale	
M. bidens	Sowerby's beaked whale	
M. densirostris	Blainville's beaked whale	
Steno bredanensis	Rough-toothed dolphin	
Tursiops truncatus	Bottlenose dolphin	
Stenella attenuata	Pantropical spotted dolphin	
S. frontalis	Atlantic spotted dolphin	
S. longirostris	Spinner dolphin	
S. clymene	Clymene dolphin	
S. coeruleoalba	Striped dolphin	
Lagenodephis hosei	Fraser's dolphin	
Grampus griseus	Risso's dolphin	
Peponocephala electra	Melon-headed whale	
Feresa attenuata	Pygmy killer whale	
Pseudorca crassidens	False killer whale	
Orcinus orca	Killer whale	
Globicephala melas	Long-finned pilot whale	
G. macrorhynchus	Short-finned pilot whale	
Order Sirenia		
Trichechus manatus	West Indian manatee	Endangered.

The information contained herein relies heavily on the data gathered in the Marine Resource Assessments (MRAs). The Navy MRA Program was implemented by the Commander, Fleet Forces Command, to initiate collection of data and information concerning the protected and commercial marine resources found in the Navy's Operating Areas (OPAREAs). Specifically, the goal of the MRA program is to describe and document the marine resources present in each of the Navy's OPAREAs. The MRA for the NSWC PCD, which includes Pensacola and Panama City OPAREAs, was recently updated in 2007 (DoN, 2008).

The MRA data were used to provide a regional context for each species. The MRA represents a compilation and synthesis of available scientific literature (for example, journals, periodicals, theses, dissertations, project reports, and other technical reports published by government agencies, private businesses, or consulting firms), and NMFS reports including stock assessment reports (SAR) (Waring *et al.,* 2007), which can be viewed at: *http://www.nmfs.noaa.gov/pr/sars/species.htm.*

A detailed description of marine mammal density estimates in the NSWC PCD Study Area is provided in the Navy's LOA application and LOA Addendum.

A Brief Background on Sound

An understanding of the basic properties of underwater sound is necessary to comprehend many of the concepts and analyses presented in this document. A summary is included below.

Sound is a wave of pressure variations propagating through a medium (for the sonar considered in this proposed rule, the medium is marine water). Pressure variations are created by compressing and relaxing the medium. Sound measurements can be expressed in two forms: intensity and pressure. Acoustic intensity is the average rate of energy transmitted through a unit area in a specified direction and is expressed in watts per square meter (W/m^2). Acoustic intensity is rarely measured directly, it is derived from ratios of pressures; the standard reference pressure for underwater sound is 1 microPascal (microPa); for airborne sound, the standard reference pressure is 20 microPa (Urick, 1983).

Acousticians have adopted a logarithmic scale for sound intensities, which is denoted in decibels (dB). Decibel measurements represent the ratio between a measured pressure value and a reference pressure value (in this case 1 microPa or, for airborne sound, 20 microPa). The logarithmic nature of the scale means that each 10 dB increase is a tenfold increase in power (e.g., 20 dB is a 100-fold increase, 30 dB is a 1,000-fold increase). Humans perceive a 10-dB increase in noise as a doubling of sound level, or a 10 dB decrease in noise as a halving of sound level. The term ''sound pressure level'' implies a decibel measure and a reference pressure that is used as the denominator of the ratio. Throughout this document, NMFS uses 1 microPa as a standard reference pressure unless noted otherwise.

It is important to note that decibels underwater and decibels in air are not the same and cannot be directly compared. To estimate a comparison between sound in air and underwater, because of the different densities of air and water and the different decibel standards (i.e., reference pressures) in water and air, a sound with the same intensity (i.e., power) in air and in water would be approximately 63 dB lower in air. Thus, a sound that is 160 dB loud underwater would have the same approximate effective intensity as a sound that is 97 dB loud in air.

Sound frequency is measured in cycles per second, or Hertz (abbreviated Hz), and is analogous to musical pitch; high-pitched sounds contain high frequencies and low-pitched sounds contain low frequencies. Natural sounds in the ocean span a huge range of frequencies: from earthquake noise at 5 Hz to harbor porpoise clicks at 150,000 Hz (150 kHz). These sounds are so low or so high in pitch that humans cannot even hear them; acousticians call these infrasonic and ultrasonic sounds, respectively. A single sound may be made up of many different frequencies together. Sounds made up of only a small range of frequencies are called ''narrowband'', and sounds with a broad range of frequencies are called ''broadband''; airguns are an example of a broadband sound source and tactical sonars are an example of a narrowband sound source.

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Based on available behavioral data, audiograms derived using auditory evoked potential, anatomical modeling, and other data, Southall *et al.* (2007) designate ''functional hearing groups'' and estimate the lower and upper frequencies of functional hearing of the groups. Further, the frequency range in which each group's hearing is estimated as being most sensitive is represented in the flat part of the M-weighting functions developed for each group. The functional groups and the associated frequencies are indicated below:

- Low frequency cetaceans (13 species of mysticetes): Functional hearing is estimated to occur between approximately 7 Hz and 22 kHz.
- Mid-frequency cetaceans (32 species of dolphins, six species of larger toothed whales, and 19 species of beaked and bottlenose whales): Functional hearing is estimated to occur between approximately 150 Hz and 160 kHz.
- High frequency cetaceans (eight species of true porpoises, six species of river dolphins, *Kogia,* the franciscana, and four species of cephalorhynchids): Functional hearing is estimated to occur between approximately 200 Hz and 180 kHz.
- Pinnipeds in Water: Functional hearing is estimated to occur between approximately 75 Hz and 75 kHz, with the greatest sensitivity between approximately 700 Hz and 20 kHz.
- Pinnipeds in Air: Functional hearing is estimated to occur between approximately 75 Hz and 30 kHz.

Because ears adapted to function underwater are physiologically different from human ears, comparisons using decibel measurements in air would still not be adequate to describe the effects of a sound on a whale. When sound travels away from its source, its loudness decreases as the distance traveled (propagates) by the sound increases. Thus, the loudness of a sound at its source is higher than the loudness of that same sound a kilometer distant. Acousticians often refer to the loudness of a sound at its source (typically measured one meter from the source) as the source level and the loudness of sound elsewhere as the received level. For example, a humpback whale three kilometers from an airgun that has a source level of 230 dB may only be exposed to sound that is 160 dB loud, depending on how the sound propagates. As a result, it is important not to confuse source levels and received levels when discussing the loudness of sound in the ocean.

As sound travels from a source, its propagation in water is influenced by various physical characteristics, including water temperature, depth, salinity, and surface and bottom properties that cause refraction, reflection, absorption, and scattering of sound waves. Oceans are not homogeneous and the contribution of each of these individual factors is extremely complex and interrelated. The physical characteristics that determine the sound's speed through the water will change with depth, season, geographic location, and with time of day (as a result, in actual sonar operations, crews will measure oceanic conditions, such as sea water temperature and depth, to calibrate models that determine the path the sonar signal will take as it travels through the ocean and how strong the sound signal will be at a given range along a particular transmission path). As sound travels through the ocean, the intensity associated with the wavefront diminishes, or attenuates. This decrease in intensity is referred to as propagation loss, also commonly called transmission loss.

Metrics Used in This Document

This section includes a brief explanation of the two sound measurements (sound pressure level (SPL) and sound exposure level (SEL)) frequently used in the discussions of acoustic effects in this document.

SPL

Sound pressure is the sound force per unit area, and is usually measured in microPa, where 1 Pa is the pressure resulting from a force of one newton exerted over an area of one square meter. SPL is expressed as the ratio of a measured sound pressure and a reference level. The commonly used reference pressure level in underwater acoustics is 1 microPa, and the units for SPLs are dB re: 1 microPa.

SPL (in dB) = 20 log (pressure/reference pressure)

SPL is an instantaneous measurement and can be expressed as the peak, the peak-peak, or the root mean square (rms). Root mean square, which is the square root of the arithmetic average of the squared instantaneous pressure values, is typically used in discussions of the effects of sounds on vertebrates and all references to SPL in this document refer to the root mean square. SPL does not take the duration of a sound into account. SPL is the applicable metric used in the risk continuum, which is used to estimate behavioral harassment takes (see Level B Harassment Risk Function (Behavioral Harassment) Section).

SEL

SEL is an energy metric that integrates the squared instantaneous sound pressure over a stated time interval. The units for SEL are dB re: 1 microPa^2-s.

SEL = SPL + 10log(duration in seconds)

As applied to tactical sonar, the SEL includes both the SPL of a sonar ping and the total duration. Longer duration pings and/or pings with higher SPLs will have a higher SEL. If an animal is exposed to multiple pings, the SEL in each individual ping is summed to calculate the total SEL. The total SEL depends on the SPL, duration, and number of pings received. The thresholds that NMFS uses to indicate at what received level the onset of temporary threshold shift (TTS) and permanent threshold shift (PTS) in hearing are likely to occur are expressed in SEL.

Potential Impacts to Marine Mammal Species

The Navy considers that the proposed NSWC PCD mission activities associated with surface operations, sonar, ordnance, and projectile firing operations are the activities with the potential to result in Level A or Level B harassment or mortality of marine mammals. The following sections discuss the potential for ship strikes to occur from surface operations, potential effects from noise related to sonar, potential effects from noise related to ordnance, potential effects from noise related to projectile firing operations, and direct physical impacts from projectile firing.

Surface Operations

Typical operations occurring at the surface include the deployment or towing of mine countermeasures (MCM) equipment, retrieval of equipment, and clearing and monitoring for non-participating vessels. As such, the potential exists for a ship to strike a marine mammal while conducting surface operations. In an effort to reduce the likelihood of a vessel strike, the mitigation and monitoring measures discussed below would be implemented.

Surface Operations in Territorial Waters

Collisions with commercial and U.S. Navy vessels can cause major wounds and may occasionally cause fatalities to marine mammals. The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., the sperm whale). Laist *et al.* (2001) identified 11 species known to be hit by ships worldwide. Of these species, fin whales are struck most frequently; followed by right whales, humpback whales, sperm whales, and gray whales. More specifically, from 1975 through 1996, there were 31 dead whale strandings involving four large whales along the GOM coastline. Stranded animals included two sei whales, four minke whales, eight Bryde's whales, and 17 sperm whales. Only one of the stranded animals, a sperm whale with propeller wounds found in Louisiana on 9 March 1990, was identified as a result of a possible ship strike (Laist *et al.,* 2001). In addition, from 1999 through 2003, there was only one stranding involving a false killer whale in the northern GOM (Alabama 1999) (Waring *et al.,* 2006). None of these identified species are likely to occur in the territorial waters of the NSWC PCD Study Area. This area encompasses waters that are less than 33 m (108 ft) in depth and it is unlikely any species, including Bryde's whales are located here.

It is unlikely that activities in territorial waters will result in a vessel strike because of the nature of the operations and size of the vessels. For example, the hours of surface operations take into consideration operation times for multiple vessels during each test event. These vessels range in size from small rigid hull inflatable boat (RHIB) to surface vessels of approximately 180 ft (55 m). The majority of these vessels are small RHIBs and medium-sized vessels. A large proportion of the timeframe for NSWC PCD test events include periods when vessels remain stationary within the test site. The greatest time spent in transit for tests includes navigation to and from the sites. At these times, the Navy follows standard operating procedures (SOPs). The captain and other crew members keep watch during vessel transits to avoid objects in the water. Furthermore, with the implementation of the proposed mitigation and monitoring measures described below, NMFS believes that it is unlikely vessel strikes would occur. Consequently, because of the nature of the surface operations and the size of the vessels, the proposed mitigation and monitoring measures, and the fact that cetaceans typically more vulnerable to ship strikes are not likely to be in the project area, the NMFS concludes that ship strikes are unlikely to occur in territorial waters.

Surface Operations in Non-Territorial Waters

As stated above, there have been two reports of possible watercraft-related cetacean deaths in the GOM. These deaths include one sperm whale found with propeller wounds in Louisiana in March 1990 and one false killer whale in Alabama in 1999 (Laist *et al.,* 2001; Waring *et al.,* 2007). According to the 2008 SAR, no other marine mammal that is likely to occur in the northern GOM has been reported as either seriously or fatally injured from a ship strike between 1999 through 2003 (Waring *et al.,* 2007). The nature of operations, size of vessels and standard operating procedures to minimize the risk of vessel collisions will be similar to those expected to occur in territorial waters. Moreover, the implementation of additional mitigation and monitoring measures will reduce further the probability of a vessel strike. Thus, NMFS concludes that the potential effects to marine mammals from surface operations in non-territorial waters will be similar to those described for territorial waters.

Acoustic Effects: Exposure to Sonar

For activities involving active tactical sonar, underwater detonations, and projectile firing, NMFS's analysis will identify the probability of lethal responses, physical trauma, sensory impairment (permanent and temporary threshold shifts and acoustic masking), physiological responses (particular stress responses), behavioral disturbance (that rises to the level of harassment), and social responses that would be classified as behavioral harassment or injury and/or would be likely to adversely affect the species or stock through effects on annual rates of recruitment or survival. In this section, we will focus qualitatively on the different ways that mid-frequency active sonar (MFAS) and high frequency active sonar (HFAS), ordnance, and projectile firing may affect marine mammals (some of which NMFS would not classify as harassment). Then, in the Estimated Take of Marine Mammals section, NMFS will relate the potential effects to marine mammals from HFAS/MFAS, ordnance, and projectile firing to the MMPA regulatory definitions of Level A and Level B Harassment and attempt to quantify those effects.

Direct Physiological Effects

Based on the literature, there are two basic ways that HFAS/MFAS might directly result in physical trauma or damage: Noise-induced loss of hearing sensitivity (more commonly-called ''threshold shift'') and acoustically mediated bubble growth. Separately, an animal's behavioral reaction to an acoustic exposure might lead to physiological effects that might ultimately lead to injury or death, which is discussed later in the Stranding section.

Threshold Shift (Noise-Induced Loss of Hearing)

When animals exhibit reduced hearing sensitivity (i.e., sounds must be louder for an animal to recognize them) following exposure to a sufficiently intense sound, it is referred to as a noise-induced threshold shift (TS). An animal can experience temporary threshold shift (TTS) or permanent threshold shift (PTS). TTS can last from minutes or hours to days (i.e., there is recovery), occurs in specific frequency ranges (i.e., an animal might only have a temporary loss of hearing sensitivity between the frequencies of 1 and 10 kHz), and can be of varying amounts (for example, an animal's hearing sensitivity might be reduced by only 6 dB or reduced by 30 dB). PTS is permanent (i.e., there is no recovery), but also occurs in a specific frequency range and amount as mentioned in the TTS description.

The following physiological mechanisms are thought to play a role in inducing auditory TSs: Effects to sensory hair cells in the inner ear that reduce their sensitivity, modification of the chemical environment within the sensory cells, residual muscular activity in the middle ear, displacement of certain inner ear membranes, increased blood flow, and post-stimulatory reduction in both efferent and sensory neural output (Southall *et al.,* 2007). The amplitude, duration, frequency, temporal pattern, and energy distribution of sound exposure all affect the amount of associated TS and the frequency range in which it occurs. As amplitude and duration of sound exposure increase, so, generally, does the amount of TS. For continuous sounds, exposures of equal energy (the same SEL) will lead to approximately equal effects. For intermittent sounds, less TS will occur than from a continuous exposure with the same energy (some recovery will occur between exposures) (Kryter *et al.,* 1966; Ward, 1997). For example, one short but loud (higher SPL) sound exposure may induce the same impairment as one longer but softer sound, which in turn may cause more impairment than a series of several intermittent softer sounds with the same total energy (Ward, 1997). Additionally, though TTS is temporary, very prolonged exposure to sound strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals (Kryter, 1985) (although in the case of HFAS/MFAS, animals are not expected to be exposed to levels high enough or durations long enough to result in PTS).

PTS is considered auditory injury (Southall *et al.,* 2007). Irreparable damage to the inner or outer cochlear hair cells may cause PTS, however, other mechanisms are also involved, such as exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of the inner ear fluids (Southall *et al.,* 2007).

Although the published body of scientific literature contains numerous theoretical studies and discussion papers on hearing impairments that can occur with exposure to a loud sound, only a few studies provide empirical information on the levels at which noise-induced loss in hearing sensitivity occurs in nonhuman animals. For cetaceans, published data are limited to the captive bottlenose dolphin and beluga whale (Finneran *et al.,* 2000, 2002b, 2005a; Schlundt *et al.,* 2000; Nachtigall *et al.,* 2003, 2004).

Marine mammal hearing plays a critical role in communication with conspecifics, and interpreting environmental cues for purposes such as predator avoidance and prey capture. Depending on the frequency range of TTS degree (dB), duration, and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious (similar to those discussed in auditory masking, below). For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that takes place during a time when the animal is traveling through the open ocean, where ambient noise is lower and there are not as many competing sounds present.

Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical for successful mother/calf interactions could have more serious impacts. Also, depending on the degree and frequency range, the effects of PTS on an animal could range in severity, although it is considered generally more serious because it is a long term condition. Of note, reduced hearing sensitivity as a simple function of development and aging has been observed in marine mammals, as well as humans and other taxa (Southall *et al.,* 2007), so we can infer that strategies exist for coping with this condition to some degree, though likely not without cost. There is no empirical evidence that exposure to HFAS/MFAS can cause PTS in any marine mammals; instead the probability of PTS has been inferred from studies of TTS (see Richardson *et al.,* 1995).

Acoustically Mediated Bubble Growth

One theoretical cause of injury to marine mammals is rectified diffusion (Crum and Mao, 1996), the process of increasing the size of a bubble by exposing it to a sound field. This process could be facilitated if the environment in which the ensonified bubbles exist is supersaturated with gas. Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard, 1979). The deeper and longer dives of some marine mammals (for example, beaked whales) are theoretically predicted to induce greater supersaturation (Houser *et al.,* 2001b). If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue supersaturation could theoretically speed the rate and increase the size of bubble growth. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness.

It is unlikely that the short duration of sonar pings would be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs. Recent work conducted by Crum *et al.* (2005) demonstrated the possibility of rectified diffusion for short duration signals, but at sound exposure levels and tissue saturation levels that are improbable to occur in a diving marine mammal. However, an alternative but related hypothesis has also been suggested: Stable bubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. In such a scenario the marine mammal would need to be in a gas-supersaturated state for a long enough period of time for bubbles to become of a problematic size. Yet another hypothesis (decompression sickness) has speculated that rapid ascent to the surface following exposure to a startling sound might produce tissue gas saturation sufficient for the evolution of nitrogen bubbles (Jepson *et al.,* 2003; Fernandez *et al.,* 2005). In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation. Collectively, these hypotheses can be referred to as ''hypotheses of acoustically mediated bubble growth.''

Although theoretical predictions suggest the possibility for acoustically mediated bubble growth, there is considerable disagreement among scientists as to its likelihood (Piantadosi and Thalmann, 2004; Evans and Miller, 2003). Crum and Mao (1996) hypothesized that received levels would have to exceed 190 dB in order for there to be the possibility of significant bubble growth due to supersaturation of gases in the blood (i.e., rectified diffusion). More recent work conducted by Crum *et al.* (2005) demonstrated the possibility of rectified diffusion for short duration signals, but at SELs and tissue saturation levels that are highly improbable to occur in diving marine mammals. To date, Energy Levels (ELs) predicted to cause in vivo bubble formation within diving cetaceans have not been evaluated (NOAA, 2002b). Although it has been argued that traumas from some recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson *et al.,* 2003), there is no conclusive evidence of this. However, Jepson *et al.* (2003, 2005) and Fernandez *et al.* (2004, 2005) concluded that in vivo bubble formation, which may be exacerbated by deep, long duration, repetitive dives may explain why beaked whales appear to be particularly vulnerable to sonar exposures. Further investigation is needed to further assess the potential validity of these hypotheses. More information regarding hypotheses that attempt to explain how behavioral responses to HFAS/MFAS can lead to strandings is included in the Behaviorally Mediated Bubble Growth section, after the summary of strandings.

Acoustic Masking

Marine mammals use acoustic signals for a variety of purposes, which differ among species, but include communication between individuals, navigation, foraging, reproduction, and learning about their environment (Erbe and Farmer, 2000; Tyack, 2000). Masking, or auditory interference, generally occurs when sounds in the environment are louder than and of a similar frequency to, auditory signals an animal is trying to receive. Masking is a phenomenon that affects animals that are trying to receive acoustic information about their environment, including sounds from other members of their species, predators, prey, and sounds that allow them to orient in their environment. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations.

The extent of the masking interference depends on the spectral, temporal, and spatial relationships between the signals an animal is trying to receive and the masking noise, in addition to other factors. In humans, significant masking of tonal signals occurs as a result of exposure to noise in a narrow band of similar frequencies. As the sound level increases, though, the detection of frequencies above those of the masking stimulus decreases also. This principle is expected to apply to marine mammals as well because of common biomechanical cochlear properties across taxa.

Richardson *et al.* (1995) argued that the maximum radius of influence of an industrial noise (including broadband low frequency sound transmission) on a marine mammal is the distance from the source to the point at which the noise can barely be heard. This range is determined by either the hearing sensitivity of the animal or the background noise level present. Industrial masking is most likely to affect some species' ability to detect communication calls and natural sounds (i.e., surf noise, prey noise, etc.; Richardson *et al.,* 1995).

The echolocation calls of odontocetes (toothed whales) are subject to masking by high frequency sound. Human data indicate low frequency sound can mask high frequency sounds (i.e., upward masking). Studies on captive odontocetes by Au *et al.* (1974, 1985, 1993) indicate that some species may use various processes to reduce masking effects (e.g., adjustments in echolocation call intensity or frequency as a function of background noise conditions). There is also evidence that the directional hearing abilities of odontocetes are useful in reducing masking at the high frequencies these cetaceans use to echolocate, but not at the low-to moderate frequencies they use to communicate (Zaitseva *et al.,* 1980).

As mentioned previously, the functional hearing ranges of mysticetes (baleen whales) and odontocetes (toothed whales) all encompass the frequencies of the sonar sources used in the Navy's RDT&E activities. Additionally, almost all species' vocal repertoires span across the frequencies of the sonar sources used by the Navy. The closer the characteristics of the masking signal to the signal of interest, the more likely masking is to occur. However, because the pulse length and duty cycle of the HFAS/MFAS signal are of short duration and would not be continuous, masking is unlikely to occur as a result of exposure to HFAS/MFAS during the mission activities in the NSWC PCD Study Area.

Impaired Communication

In addition to making it more difficult for animals to perceive acoustic cues in their environment, anthropogenic sound presents separate challenges for animals that are vocalizing. When they vocalize, animals are aware of environmental conditions that affect the ''active space'' of their vocalizations, which is the maximum area within which their vocalizations can be detected before it drops to the level of ambient noise (Brenowitz, 2004; Brumm *et al.,* 2004; Lohr *et al.,* 2003). Animals are also aware of environmental conditions that affect whether listeners can discriminate and recognize their vocalizations from other sounds, which are more important than detecting a vocalization (Brenowitz, 1982; Brumm *et al.,* 2004; Dooling, 2004; Marten and Marler, 1977; Patricelli *et al.,* 2006). Most animals that vocalize have evolved an ability to make vocal adjustments to their vocalizations to increase the signal-to-noise ratio, active space, and recognizability of their vocalizations in the face of temporary changes in background noise (Brumm *et al.,* 2004; Patricelli *et al.,* 2006). Vocalizing animals will make one or more of the following adjustments to their vocalizations: Adjust the frequency structure; adjust the amplitude; adjust temporal structure; or adjust temporal delivery.

Many animals will combine several of these strategies to compensate for high levels of background noise. Anthropogenic sounds that reduce the signal-to-noise ratio of animal vocalizations, increase the masked auditory thresholds of animals listening for such vocalizations, or reduce the active space of an animal's vocalizations impair communication between animals. Most animals that vocalize have evolved strategies to compensate for the effects of short-term or temporary increases in background or ambient noise on their songs or calls. Although the fitness consequences of these vocal adjustments remain unknown, like most other trade-offs animals must make, some of these strategies probably come at a cost (Patricelli *et al.,* 2006). For example, vocalizing more loudly in noisy environments may have energetic costs that decrease the net benefits of vocal adjustment and alter a bird's energy budget (Brumm, 2004; Wood and Yezerinac, 2006). Shifting songs and calls to higher frequencies may also impose energetic costs (Lambrechts, 1996).

Stress Responses

Classic stress responses begin when an animal's central nervous system perceives a potential threat to its homeostasis. That perception triggers stress responses regardless of whether a stimulus actually threatens the animal; the mere perception of a threat is sufficient to trigger a stress response (Moberg, 2000; Sapolsky *et al.,* 2005; Seyle, 1950). Once an animal's central nervous system perceives a threat, it mounts a biological response or defense that consists of a combination of the four general biological defense responses: Behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune response.

In the case of many stressors, an animal's first and most economical (in terms of biotic costs) response is behavioral avoidance of the potential stressor or avoidance of continued exposure to a stressor. An animal's second line of defense to stressors involves the autonomic nervous system and the classical ''fight or flight'' response which includes the cardiovascular system, the gastrointestinal system, the exocrine glands, and the adrenal medulla to produce changes in heart rate, blood pressure, and gastrointestinal activity that humans commonly associate with ''stress.'' These responses have a relatively short duration and may or may not have significant long-term effects on an animal's welfare.

An animal's third line of defense to stressors involves its neuroendocrine or sympathetic nervous systems; the system that has received the most study has been the hypothalamus-pituitary-adrenal system (also known as the HPA axis in mammals or the hypothalamus-pituitary-interrenal axis in fish and some reptiles). Unlike stress responses associated with the autonomic nervous system, virtually all neuro-endocrine functions that are affected by stress—including immune competence, reproduction, metabolism, and behavior—are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg, 1987; Rivier, 1995) and altered metabolism (Elasser *et al.,* 2000), reduced immune competence (Blecha, 2000) and behavioral disturbance. Increases in the circulation of glucocorticosteroids (cortisol, corticosterone, and aldosterone in marine mammals; Romano *et al.,* 2004) have been equated with stress for many years.

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and distress is the biotic cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose a risk to the animal's welfare. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other biotic functions, which impair those functions that experience the diversion. For example, when mounting a stress response diverts energy away from growth in young animals, those animals may experience stunted growth. When mounting a stress response diverts energy from a fetus, an animal's reproductive success and its fitness will suffer. In these cases, the animals will have entered a pre-pathological or pathological state which is called ''distress'' (sensu Seyle, 1950) or ''allostatic loading'' (sensu McEwen and Wingfield, 2003). This pathological state will last until the animal replenishes its biotic reserves sufficient to restore normal function.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiments; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005; Reneerkens *et al.,* 2002; Thompson and Hamer, 2000). Although no information has been collected on the physiological responses of marine mammals to exposure to anthropogenic sounds, studies of other marine animals and terrestrial animals would lead us to expect some marine mammals to experience physiological stress responses and, perhaps, physiological responses that would be classified as ''distress'' upon exposure to mid-frequency and low frequency sounds.

For example, Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (for example, elevated respiration and increased heart rates). Jones (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper *et al.* (1998) reported on the physiological stress responses of osprey to low-level aircraft noise while Krausman *et al.* (2004) reported on the auditory and physiology stress responses of endangered Sonoran pronghorn to military overflights. Smith *et al.* (2004a, 2004b) identified noise induced physiological transient stress responses in hearing-specialist fish that accompanied short- and long-term hearing losses. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Hearing is one of the primary senses cetaceans use to gather information about their environment and to communicate with conspecifics. Although empirical information on the relationship between sensory impairment (TTS, PTS, and acoustic masking) on cetaceans remains limited, it seems reasonable to assume that reducing an animal's ability to gather information about its environment and to communicate with other members of its species would be stressful for animals that use hearing as their primary sensory mechanism. Therefore, we assume that acoustic exposures sufficient to trigger onset PTS or TTS would be accompanied by physiological stress responses because terrestrial animals exhibit those responses under similar conditions (NRC, 2003). More importantly, marine mammals might experience stress responses at received levels lower than those necessary to trigger onset TTS. Based on empirical studies of the time required to recover from stress responses (Moberg, 2000), we also assume that stress responses are likely to persist beyond the time interval required for animals to recover from TTS and might result in pathological and pre-pathological states that would be as significant as behavioral responses to TTS.

Behavioral Disturbance

Behavioral responses to sound are highly variable and context-specific. Exposure of marine mammals to sound sources can result in (but is not limited to) the following observable responses: Increased alertness; orientation or attraction to a sound source; vocal modifications; cessation of feeding; cessation of social interaction; alteration of movement or diving behavior; habitat abandonment (temporary or permanent); and, in severe cases, panic, flight, stampede, or stranding, potentially resulting in death (Southall *et al.,* 2007).

Many different variables can influence an animal's perception of and response to (nature and magnitude) an acoustic event. An animal's prior experience with a sound type affects whether it is less likely (habituation) or more likely (sensitization) to respond to certain sounds in the future (animals can also be innately pre-disposed to respond to certain sounds in certain ways) (Southall *et al.,* 2007). Related to the sound itself, the perceived nearness of the sound, bearing of the sound (approaching vs. retreating), similarity of a sound to biologically relevant sounds in the animal's environment (i.e., calls of predators, prey, or conspecifics), and familiarity of the sound may affect the way an animal responds to the sound (Southall *et al.,* 2007). Individuals (of different age, gender, reproductive status, etc.) among most populations will have variable hearing capabilities, and differing behavioral sensitivities to sounds that will be affected by prior conditioning, experience, and current activities of those individuals. Often, specific acoustic features of the sound and contextual variables (i.e., proximity, duration, or recurrence of the sound or the current behavior that the marine mammal is engaged in or its prior experience), as well as entirely separate factors such as the physical presence of a nearby vessel, may be more relevant to the animal's response than the received level alone.

There are few empirical studies of avoidance responses of free-living cetaceans to mid-frequency sonars. Much more information is available on the avoidance responses of free-living cetaceans to other acoustic sources, like seismic airguns and low frequency sonar, than mid-frequency active sonar. Richardson *et al.,* (1995) noted that avoidance reactions are the most obvious manifestations of disturbance in marine mammals.

Behavioral Responses (Southall et al. (2007))

Southall *et al.,* (2007) reports the results of the efforts of a panel of experts in acoustic research from behavioral, physiological, and physical disciplines that convened and reviewed the available literature on marine mammal hearing and physiological and behavioral responses to man-made sound with the goal of proposing exposure criteria for certain effects. This compilation of literature is very valuable, though Southall *et al.* note that not all data is equal, some have poor statistical power, insufficient controls, and/or limited information on received levels, background noise, and other potentially important contextual variables—such data were reviewed and sometimes used for qualitative illustration, but were not included in the quantitative analysis for the criteria recommendations.

In the Southall *et al.,* (2007) report, for the purposes of analyzing responses of marine mammals to anthropogenic sound and developing criteria, the authors differentiate between single pulse sounds, multiple pulse sounds, and non-pulse sounds. HFAS/MFAS sonar is considered a non-pulse sound. Southall *et al.,* (2007) summarize the reports associated with low, mid, and high frequency cetacean responses to non-pulse sounds (there are no pinnipeds in the Gulf of Mexico (GOM)) in Appendix C of their report (incorporated by reference and summarized in the three paragraphs below).

The reports that address responses of low frequency cetaceans to non-pulse sounds include data gathered in the field and related to several types of sound sources (of varying similarity to HFAS/MFAS) including: Vessel noise, drilling and machinery playback, low frequency M-sequences (sine wave with multiple phase reversals) playback, low frequency active sonar playback, drill vessels, Acoustic Thermometry of Ocean Climate (ATOC) source, and non-pulse playbacks. These reports generally indicate no (or very limited) responses to received levels in the 90 to 120 dB re 1 micro Pa range and an increasing likelihood of avoidance and other behavioral effects in the 120 to 160 dB range. As mentioned earlier, however, contextual variables play a very important role in the reported responses and the severity of effects are not linear when compared to received level. Also, few of the laboratory or field datasets had common conditions, behavioral contexts or sound sources, so it is not surprising that responses differ.

The reports that address responses of mid-frequency cetaceans to non-pulse sounds include data gathered both in the field and the laboratory and related to several different sound sources (of varying similarity to HFAS/MFAS) including: Pingers, drilling playbacks, vessel and ice-breaking noise, vessel noise, Acoustic Harassment Devices (AHDs), Acoustic Deterrent Devices (ADDs), HFAS/MFAS, and non-pulse bands and tones. Southall *et al.* were unable to come to a clear conclusion regarding these reports. In some cases, animals in the field showed significant responses to received levels between 90 and 120 dB, while in other cases these responses were not seen in the 120 to 150 dB range. The disparity in results was likely due to contextual variation and the differences between the results in the field and laboratory data (animals responded at lower levels in the field).

The reports that address the responses of high frequency cetaceans to non-pulse sounds include data gathered both in the field and the laboratory and related to several different sound sources (of varying similarity to HFAS/MFAS) including: acoustic harassment devices, Acoustical Telemetry of Ocean Climate (ATOC), wind turbine, vessel noise, and construction noise. However, no conclusive results are available from these reports. In some cases, high frequency cetaceans (harbor porpoises) are observed to be quite sensitive to a wide range of human sounds at very low exposure RLs (90 to 120 dB). All recorded exposures exceeding 140 dB produced profound and sustained avoidance behavior in wild harbor porpoises (Southall *et al.,* 2007).

In addition to summarizing the available data, the authors of Southall *et al.* (2007) developed a severity scaling system with the intent of ultimately being able to assign some level of biological significance to a response. Following is a summary of their scoring system, a comprehensive list of the behaviors associated with each score may be found in the report:

- 0–3 (Minor and/or brief behaviors) includes, but is not limited to: No response; minor changes in speed or locomotion (but with no avoidance); individual alert behavior; minor cessation in vocal behavior; minor changes in response to trained behaviors (in laboratory).
- 4–6 (Behaviors with higher potential to affect foraging, reproduction, or survival) includes, but is not limited to: Moderate changes in speed, direction, or dive profile; brief shift in group distribution; prolonged cessation or modification of vocal behavior (duration > duration of sound),

minor or moderate individual and/or group avoidance of sound; brief cessation of reproductive behavior; or refusal to initiate trained tasks (in laboratory).

• 7–9 (Behaviors considered likely to affect the aforementioned vital rates) includes, but are not limited to: Extensive of prolonged aggressive behavior; moderate, prolonged or significant separation of females and dependent offspring with disruption of acoustic reunion mechanisms; long-term avoidance of an area; outright panic, stampede, stranding; threatening or attacking sound source (in laboratory).

In Table 4 we have summarized the scores that Southall *et al.* (2007) assigned to the papers that reported behavioral responses of low frequency cetaceans, mid-frequency cetaceans, and high frequency cetaceans to non-pulse sounds.

Table 4. Data compiled from three tables from Southall et al. (2007) indicating when marine mammals (low-frequency cetacean = L, mid-frequency cetacean = M, and high-frequency cetacean = H) were reported as having a behavioral response of the indicated severity to a non-pulse sound of the indicated received level. As discussed in the text, responses are highly variable and context specific.

	Received RMS Sound Pressure Level (dB re 1 microPa)											
Response Score	80 to <90	90 to < 100	100 to < 110	110 to <120	120 to < 130	130 to < 140	140 to < 150	150 to < 160	160 to < 170	170 to < 180	180 to < 190	190 to < 200
9												
8		M	M		M		M				M	M
7						L	L					
6	H	L/H	L/H	L/M/H	L/M/H	L	L/H	H	M/H	M		
5					M							
4			H	L/M/H	L/M		L					
3		M	L/M	L/M	M							
2			L	L/M	L	L	L					
1			M	M	M							
0	L/H	L/H	L/M/H	L/M/H	L/M/H	L	M				M	M

Potential Effects of Behavioral Disturbance

The different ways that marine mammals respond to sound are sometimes indicators of the ultimate effect that exposure to a given stimulus will have on the well-being (survival, reproduction, etc.) of an animal. There is little marine mammal data quantitatively relating the exposure of marine mammals to sound to effects on reproduction or survival, though data exists for terrestrial species to which we can draw comparisons for marine mammals.

Attention is the cognitive process of selectively concentrating on one aspect of an animal's environment while ignoring other things (Posner, 1994). Because animals (including humans) have limited cognitive resources, there is a limit to how much sensory information they can process at any time. The phenomenon called ''attentional capture'' occurs when a stimulus (usually a stimulus that an animal is not concentrating on or attending to) ''captures'' an animal's attention. This shift in attention can occur consciously or unconsciously (for example, when an animal hears sounds that it associates with the approach of a predator) and the shift in attention can be sudden (Dukas, 2002; van Rij, 2007). Once a stimulus has captured an animal's attention, the animal can respond by ignoring the stimulus, assuming a ''watch and wait'' posture, or treat the stimulus as a disturbance and respond accordingly, which includes scanning for the source of the stimulus or ''vigilance'' (Cowlishaw *et al.,* 2004).

Vigilance is normally an adaptive behavior that helps animals determine the presence or absence of predators, assess their distance from conspecifics, or to attend cues from prey (Bednekoff and Lima,1998; Treves, 2000). Despite those benefits, however, vigilance has a cost of time: When animals focus their attention on specific environmental cues, they are not attending to other activities such a foraging. These costs have been documented best in foraging animals, where vigilance has been shown to substantially reduce feeding rates (Saino, 1994; Beauchamp and Livoreil, 1997; Fritz *et al.,* 2002).

Animals will spend more time being vigilant, which may translate to less time foraging or resting, when disturbance stimuli approach them more directly, remain at closer distances, have a greater group size (for example, multiple surface vessels), or when they co-occur with times that an animal perceives increased risk (for example, when they are giving birth or accompanied by a calf). Most of the published literature, however, suggests that direct approaches will increase the amount of time animals will dedicate to being vigilant. For example, bighorn sheep and Dall's sheep dedicated more time being vigilant, and less time resting or foraging, when aircraft made direct approaches over them (Frid, 2001; Stockwell *et al.,* 1991).

Several authors have established that long-term and intense disturbance stimuli can cause population declines by reducing the body condition of individuals that have been disturbed, followed by reduced reproductive success, reduced survival, or both (Daan *et al.,* 1996; Madsen, 1994; White, 1983). For example, Madsen (1994) reported that pink-footed geese (*Anser brachyrhynchus*) in undisturbed habitat gained body mass and had about a 46-percent reproductive success compared with geese in disturbed habitat (being consistently scared off the fields on which they were foraging) which did not gain mass and has a 17 percent reproductive success. Similar reductions in reproductive success have been reported for mule deer (*Odocoileus hemionus*) disturbed by all-terrain vehicles (Yarmoloy *et al.,* 1988), caribou disturbed by seismic exploration blasts (Bradshaw *et al.,* 1998), caribou disturbed by low-elevation military jetfights (Luick *et al.,* 1996), and caribou disturbed by low-elevation jet flights (Harrington and Veitch, 1992). Similarly, a study of elk (*Cervus elaphus*) that were disturbed experimentally by pedestrians concluded that the ratio of young to mothers was inversely related to disturbance rate (Phillips and Alldredge, 2000).

The primary mechanism by which increased vigilance and disturbance appear to affect the fitness of individual animals is by disrupting an animal's time budget and, as a result, reducing the time they might spend foraging and resting (which increases an animal's activity rate and energy demand). For example, a study of grizzly bears (*Ursus horribilis*) reported that bears disturbed by hikers reduced their energy intake by an average of 12 kcal/min (50.2×103kJ/min), and spent energy fleeing or acting aggressively toward hikers (White *et al.,* 1999).

On a related note, many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hr. cycle). Substantive behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007).

Stranding and Mortality

When a live or dead marine mammal swims or floats onto shore and becomes ''beached'' or incapable of returning to sea, the event is termed a ''stranding'' (Geraci *et al.,* 1999; Perrin and Geraci, 2002; Geraci and Lounsbury, 2005; NMFS, 2007). The legal definition for a stranding within the United States is that ''a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance.'' (16 U.S.C. 1421h).

Marine mammals are known to strand for a variety of reasons, such as infectious agents, biotoxicosis, starvation, fishery interaction, ship strike, unusual oceanographic or weather events, sound exposure, or combinations of these stressors sustained concurrently or in series. However, the cause or causes of most stranding are unknown (Geraci *et al.,* 1976; Eaton, 1979; Odell *et al.,* 1980; Best, 1982). Numerous studies suggest that the physiology, behavior, habitat relationships, age, or condition of cetaceans may cause them to strand or might pre-dispose them to strand when exposed to these phenomena. These suggestions are consistent with the conclusions of numerous other studies that have demonstrated that combinations of dissimilar stressors commonly combine to kill an animal or dramatically reduce its fitness, even though one exposure without the other does not produce the same result (Chroussos, 2000; Creel, 2005; DeVries *et al.,* 2003; Fair and Becker, 2000; Foley *et al.,* 2001; Moberg, 2000; Relyea, 2005a; 2005b, Romero, 2004; Sih *et al.,* 2004).

Several sources have published lists of mass stranding events of cetaceans during attempts to identify relationships between those stranding events and military sonar (Hildebrand, 2004; IWC, 2005; Taylor *et al.,* 2004). For example, based on a review of stranding records between 1960 and 1995, the International Whaling Commission (IWC, 2005) identified ten mass stranding events of Cuvier's beaked whales that had been reported and one mass stranding of four Baird's beaked whales (*Berardius bairdii*). The IWC concluded that, out of eight stranding events reported from the mid-1980s to the summer of 2003, seven had been associated with the use of mid-frequency sonar, one of those seven had been associated with the use of low frequency sonar, and the remaining stranding event had been associated with the use of seismic airguns.

Most of the stranding events reviewed by the IWC involved beaked whales. A mass stranding of Cuvier's beaked whales in the eastern Mediterranean Sea occurred in 1996 (Frantzis, 1998) and mass stranding events involving Gervais' beaked whales, Blainville's beaked whales, and Cuvier's beaked whales occurred off the coast of the Canary Islands in the late 1980s (Simmonds and Lopez-Jurado, 1991). The stranding events that occurred in the Canary Islands and Kyparissiakos Gulf in the late 1990s and the Bahamas in 2000 have been the most intensively studied mass stranding events and have been associated with naval maneuvers that were using sonar.

Between 1960 and 2006, 48 strandings (68 percent) involved beaked whales, 3 (4 percent) involved dolphins, and 14 (20 percent) involved other whale species. Cuvier's beaked whales were involved in the greatest number of these events (48 or 68 percent), followed by sperm whales (7 or 10 percent), and Blainville's and Gervais' beaked whales (4 each or 6 percent). Naval activities that might have involved active sonar are reported to have coincided with 9 (13 percent) or 10 (14 percent) of those stranding events. Between the mid-1980s and 2003 (the period reported by the IWC), we identified reports of 44 mass cetacean stranding events of which at least 7 were coincident with naval exercises that were using mid-frequency sonar. A list of stranding events that are considered to be associated with MFAS is presented in the proposed rulemaking for the Navy's training in the Hawaii Range Complex (73 FR 35510; June 23, 2008).

Association Between Mass Stranding Events and Exposure to MFAS

Several authors have noted similarities between some of these stranding incidents: they occurred in islands or archipelagoes with deep water nearby, several appeared to have been associated with acoustic waveguides like surface ducting, and the sound fields created by vessels transmitting mid-frequency sonar (Cox *et al.,* 2006, D'Spain *et al.,* 2006). However, only 77 hours of the proposed NSWC PCD RDT&E activities would involve the use of mid-frequency sonar. Of the mid-frequency sonar sources proposed to be used per year, only 4 hours would be associated with the highest powered surface vessel source (AN/SQS–53/56). The remaining mid-frequency sonar sources do not have strong source levels, therefore, their zones of influence are much smaller compared to these highest powered surface vessel sources, and animals can be more easily detected, thereby increasing the probability that sonar operations can be modified to reduce the risk of injury to marine mammals. In addition, the proposed test events differ significantly from major Navy exercises and training which involve multi-vessel training scenarios using the AN/SQS–53/56 source that have been associated with past strandings. In contrast, the majority of sonar operations (1,277 hours) would be using high-frequency sonar. Source levels of the HFAS are not as high as the 53C series MFAS or other proposed MFAS sources. In addition, high frequency signals tend to have more attenuation in the water column and are more prone to lose their energy during propagation. Therefore, their zones of influence are much smaller and are less likely to affect marine mammals. Although Cuvier's beaked whales have been the most common species involved in these stranding events (81 percent of the total number of stranded animals and see Figure 1), other beaked whales (including *Mesoplodon europeaus, M. densirostris,* and *Hyperoodon ampullatus*) comprise 14 percent of the total. Other species (*Stenella coeruleoalba, Kogia breviceps* and *Balaenoptera acutorostrata*) have stranded, but in much lower numbers and less consistently than beaked whales.

Based on the available evidence, however, we cannot determine whether (a) Cuvier's beaked whale is more prone to injury from high-intensity sound than other species, (b) their behavioral responses to sound makes them more likely to strand, or (c) they are more likely to be exposed to mid-frequency active sonar than other cetaceans (for reasons that remain unknown). Because the association between active sonar (mid-frequency) exposures and marine mammal mass stranding events is not consistent—some marine mammals strand without being exposed to sonar and some sonar transmissions are not associated with marine mammal stranding events despite their co-occurrence—other risk factors or a grouping of risk factors probably contribute to these stranding events.

Behaviorally Mediated Responses to HFAS/MFAS That May Lead to Stranding

Although the confluence of Navy mid-frequency active tactical sonar with the other contributory factors noted in the report was identified as the cause of the 2000 Bahamas stranding event, the specific mechanisms that led to that stranding (or the others) are not understood, and there is uncertainty regarding the ordering of effects that led to the stranding. It is unclear whether beaked whales were directly injured by sound (acoustically mediated bubble growth, addressed above) prior to stranding or whether a behavioral response to sound occurred that ultimately caused the beaked whales to be injured and strand.

Although causal relationships between beaked whale stranding events and active sonar remain unknown, several authors have hypothesized that stranding events involving these species in the Bahamas and Canary Islands may have been triggered when the whales changed their dive behavior in a startled response to exposure to active sonar or to further avoid exposure (Cox *et al.,* 2006, Rommel *et al.,* 2006). These authors proposed two mechanisms by which the behavioral responses of beaked whales upon being exposed to active sonar might result in a stranding event. These include: gas bubble formation caused by excessively fast surfacing; remaining at the surface too long when tissues are supersaturated with nitrogen; or diving prematurely when extended time at the surface is necessary to eliminate excess nitrogen. More specifically, beaked whales that occur in deep waters that are in close proximity to shallow waters (for example, the ''canyon areas'' that are cited in the Bahamas stranding event; see D'Spain and D'Amico, 2006), may respond to active sonar by swimming into shallow waters to avoid further exposures and strand if they were not able to swim back to deeper waters. Second, beaked whales exposed to active sonar might alter their dive behavior. Changes in their dive behavior might cause them to remain at the surface or at depth for extended periods of time, which could lead to hypoxia directly by increasing their oxygen demands or indirectly by increasing their energy expenditures (to remain at depth) and increase their oxygen demands as a result. If beaked whales are at depth when they detect a ping from an active sonar transmission and change their dive profile, this could lead to the formation of significant gas bubbles, which could damage multiple organs or interfere with normal physiological function (Cox *et al.,* 2006; Rommel *et al.,* 2006; Zimmer and Tyack, 2007). Baird *et al.* (2005) found that slow ascent rates from deep dives and long periods of time spent within 50 m of the surface were typical for both Cuvier's and Blainville's beaked whales, the two species involved in mass strandings related to naval sonar. These two behavioral mechanisms may be necessary to purge excessive dissolved nitrogen concentrated in their tissues during their frequent long dives (Baird *et al.,* 2005). Baird *et al.* (2005) further suggests that abnormally rapid ascents or premature dives in response to high intensity sonar could indirectly result in physical harm to the beaked whales, through the mechanisms described above (gas bubble formation or non-elimination of excess nitrogen).

Because many species of marine mammals make repetitive and prolonged dives to great depths, it has long been assumed that marine mammals have evolved physiological mechanisms to protect against the effects of rapid and repeated decompressions. Although several investigators have identified physiological adaptations that may protect marine mammals against nitrogen gas supersaturation (alveolar collapse and elective circulation; Kooyman *et al.,* 1972; Ridgway and Howard, 1979), Ridgway and Howard (1979) reported that bottlenose dolphins that were trained to dive repeatedly had muscle tissues that were substantially supersaturated with nitrogen gas. Houser *et al.* (2001) used these data to model the accumulation of nitrogen gas within the muscle tissue of other marine mammal species and concluded that cetaceans that dive deep and have slow ascent or descent speeds would have tissues that are more supersaturated with nitrogen gas than other marine mammals. Based on these data, Cox *et al.* (2006) hypothesized that a critical dive sequence might make beaked whales more prone to stranding in response to acoustic exposures. The sequence began with (1) very deep (to depths as deep as 2 kilometers) and long (as long as 90 minutes) foraging dives with (2) relatively slow, controlled ascents, followed by (3) a series of ''bounce'' dives between 100 and 400 m (328 and 1,323 ft) in depth (also see Zimmer and Tyack, 2007). They concluded that acoustic exposures that disrupted any part of this dive sequence (for example, causing beaked whales to spend more time at surface without the bounce dives that are necessary to recover from the deep dive) could produce excessive levels of nitrogen supersaturation in their tissues, leading to gas bubble and emboli formation that produces pathologies similar to decompression sickness.

Recently, Zimmer and Tyack (2007) modeled nitrogen tension and bubble growth in several tissue compartments for several hypothetical dive profiles and concluded that repetitive shallow dives (defined as a dive where depth does not exceed the depth of alveolar collapse, approximately 72 m (236 ft) for *Ziphius*), perhaps as a consequence of an extended avoidance reaction to sonar sound, could pose a risk for decompression sickness and that this risk should increase with the duration of the response. Their models also suggested that unrealistically more rapid ascent rates from normal dive behaviors are unlikely to result in supersaturation to the extent that bubble formation would be expected. Tyack *et al.* (2006) suggested that emboli observed in animals exposed to midfrequency range sonar (Jepson *et al.,* 2003; Fernandez *et al.,* 2005) could stem from a behavioral response that involves repeated dives shallower than the depth of lung collapse. Given that nitrogen gas accumulation is a passive process (i.e., nitrogen is metabolically inert), a bottlenose dolphin was trained to repetitively dive a profile predicted to elevate nitrogen saturation to the point that nitrogen bubble formation was predicted to occur. However, inspection of the vascular system of the dolphin via ultrasound did not demonstrate the formation of asymptomatic nitrogen gas bubbles (Houser *et al.,* 2007).

If marine mammals respond to a Navy vessel that is transmitting active sonar in the same way that they might respond to a predator, their probability of flight responses should increase when they perceive that Navy vessels are approaching them directly, because a direct approach may convey detection and intent to capture (Burger and Gochfeld, 1981, 1990; Cooper, 1997, 1998). The probability of flight responses should also increase as received levels of active sonar increase (and the vessel is, therefore, closer) and as vessel speeds increase (that is, as approach speeds increase). For example, the probability of flight responses in Dall's sheep (*Ovis dalli dalli*) (Frid, 2001a, b), ringed seals (*Phoca hispida*) (Born *et al.,* 1999), Pacific brant (*Branta bernic nigricans*) and Canada geese (*B. canadensis*) increased as a helicopter or fixed-wing aircraft approached groups of these animals more directly (Ward *et al.,* 1999). Bald eagles (*Haliaeetus leucocephalus*) perched on trees alongside a river were also more likely to flee from a paddle raft when their perches were closer to the river or were closer to the ground (Steidl and Anthony, 1996).

Despite the many theories involving bubble formation (both as a direct cause of injury (see Acoustically Mediated Bubble Growth Section) and an indirect cause of stranding (See Behaviorally Mediated Bubble Growth Section), Southall *et al.,* (2007) summarize that scientific disagreement or complete lack of information exists regarding the following important points: (1) Received acoustical exposure conditions for animals involved in stranding events; (2) pathological interpretation of observed lesions in stranded marine mammals; (3) acoustic exposure conditions required to induce such physical trauma directly; (4) whether noise exposure may cause behavioral reactions (such as atypical diving behavior) that secondarily cause bubble formation and tissue damage; and (5) the extent the post mortem artifacts introduced by decomposition before sampling, handling, freezing, or necropsy procedures affect interpretation of observed lesions.

Unlike those past stranding events that were coincident with military mid-frequency sonar use and were speculated to most likely have been caused by exposure to the sonar, those naval exercises involved multiple vessels in waters with steep bathymetry where deep channeling of sonar signals was more likely. The proposed NSWC PCD RDT&E activities would not involve multi-vessel operations and the bathymetry has none of the similarities where those mass strandings occurred. (e.g., Greece (1996); the Bahamas (2000); Madeira (2000); Canary Islands (2002); Hanalei Bay, Kaua'I, Hawaii (2004); and Spain (2006)). Consequently, because of the nature of the NSWC PCD operations (which involve low total hours of MFAS use, very limited use of high-powered surface vessel source, and no high-speed, multi-vessel training scenarios) and the fact that the NSWC PCD has none of the bathymetric features that have been associated with mass strandings in the past, NMFS concludes it is unlikely that sonar use would result in a stranding event in the NSWC PCD region.

Acoustic Effects: Exposure to Ordnance and Projectile Firing

Some of the Navy's RDT&E activities include the underwater detonation of explosives. For many of the exercises discussed, inert ordnance is used for a subset of the exercises. The underwater explosion from a weapon would send a shock wave and blast noise through the water, release gaseous by-products, create an oscillating bubble, and cause a plume of water to shoot up from the water surface. The shock wave and blast noise are of most concern to marine animals. Depending on the intensity of the shock wave and size, location, and depth of the animal, an animal can be injured, killed, suffer non-lethal physical effects, experience hearing-related effects with or without behavioral responses, or exhibit temporary behavioral responses or tolerance from hearing the blast sound. Generally, exposures to higher levels of impulse and pressure levels would result in worse impacts to an individual animal.

Injuries resulting from a shock wave take place at boundaries between tissues of different density. Different velocities are imparted to tissues of different densities, and this can lead to their physical disruption. Blast effects are greatest at the gas-liquid interface (Landsberg, 2000). Gas-containing organs, particularly the lungs and gastrointestinal tract, are especially susceptible (Goertner, 1982; Hill, 1978; Yelverton *et al.,* 1973). In addition, gas-containing organs including the nasal sacs, larynx, pharynx, trachea, and lungs may be damaged by compression/expansion caused by the oscillations of the blast gas bubble (Reidenberg and Laitman, 2003). Intestinal walls can bruise or rupture, with subsequent hemorrhage and escape of gut contents into the body cavity. Less severe gastrointestinal tract injuries include contusions, petechiae (small red or purple spots caused by bleeding in the skin), and slight hemorrhaging (Yelverton *et al.,* 1973).

Because the ears are the most susceptible to changes in pressure, they are the organs most sensitive to injury (Ketten, 2000). Sound-related damage associated with blast noise can be theoretically distinct from injury from the shock wave, particularly farther from the explosion. If an animal is able to hear a noise, at some level it can damage its hearing by causing decreased sensitivity (Ketten, 1995) (See Noise-induced Threshold Shift Section above). Sound-related trauma can be lethal or sublethal. Lethal impacts are those that result in immediate death or serious debilitation in or near an intense source and are not, technically, pure acoustic trauma (Ketten, 1995). Sublethal impacts include hearing loss, which is caused by exposures to perceptible sounds. Severe damage (from the shock wave) to the ears includes tympanic membrane rupture, fracture of the ossicles, damage to the cochlea, hemorrhage, and cerebrospinal fluid leakage into the middle ear. Moderate injury implies partial hearing loss due to tympanic membrane rupture and blood in the middle ear. Permanent hearing loss also can occur when the hair cells are damaged by one very loud event, as well as by prolonged exposure to a loud noise or chronic exposure to noise. The level of impact from blasts depends on both an animal's location and, at outer zones, on its sensitivity to the residual noise (Ketten, 1995).

There have been fewer studies addressing the behavioral effects of explosives on marine mammals than HFAS/MFAS. However, though the nature of the sound waves emitted from an explosion is different (in shape and rise time) from HFAS/MFAS, we still anticipate the same sorts of behavioral responses (see Exposure to HFAS/MFAS: Behavioral Disturbance Section) to result from repeated explosive detonations (a smaller range of likely less severe responses would be expected to occur as a result of exposure to a single explosive detonation).

Estimated Take of Marine Mammals

With respect to the MMPA, NMFS' effects assessment serves four primary purposes: (1) To prescribe the permissible methods of taking (i.e., Level B Harassment (behavioral harassment), Level A harassment (injury), or mortality, including an identification of the number and types of take that could occur by Level A or B harassment or mortality) and to prescribe other means of effecting the least practicable adverse impact on such species or stock and its habitat (i.e., mitigation); (2) to determine whether the specified activity will have a negligible impact on the affected species or stocks of marine mammals (based on the likelihood that the activity will adversely affect the species or stock through effects on annual rates of recruitment or survival); (3) to determine whether the specified activity will have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (however, there are no subsistence communities that would be affected in the NSWC PCD Study Area, so this determination is inapplicable for this rulemaking); and (4) to prescribe requirements pertaining to monitoring and reporting.

In the Potential Effects of Exposure of Marine Mammal to HFAS/MFAS and Underwater Detonations sections, NMFS identifies the lethal responses, physical trauma, sensory impairment (permanent and temporary threshold shifts and acoustic masking), physiological responses (particular stress responses), and behavioral responses that could potentially result from exposure to HFAS/MFAS or underwater explosive detonations. In this section, we will relate the potential effects to marine mammals from HFAS/MFAS and underwater detonation of explosives to the MMPA regulatory definitions of Level A and Level B Harassment and attempt to quantify the effects that might occur from the specific RDT&E activities that the Navy is proposing in the NSWC PCD.

Definition of Harassment

As mentioned previously, with respect to military readiness activities, Section 3(18)(B) of the MMPA defines ''harassment'' as: (i) Any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].

Level B Harassment

Of the potential effects that were described in the Potential Effects of Exposure of Marine Mammals to HFAS/MFAS and Underwater Detonations sections, the following are the types of effects that fall into the Level B Harassment category:

Behavioral Harassment—Behavioral disturbance that rises to the level described in the definition above, when resulting from exposures to HFAS/MFAS or underwater detonations, is considered Level B Harassment. Some of the lower level physiological stress responses will also likely co-occur with the predicted harassments, although these responses are more difficult to detect and fewer data exist relating these responses to specific received levels of sound. When Level B Harassment is predicted based on estimated behavioral responses, those takes may have a stress-related physiological component as well.

In the effects section above, we described the Southall *et al.,* (2007) severity scaling system and listed some examples of the three broad categories of behaviors: (0–3: Minor and/or brief behaviors); 4–6 (Behaviors with higher potential to affect foraging, reproduction, or survival); 7–9 (Behaviors considered likely to affect the aforementioned vital rates). Generally speaking, MMPA Level B Harassment, as defined in this document, would include the behaviors described in the 7–9 category, and a subset, dependent on context and other considerations, of the behaviors described in the 4–6 categories. Behavioral harassment generally does not include behaviors ranked 0–3 in Southall *et al.,* (2007).

Acoustic Masking and Communication Impairment—Acoustic masking is considered Level B Harassment as it can disrupt natural behavioral patterns by interrupting or limiting the marine mammal's receipt or transmittal of important information or environmental cues.

TTS—As discussed previously, TTS can affect how an animal behaves in response to the environment, including conspecifics, predators, and prey. The following physiological mechanisms are thought to play a role in inducing auditory fatigue: Effects to sensory hair cells in the inner ear that reduce their sensitivity, modification of the chemical environment within the sensory cells, residual muscular activity in the middle ear, displacement of certain inner ear membranes, increased blood flow, and post-stimulatory reduction in both efferent and sensory neural output. Ward (1997) suggested that when these effects result in TTS rather than PTS, they are within the normal bounds of physiological variability and tolerance and do not represent a physical injury. Additionally, Southall *et al.* (2007) indicate that although PTS is a tissue injury, TTS is not because the reduced hearing sensitivity following exposure to intense sound results primarily from fatigue, not loss, of cochlear hair cells and supporting structures and is reversible. Accordingly, NMFS classifies TTS (when resulting from exposure to either HFAS/MFAS or underwater detonations) as Level B Harassment, not Level A Harassment (injury).

Level A Harassment

Of the potential effects that were described in the Potential Effects of Exposure of Marine Mammal to HFAS/MFAS and Underwater Detonations Section, following are the types of effects that fall into the Level A Harassment category:

PTS—PTS (resulting either from exposure to HFAS/MFAS or explosive detonations) is irreversible and considered an injury. PTS results from exposure to intense sounds that cause a permanent loss of inner or outer cochlear hair cells or exceed the elastic limits of certain tissues and membranes in the middle and inner ears and results in changes in the chemical composition of the inner ear fluids.

Acoustically Mediated Bubble Growth—A few theories suggest ways in which gas bubbles become enlarged through exposure to intense sounds (HFAS/MFAS) to the point where tissue damage results. In rectified diffusion, exposure to a sound field would cause bubbles to increase in size. Alternately, bubbles could be destabilized by high level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. Tissue damage from either of these processes would be considered an injury.

Behaviorally Mediated Bubble Growth—Several authors suggest mechanisms in which marine mammals could behaviorally respond to exposure to HFAS/MFAS by altering their dive patterns in a manner (unusually rapid ascent, unusually long series of surface dives, etc.) that might result in unusual bubble formation or growth ultimately resulting in tissue damage (emboli, etc.).

Physical Disruption of Tissues Resulting from Explosive Shock Wave—Physical damage of tissues resulting from a shock wave (from an explosive detonation) is classified as an injury. Blast effects are greatest at the gas-liquid interface (Landsberg, 2000) and gas-containing organs, particularly the lungs and gastrointestinal tract, are especially susceptible (Goertner, 1982; Hill 1978; Yelverton *et al.,* 1973). Nasal sacs, larynx, pharynx, trachea, and lungs may be damaged by compression/expansion caused by the oscillations of the blast gas bubble (Reidenberg and Laitman, 2003). Severe damage (from the shock wave) to the ears can include tympanic membrane rupture, fracture of the ossicles, damage to the cochlea, hemorrhage, and cerebrospinal fluid leakage into the middle ear.

Acoustic Take Criteria

For the purposes of an MMPA incidental take authorization, three types of take are identified: Level B harassment; Level A harassment; and mortality (or serious injury leading to mortality). The categories of marine mammal responses (physiological and behavioral) that fall into the two harassment categories were described in the previous section.

Because the physiological and behavioral responses of the majority of the marine mammals exposed to HFAS/MFAS and underwater detonations cannot be detected or measured, a method is needed to estimate the number of individuals that will be taken, pursuant to the MMPA, based on the proposed action. To this end, NMFS uses acoustic criteria that estimate at what received level (when exposed to HFAS/MFAS or explosive detonations) Level B Harassment, Level A Harassment, and mortality (for explosives) of marine mammals would occur. The acoustic criteria for HFAS/MFAS and Underwater Detonations are discussed below.

HFAS/MFAS Acoustic Criteria

Because relatively few applicable data exist to support acoustic criteria specifically for HFAS, and it is suspected that the majority of the adverse affects are from the MFAS due to their larger impact ranges, NMFS will apply the criteria developed for the MFAS to the HFAS as well.

NMFS utilizes three acoustic criteria for HFAS/MFAS: PTS (injury—Level A Harassment), behavioral harassment from TTS, and sub-TTS (Level B Harassment). Because the TTS and PTS criteria are derived similarly and the PTS criteria was extrapolated from the TTS data, the TTS and PTS acoustic criteria will be presented first, before the behavioral criteria.

For more information regarding these criteria, please see the Navy's DEIS for the NSWC PCD.

Level B Harassment Threshold (TTS)

As mentioned above, behavioral disturbance, acoustic masking, and TTS are all considered Level B Harassment. Marine mammals would usually be behaviorally disturbed at lower received levels than those at which they would likely sustain TTS, so the levels at which behavioral disturbance is likely to occur are considered the onset of Level B Harassment. The behavioral responses of marine mammals to sound are variable, context specific, and, therefore, difficult to quantify (see Risk Function section, below). TTS is a physiological effect that has been studied and quantified in laboratory conditions. NMFS also uses an acoustic criteria to estimate the number of marine mammals that might sustain TTS incidental to a specific activity (in addition to the behavioral criteria).

A number of investigators have measured TTS in marine mammals. These studies measured hearing thresholds in trained marine mammals before and after exposure to intense sounds. The existing cetacean TTS data are summarized in the following bullets.

- Schlundt *et al.* (2000) reported the results of TTS experiments conducted with 5 bottlenose dolphins and 2 belugas exposed to 1-second tones. This paper also includes a reanalysis of preliminary TTS data released in a technical report by Ridgway *et al.* (1997). At frequencies of 3, 10, and 20 kHz, sound pressure levels (SPLs) necessary to induce measurable amounts (6 dB or more) of TTS were between 192 and 201 dB re 1 microPa (EL = 192 to 201 dB re 1 microPa^2-s). The mean exposure SPL and EL for onset-TTS were 195 dB re 1 microPa and 195 dB re 1 microPa^2-s, respectively.
- Finneran *et al.* (2001, 2003, 2005) described TTS experiments conducted with bottlenose dolphins exposed to 3-kHz tones with durations of 1, 2, 4, and 8 seconds. Small amounts of TTS (3 to 6 dB) were observed in one dolphin after exposure to ELs between 190 and 204 dB re 1 microPa^2-s. These results were consistent with the data of Schlundt *et al.* (2000) and showed that the Schlundt *et al.* (2000) data were not significantly affected by the masking sound used. These results also confirmed that, for tones with different durations, the amount of TTS is best correlated with the exposure EL rather than the exposure SPL.
- Nachtigall *et al.* (2003) measured TTS in a bottlenose dolphin exposed to octave-band sound centered at 7.5 kHz. Nachtigall *et al.* (2003a) reported TTSs of about 11 dB measured 10 to 15 minutes after exposure to 30 to 50 minutes of sound with SPL 179 dB re 1 microPa (EL about 213 dB re microPa^2-s). No TTS was observed after exposure to the same sound at 165 and 171 dB re 1 microPa. Nachtigall *et al.* (2004) reported TTSs of around 4 to 8 dB 5 minutes after exposure to 30 to 50 minutes of sound with SPL 160 dB re 1 microPa (EL about 193 to 195 dB re 1 microPa^2-s). The difference in results was attributed to faster post-exposure threshold measurement—TTS may have recovered before being detected by Nachtigall *et al.* (2003). These studies showed that, for long duration exposures, lower sound pressures are required to induce TTS than are required for short-duration tones.
- Finneran *et al.* (2000, 2002) conducted TTS experiments with dolphins and belugas exposed to impulsive sounds similar to those produced by distant underwater explosions and seismic waterguns. These studies showed that, for very short-duration impulsive sounds, higher sound pressures were required to induce TTS than for longer-duration tones.

Some of the more important data obtained from these studies are onset-TTS levels (exposure levels sufficient to cause a just-measurable amount of TTS) often defined as 6 dB of TTS (for example, Schlundt *et al.,* 2000) and the fact that energy metrics (sound exposure levels (SEL), which include a duration component) better predict when an animal will sustain TTS than pressure (SPL) alone. NMFS' TTS criteria (which indicate the received level at which onset TTS (≤6dB) is induced) for HFAS/MFAS are as follows:

- Cetaceans—195 dB re 1 microPa^2-s (based on mid-frequency cetaceans—no published data exist on auditory effects of noise in low or high frequency cetaceans (Southall *et al.,* 2007).

A detailed description of how TTS criteria were derived from the results of the above studies may be found in Chapter 3 of Southall *et al.* (2007), as well as the Navy's NSWC PCD LOA application.

Level A Harassment Threshold (PTS)

For acoustic effects, because the tissues of the ear appear to be the most susceptible to the physiological effects of sound, and because threshold shifts tend to occur at lower exposures than other more serious auditory effects, NMFS has determined that PTS is the best indicator for the smallest degree of injury that can be measured. Therefore, the acoustic exposure associated with onset-PTS is used to define the lower limit of the Level A harassment.

PTS data do not currently exist for marine mammals and are unlikely to be obtained due to ethical concerns. However, PTS levels for these animals may be estimated using TTS data from marine mammals and relationships between TTS and PTS that have been discovered through study of terrestrial mammals. NMFS uses the following acoustic criteria for injury:

- Cetaceans—215 dB re 1 microPa ^{2}-s (based on mid-frequency cetaceans—no published data exist on auditory effects of noise in low or high frequency cetaceans (Southall *et al.*, 2007).

These criteria are based on a 20 dB increase in SEL over that required for onset-TTS. Extrapolations from terrestrial mammal data indicate that PTS occurs at 40 dB or more of TS, and that TS growth occurs at a rate of approximately 1.6 dB TS per dB increase in EL. There is a 34-dB TS difference between onset-TTS (6 dB) and onset-PTS (40 dB). Therefore, an animal would require approximately 20-dB of additional exposure (34 dB divided by 1.6 dB) above onset-TTS to reach PTS. A detailed description of how TTS criteria were derived from the results of the above studies may be found in Chapter 3 of Southall *et al.* (2007), as well as the Navy's NSWC PCD LOA application. Southall *et al.* (2007) recommend a precautionary dual criteria for TTS (230 dB re 1 microPa (SPL) in addition to 215 re 1 microPa ^{2}-s (SEL)) to account for the potentially damaging transients embedded within non-pulse exposures. However, in the case of HFAS/MFAS, the distance at which an animal would receive 215 (SEL) is farther from the source than the distance at which they would receive 230 (SPL) and therefore, it is not necessary to consider 230 dB.

We note here that behaviorally mediated injuries (such as those that have been hypothesized as the cause of some beaked whale strandings) could potentially occur in response to received levels lower than those believed to directly result in tissue damage. As mentioned previously, data to support a quantitative estimate of these potential effects (for which the exact mechanism is not known and in which factors other than received level may play a significant role) do not exist.

Level B Harassment Risk Function (Behavioral Harassment)

The first MMPA authorization for take of marine mammals incidental to tactical active sonar was issued in 2006 for Navy Rim of the Pacific training exercises in Hawaii. For that authorization, NMFS used 173 dB SEL as the criterion for the onset of behavioral harassment (Level B Harassment). This type of single number criterion is referred to as a step function, in which (in this example) all animals estimated to be exposed to received levels above 173 dB SEL would be predicted to be taken by Level B Harassment and all animals exposed to less than 173 dB SEL would not be taken by Level B Harassment. As mentioned previously, marine mammal behavioral responses to sound are highly variable and context specific (affected by differences in acoustic conditions; differences between species and populations; differences in gender, age, reproductive status, or social behavior; or the prior experience of the individuals), which does not support the use of a step function to estimate behavioral harassment.

Unlike step functions, acoustic risk continuum functions (which are also called ''exposure-response functions,'' ''dose-response functions,'' or ''stress response functions'' in other risk assessment contexts) allow for probability of a response that NMFS would classify as harassment to occur over a range of possible received levels (instead of one number) and assume that the probability of a response depends first on the ''dose'' (in this case, the received level of sound) and that the probability of a response increases as the ''dose'' increases. The Navy and NMFS have previously used acoustic risk functions to estimate the probable responses of marine mammals to acoustic exposures in the Navy FEISs on the SURTASS LFA sonar (DoN, 2001c) and the North Pacific Acoustic Laboratory experiments conducted off the Island of Kauai (ONR, 2001). The specific risk functions used here were also used in the MMPA regulations and FEIS for Hawaii Range Complex (HRC), Southern California Range Complex (SOCAL), and Atlantic Fleet Active Sonar Testing (AFAST). As discussed in the Effects section, factors other than received level (such as distance from or bearing to the sound source) can affect the way that marine mammals respond; however, data to support a quantitative analysis of those (and other factors) do not currently exist. NMFS will continue to modify these criteria as new data become available.

To assess the potential effects on marine mammals associated with active sonar used during training activity the Navy and NMFS applied a risk function that estimates the probability of behavioral responses that NMFS would classify as harassment for the purposes of the MMPA given exposure to specific received levels of MFA sonar. The mathematical function is derived from a solution in Feller (1968) as defined in the SURTASS LFA Sonar Final OEIS/EIS (DoN, 2001), and relied on in the Supplemental SURTASS LFA Sonar EIS (DoN, 2007a) for the probability of MFA sonar risk for MMPA Level B behavioral harassment with input parameters modified by NMFS for MFA sonar for mysticetes and odontocetes (NMFS, 2008). The same risk function and input parameters will be applied to high frequency active (HFA) (<10 kHz) sources until applicable data becomes available for high frequency sources.

In order to represent a probability of risk, the function should have a value near zero at very low exposures, and a value near one for very high exposures. One class of functions that satisfy this criterion is cumulative probability distributions, a type of cumulative distribution function. In selecting a particular functional expression for risk, several criteria were identified:

- The function must use parameters to focus discussion on areas of uncertainty;
- The function should contain a limited number of parameters;
- The function should be capable of accurately fitting experimental data; and
- The function should be reasonably convenient for algebraic manipulations.

As described in U.S. Department of the Navy (2001), the mathematical function below is adapted from a solution in Feller (1968).

$$R = \frac{1-\left(\frac{L-B}{K}\right)^{-A}}{1-\left(\frac{L-B}{K}\right)^{-2A}}$$

Where:
R = Risk (0–1.0)
L = Received level (dB re: 1 μPa)
B = Basement received level = 120 dB re: 1 μPa
K = Received level increment above B where 50 percent risk = 45 dB re: 1 μPa
A = Risk transition sharpness parameter = 10 (odontocetes) or 8 (mysticetes)

In order to use this function to estimate the percentage of an exposed population that would respond in a manner that NMFS classifies as Level B harassment, based on a given received level, the values for B, K and A need to be identified.

B Parameter (Basement)—The B parameter is the estimated received level below which the probability of disruption of natural behavioral patterns, such as migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered approaches zero for the HFAS/MFAS risk assessment. At this received level, the curve would predict that the percentage of the exposed population that would be taken by Level B Harassment approaches zero. For HFAS/MFAS, NMFS has determined that B = 120 dB. This level is based on a broad overview of the levels at which many species have been reported responding to a variety of sound sources.

K Parameter (representing the 50 percent Risk Point)—The K parameter is based on the received level that corresponds to 50 percent risk, or the received level at which we believe 50 percent of the animals exposed to the designated received level will respond in a manner that NMFS classifies as Level B Harassment. The K parameter (K = 45 dB) is based on three datasets in which marine mammals exposed to mid-frequency sound sources were reported to respond in a manner that NMFS would classify as Level B Harassment. There is widespread consensus that marine mammal responses to HFA/MFA sound signals need to be better defined using controlled exposure experiments (Cox *et al.,* 2006; Southall *et al.,* 2007). The Navy is contributing to an ongoing behavioral response study in the Bahamas that is expected to provide some initial information on beaked whales, the species identified as the most sensitive to MFAS. NMFS is leading this international effort with scientists from various academic institutions and research organizations to conduct studies on how marine mammals respond to underwater sound exposures. Until additional data is available, however, NMFS and the Navy have determined that the following three data sets are most applicable for the direct use in establishing the K parameter for the HFAS/MFAS risk function. These data sets, summarized below, represent the only known data that specifically relate altered behavioral responses (that NMFS would consider Level B Harassment) to exposure to HFAS/MFAS sources.

Even though these data are considered the most representative of the proposed specified activities, and therefore the most appropriate on which to base the K parameter (which basically determines the midpoint) of the risk function, these data have limitations, which are discussed in Appendix J of the Navy's EIS for the NSWC PCD .

1. Controlled Laboratory Experiments with Odontocetes (SSC Dataset)—Most of the observations of the behavioral responses of toothed whales resulted from a series of controlled experiments on bottlenose dolphins and beluga whales conducted by researchers at SSC's facility in San Diego, California (Finneran *et al.,* 2001, 2003, 2005; Finneran and Schlundt, 2004; Schlundt *et al.,* 2000). In experimental trials (designed to measure TTS) with marine mammals trained to perform tasks when prompted, scientists evaluated whether the marine mammals performed these tasks when exposed to mid-frequency tones. Altered behavior during experimental trials usually involved refusal of animals to return to the site of the sound stimulus, but also included attempts to avoid an exposure in progress, aggressive behavior, or refusal to further participate in tests.

Finneran and Schlundt (2004) examined behavioral observations recorded by the trainers or test coordinators during the Schlundt *et al.* (2000) and Finneran *et al.* (2001, 2003, 2005) experiments. These included observations from 193 exposure sessions (fatiguing stimulus level > 141 dB re 1microPa) conducted by Schlundt *et al.* (2000) and 21 exposure sessions conducted by Finneran et al. (2001, 2003, 2005). The TTS experiments that supported Finneran and Schlundt (2004) are further explained below:

- Schlundt *et al.* (2000) provided a detailed summary of the behavioral responses of trained marine mammals during TTS tests conducted at SSC San Diego with 1-sec tones and exposure frequencies of 0.4 kHz, 3 kHz, 10 kHz, 20 kHz and 75 kHz. Schlundt *et al.* (2000) reported eight individual TTS experiments. The experiments were conducted in San Diego Bay. Because of the variable ambient noise in the bay, low-level broadband masking noise was used to keep hearing thresholds consistent despite fluctuations in the ambient noise. Schlundt *et al.* (2000) reported that ''behavioral alterations,'' or deviations from the behaviors the animals being tested had been trained to exhibit, occurred as the animals were exposed to increasing fatiguing stimulus levels.
- Finneran *et al.* (2001, 2003, 2005) conducted 2 separate TTS experiments using 1-sec tones at 3 kHz. The test methods were similar to that of Schlundt *et al.* (2000) except the tests were conducted in a pool with very low ambient noise level (below 50 dB re 1 $microPa^2/Hz$), and no masking noise was used. In the first, fatiguing sound levels were increased from 160 to 201 dB SPL. In the second experiment, fatiguing sound levels between 180 and 200 dB SPL were randomly presented.

Bottlenose dolphins exposed to 1-sec intense tones exhibited short-term changes in behavior above received sound levels of 178 to 193 dB re 1 microPa (rms), and beluga whales did so at received levels of 180 to 196 dB and above.

2. Mysticete Field Study (Nowacek *et al.,* 2004)—The only available and applicable data relating mysticete responses to exposure to mid-frequency sound sources is from Nowacek *et al.* (2004). Nowacek *et al.* (2004) documented observations of the behavioral response of North Atlantic right whales exposed to alert stimuli containing mid-frequency components in the Bay of Fundy. Investigators used archival digital acoustic recording tags (DTAG) to record the behavior (by measuring pitch, roll, heading, and depth) of right whales in the presence of an alert signal, and to calibrate received sound levels. The alert signal was 18 minutes of exposure consisting of three 2-minute signals played sequentially three times over. The three signals had a 60 percent duty cycle and consisted of: (1) Alternating 1-sec pure tones at 500 Hz and 850 Hz; (2) a 2-sec logarithmic down-sweep from 4,500 Hz to 500 Hz; and (3) a pair of low (1,500 Hz)-high (2,000 Hz) sine wave tones amplitude modulated at 120 Hz and each 1-sec long. The purposes of the alert signal were (a) to pique the mammalian auditory system with disharmonic signals that cover the whales' estimated hearing range; (b) to maximize the signal to noise ratio (obtain the largest difference between background noise) and c) to provide localization cues for the whale. The maximum source level used was 173 dB SPL.

Nowacek *et al.* (2004) reported that five out of six whales exposed to the alert signal with maximum received levels ranging from 133 to 148 dB re 1 microPa significantly altered their regular behavior and did so in identical fashion. Each of these five whales: (i) Abandoned their current foraging dive prematurely as evidenced by curtailing their 'bottom time'; (ii) executed a shallow-angled, high power (i.e. significantly increased fluke stroke rate) ascent; (iii) remained at or near the surface for the duration of the exposure, an abnormally long surface interval; and (iv) spent significantly more time at subsurface depths (1–10 m) compared with normal surfacing periods when whales normally stay within 1 m (1.1 yd) of the surface.

3. Odontocete Field Data (Haro Strait—USS SHOUP)—In May 2003, killer whales were observed exhibiting behavioral responses generally described as avoidance behavior while the U.S. Ship (USS) SHOUP was engaged in MFAS in the Haro Strait in the vicinity of Puget Sound, Washington. Those observations have been documented in three reports developed by Navy and NMFS (NMFS, 2005a; Fromm, 2004a, 2004b; DON, 2003). Although these observations were made in an uncontrolled environment, the sound field that may have been associated with the sonar operations was estimated using standard acoustic propagation models that were verified (for some but not all signals) based on calibrated in situ measurements from an independent researcher who recorded the sounds during the event. Behavioral observations were reported for the group of whales during the event by an experienced marine mammal biologist who happened to be on the water studying them at the time. The observations associated with the USS SHOUP provide the only data set available of the behavioral responses of wild, non-captive animal upon actual exposure to AN/SQS–53 sonar.

U.S. Department of Commerce (NMFS, 2005a); U.S. Department of the Navy (2004b); Fromm (2004a, 2004b) documented reconstruction of sound fields produced by USS SHOUP associated with the behavioral response of killer whales observed in Haro Strait. Observations from this reconstruction included an approximate closest approach time which was correlated to a reconstructed estimate of received level (which ranged from 150 to 180 dB) at an approximate whale location with a mean value of 169.3 dB SPL.

Calculation of K Parameter—NMFS and the Navy used the mean of the following values to define the midpoint of the function: (1) The mean of the lowest received levels (185.3 dB) at which individuals responded with altered behavior to 3 kHz tones in the SSC data set; (2) the estimated mean received level value of 169.3 dB produced by the reconstruction of the USS SHOUP incident in which killer whales exposed to MFA sonar (range modeled possible received levels: 150 to 180 dB); and (3) the mean of the 5 maximum received levels at which Nowacek *et al.* (2004) observed significantly altered responses of right whales to the alert stimuli than to the control (no input signal) is 139.2 dB SPL. The arithmetic mean of these three mean values is 165 dB SPL. The value of K is the difference between the value of B (120 dB SPL) and the 50 percent value of 165 dB SPL; therefore, K=45.

A Parameter (Steepness)—NMFS determined that a steepness parameter (A)=10 is appropriate for odontocetes (except harbor porpoises) and pinnipeds and A=8 is appropriate for mysticetes.

The use of a steepness parameter of A=10 for odontocetes (except harbor porpoises) for the HFAS/MFAS risk function was based on the use of the same value for the SURTASS LFA risk continuum, which was supported by a sensitivity analysis of the parameter presented in Appendix D of the SURTASS/LFA FEIS (DON, 2001c). As concluded in the SURTASS FEIS/EIS, the value of A=10 produces a curve that has a more gradual transition than the curves developed by the analyses of migratory gray whale studies (Malme *et al.,* 1984; Buck and Tyack, 2000; and SURTASS LFA Sonar EIS, Subchapters 1.43, 4.2.4.3 and Appendix D, and NMFS, 2008).

NMFS determined that a lower steepness parameter (A=8), resulting in a shallower curve, was appropriate for use with mysticetes and HFAS/MFAS. The Nowacek *et al.* (2004) dataset contains the only data illustrating mysticete behavioral responses to a mid-frequency sound source. A shallower curve (achieved by using A=8) better reflects the risk of behavioral response at the relatively low received levels at which behavioral responses of right whales were reported in the Nowacek *et al.* (2004) data. Compared to the odontocete curve, this adjustment results in an increase in the proportion of the exposed population of mysticetes being classified as behaviorally harassed at lower RLs, such as those reported in and is supported by the only dataset currently available.

Basic Application of the Risk Function—The risk function is used to estimate the percentage of an exposed population that is likely to exhibit behaviors that would qualify as harassment (as that term is defined by the MMPA applicable to military readiness activities, such as the Navy's testing and research activities with HFA/MFA sonar) at a given received level of sound. For example, at 165 dB SPL (dB re: 1 microPa rms), the risk (or probability) of harassment is defined according to this function as 50 percent, and Navy/NMFS applies that by estimating that 50 percent of the individuals exposed at that received level are likely to respond by exhibiting behavior that NMFS would classify as behavioral harassment. The risk function is not applied to individual animals, only to exposed populations.

The data primarily used to produce the risk function (the K parameter) were compiled from four species that had been exposed to sound sources in a variety of different circumstances. As a result, the risk function represents a general relationship between acoustic exposures and behavioral responses that is then applied to specific circumstances. That is, the risk function represents a relationship that is deemed to be generally true, based on the limited, best-available science, but may not be true in specific circumstances. In particular, the risk function, as currently derived, treats the received level as the only variable that is relevant to a marine mammal's behavioral response. However, we know that many other variables—the marine mammal's gender, age, and prior experience; the activity it is engaged in during an exposure event, its distance from a sound source, the number of sound sources, and whether the sound sources are approaching or moving away from the animal—can be critically important in determining whether and how a marine mammal will respond to a sound source (Southall *et al.*, 2007). The data that are currently available do not allow for incorporation of these other variables in the current risk functions; however, the risk function represents the best use of the data that are available (Figure 1).

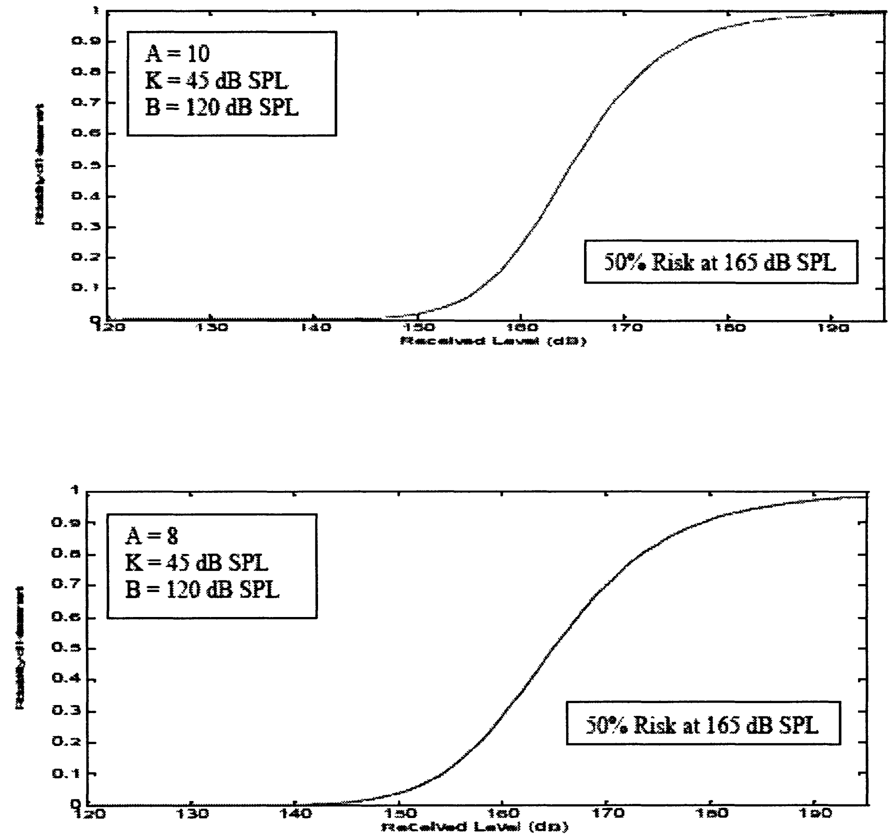

Figure 1. Risk Functions for Odontocetes (above) and Mysticetes (below).

As more specific and applicable data become available for HFAS/MFAS sources, NMFS can use these data to modify the outputs generated by the risk function to make them more realistic. Ultimately, data may exist to justify the use of additional, alternate, or multivariate functions. For example, as mentioned previously, the distance from the sound source and whether it is perceived as approaching or moving away can affect the way an animal responds to a sound (Wartzok *et al.*, 2003).

Explosive Detonation Criteria

Acoustic Effects: Ordnance

Live ordnance testing may occur from the surf zone out to the outer perimeter of the NSWC PCD Study Area. The size and weight of the explosives used would vary from 0.91 to 272 kg (2 to 600 lb) trinitrotoluene (TNT) equivalent net explosive weight (NEW). No detonations over 34 kg (75 lb) NEW will be conducted within the territorial waters of the NSWC PCD Study Area. Operations involving live explosives include mine detonations and surf zone line charge detonations.

Underwater detonations may project pressure and sound intensities sufficient to cause physical trauma or acoustic or behavioral effects to protected marine mammals. Determining the potential exposures associated with ordnance operations is very similar to determining potential exposures associated with sonar operations described above.

Metrics: Underwater Explosive Sound

Four standard acoustic metrics for measuring underwater pressure waves were used in this analysis:

- Total Energy Flux Density Level (EFD)
- ⅓-Octave EFD
- Positive Impulse
- Peak Pressure

Total EFD—Total EFD is the metric used for analyzing the level of sound that would cause a permanent decrease in hearing sensitivity. Decibels are used to express this metric.

⅓-Octave EFD—One-third octave EFD is the metric used in discussions of temporary (i.e., recoverable) hearing loss and for behavioral response thresholds of protected species to sound. One-third octave EFD is the energy flux density in the ⅓-octave frequency band at which the animal potentially exposed hears best. Decibels are also used to express this metric. This metric is used for analyzing underwater detonations.

Positive Impulse—Positive impulse is the metric used for analyzing lethal sound levels, as well as sound that marks the onset of slight lung injury in cetaceans. Positive impulse as it is used here is based on an equation modified by Goertner (1982); thus it is more completely stated as the Goertner-modified positive impulse. The units to express this metric are pounds per square inch millisecond (psi-ms).

Peak Pressure—This is the maximum positive pressure for an arrival of a sound pressure wave that a marine mammal would receive at some distance away from a detonation. Units used here are pounds per square inch (psi) and dB levels.

Criteria and Thresholds for Explosive Sound

Criteria and thresholds for estimating the effects on protected species including marine mammals and sea turtles from a single explosive event were established and publicly vetted through the NEPA process during the Seawolf Submarine Shock Test FEIS (''Seawolf'') and the USS Winston S. Churchill (DDG–81) Ship Shock FEIS (''Churchill'') (DON, 2001). These criteria and thresholds were adopted by NMFS in its final rule on unintentional taking of marine animals incidental to the shock testing. The risk assessment approach for all gunfire-related sound in water was derived from the Seawolf/ Churchill approach.

Criteria and Thresholds for Physiological Effects to Explosive Sound

The criterion for mortality for marine mammals used in the Churchill FEIS is ''onset of severe lung injury.'' This criterion is conservative in that it corresponds to a 1 percent chance of mortal injury, and yet any animal experiencing onset severe lung injury is counted as a lethal exposure. The threshold is stated in terms of the Goertner (1982) modified positive impulse with value ''indexed to 31 psi-msec.'' Since the Goertner approach depends on propagation, source/animal depths, and animal mass in a complex way, the actual impulse value corresponding to the 31 psi-msec index is a complicated calculation. Again, to be conservative, Churchill used the mass of a calf dolphin (at 12.2 kg or 26.9 lb), so that the threshold index is 30.5 psi-msec.

Dual criteria are used for injury: 50 percent eardrum rupture (i.e., tympanic membrane [TM] rupture) and onset of slight lung injury. These criteria are considered indicative of the onset of injury. The threshold for TM rupture corresponds to a 50 percent rate of rupture (i.e., 50 percent of animals exposed to the level are expected to suffer TM); this is stated in terms of an EL value of 1.17 inches pound per square inch (in-lb/in^2) (about 205 dB re 1 microPa^2-s). This recognizes that TM rupture is not necessarily a serious or life-threatening injury but is a useful index of possible injury that is well-correlated with measures of permanent hearing impairment (e.g., Ketten (1998) indicates a 30 percent incidence of PTS at the same threshold).

The threshold for onset of slight lung injury is calculated for a calf dolphin (12.2 kg, or 27 lb); it is given in terms of the ''Goertner modified positive impulse,'' indexed to 13 psi-ms. This is a departure from the Churchill and Seawolf approaches in the use of animal mass in the Goertner threshold for slight lung injury. In this assessment, cetaceans are assessed as calves, defined as those with mass less than 174 kg (384 lb). The associated threshold is indexed to 13 psi-msec, which corresponds to a calf dolphin at 12.2 kg (27 lb) (DON, 2001).

The first criterion for non-injurious harassment is TTS, which is defined as a temporary, recoverable loss of hearing sensitivity (NMFS, 2001; DON, 2001). The criterion for TTS is 182 dB re 1 microPa^2-s, which is the greatest energy flux density level in any ⅓-octave band at frequencies above 100 Hz for marine mammals.

The second criterion for estimating TTS threshold applies to all cetacean species and is stated in terms of peak pressure at 23 psi. The threshold is derived from the Churchill threshold which was subsequently adopted by NMFS in its Final Rule on the unintentional taking of marine animals incidental to the shock testing (NMFS, 2001). The original criteria in Churchill incorporated 12 psi. The current criteria and threshold for peak pressure over all exposures was updated from 12 psi to 23 psi for explosives less than 907 kg (2,000 lb) based on an IHA issued to the Air Force for a similar action (NOAA, 2006a). Peak pressure and energy scale at different rates with charge weight, so that ranges based on the peak-pressure threshold are much greater than those for the energy metric when charge weights are small, even when source and animal are away from the surface. In order to more accurately estimate TTS for smaller shots while preserving the safety feature provided by the peak pressure threshold, the peak pressure threshold is appropriately scaled for small shot detonations. This scaling is based on the similitude formulas (e.g., Urick, 1983) used in virtually all compliance documents for short ranges. Further, the peak-pressure threshold for marine mammal TTS for explosives offers a safety margin for source or animal near the ocean surface.

Criteria and Thresholds for Behavioral Effects to Explosive Sound

For a single explosion, to be consistent with Churchill, TTS is the criterion for Level B harassment. In other words, because behavioral disturbance for a single explosion is likely to be limited to a short-lived startle reaction, use of the TTS criterion is considered sufficient protection. Behavioral modification (sub-TTS) is only applied to successive detonations. Table 5 summarizes the criteria and thresholds used in calculating the potential impacts to marine mammal from explosive sound.

TABLE 5—EFFECTS, CRITERIA, AND THRESHOLDS FOR EXPLOSIVE DETONATIONS

Effect	Criteria	Metric	Threshold	Effect
Mortality	Onset of Severe Lung Injury (1% probability of mortality).	Goertner modified positive impulse.	indexed to 30.5 psi-msec (assumes 100 percent small animal at 26.9 lbs).	Mortality.
Injurious Physiological	Onset Slight Lung Injury	Goertner modified positive impulse.	indexed to 13 psi-msec (assumes 100 percent small animal at 26.9 lbs).	Level A.
Injurious Physiological	50% Tympanic Membrane Rupture.	Energy flux density	1.17 in-lb/in^2 (about 205 dB re 1 microPa^2-sec).	Level A.
Non-injurious Physiological.	TTS	Greatest energy flux density level in any ⅓-octave band (>100 Hz for toothed whales and >10 Hz for baleen whales)—for total energy over all exposures.	182 dB re 1 microPa^2-sec	Level B.
Non-injurious Physiological.	TTS	Peak pressure over all exposures	23 psi	Level B.
Non-injurious Behavioral.	Multiple Explosions Without TTS	Greatest energy flux density level in any ⅓-octave (>100 Hz for toothed whales and >10 Hz for baleen whales)—for total energy over all exposures (multiple explosions only).	177 dB re 1 microPa^2-sec	Level B.

Acoustic Effects: Projectile Firing

Projectile firing includes the use of inert rounds of ammunition as well as high-explosive (HE) 5-in gun-rounds. The primary concern with respect to projectile firing and marine mammals encompasses the potential sound effects associated with their detonations. The same thresholds were used to analyze projectile firing as the previous section on ordnance operations. Modeling took into account the firing of single shots separated in time.

Estimated Exposures of Marine Mammals

Marine Mammal Exposures Due to HFAS/MFAS Operations

Acoustical modeling provides an estimate of the actual exposures. Detailed information and formulas to model the effects of sonar from RDT&E activities in the NSWC PCD Study Area is provided in Appendix A, Supplemental Information for Underwater Noise Analysis of the LOA application.

The quantitative analysis was based on conducting sonar operations in 16 different geographical regions, or provinces. Using combined marine mammal density and depth estimates, acoustical modeling was conducted to calculate the actual exposures. Refer to Appendix B, Geographic Description of Environmental Provinces of the LOA application, for additional information on provinces. Refer to Appendix C, Definitions and Metrics for Acoustic Quantities of the LOA application, for additional information regarding the acoustical analysis.

The approach for estimating potential acoustic effects from NSWC PCD RDT&E activities on cetacean species uses the methodology that the DON developed in cooperation with NOAA for the Navy's USWTR Draft OEIS/EIS (2005), Undersea Warfare Exercise (USWEX) Environmental Assessment (EA)/ Overseas Environmental Assessment (OEA) (U.S. DON, 45, 2007a), RIMPAC EA/OEA (DON, Commander Third Fleet, 2006), Composite Training Unit Exercises (COMPTUEX)/Joint Task Force Exercises (JTFEX) EA/OEA (DON, 2007b), and HRC Draft EIS (DON, 2007c). The exposure analysis for behavioral response to sound in the water uses energy flux density for Level A harassment and the methods for risk function for Level B harassment (behavioral). The methodology is provided here to determine the number and species of marine mammals for which incidental take authorization is requested.

To estimate acoustic effects from the NSWC PCD RDT&E activities, acoustic sources to be used were examined with regard to their operational characteristics as described in the previous section. In addition, systems with an operating frequency greater than 200 kHz were not analyzed in the detailed modeling as these signals attenuate rapidly, resulting in very short propagation distances. Acoustic countermeasures were previously examined and found not to be problematic. These acoustic sources, therefore, did not require further examination in this analysis. Based on the information above, the Navy modeled the following systems:

- Kingfisher
- Sub-bottom profilers
- SAS–LFs and SAS–HFs
- Modems
- AN/SQQ–32
- BPAUVs
- ACL
- TVSS
- F84Y
- AN/AQS–20
- Navigation systems

Sonar parameters including source levels, ping length, the interval between pings, output frequencies, directivity (or angle), and other characteristics were based on records from previous test scenarios and projected future testing. Additional information on sonar systems and their associated parameters is in Appendix A, Supplemental Information for Underwater Noise Analysis of the LOA application.

Every active sonar operation has the potential of exposing marine animals in the neighboring waters. The number of animals exposed to the sonar in any such action is dictated by the propagation field and the manner in which the sonar is operated (i.e., source level, depth, frequency, pulse length, directivity, platform speed, repetition rate). The modeling for NSWC PCD RDT&E activities involving sonar occurred in five broad steps, listed below and was conducted based on the typical RDT&E activities planned for the NSWC PCD Study Area.

Step 1. Environmental Provinces. The NSWC PCD Study Area is divided into 16 environmental provinces, and each has a unique combination of environmental conditions. These represent various combinations of eight bathymetry provinces, one Sound Velocity Profile (SVP) province, and three Low-Frequency Bottom Loss geo-acoustic provinces and two High-Frequency Bottom Loss classes. These are addressed by defining eight fundamental environments in two seasons that span the variety of depths, bottom types, sound speed profiles, and sediment thicknesses found in the NSWC PCD Study Area. The two seasons encompass winter and summer, which are the two extremes and for the GOM, the acoustic propagation characteristics do not vary significantly between the two. Each marine modeling area can be quantitatively described as a unique combination of these environments.

Step 2. Transmission Loss. Since sound propagates differently in these environments, separate transmission loss calculations must be made for each, in both seasons. The transmission loss is predicted using Comprehensive Acoustic Simulation System/Gaussian Ray Bundle (CASS–GRAB) sound modeling software.

Step 3. Exposure Volumes. The transmission loss, combined with the source characteristics, gives the energy field of a single ping. The energy of over 10 hours of pinging is summed, carefully accounting for overlap of several pings, so an accurate average exposure of an hour of pinging is calculated for each depth increment. At more than ten hours, the source is too far away and the energy is negligible. In addition, the acoustic modeling takes into account the use of a single system. Only one source will operate at any one time during NSWC PCD RDT&E activities.

Repeating this calculation for each environment in each season gives the hourly ensonified volume, by depth, for each environment and season. This step begins the method for risk function modeling.

Step 4. Marine Mammal Densities. The marine mammal densities were given in two dimensions, but using reliable peer-reviewed literature sources (published literature and agency reports) described in the following subsection, the depth regimes of these marine mammals are used to project the two dimensional densities (expressed as the number of animals per area where all individuals are assumed to be at the water's surface) into three dimensions (a volumetric approach whereby two-dimensional animal density incorporates depth into the calculation estimates).

Step 5. Exposure Calculations. Each marine mammal's three-dimensional (3–D) density is multiplied by the calculated impact volume to that marine mammal depth regime. This value is the number of exposures per hour for that particular marine mammal. In this way, each marine mammal's exposure count per hour is based on its density, depth habitat, and the ensonified volume by depth.

The planned sonar hours for each system were inserted and a cumulative number of exposures were determined for each alternative.

As previously mentioned, NSWC PCD RDT&E activities involve mid-frequency sonar operation for only 6 percent of operational hours. Furthermore, testing generally involves short-term use and single systems at a time. Appendix A, Supplemental Information for Underwater Noise Analysis of the LOA application, includes specific formulas and more detailed information.

Marine Mammal Sonar Exposures in Territorial Waters

Sonar operations in territorial waters may expose bottlenose dolphins and Atlantic spotted dolphins to sound likely to result in Level B (behavioral) harassment. In addition, three bottlenose dolphins and two Atlantic spotted dolphins may be exposed to levels of sound likely to result in TTS (Table 6).

TABLE 6—ESTIMATES OF MARINE MAMMAL EXPOSURES FROM SONAR MISSIONS IN TERRITORIAL WATERS PER YEAR

Marine mammal species	Level A	Level B (TTS)	Level B (behavioral)
Bottlenose dolphin	0	3	521
Atlantic spotted dolphin	0	2	408

Marine Mammal Sonar Exposures in Non-Territorial Waters

Sonar operations in non-territorial waters may expose up to ten species to sound likely to result in Level B (behavioral) harassment (Table 7). They include the sperm whale, Risso's dolphin, rough-toothed dolphin, bottlenose dolphin, Atlantic bottlenose dolphin, Atlantic spotted dolphin, pantropical spotted dolphin, striped dolphin, spinner dolphin, Clymene dolphin, melon-headed whale, and short-finned pilot whale. In addition, sonar operations in non-territorial waters may expose up to one bottlenose dolphin and one Atlantic spotted dolphin to levels of sound likely to result in TTS. Marine mammals are likely to incur only Level B harassment from sonar exercises in non-territorial waters.

TABLE 7—ESTIMATES OF MARINE MAMMAL EXPOSURES FROM SONAR MISSIONS IN NON-TERRITORIAL WATERS PER YEAR

Marine mammal species	Level A	Level B (TTS)	Level B (behavioral)
Bryde's whale	0	0	0
Sperm whale	0	0	1
Dwarf/Pygmy sperm whale	0	0	0
All beaked whales	0	0	0
Killer whale	0	0	0
False killer whale	0	0	0
Pygmy killer whale	0	0	0
Melon-headed whale	0	0	1
Short-finned pilot whale	0	0	1
Risso's dolphin	0	0	1
Rough-toothed dolphin	0	0	0
Bottlenose dolphin	0	1	46
Atlantic spotted dolphin	0	1	39
Pantropical spotted dolphin	0	0	16
Striped dolphin	0	0	3
Spinner dolphin	0	0	13
Clymene dolphin	0	0	5
Fraser's dolphin	0	0	0

Marine Mammal Exposures Due to Ordnance

Calculation Methods

An overview of the methods to determine the number of exposures of MMPA-protected species to sound likely to result in mortality, Level A harassment (injury), or Level B harassment is provided in the following paragraphs. Appendix A, ''Supplemental Information for Underwater Noise Analysis'' of the LOA application, includes specific formulas and more detailed information.

Acoustic threshold areas are derived from mathematical calculations and models that predict the distances or range to which threshold sound levels will travel. Sound is assumed to spread more or less spherically. Therefore, the range of influence is the radius of an ensonified area (the area exposed to sound). The equations for the models consider the amount of net explosive and the properties of detonations under water as well as environmental factors such as depth of the explosion, overall water depth, water temperature, and bottom type. Various combinations of these environmental factors result in a number of environmental provinces.

The result of the calculations and/or modeling is a volume. There are separate volumes for mortality, harassment resulting in injury (hearing-related and slight lung), and behavioral harassment (from TTS and sub-TTS). For mine detonations, the sound effects were modeled using the different net explosive weights at 16 environmental provinces during the winter and summer seasons. There are three ranges of NEW: 1–10 lb (0.45–4.5 kg), 11–75 lb (5–34 kg), and 76–600 lbs (34.5–272 kg). The three ranges of NEW for mine detonations mirror the ranges identified in the analysis of alternatives. Due to differences in delivery and orientation, line charges are not included within these three ranges of NEW, and their potential effects were analyzed and presented separately. A discussion of the equations used and environmental provinces and equations used are provided in Appendix A, ''Supplemental Information for Underwater Noise Analysis,'' and Appendix B, ''Geographic Description of Acoustic Environmental Provinces'' of the LOA application.

Based on the model calculation, the various zones of influence from these three ranges of NEW are listed below in Table 8.

TABLE 8—ZONES OF INFLUENCE (IN METERS) FROM DIFFERENT RANGES OF NEW UNDER EXPLOSIVE ACOUSTIC CRITERIA

Size of NEW	182 dB re 1 microPa ^{2}-sec	23 psi	1.17 in-lb/in ^{2} (about 205 dB re 1 microPa ^{2}-sec)	Indexed to 13 psi-msec (assumes 100 percent small animal at 26.9 lbs)	Indexed to 30.5 psi-msec (assumes 100 percent small animal at 26.9 lbs)
10 lb	345	379	151	70	15
75 lb	997	535	357	190	66
600 lb	2,863	1,186	927	502	203

Analysis for mine-clearing line charges followed methods similar to detonations. The major differences in the line charge analysis included (1) focus on propagation through the sediment layer(s) rather than treating the bottom as a boundary with a particular reflection loss and (2) modeling according to its unique physical characteristics. The specific information on calculations for mine-clearing line charges is presented in Appendix A, ''Supplemental Information for Underwater Noise Analysis'' of the LOA application.

Acoustical modeling is a conservative measure of the actual exposures and, therefore, the numbers presented in the following paragraphs are not necessarily indicative of actual exposures under the MMPA. In an effort to reduce the potential exposures associated with live detonations, the mitigation and protective measures will be implemented.

Marine Mammal Ordnance Exposures in Territorial Waters

Detonations in territorial waters may expose up to three bottlenose dolphins and two Atlantic spotted dolphins to sound likely to result in harassment (Table 9). Marine mammals are likely to incur only Level B harassment from ordnance exercises conducted in territorial waters.

TABLE 9—ESTIMATES OF MARINE MAMMAL EXPOSURES FROM DETONATIONS (0–34 KG OR 0–75 LB) IN TERRITORIAL WATERS PER YEAR

Marine mammal species	Mortality (severe lung injury)	Level A (slight lung injury)	Level B (non-injury)
Bottlenose dolphin	0	0	3
Atlantic spotted dolphin	0	0	2

Line charge events will only be conducted in the surf zone along a portion of Santa Rosa Island in water depth between 1–3 meters (which is not a normal habitat for marine mammals). The charge is considered one explosive source that has multiple increments that detonate at one time. Line charge events produce a series of small detonations (5 lb. increments) that occur sequentially, rather than a simultaneous large explosion. The instantaneous SPL produced by these sequential detonations is significantly less than a single, large explosion and is unlikely to produce harmful levels of energy. The Navy's model revealed that given the small, sequential explosions, the ZOIs would be small as compared to a single large explosion. Combined with shallow water in which the exercises are proposed to be conducted and the fewer marine mammals expected in the surf zone, NMFS and the Navy do not expect marine mammals to experience harassment from sound generated by line charge exercises in territorial waters (Table 10).

TABLE 10—ESTIMATES OF MARINE MAMMAL EXPOSURES FROM LINE CHARGES (794 KG OR 1,750 LB) IN TERRITORIAL WATERS PER YEAR

Marine mammal species	Mortality (severe lung injury)	Level A (slight lung injury)	Level B (non-injury)
Bottlenose dolphin	0	0	0
Atlantic spotted dolphin	0	0	0

Marine Mammal Ordnance Exposures in Non-Territorial Waters

Detonations in non-territorial waters may expose up to eight marine mammal species to sound likely to result in Level B harassment (Table 11). They include the sperm whale, melon-headed whale, Risso's dolphin, rough-toothed dolphin, bottlenose dolphin, Atlantic spotted dolphin, pantropical spotted dolphin, striped dolphin, and spinner dolphin. In addition, two bottlenose dolphin, two Atlantic spotted dolphin, one pantropical spotted dolphin, and one spinner dolphin may be exposed to levels of sound likely to result in Level A harassment (slight lung injury). Although Navy's modeling showed that one bottlenose dolphin and one Atlantic spotted dolphin may be exposed to levels of sound likely to result in mortality (severe lung injury), NMFS considers that such events are unlikely. Based on the ZOIs calculated for different categories of NEW explosives, the animals have to be within a range of 203 m from the explosion in order to experience severe lung injury or mortality. NMFS expects that the mitigation and monitoring measures associated with ordnance exercises will provide sufficient protection to marine mammals, and will prevent mortality because operations will not be conducted (or will be suspended, as appropriate) if animals are detected within or approaching the ZOI.

TABLE 11—ESTIMATES OF MARINE MAMMAL EXPOSURES FROM DETONATIONS (34–272 KG [76–600 LB]) IN NON-TERRITORIAL WATERS PER YEAR*

Marine mammal species	Mortality (severe lung injury)	Level A (slight lung injury)	Level B (non-injury)
Bryde's whale	0	0	0
Sperm whale	0	0	1
Dwarf/Pygmy sperm whale	0	0	0
All beaked whales	0	0	0
Killer whale	0	0	0
False killer whale	0	0	0
Pygmy killer whale	0	0	0
Melon-headed whale	0	0	1
Short-finned pilot whale	0	0	0
Risso's dolphin	0	0	1
Rough-toothed dolphin	0	0	0
Bottlenose dolphin	0	2	38
Atlantic spotted dolphin	0	2	18
Pantropical spotted dolphin	0	1	6
Striped dolphin	0	0	2
Spinner dolphin	0	1	10
Clymene dolphin	0	0	0

* The Navy's estimates were revised by NMFS after further analysis and consideration of the proposed mitigation and monitoring measures.

Marine Mammal Exposures Due to Projectile Firing

Live projectile firing operations will not occur in territorial waters.

Five-inch round testing is to have 60, 5-inch rounds tested annually. Projectile firing in non-territorial waters may expose up to three species of marine mammals to sound likely to result in Level B harassment (Table 12). They include the bottlenose dolphin and Atlantic spotted dolphin, pantropical and striped dolphin. Marine mammals are likely to incur only Level B harassment from the projectile firing exercises occurring in non-territorial waters.

In addition, tests involving projectile firing are conducted at close range. The probability is low that a marine mammal will enter the firing area directly adjacent to the target undetected simultaneous to projectile firing. The noise associated with the firing and the support aircraft and/or surface vessels would likely cause animals to avoid the area. Furthermore, the mitigation and clearance procedures described below will be implemented, thereby reducing the likelihood that a marine mammal will enter the firing area at the same time a projectile firing exercise is initiated. If present, large groups of cetaceans such as schools of dolphin species and large species of whales such as sperm whales and Bryde's whales will be sighted at the surface during standard clearance procedures and operations would be suspended until such time as these animals leave the target area.

TABLE 12—ESTIMATES OF MARINE MAMMAL EXPOSURES FROM 5-INCH ROUND DETONATIONS IN NON-TERRITORIAL WATERS PER YEAR

Marine mammal species	Mortality (severe lung injury)	Level A (slight lung injury)	Level B (non-injury)
Bryde's whale	0	0	0
Sperm whale	0	0	0
Dwarf/Pygmy sperm whale	0	0	0
All beaked whales	0	0	0
Killer whale	0	0	0
False killer whale	0	0	0
Pygmy killer whale	0	0	0
Melon-headed whale	0	0	0
Short-finned pilot whale	0	0	0

TABLE 12—ESTIMATES OF MARINE MAMMAL EXPOSURES FROM 5-INCH ROUND DETONATIONS IN NON-TERRITORIAL WATERS PER YEAR—Continued

Marine mammal species	Mortality (severe lung injury)	Level A (slight lung injury)	Level B (non-injury)
Risso's dolphin	0	0	0
Rough-toothed dolphin	0	0	0
Bottlenose dolphin	0	0	2
Atlantic spotted dolphin	0	0	1
Pantropical spotted dolphin	0	0	1
Striped dolphin	0	0	0
Spinner dolphin	0	0	0
Clymene dolphin	0	0	0

Table 13 provides a summary of estimated marine mammals under NMFS jurisdiction that could be affected by the proposed NSWC PCD RDT&E activities.

TABLE 13—ESTIMATES OF TOTAL MARINE MAMMAL EXPOSURES FROM THE NSWC PCD MISSION ACTIVITIES PER YEAR

Marine mammal species	Mortality (severe lung injury)	Level A (slight lung injury)	Level B (non-injury)
Bryde's whale			
Sperm whale			2
Dwarf/Pygmy sperm whale			
All beaked whales			
Killer whale			
False killer whale			
Pygmy killer whale			
Melon-headed whale			2
Short-finned pilot whale			1
Risso's dolphin			2
Rough-toothed dolphin			
Bottlenose dolphin	0	2	614
Atlantic spotted dolphin	0	2	471
Pantropical spotted dolphin		1	23
Striped dolphin			5
Spinner dolphin		1	23
Clymene dolphin			5

Effects on Marine Mammal Habitat

There are no areas within the NSWC PCD that are specifically considered as important physical habitat for marine mammals.

The prey of marine mammals are considered part of their habitat. The Navy's DEIS for the NSWC PCD contains a detailed discussion of the potential effects to fish from HFAS/MFAS and explosive detonations. Below is a summary of conclusions regarding those effects.

Effects on Fish From HFAS/MFAS

The extent of data, and particularly scientifically peer-reviewed data, on the effects of high intensity sounds on fish is limited. In considering the available literature, the vast majority of fish species studied to date are hearing generalists and cannot hear sounds above 500 to 1,500 Hz (depending upon the species), and, therefore, behavioral effects on these species from higher frequency sounds are not likely. Moreover, even those fish species that may hear above 1.5 kHz, such as a few sciaenids and the clupeids (and relatives), have relatively poor hearing above 1.5 kHz as compared to their hearing sensitivity at lower frequencies. Therefore, even among the species that have hearing ranges that overlap with some mid- and high frequency sounds, it is likely that the fish will only actually hear the sounds if the fish and source are very close to one another. Finally, since the vast majority of sounds that are of biological relevance to fish are below 1 kHz (e.g., Zelick *et al.,* 1999; Ladich and Popper, 2004), even if a fish detects a mid- or high frequency sound, these sounds will not mask detection of lower frequency biologically relevant sounds. Based on the above information, there will likely be few, if any, behavioral impacts on fish.

Alternatively, it is possible that very intense mid- and high frequency signals, and particularly explosives, could have a physical impact on fish, resulting in damage to the swim bladder and other organ systems. However, even these kinds of effects have only been shown in a few cases in response to explosives, and only when the fish has been very close to the source. Such effects have never been indicated in response to any Navy sonar. Moreover, at greater distances (the distance clearly would depend on the intensity of the signal from the source) there appears to be little or no impact on fish, and particularly no impact on fish that do not have a swim bladder or other air bubble that would be affected by rapid pressure changes.

Effects on Fish From Explosive Detonations

There are currently no well-established thresholds for estimating effects to fish from explosives other than mortality models. Fish that are located in the water column, in proximity to the source of detonation could be injured, killed, or disturbed by the impulsive sound and possibly temporarily leave the area. Continental Shelf Inc. (2004) summarized a few studies conducted to determine effects associated with removal of offshore structures (e.g., oil rigs) in the Gulf of Mexico. Their findings revealed that at very close range, underwater explosions are lethal to most fish species regardless of size, shape, or internal anatomy. For most situations, cause of death in fishes has been massive organ and tissue damage and internal bleeding. At longer range, species with gas-filled swimbladders (e.g., snapper, cod, and striped bass) are more susceptible than those without swimbladders (e.g., flounders, eels). Studies also suggest that larger fishes are generally less susceptible to death or injury than small fishes. Moreover, elongated forms that are round in cross section are less at risk than deep-bodied forms; and orientation of fish relative to the shock wave may affect the extent of injury. Open water pelagic fish (e.g., mackerel) also seem to be less affected than reef fishes. The results of most studies are dependent upon specific biological, environmental, explosive, and data recording factors.

The huge variations in the fish population, including numbers, species, sizes, and orientation and range from the detonation point, make it very difficult to accurately predict mortalities at any specific site of detonation. Fish have the ability to quickly and easily leave an area temporarily when vessels and/or helicopters approach; it is reasonable to assume that fish will leave an area prior to ordnance detonation and will return when operations are completed. Thus, it is anticipated that the quantity of fish affected will be small and will not imperil any fish populations. In addition, most fish species experience large number of natural mortalities, especially during early life-stages, and any small level of mortality caused by the NSWC PCD's limited RDT&E activities involving the explosive detonations will likely be insignificant to the population as a whole.

Proposed Mitigation Measures

In order to issue an incidental take authorization (ITA) under Section 101(a)(5)(A) of the MMPA, NMFS must set forth the ''permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.'' The National Defense Authorization Act (NDAA) of 2004 amended the MMPA as it relates to military-readiness activities and the incidental take authorization process such that ''least practicable adverse impact'' shall include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the ''military readiness activity.'' The mission activities described in the NSWC PCD LOA application and LOA Addendum are considered military readiness activities.

In addition, any mitigation measure prescribed by NMFS should be known 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:

(a) Avoidance or minimization of injury or death of marine mammals wherever possible (goals b, c, and d may contribute to this goal).

(b) A reduction in the numbers of marine mammals (total number or number at a biologically important time or location) exposed to received levels of underwater detonations or other activities expected to result in the take of marine mammals (this goal may contribute to a, above, or to reducing harassment takes only).

(c) A reduction in the number of times (total number or number at biologically important time or location) individuals would be exposed to received levels of underwater detonations or other activities expected to result in the take of marine mammals (this goal may contribute to a, above, or to reducing harassment takes only).

(d) A reduction in the intensity of exposures (either total number or number at biologically important time or location) to received levels of underwater detonations or other activities expected to result in the take of marine mammals (this goal may contribute to a, above, or to reducing the severity of harassment takes only).

(e) A reduction in adverse effects to marine mammal habitat, paying special attention to the food base, activities that block or limit passage to or from biologically important areas, permanent destruction of habitat, or temporary destruction/disturbance of habitat during a biologically important time.

(f) For monitoring directly related to mitigation—an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation (shut-down zone, etc.).

NMFS worked with the Navy and identified potential practicable and effective mitigation measures, which included a careful balancing of the likely benefit of any particular measure to the marine mammals with the likely effect of that measure on personnel safety, practicality of implementation, and impact on the ''military-readiness activity''. These mitigation measures are listed below.

Proposed Mitigation Measures for HFAS/MFAS Operations

Current protective measures employed by the Navy include applicable training of personnel and implementation of activity specific procedures resulting in minimization and/or avoidance of interactions with protected resources.

The Navy includes marine species awareness as part of its training for its Navy personnel on vessels. Marine Species Awareness Training (MSAT) was updated in 2005, and the additional training materials are now included as required training for Navy marine observers. This training addresses the marine observer's (equivalent to lookout or watchstander in other Navy actions) role in environmental protection, laws governing the protection of marine species, Navy stewardship commitments, and general observation information to aid in avoiding interactions with marine species. Marine species awareness and training is reemphasized by the following means:

- Marine observers—Personnel are required to utilize marine species awareness training techniques as standard operating procedure, have available a marine species visual identification aid when marine mammals are sighted, and receive updates to the current marine species awareness training as appropriate.

Implementation of these protective measures is required of all units. The activities undertaken on a Navy vessel or aircraft are highly controlled. The chain of command supervises these activities. Failure to follow orders can result in disciplinary action.

Personnel Training

1. All marine observers onboard platforms involved in the mission activities will review the NMFS-approved MSAT material prior to use of mid- and high-frequency active sonar.

2. Navy marine observers will undertake extensive training in order to qualify as a watchstander in accordance with the Lookout Training Handbook (NAVEDTRA, 12968–D).

3. Marine observer training will include on-the-job instruction under the supervision of a qualified, experienced watchstander. Following successful completion of this supervised training period, Marine observers will complete the Personal Qualification Standard program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects). This does not forbid personnel being trained as marine observers from being counted as those listed in previous measures so long as supervisors monitor their progress and performance.

4. Marine observers will be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of mitigation measures if marine species are spotted.

Marine Observer Responsibilities

1. On the bridge of surface vessels, there will always be at least one to three persons (depending on the length of the vessel) on watch whose duties include observing the water surface around the vessel.

Manned motor-driven vessels with length overall less than 65 ft (20 m) would require at least one marine species awareness trained observer; vessels with length overall between 65–200 ft (20–61 m) would require at least two marine species awareness trained observers; and vessels with length overall over 200 ft (61 m) would require at least 3 marine species awareness trained observers.

2. Each marine observer will have at their disposal at least one set of binoculars available to aid in the detection of marine mammals.

3. On surface vessels equipped with the AN/SQQ–53C/56, pedestal mounted ‘‘Big Eye’’ (20 x 110) binoculars will be present and in good working order to assist in the detection of marine mammals in the vicinity of the vessel.

4. Marine observers will employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968–D).

5. Marine observers would scan the water from the vessel to the horizon and be responsible for all contacts in their sector. In searching the assigned sector, the marine observer would always start at the forward part of the sector and search aft (toward the back). To search and scan, the marine observer would hold the binoculars steady so the horizon is in the top third of the field of vision and direct the eyes just below the horizon. The marine observer would scan for approximately five seconds in as many small steps as possible across the field seen through the binoculars. They would search the entire sector in approximately five-degree steps, pausing between steps for approximately five seconds to scan the field of view. At the end of the sector search, the glasses would be lowered to allow the eyes to rest for a few seconds, and then the marine observer would search back across the sector with the naked eye.

6. After sunset and prior to sunrise, marine observers will employ Night Lookout Techniques in accordance with the Lookout Training Handbook.

7. At night, marine observers would not sweep the horizon with their eyes because eyes do not see well when they are moving. Marine observers would scan the horizon in a series of movements that would allow their eyes to come to periodic rests as they scan the sector. When visually searching at night, they would look a little to one side and out of the corners of their eyes, paying attention to the things on the outer edges of their field of vision.

8. Marine observers will be responsible for reporting all objects or anomalies sighted in the water (regardless of the distance from the vessel) to the Test Director or the Test Director’s designee, since any object or disturbance (e.g., trash, periscope, surface disturbance, discoloration) in the water may be indicative of a threat to the vessel and its crew or indicative of a marine species that may need to be avoided as warranted.

Operating Procedures

1. A Record of Environmental Consideration will be included in the Test Plan prior to the test event to further disseminate the personnel testing requirement and general marine mammal mitigation measures.

2. Test Directors will make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the vessel.

3. All personnel engaged in passive acoustic sonar operation (including aircraft or surface vessels) will monitor for marine mammal vocalizations and report the detection of any marine mammal to the appropriate watch station for dissemination and appropriate action.

4. During mid- and high frequency active sonar activities, personnel will utilize all available sensor and optical systems (such as Night Vision Goggles) to aid in the detection of marine mammals.

5. Navy aircraft participating in exercises at sea will conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties.

6. Aircraft with deployed sonobuoys will use only the passive capability of sonobuoys when marine mammals are detected within 200 yards of the sonobuoy.

7. Marine mammal detections will be immediately reported to assigned Test Director or the Test Director’s designee for further dissemination to vessels in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the vessel will likely result in a closing of the distance to the detected marine mammal.

8. Safety Zones—When marine mammals are detected by any means (aircraft, marine observer, or acoustically) the Navy will ensure that HFAS/MFAS transmission levels are limited to at least 6 dB below normal operating levels if any detected marine mammals are within 1,000 yards (914 m) of the sonar dome (the bow).

(1) Vessels will continue to limit maximum HFAS/MFAS transmission levels by this 6-dB factor until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards (1,828 m) beyond the location of the last detection.

(2) The Navy will ensure that HFAS/MFAS transmissions will be limited to at least 10 dB below the equipment’s normal operating level if any detected animals are within 500 yards (457 m) of the sonar dome. Vessels will continue to limit maximum ping levels by this 10-dB factor until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards (1,828 m) beyond the location of the last detection.

(3) The Navy will ensure that HFAS/MFAS transmissions are ceased if any detected marine mammals are within 200 yards (183 m) of the sonar dome. HFAS/MFAS will not resume until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards (1,828 m) beyond the location of the last detection.

(4) Special conditions applicable for dolphins only: If, after conducting an initial maneuver to avoid close quarters with dolphins, the Test Director or the Test Director’s designee concludes that dolphins are deliberately closing to ride

the vessel's bow wave, no further mitigation actions are necessary while the dolphins or porpoises continue to exhibit bow wave riding behavior.

(5) If the need for power-down should arise as detailed in ''Safety Zones'' above, Navy shall follow the requirements as though they were operating at 235 dB—the normal operating level (i.e., the first power-down will be to 229 dB, regardless of at what level above 235 sonar was being operated).

9. Prior to start up or restart of active sonar, operators will check that the Safety Zone radius around the sound source is clear of marine mammals.

10. Sonar levels (generally)—Navy will operate sonar at the lowest practicable level, not to exceed 235 dB, except as required to meet testing objectives.

11. Helicopters shall observe/survey the vicinity of the mission activities for 10 minutes before the first deployment of active (dipping) sonar in the water.

12. Helicopters shall not dip their sonar within 200 yards (183 m) of a marine mammal and shall cease pinging if a marine mammal closes within 200 yards (183 m) after pinging has begun.

Proposed Mitigation Measures for Ordnance and Projectile Firing

To ensure protection of marine mammals during ordnance and projectile firing related underwater detonation mission activities, the operating area must be determined to be clear of marine mammals prior to detonation. Implementation of the following mitigation measures would ensure that marine mammals would not be exposed to TTS, PTS or injury from ordnance and projectile firing exercises.

- No detonations over 34 kg (75 lb) will be conducted in territorial waters. This does not apply to the line charge detonation, which is a 107 m (350 ft) detonation cord with explosives lined from one end to the other end in 2 kg (5 lb) increments and total 794 kg (1,750 lb) of NEW. This charge is considered one explosive source that has multiple increments that detonate at one time.
- The number of live mine detonations will be minimized and the smallest amount of explosive material possible to achieve test objectives will be used.
- Activities will be coordinated through the Environmental Help Desk to allow potential concentrations of detonations in a particular area over a short time to be identified and avoided.
- Visual surveys and aerial surveys will be conducted for all test operations that involve detonation events with for 30 minutes before and during the test event.
- Line charge tests would not be conducted during the nighttime.
- Additional mitigation will be determined through the NSWC PCD's Environmental Review Process review based on test activities including the size of detonations, test platforms, and environmental effects documented in the Navy's EIS/OEIS. Various zones of influence (ZOIs) from different ranges of NEW are shown in Table 8. As a mitigation measure, the largest ZOI associated with the upper limit of each NEW would be adopted as a clearance zone for such range of NEW. Therefore, for the following ranges of NEW, the clearance zones are: 2,863 m for NEW between 76–600 lb, 997 m for NEW between 11–75 lb, and 345 m for NEW under 11 lb.

Proposed Mitigation Measures for Surface Operations and Other Activities

For surface operations, vessel-based visual surveys would be conducted for all test operations to reduce the potential for vessel collisions with a protected species.

(a) While underway, vessels will have at least one to three marine species awareness trained observers (based on the length of the vessel) with binoculars. Manned motor-driven vessels with length overall less than 65 ft (20 m) would require at least one marine species awareness trained observer; vessels with length overall between 65–200 ft (20–61 m) would require at least two marine species awareness trained observers; and vessels with length overall over 200 ft (61 m) would require at least three marine species awareness trained observers. As part of their regular duties, marine observers will watch for and report to the Test Director or Test Director's designee the presence of marine mammals.

(b) Marine observers will employ visual search procedures employing a scanning method in accordance with the Lookout Training Handbook (NAVEDTRA 12968–D).

(c) While in transit, naval vessels shall be alert at all times, use extreme caution, and proceed at a ''safe speed'' (the minimum speed at which mission goals or safety will not be compromised) so that the vessel can take proper and effective action to avoid a collision with any marine animal and can be stopped within a distance appropriate to the prevailing circumstances and conditions.

(d) When marine mammals have been sighted in the area, Navy vessels will increase vigilance and implement measures to avoid collisions with marine mammals and avoid activities that might result in close interaction of naval assets and marine mammals. Actions shall include changing speed and/or direction and are dictated by environmental and other conditions (e.g., safety, weather).

(e) Naval vessels will maneuver to keep at least 500 yd (460 m) away from any observed whale and avoid approaching whales head-on. This requirement does not apply if a vessel's safety is threatened, such as when change of course will create an imminent and serious threat to a person, vessel, or aircraft, and to the extent vessels are restricted in their ability to maneuver. Vessels will take reasonable steps to alert other vessels in the vicinity of the whale.

(f) Where feasible and consistent with mission and safety, vessels will avoid closing to within 200 yards (183 m) of marine mammals other than whales (whales addressed above).

(g) Floating weeds, algal mats, Sargassum rafts, clusters of seabirds, and jellyfish are good indicators of marine mammal presence. Therefore, increased vigilance in watching for marine mammals will be taken where these conditions exist.

(h) All vessels will maintain logs and records documenting RDT&E activities should they be required for event reconstruction purposes. Logs and records will be kept for a period of 30 days following completion of a RDT&E mission activity.

Research and Conservation Measures for Marine Mammals

The Navy provides a significant amount of funding and support for marine research. The Navy provided $26 million in Fiscal Year 2008 and plans for $22 million in Fiscal Year 2009 to universities, research institutions, Federal laboratories, private companies, and independent researchers around the world to study marine mammals. Over the past five years the Navy has funded over $100 million in marine mammal research. The U.S. Navy sponsors seventy percent of all U.S. research concerning the effects of human-generated sound on marine mammals and 50 percent of such research conducted worldwide. Major topics of Navy-supported research include the following:

- Better understanding of marine species distribution and important habitat areas,
- Developing methods to detect and monitor marine species before and during training,

• Understanding the effects of sound on marine mammals, sea turtles, fish, and birds, and

• Developing tools to model and estimate potential effects of sound.

The Navy's Office of Naval Research currently coordinates six programs that examine the marine environment and are devoted solely to studying the effects of noise and/or the implementation of technology tools that will assist the Navy in studying and tracking marine mammals. The six programs are as follows:

• Environmental Consequences of Underwater Sound,

• Non-Auditory Biological Effects of Sound on Marine Mammals,

• Effects of Sound on the Marine Environment,

• Sensors and Models for Marine Environmental Monitoring,

• Effects of Sound on Hearing of Marine Animals, and

• Passive Acoustic Detection, Classification, and Tracking of Marine Mammals.

Furthermore, research cruises by NMFS and by academic institutions have received funding from the Navy.

The Navy has sponsored several workshops to evaluate the current state of knowledge and potential for future acoustic monitoring of marine mammals. The workshops brought together acoustic experts and marine biologists from the Navy and other research organizations to present data and information on current acoustic monitoring research efforts and to evaluate the potential for incorporating similar technology and methods on instrumented ranges. However, acoustic detection, identification, localization, and tracking of individual animals still requires a significant amount of research effort to be considered a reliable method for marine mammal monitoring. The Navy supports research efforts on acoustic monitoring and will continue to investigate the feasibility of passive acoustics as a potential mitigation and monitoring tool.

Overall, the Navy will continue to fund ongoing marine mammal research, and is planning to coordinate long-term monitoring/studies of marine mammals on various established ranges and operating areas. The Navy will continue to research and contribute to university/external research to improve the state of the science regarding marine species biology and acoustic effects. These efforts include mitigation and monitoring programs; data sharing with NMFS and via the literature for research and development efforts.

Long-Term Prospective Study

NMFS, with input and assistance from the Navy and several other agencies and entities, will perform a longitudinal observational study of marine mammal strandings to systematically observe for and record the types of pathologies and diseases and investigate the relationship with potential causal factors (e.g., sonar, seismic, weather). The study will not be a true ''cohort'' study, because we will be unable to quantify or estimate specific sonar or other sound exposures for individual animals that strand. However, a cross-sectional or correlational analysis, a method of descriptive rather than analytical epidemiology, can be conducted to compare population characteristics, e.g., frequency of strandings and types of specific pathologies between general periods of various anthropogenic activities and non-activities within a prescribed geographic space. In the long term study, we will more fully and consistently collect and analyze data on the demographics of strandings in specific locations and consider anthropogenic activities and physical, chemical, and biological environmental parameters. This approach in conjunction with true cohort studies (tagging animals, measuring received sounds, and evaluating behavior or injuries) in the presence of activities and non-activities will provide critical information needed to further define the impacts of MTEs and other anthropogenic and non-anthropogenic stressors. In coordination with the Navy and other federal and non-federal partners, the comparative study will be designed and conducted for specific sites during intervals of the presence of anthropogenic activities such as sonar transmission or other sound exposures and absence to evaluate demographics of morbidity and mortality, lesions found, and cause of death or stranding. Additional data that will be collected and analyzed in an effort to control potential confounding factors include variables such as average sea temperature (or just season), meteorological or other environmental variables (e.g., seismic activity), fishing activities, etc. All efforts will be made to include appropriate controls (i.e., no sonar or no seismic); environmental variables may complicate the interpretation of ''control'' measurements. The Navy and NMFS along with other partners are evaluating mechanisms for funding this study.

Proposed Monitoring Measures

In order to issue an ITA for an activity, section 101(a)(5)(A) 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 LOAs 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.

Monitoring measures prescribed by NMFS should accomplish one or more of the following general goals:

(a) An increase in the probability of detecting marine mammals, both within the safety zone (thus allowing for more effective implementation of the mitigation) and in general to generate more data to contribute to the analyses mentioned below.

(b) An increase in our understanding of how many marine mammals are likely to be exposed to levels of HFAS/MFAS (or explosives or other stimuli) that we associate with specific adverse effects, such as behavioral harassment, TTS, or PTS.

(c) An increase in our understanding of how marine mammals respond to HFAS/MFAS (at specific received levels), explosives, or other stimuli expected to result in take and how anticipated adverse effects on individuals (in different ways and to varying degrees) may impact the population, species, or stock (specifically through effects on annual rates of recruitment or survival) through any of the following methods:

• Behavioral observations in the presence of HFAS/MFAS compared to observations in the absence of sonar (need to be able to accurately predict received level and report bathymetric conditions, distance from source, and other pertinent information).

• Physiological measurements in the presence of HFAS/MFAS compared to observations in the absence of sonar (need to be able to accurately predict received level and report bathymetric conditions, distance from source, and other pertinent information), and/or

• Pre-planned and thorough investigation of stranding events that occur coincident to naval activities.

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

(d) An increased knowledge of the affected species.

(e) An increase in our understanding of the effectiveness of certain mitigation and monitoring measures.

With these goals in mind, the following monitoring procedures for the proposed Navy's NSWC PCD mission activities have been worked out between NMFS and the Navy. NMFS and the Navy continue to improve the plan and may modify the monitoring plan based on input received during the public comment period.

Several monitoring techniques were prescribed for other Navy activities related to sonar exercises and underwater detonations (see monitoring plan for Navy's Hawaii Range Complex; Navy, 2008). Every known monitoring technique has advantages and disadvantages that vary temporally and spatially. Therefore, a combination of techniques are proposed to be used so that the detection and observation of marine animals is maximized. Monitoring methods proposed during mission activity events in the NSWC PCD Study Area include a combination of the following research elements that would be used to collection data for comprehensive assessment:

- Visual Surveys—Vessel, Aerial and Shore-based
- Passive Acoustic Monitoring (PAM)
- Marine Mammal Observers (MMOs) on Navy vessels

Visual Surveys—Vessel, Aerial and Shore-Based

Visual surveys of marine animals can provide detailed information about the behavior, distribution, and abundance. Baseline measurements and/or data for comparison can be obtained before, during and after mission activities. Changes in behavior and geographical distribution may be used to infer if and how animals are impacted by sound. In accordance with all safety considerations, observations will be maximized by working from all available platforms: Vessels, aircraft, land and/or in combination. Vessel and aerial surveys will be conducted on commercial vessels and aircraft. Visual surveys will be conducted during Navy RDT&E events that have been identified as providing the highest likelihood of success.

Vessel surveys are often preferred by researchers because of their slow speed, offshore survey ability, duration and ability to more closely approach animals under observation. They also result in higher rate of species identification, the opportunity to combine line transect and mark-recapture methods of estimating abundance, and collection of oceanographic and other relevant data. Vessels can be less expensive per unit of time, but because of the length of time to cover a given survey area, may actually be more expensive in the long run compared to aerial surveys (Dawson *et al.,* 2008). Changes in behavior and geographical distribution may be used to infer if and how animals are impacted by sound. However, it should be noted that animal reaction (reactive movement) to the survey vessel itself is possible (Dawson *et al.,* 2008). Vessel surveys typically do not allow for observation of animals below the ocean's surface (e.g., in the water column) as compared to aerial surveys (DoN, 2008a; Slooten *et al.,* 2004).

For underwater detonations, the size of the survey area has been determined based upon the type of explosive event planned and the amount of NEW used. As a conservative measure, the largest ZOI associated with the upper limit of each NEW would be surveyed during the training event. For example, the Navy would be required to observe the following ZOIs and ensure they are clear of marine mammals prior to conducting explosive ordnance exercises: 2,863 m for NEW between 76–600 lb; 997 m for NEW between 11–75 lb; and 345 m for NEW under 11 lb.

If animals are observed prior to or during an explosion, a focal follow of that individual or group will be conducted to record behavioral responses. Navy mitigation measures will prevent the mission activity from occurring should animals be seen within these ZOIs of the events listed above.

The visual survey team will collect the same data that are collected by Navy marine observers, including but not limited to: (1) Location of sighting; (2) species; (3) number of individuals; (4) number of calves present, if any; (5) duration of sighting; (6) behavior of marine animals sighted; (7) direction of travel; (8) environmental information associated with sighting event including Beaufort sea state, wave height, swell direction, wind direction, wind speed, glare, percentage of glare, percentage of cloud cover; and (9) when in relation to navy exercises did the sighting occur (before, during or after detonations/exercise). Animal sightings and relative distance from a particular detonation site will be used post-survey to estimate the number of marine mammals exposed to different received levels (energy and pressure of discharge based on distance to the source, bathymetry, oceanographic conditions and the type and size of detonation) and their corresponding behavior. For vessel based surveys a passive acoustic system (hydrophone or towed array) or sonobuoys may be used to help determine if marine mammals are in the area before and after a detonation event.

Although photo-identification studies are not typically a component of Navy exercise monitoring surveys, the Navy supports using the contracted platforms to obtain opportunistic data collection. Therefore, any digital photographs that are taken of marine mammals during visual surveys will be provided to local researchers for their regional research.

1. Aerial Surveys

During sonar operations, an aerial survey team will fly transects relative to a Navy surface vessel that is transmitting HFA/MFA sonar. The aerial survey team will collect both visual sightings and behavioral observations of marine animals. These transect data will provide an opportunity to collect data of marine mammals at different received levels and their behavioral responses and movement relative to the Navy vessel's position. Surveys will include time with and without active sonar in order to compare density, geographical distribution and behavioral observations. After declassification, related sonar transmissions will be used to calculate exposure levels.

Behavioral observation methods will involve three professionally trained marine mammal observers and a pilot. Two observers will observe behaviors, one with hand-held binoculars and one with the naked eye per Wursig *et al.* (1985) and Richardson *et al.* (1986). If there is more than one whale, each observer will record respirations of different animals, ideally from the same animal. In the case of large groups, e.g., of delphinids, group behavior, speed, orientation, etc., will be recorded as described in Smultea and Würsig (1995). An observer will use a video camera to record behaviors in real time. Two external microphones will be input and attached to the video camera to record vocal behavioral descriptions on two different channels of the video camera. The videotape will be time-stamped and observers will also call out times. The third observer will record notes, environmental data, and operate a laptop connected to a GPS and the plane's altimeter.

Detailed behavioral focal observations of cetaceans will be recorded, including the following variables where possible: Species, group size and composition (number of calves, etc.), latitude/longitude, surface and dive durations and times, number and spacing/times of respirations, conspicuous behaviors (e.g., breach, tail slap, etc.), behavioral states, orientation and changes in orientation, estimated group travel speed, inter-individual distances, defecations, social interactions, aircraft speed, aircraft altitude, distance to focal group (using the plane's radar) and any unusual behaviors or apparent reactions following previously established protocol (Richardson *et al.,* 1985; 1986; 1990; Wursig *et al.,* 1985; 1989; Smultea and Würsig, 1995; Patenaude *et al.,* 2002).

In addition, to measure whether marine mammals are displaced geographically as a result of sonar operations, systematic line-transect aerial surveys will be conducted on the two days before and a variation of one to five days after a NSWC PCD RDT&E testing activity to collect relative density data in the testing area for marine mammals in the area. Attempts will be made to survey during a test event, but safety of navigation for the survey vessel may preclude conduction this kind of survey during certain NSWC PCD RDT&E activities. Rationale supporting variation in the number of days after a test event allows for detection of animals that gradually return to an area, if their distribution changes as a response. One survey day following the mission activity event will be devoted to flying coastlines nearest the mission event to look for potential marine mammal strandings. If a stranding is observed, an assessment of the animal's condition (alive, injured, dead, and/or decayed) will be immediately reported to the Navy for appropriate action and the information will be transmitted immediately to NMFS.

2. Vessel Surveys

The primary purpose of vessel surveys will be to document and monitor potential behavioral effects of the mission activities on marine mammals. As such, parameters to be monitored for potential effects are changes in the occurrence, distribution, numbers, surface behavior, and/or disposition (injured or dead) of marine mammal species before, during and after the mission activities. While challenging, the vessel surveys will attempt to conduct focal follows on animals with Navy vessels in view.

As with the aerial surveys, the vessel surveys will be designed to maximize detections of any target species near mission activity events for focal follows. Systematic transects will be used to locate marine mammals, however, the survey should deviate from transect protocol to collect behavioral data particularly if a Navy vessel is visible on the horizon or closer. At this point, they will approach within three nautical miles of the vessel(s), if weather and conditions allow, and will work in 'focal follow mode' (e.g. collect behavioral data using the big eyes, and observe the behavior of any animals that are seen). The team will go off effort for photo-id and close approach 'focal animal follows' as feasible, and when marine animal encounters occur in proximity to the vessel. While in focal follow mode, observers will gather detailed behavioral data from the animals, for as long as the animal allows. Analysis of behavioral observations will be made after the RDT&E event (Altman, 1974; Martin and Bateson, 1993). While the Navy vessels are within view, attempts will be made to position the dedicated survey vessel in the best possible way to obtain focal follow data in the presence of the NSWC PCD test event. If Navy vessels are not in view, then the vessel will begin a systematic line transect survey within the area to assess marine mammal occurrence and observe behavior. The goal of this part of the survey is to observe marine mammals that may not have been exposed to HFAS/MFAS or explosions. Therefore, post-analysis will focus on how the location, speed and vector of the survey vessel and the location and direction of the sonar source (e.g., Navy surface vessel) relates to the animal. Any other vessels or aircraft observed in the area will also be documented.

3. Shore-Based Surveys

If explosive events are planned in advance to occur adjacent to nearshore areas where there are elevated coastal structures (e.g. lookout tower at Eglin Air Force Base) or topography, then shore-based monitoring, using binoculars or theodolite, may be used to augment other visual survey methods. These methods have been proven valuable in similar monitoring studies such as ATOC and others (Frankel and Clark, 1998; Clark and Altman, 2006).

Passive Acoustic Monitoring

There are both benefits and limitations to passive acoustic monitoring (Mellinger *et al.,* 2007). Passive acoustic monitoring allows detection of marine mammals that may not be seen during a visual survey. When interpreting data collected from PAM, it is understood that species specific results must be viewed with caution because not all animals within a given population are calling, or may be calling only under certain conditions (Mellinger, 2007; ONR, 2007). Because the NSWC PCD study area does not have some of the advanced features that the South Atlantic Range and Atlantic Undersea Testing and Evaluation Center have, allowing for the potential to track real-time, passive acoustic monitoring in the NSWC PCD will utilize a stationary, bottom-set hydrophone array for PAM.

The array would be deployed for each of the days the ship is at sea. NSWC PCD has a bottom set hydrophone array, which can detect marine mammals that vocalize and would be used to supplement the ship based systematic line transect surveys (particularly for species such as beaked whales that are rarely seen). The array would need to detect low frequency vocalizations (less than 1,000 Hertz) for baleen whales and relatively high frequency vocalizations (up to 30 kilohertz) for odontocetes such as sperm whales.

Marine Mammal Observers on Navy Vessels

Civilian Marine Mammal Observers (MMOs) aboard Navy vessels will be used to research the effectiveness of Navy marine observers, as well as for data collection during other monitoring surveys.

MMOs will be field-experienced observers that are Navy biologists or contracted observers. These civilian MMOs will be placed alongside existing Navy marine observers during a sub-set of NSWC PCD RDT&E activities. This can only be done on certain vessels and observers may be required to have security clearance. Use of MMOs will verify Navy marine observer sighting efficiency, offer an opportunity for more detailed species identification, provide an opportunity to bring animal protection awareness to the vessels' crew, and provide the opportunity for an experienced biologist to collect data on marine mammal behavior. Data collected by the MMOs is anticipated to assist the Navy with potential improvements to marine observer training as well as providing the marine observers with a chance to gain additional knowledge on marine mammals.

Events selected for MMO participation will be an appropriate fit in terms of security, safety, logistics, and compatibility with NSWC PCD RDT&E activities. The MMOs will not be part of the Navy's formal reporting chain of command during their data collection efforts and Navy marine observers will follow their chain of command in reporting marine mammal sightings. Exceptions will be made if an animal is observed by the MMO within the shutdown zone and was not seen by the Navy marine observer. The MMO will inform the marine observer of the sighting so that appropriate action may be taken by the chain of command. For less biased data, it is recommended that

MMOs should schedule their daily observations to duplicate the Navy marine observers' schedule.

Civilian MMOs will be aboard Navy vessels involved in the study. As described earlier, MMOs will meet and adhere to necessary qualifications, security clearance, logistics and safety concerns. MMOs will monitor for marine mammals from the same height above water as the marine observers and as all visual survey teams, they will collect the same data collected by Navy marine observers, including but not limited to: (1) Location of sighting; (2) species (if not possible, identification of whale or dolphin); (3) number of individuals; (4) number of calves present, if any; (5) duration of sighting; (6) behavior of marine animals sighted; (7) direction of travel; (8) environmental information associated with sighting event including Beaufort sea state, wave height, swell direction, wind direction, wind speed, glare, percentage of glare, percentage of cloud cover; and (9) when in relation to navy exercises did the sighting occur (before, during or after detonations/exercise).

In addition, the Navy is developing an Integrated Comprehensive Monitoring Program (ICMP) for marine species to assess the effects of NSWC PCD RDT&E activities on marine species and investigate population trends in marine species distribution and abundance in locations where NSWC PCD RDT&E activities regularly occurs.

The ICMP will provide the overarching coordination that will support compilation of data from range-specific monitoring plans (e.g., NSWC PCD plan) as well as Navy funded research and development (R&D) studies. The ICMP will coordinate the monitoring programs progress towards meeting its goals and develop a data management plan. The ICMP will be evaluated annually to provide a matrix for progress and goals for the following year, and will make recommendations on adaptive management for refinement and analysis of the monitoring methods.

The primary objectives of the ICMP are to:

• Monitor and assess the effects of Navy activities on protected species;

• Ensure that data collected at multiple locations is collected in a manner that allows comparison between and among different geographic locations;

• Assess the efficacy and practicality of the monitoring and mitigation techniques;

• Add to the overall knowledge-base of marine species and the effects of Navy activities on marine species.

The ICMP will be used both as: (1) a planning tool to focus Navy monitoring priorities (pursuant to ESA/MMPA requirements) across Navy Range Complexes and Exercises; and (2) an adaptive management tool, through the consolidation and analysis of the Navy's monitoring and watchstander data, as well as new information from other Navy programs (e.g., R&D), and other appropriate newly published information.

In combination with the adaptive management component of the proposed NSWC PCD rule and the other planned Navy rules (e.g., Atlantic Fleet Active Sonar Training, Hawaii Range Complex, and Southern California Range Complex), the ICMP could potentially provide a framework for restructuring the monitoring plans and allocating monitoring effort based on the value of particular specific monitoring proposals (in terms of the degree to which results would likely contribute to stated monitoring goals, as well as the likely technical success of the monitoring based on a review of past monitoring results) that have been developed through the ICMP framework, instead of allocating based on maintaining an equal (or commensurate to effects) distribution of monitoring effort across Range complexes. For example, if careful prioritization and planning through the ICMP (which would include a review of both past monitoring results and current scientific developments) were to show that a large, intense monitoring effort in GOM would likely provide extensive, robust and much-needed data that could be used to understand the effects of sonar throughout different geographical areas, it may be appropriate to have other Range Complexes dedicate money, resources, or staff to the specific monitoring proposal identified as ''high priority'' by the Navy and NMFS, in lieu of focusing on smaller, lower priority projects divided throughout their home Range Complexes. The ICMP will identify:

• A means by which NMFS and the Navy would jointly consider prior years' monitoring results and advancing science to determine if modifications are needed in mitigation or monitoring measures to better effect the goals laid out in the Mitigation and Monitoring sections of the NSWC PCD rule.

• Guidelines for prioritizing monitoring projects.

• If, as a result of the workshop and similar to the example described in the paragraph above, the Navy and NMFS decide it is appropriate to restructure the monitoring plans for multiple ranges such that they are no longer evenly allocated (by Range Complex), but rather focused on priority monitoring projects that are not necessarily tied to the geographic area addressed in the rule, the ICMP will be modified to include a very clear and unclassified record-keeping system that will allow NMFS and the public to see how each Range Complex/project is contributing to all of the ongoing monitoring (resources, effort, money, etc.).

Adaptive Management

Our understanding of the effects of HFAS/MFAS on marine mammals is still in its relative infancy, and yet the science in this field is evolving fairly quickly. These circumstances make the inclusion of an adaptive management component both valuable and necessary within the context of 5-year regulations for activities that have been associated with marine mammal mortality in certain circumstances and locations (though not the NSWC PCD Study Area). The use of adaptive management will give NMFS the ability to consider new data from different sources to determine (in coordination with the Navy), on an annual basis, if new or modified mitigation or monitoring measures are appropriate for subsequent annual LOAs. Following are some of the possible sources of applicable data:

• Results from the Navy's monitoring from the previous year (either from the NSWC PCD Study Area or other locations).

• Results from specific stranding investigations (either from the NSWC PCD Study Area or other locations, and involving coincident NSWC PCD RDT&E or not involving coincident use).

• Results from the research activities associated with Navy's HFAS/MFAS.

• Results from general marine mammal and sound research (funded by the Navy or otherwise).

• Any information which reveals that marine mammals may have been taken in a manner, extent or number not authorized by these regulations or subsequent Letters of Authorization.

Mitigation measures could be modified or added if new data suggest that such modifications would have a reasonable likelihood of accomplishing the goals of mitigation laid out in this proposed rule and if the measures are practicable. NMFS would also coordinate with the Navy to modify or add to the existing monitoring requirements if the new data suggest that the addition of a particular measure would more effectively accomplish the goals of monitoring laid out in this proposed rule. The reporting requirements associated with this proposed rule are designed to provide

NMFS with monitoring data from the previous year to allow NMFS to consider the data in issuing annual LOAs. NMFS and the Navy will meet annually prior to LOA issuance to discuss the monitoring reports, Navy R&D developments, and current science and whether mitigation or monitoring modifications are appropriate.

Reporting

In order to issue an ITA for an activity, section 101(a)(5)(A) of the MMPA states that NMFS must set forth ''requirements pertaining to the monitoring and reporting of such taking.'' Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring. Some of the reporting requirements are still in development and the final rule may contain additional details not contained in the proposed rule. Additionally, proposed reporting requirements may be modified, removed, or added based on information or comments received during the public comment period.

General Notification of Injured or Dead Marine Mammals

Navy personnel will ensure that NMFS (regional stranding coordinator) is notified immediately (or as soon as clearance procedures allow) if an injured or dead marine mammal is found during or shortly after, and in the vicinity of, any Navy mission activities utilizing MFAS, HFAS, or underwater explosive detonations. The Navy will provide NMFS with species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available). The Stranding Response Plan contains more specific reporting requirements for specific circumstances.

Annual Report

The Navy will submit its first annual report to the Office of Protected Resources, NMFS, no later than 120 days before the expiration of the LOA. These reports will, at a minimum, include the following information:

• The estimated number of hours of sonar operation, broken down by source type.

• If possible, the total number of hours of observation effort (including observation time when sonar was not operating).

• A report of all marine mammal sightings (at any distance—not just within a particular distance) to include, when possible and to the best of their ability, and if not classified:

—Species.
—Number of animals sighted.
—Location of marine mammal sighting.
—Distance of animal from any operating sonar sources.
—Whether animal is fore, aft, port, starboard.
—Direction animal is moving in relation to source (away, towards, parallel).
—Any observed behaviors of marine mammals.

• The status of any sonar sources (what sources were in use) and whether or not they were powered down or shut down as a result of the marine mammal observation.

• The platform that the marine mammals were sighted from.

NSWC PCD Comprehensive Report

The Navy will submit to NMFS a draft report that analyzes and summarizes all of the multi-year marine mammal information gathered during HFAS/MFAS and underwater detonation related mission activities for which annual reports are required as described above. This report will be submitted at the end of the fourth year of the rule (March 2013), covering activities that have occurred through October 1, 2012. The Navy will respond to NMFS comments on the draft comprehensive report if submitted within 3 months of receipt. The report will be considered final after the Navy has addressed NMFS' comments, or three months after the submittal of the draft if NMFS does not comment by then.

Analysis and Negligible Impact Determination

Pursuant to NMFS' regulations implementing the MMPA, an applicant is required to estimate the number of animals that will be ''taken'' by the specified activities (i.e., takes by harassment only, or takes by harassment, injury, and/or death). This estimate informs the analysis that NMFS must perform to determine whether the activity will have a ''negligible impact'' on the species or stock. Level B (behavioral) harassment occurs at the level of the individual(s) and does not assume any resulting population-level consequences, though there are known avenues through which behavioral disturbance of individuals can result in population-level effects. 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, NMFS must consider other factors, such as the likely nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), or any of the other variables mentioned in the first paragraph (if known), as well as the number and nature of estimated Level A takes, the number of estimated mortalities, and effects on habitat.

The Navy's specified activities have been described based on best estimates of the number of HFAS/MFAS hours that the Navy will conduct and the planned detonation events. Taking the above into account, considering the sections discussed below, and dependent upon the implementation of the proposed mitigation measures, NMFS has preliminarily determined that Navy's RDT&E activities utilizing HFAS/MFAS and underwater detonations will have a negligible impact on the marine mammal species and stocks present in the NSWC PCD Study Area.

Behavioral Harassment

As discussed in the Potential Effects of Exposure of Marine Mammals to HFAS/MFAS and illustrated in the conceptual framework, marine mammals can respond to HFAS/MFAS in many different ways, a subset of which qualifies as harassment. One thing that the take estimates do not take into account is the fact that most marine mammals will likely avoid strong sound sources to one extent or another. Although an animal that avoids the sound source will likely still be taken in some instances (such as if the avoidance results in a missed opportunity to feed, interruption of reproductive behaviors, etc.) in other cases avoidance may result in fewer instances of take than were estimated or in the takes resulting from exposure to a lower received level than was estimated, which could result in a less severe response. The Navy proposes only 77 hours of mid-frequency sonar operations per year (Table 2) in the NSWC PCD Study Area, and the use of the most powerful 53C series sonar will be limited to just 4 hours per year. Therefore, any disturbance to marine mammals resulting from 53C and other MFAS is expected to be significantly less in terms of severity and duration when compared to major sonar exercises (e.g., AFAST, HRC, SOCAL). As for the HFAS, source levels of those HFAS are not as high as the 53C series MFAS. In addition, high frequency signals tend to have more attenuation in the water column and are more prone to lose their energy during propagation. Therefore, their zones of influence are much smaller, thereby making it easier to detect marine mammals and prevent adverse effects from occurring.

There is little information available concerning marine mammal reactions to MFAS/HFAS. The Navy has only been conducting monitoring activities since 2006 and has not compiled enough data to date to provide a meaningful picture of effects of HFAS/MFAS on marine mammals, particularly in the NSWC PCD Study Area. From the four major training exercises (MTEs) of HFAS/MFAS in the AFAST Study Area for which NMFS has received a monitoring report, no instances of obvious behavioral disturbance were observed by the Navy watchstanders in the 700+ hours of effort in which 79 sightings of marine mammals were made (10 during active sonar operation). One cannot conclude from these results that marine mammals were not harassed from HFAS/MFAS, as a portion of animals within the area of concern were not seen (especially those more cryptic, deep-diving species, such as beaked whales or *Kogia* sp.) and some of the non-biologist watchstanders might not have had the expertise to characterize behaviors. However, the data demonstrate that the animals that were observed did not respond in any of the obviously more severe ways, such as panic, aggression, or anti-predator response.

In addition to the monitoring that will be required pursuant to these regulations and subsequent LOAs, which is specifically designed to help us better understand how marine mammals respond to sound, the Navy and NMFS have developed, funded, and begun conducting a controlled exposure experiment with beaked whales in the Bahamas.

Diel Cycle

As noted previously, many animals perform vital functions, such as feeding, resting, traveling, and socializing on a diel cycle (24-hr cycle). Substantive behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007).

In the previous section, we discussed the fact that potential behavioral responses to HFAS/MFAS and underwater detonations that fall into the category of harassment could range in severity. By definition, the takes by behavioral harassment involve the disturbance of a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns (such as migration, surfacing, nursing, breeding, feeding, or sheltering) to a point where such behavioral patterns are abandoned or significantly altered. These reactions would, however, be more of a concern if they were expected to last over 24 hours or be repeated in subsequent days. For hull-mounted sonar 53C series sonar (the highest power source), the total time of operation is only 4 hours per year, with 3 hours planned in territorial waters and 1 hour in non-territorial waters. Different sonar testing and underwater detonation activities will not occur simultaneously. When this is combined with the fact that the majority of the cetaceans in the NSWC PCD Study Area would not likely remain in the same area for successive days, it is unlikely that animals would be exposed to HFAS/MFAS and underwater detonations at levels or for a duration likely to result in a substantive response that would then be carried on for more than one day or on successive days.

TTS

NMFS and the Navy have estimated that individuals of some species of marine mammals may sustain some level of TTS from HFAS/MFAS and/or underwater detonation. As mentioned previously, TTS can last from a few minutes to days, be of varying degree, and occur across various frequency bandwidths. The TTS sustained by an animal is primarily classified by three characteristics:

- Frequency—Available data (of mid-frequency hearing specialists exposed to mid to high frequency sounds—Southall *et al.,* 2007) suggest that most TTS occurs in the frequency range of the source up to one octave higher than the source (with the maximum TTS at ½ octave above).
- Degree of the shift (i.e., how many dB is the sensitivity of the hearing reduced by)—generally, both the degree of TTS and the duration of TTS will be greater if the marine mammal is exposed to a higher level of energy (which would occur when the peak dB level is higher or the duration is longer). The threshold for the onset of TTS (>6 dB) for Navy sonars is 195 dB (SEL), which might be received at distances of up to 275–500 m from the most powerful MFAS source, the AN/SQS–53 (the maximum ranges to TTS from other sources would be less). An animal would have to approach closer to the source or remain in the vicinity of the sound source appreciably longer to increase the received SEL, which would be difficult considering the marine observers and the nominal speed of a sonar vessel (10–12 knots). Of all TTS studies, some using exposures of almost an hour in duration or up to 217 SEL, most of the TTS induced was 15 dB or less, though Finneran *et al.* (2007) induced 43 dB of TTS with a 64-sec exposure to a 20 kHz source (MFAS emits a 1-s ping 2 times/minute). The threshold for the onset of TTS for detonations is a dual criteria: 182 dB re 1 microPa^2-sec or 23 psi, which might be received at distances from 345–2,863 m from the centers of detonation based on the types of NEW involved.
- Duration of TTS (Recovery time)—see above. Of all TTS laboratory studies, some using exposures of almost an hour in duration or up to 217 SEL, almost all recovered within 1 day (or less, often in minutes), though in one study (Finneran *et al.,* 2007), recovery took 4 days.

Based on the range of degree and duration of TTS reportedly induced by exposures to non-pulse sounds of energy higher than that to which free-swimming marine mammals in the field are likely to be exposed during HFAS/MFAS testing activities, it is unlikely that marine mammals would sustain a TTS from MFAS that alters their sensitivity by more than 20 dB for more than a few days (and the majority would be far less severe). Also, for the same reasons discussed in the Diel Cycle section, and because of the short distance within which animals would need to approach the sound source, it is unlikely that animals would be exposed to the levels necessary to induce TTS in subsequent time periods such that their recovery were impeded. Additionally, though the frequency range of TTS that marine mammals might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from MFAS (the source from which TTS would more likely be sustained because the higher source level and slower attenuation make it more likely that an animal would be exposed to a higher level) would not usually span the entire frequency range of one vocalization type, much less span all types of vocalizations.

For underwater detonations, due to its brief impulse of sounds, animals have to be at distances from 345–2,863 m from the center of detonation, based on the types of NEW involved to receive the

SEL that causes TTS compared to similar source level with longer durations (such as sonar signals).

Acoustic Masking or Communication Impairment

As discussed above, it is also possible that anthropogenic sound could result in masking of marine mammal communication and navigation signals. However, masking only occurs during the time of the signal (and potential secondary arrivals of indirect rays), versus TTS, which occurs continuously for its duration. Standard HFAS/MFAS sonar pings last on average one second and occur about once every 24–30 seconds for hull-mounted sources. When hull-mounted sonar is used in the Kingfisher mode, pulse length is shorter, but pings are much closer together (both in time and space, since the vessel goes slower when operating in this mode). For the sources for which we know the pulse length, most are significantly shorter than hull-mounted sonar, on the order of several microseconds to 10s of micro seconds. For hull-mounted sonar, though some of the vocalizations that marine mammals make are less than one second long, there is only a 1 in 24 chance that they would occur exactly when the ping was received, and when vocalizations are longer than one second, only parts of them are masked. Alternately, when the pulses are only several microseconds long, the majority of most animals' vocalizations would not be masked. Masking effects from HFAS/MFAS are expected to be minimal. Likewise, the masking effects from underwater detonation are also considered to be unlikely due to the much shorter impulsive signals from explosions. If masking or communication impairment were to occur briefly, it would be in the frequency range of MFAS, which overlaps with some marine mammal vocalizations; however, it would likely not mask the entirety of any particular vocalization or communication series because the pulse length, frequency, and duty cycle of the HFAS/MFAS signal does not perfectly mimic the characteristics of any marine mammal's vocalizations.

PTS, Injury, or Mortality

The Navy's model estimated that 1 individual of bottlenose dolphin and 1 individual of Atlantic spotted dolphin could experience severe lung injury (i.e., mortality) from explosive ordnance activities; and 1 individual each of bottlenose, Atlantic spotted, pantropical spotted, and spinner dolphins from slight lung injury (Level A harassment) as a result of the underwater detonation exposures in the range of 76–272 lb NEW (34–272 kg) in non-territorial waters per year. However, these estimates do not take into consideration the proposed mitigation measures. For sonar operations, NMFS believes that many marine mammals would deliberately avoid exposing themselves to the received levels necessary to induce injury (i.e., approaching to within approximately 10 m (10.9 yd) of the source). Animals would likely move away from or at least modify their path to avoid a close approach. Additionally, in the unlikely event that an animal approaches the sonar vessel at a close distance, NMFS believes that the mitigation measures (i.e., shutdown/power-down zones for HFAS/MFAS) further ensure that animals would be not be exposed to injurious levels of sound. As for underwater detonations, the animals have to be within the 203 m ZOI to experience severe lung injury or mortality. NMFS believes it is unlikely that Navy observers will fail to detect an animal in such a small area during pre-testing surveys. As discussed previously, the Navy plans to utilize aerial (when available) in addition to marine observers on vessels to detect marine mammals for mitigation implementation and indicated that they are capable of effectively monitoring safety zones. When these points are considered, NMFS does not believe that any marine mammals will experience severe lung injury or mortality from exposure to HFAS/MFAS or underwater detonation. Instead, based on proposed mitigation and monitoring measures, NMFS preliminary determines that 2 individuals of bottlenose and Atlantic spotted dolphins, and 1 individual of pantropical spotted and spinner dolphins would receive slight lung injury (Level A harassment) as a result of underwater detonation exposures in the range of 76–272 lb NEW (34–272 kg) in non-territorial waters per year.

Based on the aforementioned assessment, NMFS determines that approximately 2 sperm whales, 2 melon-headed whales, 1 short-finned pilot whale, 2 rough-toothed dolphins, 614 bottlenose dolphins, 471 Atlantic spotted dolphins, 23 pantropical spotted dolphins, 5 striped dolphins, 23 spinner dolphins, and 5 Clymene dolphins would be affected by Level B harassment (TTS and sub-TTS) as a result of the proposed NSWC PCD RDT&E sonar and underwater detonation testing activities. These numbers represent approximately 0.12%, 0.08%, 0.14%, 0.07%, 2.85%, 1.72%, 0.07%, 0.15%, 1.16%, and 0.08% of sperm whales, melon-headed whales, short-finned pilot whale, rough-toothed dolphins, bottlenose dolphins, Atlantic spotted dolphins, pantropical spotted dolphins, striped dolphins, spinner dolphins, and Clymene dolphins, respectively in the vicinity of the proposed NSWC PCD Study Area (calculation based on NMFS 2007 US Atlantic and Gulf of Mexico Marine Mammal Stock Assessment).

In addition, the Level A takes of 2 bottlenose, 2 Atlantic spotted, 1 pantropical spotted, and 1 spinner dolphins represent 0.009%, 0.007%, 0.003%, and 0.050% of these species in the vicinity of the proposed NSWC PCD Study Area (calculation based on NMFS 2007 US Atlantic and Gulf of Mexico Marine Mammal Stock Assessment).

Based on the supporting analyses, which suggest that no marine mammals will be killed as a result of these activities, only 6 individuals of dolphins (2 bottlenose, 2 Atlantic spotted, 1 pantropical spotted, and 1 spinner dolphins) would experience injury (Level A harassment), and no more than a small percentage of the individuals of any affected species will be taken in the form of short-term Level B harassment per year. Coupled with the fact that these impacts will likely not occur in areas and times critical to reproduction, NMFS has preliminarily determined that the total taking over the 5-year period of the regulations and subsequent LOAs from the Navy's NSWC PCD RDT&E mission activities will have a negligible impact on the marine mammal species and stocks present in the NSWC PCD Study Area.

Subsistence Harvest of Marine Mammals

NMFS has preliminarily determined that the total taking of marine mammal species or stocks from the Navy's mission activities in the NSWC PCD study area would not have an unmitigable adverse impact on the availability of the affected species or stocks for subsistence uses, since there are no such uses in the specified area.

ESA

There are six marine mammal species of which NMFS has jurisdiction that are listed as endangered under the ESA that could occur in the NSWC PCD study area: Humpback whale, North Atlantic right whale, blue whale, fin whale, sei whale, and sperm whale. The Navy has begun consultation with NMFS pursuant to section 7 of the ESA, and NMFS will also consult internally on the issuance of an LOA under section 101(a)(5)(A) of the MMPA for mission activities in the NSWC PCD study area. Consultation will be concluded prior to a determination on the issuance of the final rule and an LOA.

NEPA

The Navy is preparing an Environmental Impact Statement (EIS) for the proposed NSWC PCD mission activities. A draft EIS was released for public comment from April 4–May 19, 2008 and is available at *http://nswcpc.navsea.navy.mil/Environment-Documents.htm.* NMFS is a cooperating agency (as defined by the Council on Environmental Quality (40 CFR 1501.6)) in the preparation of the EIS. NMFS has reviewed the Draft EIS and will be working with the Navy on the Final EIS (FEIS).

NMFS intends to adopt the Navy's FEIS, if adequate and appropriate, and we believe that the Navy's FEIS will allow NMFS to meet its responsibilities under NEPA for the issuance of the 5-year regulations and LOAs (as warranted) for mission activities in the NSWC PCD study area. If the Navy's FEIS is not adequate, NMFS would supplement the existing analysis and documents to ensure that we comply with NEPA prior to the issuance of the final rule and LOA.

Preliminary Determination

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat and dependent upon the implementation of the mitigation and monitoring measures, NMFS preliminarily finds that the total taking from Navy mission activities utilizing HFAS/MFAS and underwater explosives in the NSWC PCD study area will have a negligible impact on the affected marine mammal species or stocks. NMFS has proposed regulations for these exercises that prescribe the means of effecting the least practicable adverse impact on marine mammals and their habitat and set forth requirements pertaining to the monitoring and reporting of such taking.

Classification

This action does not contain a collection of information requirement for purposes of the Paperwork Reduction Act.

This proposed rule has been determined by the Office of Management and Budget to be not significant for purposes of Executive Order 12866.

Pursuant to the Regulatory Flexibility Act, the Chief Counsel for Regulation of the Department of Commerce has certified to the Chief Counsel for Advocacy of the Small Business Administration that this rule, if adopted, would not have a significant economic impact on a substantial number of small entities. The RFA requires Federal agencies to prepare an analysis of a rule's impact on small entities whenever the agency is required to publish a notice of proposed rulemaking. However, a Federal agency may certify, pursuant to 5 U.S.C. 605(b), that the action will not have a significant economic impact on a substantial number of small entities. The Navy is the sole entity that will be affected by this proposed rulemaking, not a small governmental jurisdiction, small organization or small business, as defined by the RFA. This proposed rulemaking authorizes the take of marine mammals incidental to a specified activity. The specified activity defined in the proposed rule includes the use of high-frequency and mid-frequency sonar and underwater detonations during training activities that are only conducted by the U.S. Navy. Additionally, the proposed regulations are specifically written for ''military readiness'' activities, as defined by the Marine Mammal Protection Act, as amended by the National Defense Authorization Act, which means that they cannot apply to small businesses. Additionally, any requirements imposed by a Letter of Authorization issued pursuant to these regulations, and any monitoring or reporting requirements imposed by these regulations, will be applicable only to the Navy. Because this action, if adopted, would directly affect the Navy and not a small entity, NMFS concludes the action would not result in a significant economic impact on a substantial number of small entities. Accordingly, no IRFA is required and none has been prepared.

List of Subjects in 50 CFR Part 218

Exports, Fish, Imports, Incidental take, Indians, Labeling, Marine mammals, Navy, Penalties, Reporting and recordkeeping requirements, Seafood, Sonar, Transportation.

Dated: April 22, 2009.

John Oliver,

Deputy Assistant Administrator for Operations, National Marine Fisheries Service.

For the reasons set forth in the preamble, 50 CFR part 218, as proposed to be added at 73 FR 75655, December 12, 2008, is proposed to be amended as follows:

PART 218—REGULATIONS GOVERNING THE TAKING AND IMPORTING OF MARINE MAMMALS

1. The authority citation for part 218 continues to read as follows:

Authority: 16 U.S.C. 1361 *et seq.*

2. Subpart S is added to part 218 to read as follows:

Subpart S—Taking Marine Mammals Incidental to U.S. Navy Mission Activities in the Naval Surface Warfare Center Panama City Division Study Area

Sec.

Subpart S—Taking Marine Mammals Incidental to U.S. Navy Mission Activities in the Naval Surface Warfare Center Panama City Division Study Area

§ 218.180 Specified activity and specified geographical region.

(a) Regulations in this subpart apply only to the U.S. Navy for the taking of marine mammals that occurs in the area outlined in paragraph (b) of this section and that occur incidental to the activities described in paragraph (c) of this section.

(b) The taking of marine mammals by the Navy is only authorized if it occurs within the NSWC PCD Study, which includes St. Andrew Bay (SAB) and military warning areas (areas within the GOM subject to military operations) W–151 (includes Panama City Operating Area), W–155 (includes Pensacola Operating Area), and W–470. A detailed description of these specific geographic regions is listed in Figures 2–1 and 2–2 of the Navy's application for the Letter of Authorization (LOA). The NSWC PCD Study Area includes a Coastal Test Area, a Very Shallow Water Test Area, and Target and Operational Test Fields. The NSWC PCD Research, Development, Test, and Evaluation (RDT&E) activities may be conducted anywhere within the existing military operating areas and SAB from the mean high water line (average high tide mark) out to 222 km (120 nm) offshore. The locations and environments include:

(1) Test area control sites adjacent to NSWC PCD.

(2) Wide coastal shelf 97 km (52 nm) distance offshore to 183 m (600 ft), including bays and harbors.

(c) The taking of marine mammals by the Navy is only authorized if it occurs incidental to the following activities within the designated amounts of use:

(1) Surface operations in territorial and non-territorial waters:

(i) Diving;

(ii) Salvage;

(iii) Use of robotic vehicles;

(iv) Use of underwater unmanned vehicles; and

(v) Mooring and burying of mines.

(2) The use of the following high frequency active sonar (HFAS) and mid-frequency active sonar (MFAS) or similar sources for U.S. Navy mission activities in territorial waters in the amounts indicated below:

(i) AN/SQS–53/56 Kingfisher—up to 15 hours over the course of 5 years (an average of 3 hours per year);

(ii) Sub-bottom profiler (2–9 kHz)—up to 105 hours over the course of 5 years (an average of 21 hours per year);

(iii) REMUS SAS–LF (center frequency 15 kHz)—up to 60 hours over the course of 5 years (an average of 12 hours per year);

(iv) REMUS Modem—up to 125 hours over the course of 5 years (an average of 25 hours per year);

(v) Sub-bottom profiler (2–16 kHz)—up to 120 hours over the course of 5 years (an average of 24 hours per year);

(vi) AN/SQQ–32—up to 150 hours over the course of 5 years (an average of 30 hours per year);

(vii) REMUS–SAS–LF (center frequency 20 kHz)—up to 100 hours over the course of 5 years (an average of 20 hours per year);

(viii) SAS–LF—up to 175 hours over the course of 5 years (an average of 35 hours per year);

(ix) AN/WLD–1 RMS–ACL—up to 168 hours over the course of 5 years (an average of 33.5 hours per year);

(x) BPAUV Sidescan (center frequency 75 kHz)—up to 125 hours over the course of 5 years (an average of 25 hours per year);

(xi) TVSS—up to 75 hours over the course of 5 years (an average of 15 hours per year);

(xii) F84Y—up to 75 hours over the course of 5 years (an average of 15 hours per year);

(xiii) BPAUV Sidescan (center frequency 102.5 kHz)—up to 125 hours over the course of 5 years (an average of 25 hours per year);

(xiv) REMUS–SAS–HF—up to 50 hours over the course of 5 years (an average of 10 hours per year);

(xv) SAS–HF—up to 58 hours over the course of 5 years (an average of 11.5 hours per year);

(xvi) AN/SQS–20—up to 2,725 hours over the course of 5 years (an average of 545 hours per year);

(xvii) AN/WLD–11 RMS Navigation—up to 75 hours over the course of 5 years (an average of 15 hours per year); and

(xviii) BPAUV Sidescan (center frequency 120 kHz)—up to 150 hours over the course of 5 years (an average of 30 hours per year).

(3) The use of the following high frequency active sonar (HFAS) and mid-frequency active sonar (MFAS) or similar sources for U.S. Navy mission activities in non-territorial waters in the amounts indicated below:

(i) AN/SQS–53/56 Kingfisher—up to 5 hours over the course of 5 years (an average of 1 hour per year);

(ii) Sub-bottom profiler (2–9 kHz)—up to 5 hours over the course of 5 years (an average of 1 hour per year);

(iii) REMUS Modem—up to 60 hours over the course of 5 years (an average of 12 hours per year);

(iv) Sub-bottom profiler (2–16 kHz)—up to 5 hours over the course of 5 years (an average of 1 hour per year);

(v) AN/SQQ–32—up to 5 hours over the course of 5 years (an average of 1 hour per year);

(vi) SAS–LF—up to 75 hours over the course of 5 years (an average of 15 hours per year);

(vii) AN/WLD–1 RMS–ACL—up to 25 hours over the course of 5 years (an average of 5 hours per year);

(viii) BPAUV Sidescan (center frequency 75 kHz)—up to 190 hours over the course of 5 years (an average of 38 hours per year);

(ix) TVSS—up to 83 hours over the course of 5 years (an average of 16.5 hours per year);

(x) F84Y—up to 75 hours over the course of 5 years (an average of 15 hours per year);

(xi) REMUS–SAS–HF—up to 125 hours over the course of 5 years (an average of 25 hours per year);

(xii) SAS–HF—up to 75 hours over the course of 5 years (an average of 15 hours per year);

(xiii) AN/AQS–20—up to 75 hours over the course of 5 years (an average of 15 hours per year); and

(xiv) BPAUV Sidescan (center frequency 120 kHz)—up to 125 hours over the course of 5 years (an average of 25 hours per year).

(4) Ordnance operations for U.S. Navy mission activities in territorial waters in the amounts indicated below:

(i) Range 1 (0–10 lbs.)—up to 255 detonations over the course of 5 years (an average of 51 detonations per year);

(ii) Range 2 (11–75 lbs.)—up to 15 detonations over the course of 5 years (an average of 3 detonations per year); and

(iii) Line charges—up to 15 detonations over the course of 5 years (an average of 3 detonations per year).

(5) Ordnance operations for U.S. Navy mission activities in non-territorial waters in the amounts indicated below:

(i) Range 3 (76–600 lbs.)—up to 80 detonations over the course of 5 years (an average of 16 detonations per year).

(ii) Reserved.

(6) Projectile firing operations for U.S. Navy mission activities in non-territorial waters in the amounts indicated below:

(i) 5 in. Naval gunfire—up to 300 rounds over the course of 5 years (an average of 60 rounds per year);

(ii) 40 mm rounds—up to 2,400 rounds over the course of 5 years (an average of 480 rounds per year);

(iii) 30 mm rounds—up to 3,000 rounds over the course of 5 years (an average of 600 rounds per year);

(iv) 20 mm rounds—up to 14,835 rounds over the course of 5 years (an average of 2,967 rounds per year);

(v) 76 mm rounds—up to 1,200 rounds over the course of 5 years (an average of 240 rounds per year);

(vi) 25 mm rounds—up to 2,625 rounds over the course of 5 years (an average of 525 rounds per year); and

(vii) Small arms—up to 30,000 rounds over the course of 5 years (an average of 6,000 rounds per year).

§ 218.181 Permissible methods of taking.

(a) Under Letters of Authorization issued pursuant to §§ 216.106 and 218.186 of this chapter, the Holder of the Letter of Authorization may incidentally, but not intentionally, take marine mammals within the area described in § 218.180(b), provided the activity is in compliance with all terms, conditions, and requirements of these regulations and the appropriate Letter of Authorization.

(b) The incidental take of marine mammals under the activities identified in § 218.180(c) is limited to the following species, by the indicated method of take and the indicated number of times:

(1) Level B Harassment:

(i) Sperm whale (*Physeter macrocephalus*)—10 (an average of 2 annually),

(ii) Risso's dolphin (*Grampus griseus*)—10 (an average of 2 annually);

(iii) Bottlenose dolphin (*Tursiops truncatus*)—3,070 (an average of 614 annually);

(iv) Atlantic spotted dolphin (*Stenella frontalis*)—2,355 (an average of 471 annually);

(v) Pantropical spotted dolphin (*S. attenuata)*—115 (an average of 23 annually);

(vi) Striped dolphin (*S. coeruleoalba*)—25 (an average of 5 annually);

(vii) Spinner dolphin (*S. longirostris*)—115 (an average of 23 annually);

(viii) Melon-headed whale (*Peponocephala electra*)—10 (an average of 2 annually);

(ix) Short-finned pilot whale (Globicephala macrorhynchus)—5 (an average of 1 annually);

(x) Clymene dolphin (*S. clymene*)—25 (an average of 5 annually);

(2) Level A Harassment:

(i) Bottlenose dolphin (*Tursiops truncatus*)—10 (an average of 2 annually);

(ii) Atlantic spotted dolphin (*Stenella frontalis*)—10 (an average of 2 annually);

(iii) Pantropical spotted dolphin (*S. attenuata)*—5 (an average of 1 annually);

(ix) Spinner dolphin (Stenella longirostris)—5 (an average of 1 annually).

§ 218.182 Prohibitions.

Notwithstanding takings contemplated in § 218.181 and authorized by a Letter of Authorization issued under § 216.106 of this chapter and § 218.186, no person in connection with the activities described in § 218.180 may:

(a) Take any marine mammal not specified in § 218.181(b);

(b) Take any marine mammal specified in § 218.181(b) other than by incidental take as specified in § 218.181(b)(1) and (2);

(c) Take a marine mammal specified in § 218.181(b) if such taking results in more than a negligible impact on the species or stocks of such marine mammal; or

(d) Violate, or fail to comply with, the terms, conditions, and requirements of these regulations or a Letter of Authorization issued under § 216.106 of this chapter and § 218.186.

§ 218.183 Mitigation.

(a) When conducting RDT&E activities identified in § 218.180(c), the mitigation measures contained in this subpart and subsequent Letters of Authorization issued under §§ 216.106 and 218.186 of this chapter must be implemented. These mitigation measures include, but are not limited to:

(1) Mitigation Measures for HFAS/MFAS Operations

(i) Personnel Training;

(A) All marine observers onboard platforms involved in NSWC PCD RDT&E activities shall review the NMFS-approved Marine Species Awareness Training (MSAT) material prior to use of HFAS/MFAS.

(B) Marine observers shall be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of mitigation measures if marine species are spotted.

(ii) Marine Observer and Watchstander Responsibilities;

(A) On the bridge of surface vessels, there shall always be at least one to three marine species awareness trained observer(s) on watch whose duties include observing the water surface around the vessel.

(*1*) For vessels with length under 65 ft (20 m), there shall always be at least one marine observer on watch.

(*2*) For vessels with length between 65–200 ft (20–61 m), there shall always be at least two marine observers on watch.

(*3*) For vessels with length above 200 ft (61 m), there shall always be at least three marine observers on watch.

(B) Each marine observer shall have at their disposal at least one set of binoculars available to aid in the detection of marine mammals.

(C) On surface vessels equipped with AN/SQQ–53C/56, pedestal mounted ''Big Eye'' (20 x 110) binoculars shall be present and in good working order to assist in the detection of marine mammals in the vicinity of the vessel.

(D) Marine observer shall employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968–D).

(E) Marine observers shall scan the water from the vessel to the horizon and be responsible for all contacts in their sector follow the below protocols:

(*1*) In searching the assigned sector, the marine observer shall always start at the forward part of the sector and search aft (toward the back).

(*2*) To search and scan, the marine observer shall hold the binoculars steady so the horizon is in the top third of the field of vision and direct the eyes just below the horizon.

(*3*) The marine observer shall scan for approximately five seconds in as many small steps as possible across the field seen through the binoculars.

(*4*) The marine observers shall search the entire sector in approximately five-degree steps, pausing between steps for approximately five seconds to scan the field of view.

(*5*) At the end of the sector search, the glasses would be lowered to allow the eyes to rest for a few seconds, and then the marine observer shall search back across the sector with the naked eye.

(F) After sunset and prior to sunrise, marine observers shall employ Night Lookout Techniques in accordance with the Lookout Training Handbook.

(G) At night, marine observers shall scan the horizon in a series of movements that would allow their eyes to come to periodic rests as they scan the sector. When visually searching at night, marine observers shall look a little to one side and out of the corners of their eyes, paying attention to the things on the outer edges of their field of vision.

(H) Marine observers shall be responsible for reporting all objects or anomalies sighted in the water (regardless of the distance from the vessel) to the Test Director or the Test Director's designee.

(iii) Operating Procedures;

(A) A Record of Environmental Consideration shall be included in the Test Plan prior to the test event to further disseminate the personnel testing requirement and general marine mammal mitigation measures.

(B) Test Directors shall make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the vessel.

(C) All personnel engaged in passive acoustic sonar operation (including aircraft or surface vessels) shall monitor for marine mammal vocalizations and report the detection of any marine mammal to the Test Director or the Test Director's designee for dissemination and appropriate action.

(D) During HFAS/MFAS mission activities, personnel shall utilize all available sensor and optical systems (such as Night Vision Goggles) to aid in the detection of marine mammals.

(E) Navy aircraft participating in exercises at sea shall conduct and maintain surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties.

(F) Aircraft with deployed sonobuoys shall use only the passive capability of sonobuoys when marine mammals are detected within 200 yards of the sonobuoy.

(G) Marine mammal detections shall be immediately reported to assigned Aircraft Control Unit for further dissemination to vessels in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the vessel will likely result in a closing of the distance to the detected marine mammal.

(H) Safety Zones—When marine mammals are detected by any means (aircraft, shipboard marine observer, or acoustically) the Navy will ensure that HFAS/MFAS transmission levels are limited to at least 6 dB below normal operating levels if any detected marine mammals are within 1,000 yards (914 m) of the sonar dome (the bow).

(*1*) Vessels shall continue to limit maximum HFAS/MFAS transmission levels by this 6–dB factor until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards (1,828 m) beyond the location of the last detection.

(*2*) The Navy shall ensure that HFAS/MFAS transmissions will be limited to at least 10 dB below the equipment's normal operating level if any detected animals are within 500 yards (457 m) of the sonar dome. Vessels will continue to limit maximum ping levels by this 10–dB factor until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards (1,828 m) beyond the location of the last detection.

(*3*) The Navy shall ensure that HFAS/MFAS transmissions are ceased if any detected marine mammals are within 200 yards (183 m) of the sonar dome. HFAS/MFAS will not resume until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards (1,828 m) beyond the location of the last detection.

(*4*) Special conditions applicable for dolphins and porpoises only: If, after conducting an initial maneuver to avoid close quarters with dolphins or porpoises, the Officer of the Deck concludes that dolphins or porpoises are deliberately closing to ride the vessel's bow wave, no further mitigation actions are necessary while the dolphins or porpoises continue to exhibit bow wave riding behavior.

(*5*) If the need for power-down should arise as detailed in ''Safety Zones'' above, Navy shall follow the requirements as though they were operating at 235 dB—the normal operating level (i.e., the first power-down will be to 229 dB, regardless of at what level above 235 sonar was being operated).

(I) Prior to start up or restart of active sonar, operators will check that the Safety Zone radius around the sound source is clear of marine mammals.

(J) Sonar levels (generally)—Navy shall operate sonar at the lowest practicable level, not to exceed 235 dB, except as required to meet RDT&E objectives.

(K) Helicopters shall observe/survey the vicinity of mission activities for 10 minutes before the first deployment of active (dipping) sonar in the water.

(L) Helicopters shall not dip their sonar within 200 yards (183 m) of a marine mammal and shall cease pinging if a marine mammal closes within 200 yards (183 m) after pinging has begun.

(M) Submarine sonar operators shall review detection indicators of close-aboard marine mammals prior to the commencement of mission activities involving active mid-frequency and high frequency sonar.

(2) Proposed Mitigation Measures for Ordnance and Projectile Firing

(i) No detonations over 34 kg (75 lb) shall be conducted in territorial waters, except the line charge detonation, which is a 107 m (350 ft).

(ii) The number of live mine detonations shall be minimized and the smallest amount of explosive material possible to achieve test objectives will be used.

(iii) Activities shall be coordinated through the Environmental Help Desk to allow potential concentrations of detonations in a particular area over a short time to be identified and avoided.

(iv) Visual surveys and aerial surveys of the clearance zones specified in § 218.183(2)(vi)(A)–(C)shall be conducted in accordance with § 218.184(e) for all test operations that involve detonation events with large net explosive weight (NEW). Any protected species sighted will be reported.

(v) Line charge tests shall not be conducted during the nighttime.

(vi) Additional mitigation measures shall be determined through the NSWC PCD's Environmental Review Process based on test activities including the size of detonations, test platforms, and environmental effects documented in the Navy's EIS/OEIS. Clearance zones must be determined based on the upper limit of different ranges of net explosive weight (NEW) used in the tests, as listed below:

(A) NEW between 76–600 lb: clearance zone is 2,863 m;

(B) NEW between 11–75 lb: clearance zone is 997 m; and

(C) NEW under 11 lb: clearance zone is 345 m.

(3) Proposed Mitigation Measures for Surface Operations and Other Activities:

(i) While underway, vessels shall have at least one to three marine species awareness trained observers (based on vessel length) with binoculars. As part of their regular duties, marine observers shall watch for and report to the Test Director or Test Director's designee the presence of marine mammals.

(A) For vessels with length under 65 ft (20 m), there shall always be at least one marine observer on watch.

(B) For vessels with length between 65–200 ft (20–61 m), there shall always be at least two marine observers on watch.

(C) For vessels with length above 200 ft (61 m), there shall always be at least three marine observers on watch.

(ii) Marine observers shall employ visual search procedures employing a scanning method in accordance with the Lookout Training Handbook (NAVEDTRA 12968–D).

(iii) While in transit, naval vessels shall be alert at all times, use extreme caution, and proceed at a ''safe speed'' (the minimum speed at which mission goals or safety will not be compromised) so that the vessel can take proper and effective action to avoid a collision with any marine animal and can be stopped within a distance appropriate to the prevailing circumstances and conditions.

(iv) When marine mammals have been sighted in the area, Navy vessels shall increase vigilance and shall implement measures to avoid collisions with marine mammals and avoid activities that might result in close interaction of naval assets and marine mammals. Actions shall include changing speed and/or direction and are dictated by environmental and other conditions (e.g., safety, weather).

(v) Naval vessels shall maneuver to keep at least 500 yd (460 m) away from any observed whale and avoid approaching whales head-on. This requirement does not apply if a vessel's safety is threatened, such as when change of course will create an imminent and serious threat to a person, vessel, or aircraft, and to the extent vessels are restricted in their ability to maneuver. Vessels shall take reasonable steps to alert other vessels in the vicinity of the whale.

(vi) Where feasible and consistent with mission and safety, vessels shall avoid closing to within 200 yards (183 m) of marine mammals other than whales.

(vii) All vessels shall maintain logs and records documenting RDT&E activities should they be required for event reconstruction purposes. Logs and records shall be kept for a period of 30 days following completion of a RDT&E mission activity.

(b) [Reserved]

§ 218.184 Requirements for monitoring and reporting.

(a) The Holder of the Letter of Authorization issued pursuant to §§ 216.106 and 218.186 for activities described in § 218.180(c) is required to cooperate with the NMFS when monitoring the impacts of the activity on marine mammals.

(b) The Holder of the Authorization must notify NMFS immediately (or as soon as clearance procedures allow) if the specified activity identified in § 218.180(c) is thought to have resulted in the mortality or injury of any marine mammals, or in any take of marine mammals not identified or authorized in § 218.181(b).

(c) The Holder of the Letter of Authorization must conduct all monitoring and/or research required under the Letter of Authorization.

(d) The Navy shall complete an Integrated Comprehensive Monitoring Program (ICMP) Plan in 2009. This planning and adaptive management tool shall include:

(1) A method for prioritizing monitoring projects that clearly describes the characteristics of a proposal that factor into its priority.

(2) A method for annually reviewing, with NMFS, monitoring results, Navy R&D, and current science to use for potential modification of mitigation or monitoring methods.

(3) A detailed description of the Monitoring Workshop to be convened in 2011 and how and when Navy/NMFS will subsequently utilize the findings of the Monitoring Workshop to potentially modify subsequent monitoring and mitigation.

(4) An adaptive management plan.

(5) A method for standardizing data collection for the NSWC PCD Study Area and across other locations.

(e) The Holder of the Letter of Authorization shall, when conducting training events in the NSWC PCD Study Area, implement the following monitoring methods:

(1) Visual Surveys—Vessel, Aerial and Shore-based

(i) In accordance with all safety considerations, observations shall be maximized by working from all available platforms: vessels, aircraft, land and/or in combination.

(ii) Vessel and aerial surveys shall be conducted two days before, during, and one to five days after the NSWC PCD mission activities on commercial vessels and aircraft.

(iii) Visual surveys shall be conducted during Navy mission activities that have been identified to provide the highest likelihood of success.

(iv) The visual survey team shall collect the same data that are collected by Navy marine observers, including but not limited to:

(A) Location of sighting;

(B) Species (or to the lowest taxa possible);

(C) Number of individuals;

(D) Number of calves present, if any;

(E) Duration of sighting;

(F) Behavior of marine animals sighted;

(G) Direction of travel;

(H) Environmental information associated with sighting event including Beaufort sea state, wave height, swell direction, wind direction, wind speed, glare, percentage of glare, percentage of cloud cover; and

(I) When in relation to Navy exercises did the sighting occur (before, during or after detonations/exercise).

(v) Animal sightings and relative distance from a particular activity site shall be used post survey to estimate the number of marine mammals exposed to different received levels (energy and pressure of discharge based on distance to the source, bathymetry, oceanographic conditions and the type and size of detonation) and their corresponding behavior.

(vi) Any digital photographs that are taken of marine mammals during visual surveys shall be provided to local researchers for their regional research.

(A) Aerial surveys:

(*1*) During NSWC PCD mission activities, an aerial survey team shall fly transects relative to a Navy surface vessel that is conducting the mission activities.

(*2*) The aerial survey team shall collect both visual sightings and behavioral observations of marine animals.

(*3*) These transect data shall provide an opportunity to collect data of marine mammals at different received levels and their behavioral responses and movement relative to the Navy vessel's position.

(*4*) Aerial surveys shall include time with and without test events in order to compare density, geographical distribution and behavioral observations.

(*5*) Behavioral observation methods shall involve three professionally trained marine mammal observers and a pilot. Two observers shall observe behaviors, one with hand-held binoculars and one with the naked eye.

(*6*) Detailed behavioral focal observations of cetaceans shall be recorded including the following variables where possible: species (or to the lowest taxa possible), group size and composition (number of calves, etc.), latitude/longitude, surface and dive durations and times, number and spacing/times of respirations, conspicuous behaviors (e.g., breach, tail slap, etc.), behavioral states, orientation and changes in orientation, estimated group travel speed, inter-individual distances, defecation, social interactions, aircraft speed, aircraft altitude, distance to focal group (using the plane's radar) and any unusual behaviors or apparent reactions.

(B) Vessel Surveys:

(*1*) Vessel surveys shall be designed to maximize detections of any target species near mission activity event for focal follows.

(*2*) Systematic transects shall be used to locate marine mammals. In the course of conducting these surveys, the vessel(s) shall deviate from transect protocol to collect behavioral data particularly if a Navy vessel is visible on the horizon or closer.

(*3*) While the Navy vessels are within view, attempts shall be made to position the dedicated survey vessel in the best possible way to obtain focal follow data in the presence of the Navy mission activities. If Navy vessels are not in view, then the vessel shall begin a systematic line transect surveys within the area to assess marine mammal occurrence and observe behavior.

(*4*) Post-analysis shall focus on how the location, speed and vector of the survey vessel and the location and direction of the sonar source (e.g., Navy surface vessel) relates to the animal.

(*5*) Any other vessels or aircraft observed in the area shall also be documented.

(C) Shore-based Surveys:

(*1*) Shore-based monitors shall observe explosive events that are planned in advance to occur adjacent to nearshore areas where there are elevated coastal structures (e.g., lookout tower at Eglin Air Force Base) or topography, and shall use binoculars or theodolite to augment other visual survey methods.

(*2*) Shore-based surveys of the detonation area and nearby beaches shall be conducted for stranded marine animals following nearshore events. If any distressed, injured or stranded animals are observed, an assessment of the animal's condition (alive, injured, dead, or degree of decomposition) shall be reported immediately to the Navy for appropriate action and the information shall be transmitted immediately to NMFS.

(*3*) If animals are observed prior to or during an explosion, a focal follow of that individual or group shall be conducted to record behavioral responses.

(2) Passive Acoustic Monitoring (PAM):

(i) The Navy shall deploy a stationary, bottom-set hydrophone array in the NSWC PCD Study Area for PAM.

(ii) The array shall be deployed for each of the days the ship is at sea.

(iii) The array shall be able to detect low frequency vocalizations (less than 1,000 Hz) for baleen whales and relatively high frequency vocalizations (up to 30 kHz) for odontocetes.

(iv) These buoys shall be left in place for a long enough duration (e.g., months) that data are collected before, during and outside of mission activities.

(v) Acoustic data collected from the buoys shall be used in order to detect, locate, and potentially track calling whales/dolphins.

(3) Marine Mammal Observers on Navy vessels:

(i) Civilian Marine Mammal Observers (MMOs) aboard Navy vessels shall be used to research the effectiveness of Navy lookouts, as well as for data collection during other monitoring surveys.

(ii) MMOs shall be field-experienced observers that are Navy biologists or contracted observers.

(iii) MMOs shall be placed alongside existing Navy marine observers during a sub-set of RDT&E events.

(iv) MMOs shall inform the Navy marine observer of any marine mammal sighting so that appropriate action may be taken by the chain of command. For less biased data, it is recommended that MMOs schedule their daily observations to duplicate the marine observers' schedule.

(v) MMOs shall monitor for marine mammals from the same height above water as the lookouts (e.g. bridge wings) and as all visual survey teams, and they shall collect the same data collected by Navy marine observers, including but not limited to:

(A) Location of sighting;

(B) Species;

(C) Number of individuals;

(D) Number of calves present, if any;

(E) Duration of sighting;

(F) Behavior of marine animals sighted;

(G) Direction of travel;

(H) Environmental information associated with sighting event including Beaufort sea state, wave height, swell direction, wind direction, wind speed, glare, percentage of glare, percentage of cloud cover; and

(I) When in relation to Navy exercises did the sighting occur (before, during or after detonations/exercise).

(f) Monitoring Report—The Navy shall submit a report annually on September 1 describing the implementation and results (through June 1 of the same year) of the monitoring required in § 218.184(e).

(g) NSWC PCD Comprehensive Report—The Navy shall submit to NMFS a draft report that analyzes and summarizes *all* of the multi-year marine mammal information gathered during sonar and explosive exercises for which individual reports are required in § 218.184 (d–f). This report will be submitted at the end of the fourth year of the rule (November 2012), covering activities that have occurred through June 1, 2012.

(h) The Navy shall respond to NMFS comments on the draft comprehensive report if submitted within 3 months of receipt. The report will be considered final after the Navy has addressed NMFS' comments, or three months after the submittal of the draft if NMFS does not comment by then.

(i) In 2011, the Navy shall convene a Monitoring Workshop in which the Monitoring Workshop participants will be asked to review the Navy's Monitoring Plans and monitoring results and make individual recommendations (to the Navy and NMFS) of ways of improving the Monitoring Plans. The recommendations shall be reviewed by the Navy, in consultation with NMFS, and modifications to the Monitoring Plan shall be made, as appropriate.

§ 218.185 Applications for Letters of Authorization.

To incidentally take marine mammals pursuant to these regulations, the U.S. citizen (as defined by § 216.103 of this chapter) conducting the activity identified in § 218.180(c) (the U.S. Navy) must apply for and obtain either an initial Letter of Authorization in accordance with § 218.186 or a renewal under § 218.187.

§ 218.186 Letters of Authorization.

(a) A Letter of Authorization, unless suspended or revoked, will be valid for a period of time not to exceed the period of validity of this subpart, but must be renewed annually subject to annual renewal conditions in § 218.187.

(b) Each Letter of Authorization will set forth:

(1) Permissible methods of incidental taking;

(2) Means of effecting the least practicable adverse impact on the species, its habitat, and on the availability of the species for subsistence uses (i.e., mitigation); and

(3) Requirements for mitigation, monitoring and reporting.

(c) Issuance and renewal of the Letter of Authorization will be based on a determination that the total number of marine mammals taken by the activity as a whole will have no more than a negligible impact on the affected species or stock of marine mammal(s).

§ 218.187 Renewal of Letters of Authorization and adaptive management.

(a) A Letter of Authorization issued under § 216.106 and § 218.186 for the activity identified in § 218.180(c) will be renewed annually upon:

(1) Notification to NMFS that the activity described in the application submitted under § 218.185 shall be undertaken and that there will not be a substantial modification to the described work, mitigation or monitoring undertaken during the upcoming 12 months;

(2) Timely receipt of the monitoring reports required under § 218.184(b); and

(3) A determination by the NMFS that the mitigation, monitoring and reporting measures required under § 218.183 and the Letter of Authorization issued under §§ 216.106 and 218.186, were undertaken and will be undertaken during the upcoming annual period of validity of a renewed Letter of Authorization.

(b) If a request for a renewal of a Letter of Authorization issued under §§ 216.106 and 218.187 indicates that a substantial modification to the described work, mitigation or monitoring undertaken during the upcoming season will occur, the NMFS will provide the public a period of 30 days for review and comment on the request. Review and comment on renewals of Letters of Authorization are restricted to:

(1) New cited information and data indicating that the determinations made in this document are in need of reconsideration, and

(2) Proposed changes to the mitigation and monitoring requirements contained in these regulations or in the current Letter of Authorization.

(c) A notice of issuance or denial of a renewal of a Letter of Authorization will be published in the **Federal Register.**

(d) NMFS, in response to new information and in consultation with the Navy, may modify the mitigation or monitoring measures in subsequent LOAs if doing so creates a reasonable likelihood of more effectively accomplishing the goals of mitigation and monitoring set forth in the preamble of these regulations. Below are some of the possible sources of new data that could contribute to the decision to modify the mitigation or monitoring measures:

(1) Results from the Navy's monitoring from the previous year

(either from NSWC PCD Study Area or other locations).

(2) Findings of the Monitoring Workshop that the Navy will convene in 2011 (§ 218.184(i)).

(3) Compiled results of Navy funded research and development (R&D) studies (presented pursuant to the ICMP (§ 218.184(d)).

(4) Results from specific stranding investigations (either from the NSWC PCD Study Area or other locations).

(5) Results from the Long Term Prospective Study described in the preamble to these regulations.

(6) Results from general marine mammal and sound research (funded by the Navy (described below) or otherwise).

(7) Any information which reveals that marine mammals may have been taken in a manner, extent or number not authorized by these regulations or subsequent Letters of Authorization.

§ 218.188 Modifications to Letters of Authorization.

(a) Except as provided in paragraph (b) of this section, no substantive modification (including withdrawal or suspension) to the Letter of Authorization by NMFS, issued pursuant to § 216.106 of this chapter and § 218.186 and subject to the provisions of this subpart shall be made until after notification and an opportunity for public comment has been provided. For purposes of this paragraph, a renewal of a Letter of Authorization under § 218.187, without modification (except for the period of validity), is not considered a substantive modification.

(b) If the Assistant Administrator determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in § 218.181(b), a Letter of Authorization issued pursuant to § 216.106 of this chapter and § 218.186 may be substantively modified without prior notification and an opportunity for public comment. Notification will be published in the **Federal Register** within 30 days subsequent to the action.

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