Application for Letters of Authorization Under Section 101 (a)(5)(A) of the Marine Mammal Protection Act for Activities Associated with the Employment of Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar

Department of the Navy

Chief of Naval Operations

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ACRONYMS AND ABBREVIATIONS

ABR	Auditory Brainstem Response
ADC	Association of Diving Contractors
AIM	Acoustic Integration Model
AIP	Air Independent Propulsion
ARU	Autonomous Recording Unit
ASA	Acoustical Society of America
ASW	Antisubmarine Warfare
ATOC	Acoustic Thermometry of Ocean Climate
CDF	Cumulative Distribution Function
CEE	Controlled Exposure Experiment
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CLFA	Compact Low Frequency Active
CNO	Chief of Naval Operations
CW	Continuous Wave
CZ	Convergence Zone
DAN	Divers Alert Network
dB	Decibel(s)
DOC	Department of Commerce
DOD	Department of Defense
DON	Department of the Navy
DSEIS or Draft SEIS	Draft Supplemental Environmental Impact Statement
ECS	European Cetacean Society
EMCON	Emission Control
ECBC	European Cetacean Bycatch Campaign
EIS	Environmental Impact Statement
EO	(Presidential) Executive Order
ERMC	Environmental Risk Management Capability
ESA	Endangered Species Act
FBE	Fleet Battle Experiment
FOEIS/EIS	Final Overseas Environmental Impact Statement/Final Environmental Impact Statement
FM	Frequency Modulated
FR	Federal Register
Ft	Feet
ft/sec or ft/s	Feet per second
FY	Fiscal Year
HFM	Hyperbolic Frequency Modulated
HF/M3	High Frequency Marine Mammal Monitoring
HLA	Horizontal Line Array
HR	House of Representative Bill
hr	Hour
Hz	Hertz
ICES	International Council for the Exploration of the Sea
in prep.	In preparation
JASA	Journal of the Acoustical Society of America
JCS	Joint Chiefs of Staff
kg	Kilogram
kg/m^3	Kilogram per cubic meter (density)
kHz	Kilohertz
km	Kilometer(s)

kt	Knot(s)
lb	Pound(s)
lb/yd^3	Pound per cubic yard (density)
LCEE	Less-Controlled Exposure Experiment
LF	Low Frequency
LFA	Low Frequency Active
LFS SRP	Low Frequency Sound Scientific Research Program
LOA	Letter of Authorization
LTM	Long Term Monitoring
m	Meter(s)
mi	Mile(s) (statute)
MILDET	Military Detachment
Min	Minute(s)
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MMRP	Marine Mammal Research Program (ATOC)
MoD	Ministry of Defence
NATO	North Atlantic Treaty Organization
NAUI	National Association of Underwater Instructors
NDAA	National Defense Authorization Act
NEPA	National Environmental Policy Act of 1969
nm or nmi	Nautical mile(s)
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuary
NOAA	National Oceanic and Atmospheric Administration
NORLANT	North Atlantic
NPAL	North Pacific Acoustic Laboratory
NRC	National Research Council
NRW	Northern right whale
NURC	NATO Underwater Research Center
OBIA	Offshore Biologically Important Area(s)
OIC	Officer in Charge
OPAREA	Operations Area
Pa	Pascal
PADI	Professional Association of Diving Instructors
PBR	Potential Biological Removal
PTS	Permanent Threshold Shift
RL	Received Level
rms	Root Mean Squared
ROD	Record of Decision
RTC	Response to Comments
R/V	Research Vehicle
SACLANTCEN	Supreme Allied Command Atlantic Center
SEIS	Supplemental Environmental Impact Statement
SEL	Sound Exposure Level
SL	Source Level
SONAR	SOund Navigation And Ranging
SMRU	Sea Mammal Research Unit
SMM	Society for Marine Mammology
SPL	Sound Pressure Level
SRP	Scientific Research Permit
SURTASS	Surveillance Towed Array Sensor System
T-AGOS	Ocean Surveillance Ship
TTS	Temporary Threshold Shift
UK	United Kingdom

U.S. or US U.S.C. USFWS USNS	United States United States Code U.S. Fish and Wildlife Service United States Naval Ship
WDCS w/mit WHOI	Whale and Dolphin Conservation Society With mitigation Woods Hole Oceanographic Institution
VLA	Vertical Line Array
Symbols	
%	Percent
/	Divided by
≥	Greater than or equal to
>	Greater than
<	Less than
±	Plus or minus
μ	Micro (10^{-6})

1.0 INTRODUCTION

In accordance with the provisions of the Marine Mammal Protection Act of 1972 (MMPA), this document is an Application to the National Marine Fisheries Service (NMFS) for Letters of Authorization (LOAs) under Section 101 (a)(5)(A) of the MMPA for the activities associated with the employment of Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) sonar. The LOAs will cover the taking of marine mammals incidental to employment of the system during training, testing, and routine military operations. The LOAs will not address use of the system in armed conflict or direct combat support operations, nor during periods of heightened national threat conditions, as determined by the President and Secretary of Defense or their duly designated alternatives or successors, as assisted by the Chairman of the Joint Chiefs of Staff (JCS).

1.1 Proposed Action

The proposed action is U.S. Navy use of the SURTASS LFA sonar in the ocean excluding any areas necessary to prevent 180-decibel (dB) sound pressure level (SPL) or greater within specific geographic range of land, in offshore biologically important areas during biologically important seasons, and in areas necessary to prevent greater than 145-dB SPL at known recreational and commercial dive sites. These ocean areas are inhabited by marine animals, including birds, fish, sea turtles, and marine mammals. During employment of the SURTASS LFA sonar system, acoustic signals will be introduced into the water column that could potentially affect the marine environment. The Navy currently plans to operate up to four SURTASS LFA sonar systems. As a result, the Navy has prepared a Final Overseas Environmental Impact Statement and Environmental Impact Statement (FOEIS/EIS) and a Draft Supplemental Environmental Impact Statement (SEIS) to study the potential environmental effects of SURTASS LFA sonar system use.

On November 24, 2003 the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2004 (NDAA FY04) (Public Law 108-136) became law. Included in this law were amendments to the Marine Mammal Protection Act (MMPA) (16 U.S.C. 1361 *et seq.*) that apply where a “military readiness activity” is concerned. Of special importance for SURTASS LFA sonar take authorization, the NDAA amended Section 101(a)(5) of the MMPA, which governs the taking of marine mammals incidental to otherwise lawful activities. The term “military readiness activity” is defined in Public Law 107-314 (16 U.S.C. § 703 note) to include all training and operations of the Armed Forces that relate to combat; and the adequate and realistic testing of military equipment, vehicles, weapons and sensors for proper operation and suitability for combat use. NMFS and the Navy have determined that the Navy’s SURTASS LFA sonar testing and training operations that are the subject of NMFS’s July 16, 2002, Final Rule constitute a military readiness activity because those activities constitute “training and operations of the Armed Forces that relate to combat” and constitute “adequate and realistic testing of military equipment, vehicles, weapons and sensors for proper operation and suitability for combat use.”

The provisions of the NDAA FY04 that relate to SURTASS LFA concern revisions to the MMPA, as summarized below:

- Overall – Changed the MMPA definition of "harassment," adjusted the permitting system to better accommodate military readiness activities, and added a national defense exemption.
- Amended definition of "harassment" as it applies to military readiness activities and scientific activities conducted on behalf of the Federal government.
- Level A "harassment" defined as any act that injures or has the *significant* potential to injure a marine mammal.
- Level B "harassment" defined as any act that disturbs or is *likely to disturb* a marine mammal by causing disruption of natural behavioral patterns *to a point where the patterns are abandoned or significantly altered*. Behaviors include migration, surfacing, nursing, breeding, feeding, and sheltering.
- Secretary of Defense may invoke a national security exemption not to exceed two years for any action after conferring with the Secretary of Commerce and/or the Secretary of Interior, as appropriate.
- NMFS's determination of "least practicable adverse impact on species or stock" must include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.
- Eliminated the "small numbers" and "specified geographic region" requirements from the incidental take permitting process for military readiness activities.

The amended definition of "harassment" focuses authorization of military readiness and scientific research activities on biologically significant impacts to marine mammals, a science-based approach.

These revisions to the MMPA did not eliminate the requirement for mitigation and monitoring. The Navy still must operate under the Final Rule and is required to obtain annual LOAs from NMFS for each vessel. Congress also commended DoD and the Navy for their extensive marine mammal research, but directed an annual report be provided to Congress on research conducted and accompanying funding to ensure a continued level of effort of at least $7 million per year.

The FOEIS/EIS and Draft SEIS were prepared in accordance with the requirements of Presidential Executive Order (EO) 12114 (Environmental Effects Abroad for Major Federal Actions) and the National Environmental Policy Act of 1969 (NEPA). EO 12114 applies to environmental effects outside U.S. territories—the United States, its territories and possessions-and NEPA applies to activities and effects within those areas. The Department of the Navy (DON) is the lead agency with NMFS of the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) as a cooperating agency.

1.2 Purpose and Need for SURTASS LFA Sonar

The original stated purpose for the SURTASS LFA sonar system from the FOEIS/EIS was:

> "The purpose of the proposed action is to meet U.S. need for improved capability to detect quieter and harder-to-find foreign submarines at long range. This capability would provide U.S. forces with adequate time to react to, and defend against, potential submarine threats while remaining a safe distance beyond a submarine's effective weapons range." (DON, 2001)

This statement remains valid, and may be more compelling now than when it was presented in the FOEIS/EIS in January 2001. With the Cold War ending more than a decade ago, the Navy is faced with a smaller number of diesel-electric submarines with operations confined to smaller areas (Friedman, 2004). Maritime strategies rely heavily on quiet submarines to patrol the littorals, blockade strategic choke points, and stalk aircraft carrier battle groups (Goldstein and Murray, 2003).

Excerpts from Statement of Admiral William J. Fallon, U.S. Navy Vice Chief of Naval Operations before the Subcommittee on Readiness and Management Support United States Senate Armed Services Committee on Environmental Sustainment March 13, 2003
"………New ultra-quiet diesel-electric submarines armed with deadly torpedoes and cruise missiles are proliferating widely. New technologies such as these could significantly threaten our fleet as we deploy around the world to assure access for joint forces, project power from the sea, and maintain open sea-lanes for trade. To successfully defend against such threats, our Sailors must train realistically with the latest technology, including next-generation passive and active sonars." "The Navy has immediate need for SURTASS LFA. The Chief of Naval Operations has stated that Anti-Submarine Warfare (ASW) is essential to sea control and maritime dominance. Many nations are capable of employing submarines to deny access or significantly delay execution of joint and coalition operations in support of our vital interests. The submarine threat today is real and in some ways has become more challenging than during the Cold War. Of the approximately 500 non-U.S. submarines in the world, almost half that number are operated by non-allied nations. Of greatest concern are the new ultra-quiet diesel-electric submarines armed with deadly torpedoes and cruise missiles being produced by the People's Republic of China, Iran, and North Korea." "These diesel submarines are very difficult to detect outside the range at which they can launch attacks against U.S. and allied ships using passive sonar systems. Active systems like SURTASS LFA, when used in conjunction with other anti-submarine sensor and weapons systems, are necessary to detect, locate and destroy or avoid hostile submarines before they close within range of our forces. To ensure our Sailors are properly prepared to counter this growing submarine threat, we must make certain they train with the best systems available."

To meet its long-range detection need, the Navy investigated the use of a broad spectrum of acoustic and non-acoustic technologies to enhance antisubmarine warfare (ASW) capabilities. Of those technologies evaluated, low frequency active sonar was the only system capable of providing long-range, detection during most weather conditions, day or night. (See SURTASS LFA Sonar FOEIS/EIS pages 1-8 to 1-12.) Low frequency active sonar is, therefore, the only available technology capable of meeting the U.S. need to improve detection of quieter and harder-to-find foreign submarines at long range. SURTASS LFA provides a quantifiable improvement in the Navy's capabilities against this threat and markedly improves the survivability of U.S. Naval forces in a hostile ASW scenario.

Excerpts from Declaration of Vice Admiral John B. Nathman, U.S. Navy
Vice Chief of Naval Operations
To the United States District Court Northern District of California
September 25, 2002

" I am aware of the threat to naval forces posed by increasingly quiet submarines. SURTASS Low Frequency Active (LFA) is needed – and needed now – to counter this threat."

"The threat from modern, quiet diesel-electric submarines to the U.S. Navy is acute and that threat will only increase in the future. I would rank the diesel submarine threat at the very top of those facing the U.S. Navy due to the difficulty in countering it, the potential that threat will proliferate, and its ability to affect naval operations in a number of our most crucial areas of operations."

"This threat already presents a clear and present danger in crucial parts of the world including the Persian Gulf, along the Korean Peninsula, and in the Taiwan Strait, reflecting the known capabilities of Iran, North Korea and China. This threat increases daily. The U.S. Navy is conducting operations in areas that can be reached by diesel-electric submarines and our Navy's operations in those areas must continue. Our national interests demand that the U.S. Navy operate naval forces safely and effectively in these areas. The costs of not being able to do so are incalculable."

"Technologies currently in use, whether traditional mid-frequency active sonar or passive sonar, with recent enhancements, do not provide the capability to detect and engage the diesel-electric submarine threat at a sufficient stand-off distance. Without a low frequency, long-range, active sonar like SURTASS LFA, the diesel submarine threat poses an unacceptable risk to the Navy's carrier battle groups and amphibious task forces and the men and women who are embarked with these forces. Our ability to conduct the full spectrum of operations from combat, to support for peacekeeping, to non-combat evacuation, to peacetime presence is jeopardized by our vulnerability to this threat."

"No operational commander can employ a system, of any type, with confidence that it is effective in combat unless the personnel using the system have trained to use it and have used it, in a variety of realistic situations. Tactics must also be developed and honed. …………SURTASS LFA cannot simply be kept 'on the shelf' for use in time of armed conflict. The process of preparing to use it takes time. It is therefore critical that preparing to use this system not be delayed any further."

"The Navy takes its responsibility to the marine environment seriously, and has committed a great deal of time and money to ensure that the proposed use of SURTASS LFA is consistent with those responsibilities."

The Navy's primary mission is to maintain, train, equip, and operate combat-ready naval forces capable of winning wars, deterring aggression and maintaining freedom of the seas. The Secretary of the Navy and Chief of Naval Operations have continually validated that ASW is a critical part of that mission—a mission that requires unfettered access to both the high seas and the littorals. In order to be prepared for all potential threats, the Navy must not only continue to test and train in the open ocean, but also in littoral environments.

For a host of reasons, submarine forces are attractive to many nations. Because diesel submarines are relatively inexpensive, they are the most cost-effective platform for the delivery of several types of weapons, including torpedoes, long-range anti-ship cruise missiles, and a variety of anti-ship mines—as well as strategic nuclear weapons. With their stealth and ability to operate independent of escort vessels, submarines are very effective in attacking surface ships with torpedoes and missiles. Because submarines are inherently covert, they can conduct intrusive operations in sensitive areas, and can be inserted early with a minimum likelihood of being detected. Without LFA, the inability to detect a hostile submarine at long range before it can get close enough to launch a missile is a critical shortfall in the Navy's ASW capability that is harmful to U.S. national security and puts naval vessels and U.S. sailors and marines at risk.

As we enter the 21st century, the global submarine threat is becoming increasingly more challenging. The Russian Federation and the People's Republic of China have publicly declared that the submarine is the single most potent ship in their fleets and the centerpiece of their respective navies. As China's economy grows, they are able to purchase the best available Russian submarines and weapons systems to support their political goal of controlling the approaches and seas around Taiwan, the Spratly Islands, and the South China Sea (Farrell, 2003). Published naval strategies of potential adversaries, including Iran and North Korea, have expressed similar strategic doctrine. As regional Asian economies recover from the 1997-98 financial crisis, established powers and smaller nations are planning to build or buy highly capable new submarines. The competition threatens to shift the power balance among some of the region's long-standing military rivals and poses a potential threat to key trade routes. China, Taiwan, India, Pakistan, Singapore, Malaysia, South Korea, Japan and Australia are taking delivery or have ordered advanced, stealthy submarines armed with state-of-the-art missiles and torpedoes capable of striking targets at sea or on land far from their home ports. China will take delivery by 2007 of up to eight more advanced Russian-built KILO-class diesel submarines which, combined with the four KILO-class units they already have, make up a formidable force that could allow China to blockade Taiwan's ports (Baker, 2003). From China's point of view, a top-class submarine fleet might make the United States think twice about sending major warships to the Taiwan Strait. Competition between China and India for maritime influence has keyed India's plan to boost its submarine force with 17 new acquisitions over the next decade. Singapore's inventory has recently reached four Swedish-built diesel submarines. Malaysia has ordered two French-built conventional submarines expected to be operational in 2007 and 2008. With Singapore and Malaysia in the submarine market, Thailand is now considering its underwater options. When all these submarines come into service, Asia's key waterways could again become as crowded—and as dangerous—below the surface as they were at the height of the Cold War when U.S. and Soviet submarines hunted each other on a regular basis.

Potential adversary nations are investing heavily in submarine technology, including designs for nuclear attack submarines, strategic ballistic missile submarines, and advanced diesel submarines. Over 40 countries have operational modern submarines, or are planning to add them to their naval forces. Table 1-1 provides a 2003 inventory of worldwide submarines. There are over 450 submarines owned by 40 countries—operational or being built. Of these, at least 250 are diesel submarines—their combination of quiet operation and effective weapons gives them a substantial and multifaceted combat capability. World navy inventories of active combatant submarines fell to below 400 in 2003—less than half the total in the early 1990s—but important technological developments will result in more effective future submarines (Baker, 2004).

Submarine quieting technology is making submarines ever more difficult—in some cases, nearly impossible—to detect, even with the most capable passive sonar systems. A U.S.-Australian ASW exercise with the new Australian COLLINS-Class diesel submarine demonstrated that passive sonar had difficulty detecting this modern diesel submarine before ships were in range of its weapons.[1] A single diesel submarine that is able to penetrate U.S. or multinational task force defenses could cause catastrophic damage to those forces, and weaken domestic or coalition political will for peacekeeping or counter-terrorism contingency operations. No navy seems to have viable countermeasures against a wake-homing torpedo, which can be bought to arm the KILO-submarine (Friedman, 2004). Even the threat of a quiet diesel submarine, in certain circumstances, would deny access to vital operational areas to U.S. or coalition naval forces.

New-generation, ultra-quiet diesel and hybrid-powered submarines pose a major threat to U. S. Naval and allied forces and their coasts. World War II-designed diesel submarines were required to snorkel in order to recharge their batteries and could not move at speeds in excess of 20 knots without depleting their batteries within an hour or less. However, advanced, or hybrid, diesel propulsion systems that allow for long-term submergence with high-speed underwater maneuvering are a reality today. The Russian submarine builder, Rubin, now offers for sale a liquid oxygen and hydrogen fuel cell air-independent propulsion (AIP) option that permits diesel submarines to remain submerged for weeks without snorkeling (Goldstein and Murray, 2003). Submarines equipped with this type of propulsion will not be restricted to operations in shallow water nor to slow speeds.

Because of these threats, the Navy identified a need for long-range detection of hostile submarines before they could get close enough to use their weapons. The most effective and best available technology to reliably meet this long-range detection need is the SURTASS LFA sonar system. This capability is particularly significant in a concentration of friendly forces, such as the case occurring in the Arabian and Mediterranean Seas in support of operations in Afghanistan and Iraq, or during Operations Desert Shield and Desert Storm in 1990-1991. Aircraft carrier and amphibious task forces, their supporting ships and crews must operate in littoral zones and constricted waters. Choke points offer the perfect opportunity for quiet diesel submarines to stalk and ambush U.S. and allied ships. A pre-positioned diesel submarine, conducting a quiet patrol on battery power, is almost impossible to detect with passive sonar. The SURTASS LFA system,

[1] Statement of Vice Admiral Dennis V. McGinn, Deputy Chief of Naval Operations for Warfare Requirements and Programs before the Subcommittee on Fisheries Conservation, Wildlife, and Oceans of the House Committee on Resources on the Marine Mammal Protection Act and Surveillance Towed Array Sensor System Low Frequency Active Sonar, 11 October 2001.

through long-range detection, can effectively counter this threat to the Navy and national security. Without this active augmentation (LFA) to passive and tactical systems, diesel submarines pose unacceptable risks to the U.S. Navy's carrier strike groups and expeditionary strike groups, and the sailors and marines that man them.

Table 1-1. World Submarine Inventory

Country	Total Nuclear Powered	Total Nuclear Building	Total Conventional & Non-Nuc AIP	Total Conventional Building
Atlantic/Baltic/Mediterranean/Black				
Algeria			2	
Canada			3	1
Denmark			2	
Egypt			4	
Germany			12	4
Greece			8	4
Israel			3	
Italy			6	2
Netherlands			4	
Norway			6	
Poland			4	1
Portugal			2	2
Spain			6	
Sweden			5	2
Turkey			12	4
Ukraine			1	
South America				
Argentina			3	
Brazil			4	1
Chile			2	2
Columbia			2	
Ecuador			1	
Peru			6	
Venezuela			2	
Western Pacific/Indian Ocean				
Australia			6	
Peoples Republic of China	4	2	58	12
India		3	16	2
Indonesia				2
Iran			3	
Japan			16	5
Malaysia				2
North Korea			26	
Pakistan			9	1
Singapore			4	
South Africa				3
South Korea			9	3
Taiwan			2	
US/UK/France/Russia				
U.S.	69	7	1	
UK	14	3		
France	10	4		
Russia	38	3	8	2
Total Nuclear Powered	**135**			
Total Nuclear Building		**22**		
Total Conventional/Non-Nuclear AIP			**258**	
Total Conventional/Non-Nuclear AIP Building/Conversions				**55**
World Submarine Population (40 countries)				**470**

Note: World Submarine Population does not include min-subs (midget and swimmer delivery vehicles)
Reference: Saunders (2003); Scherr (2003)

The purpose of the proposed action, therefore, is to provide improved detection of quieter and harder-to-find foreign submarines, thereby meeting the Navy's need to maintain the ASW capability of its fleet. This action would maximize the opportunity for U.S. forces to safely react to and defend against potential submarine threats.

1.3 SURTASS LFA Sonar Technology

SURTASS LFA sonar systems are long-range, all-weather systems operating in the LF band (below 1,000 Hz) within the frequency range of 100 to 500 Hz. These systems are composed of both active and passive components as shown in Figure 1-1.

SONAR is an acronym for SOund NAvigation and Ranging, and its definition includes any system that uses underwater sound, or acoustics, for observations and communications. Sonar systems are used for many purposes, ranging from "fish finders" to military ASW systems for detection and classification of submarines. There are two broad types of sonar:

- Passive sonar detects the sound created by an object (source) in the water. This is a one-way transmission of sound waves traveling through the water from the source to the receiver and is basically the same as people hearing sounds that are created by another source and transmitted through the air to the ear.
- Active sonar detects objects by creating a sound pulse, or "ping," that is transmitted through the water and reflects off the target, returning in the form of an echo. This is a two-way transmission (source to reflector to receiver). Some marine mammals locate prey and navigate utilizing this form of echolocation.

Existing operational LFA systems are installed on two SURTASS vessels: Research Vessel (R/V) *Cory Chouest* and USNS IMPECCABLE (T-AGOS 23). As future undersea warfare requirements continue to transition to shallow littoral ocean regions, the development and introduction of a compact active system deployable from existing, smaller SURTASS Swath-P ships is paramount. This smaller system is known as Compact LFA, or CLFA. CLFA consists of smaller, lighter-weight source elements than the current LFA system, and will be compact enough to be installed on the existing SURTASS platforms, VICTORIOUS Class (T-AGOS 19, 21, and 22). The operational characteristics of the compact system are comparable to the existing LFA systems as presented in Subchapter 2.1 of the FOEIS/EIS and Draft SEIS. Therefore, the potential impacts from CLFA are expected to be similar to the effects from the existing SURTASS LFA systems. Hence for this analysis, the term low frequency active, or LFA, will be used to refer to both the existing LFA system and/or the CLFA system, unless otherwise specified.

The U.S. military anticipates that future naval conflicts are most likely to occur within littoral or coastal areas. This is a distinct change from the Cold War, where such conflicts were most likely to occur in mid-ocean areas. These littoral areas have highly variable and frequently high underwater background noise, largely as a result of commercial shipping, and difficult underwater acoustic propagation conditions, such as multi-path propagation, that make for shorter detection ranges. Passive sonar is significantly degraded in such complex littoral environments. SURTASS LFA provides the U.S. Navy with the most effective and best available means to monitor submarines in the littoral areas at distances sufficient to allow them to be detected, tracked and, if necessary, attacked, before they pose threats to U.S. or allied naval/land forces, or civilian coastal targets.

Littoral Environment
The term “littoral” is one of the most misunderstood terms used in naval warfare. Based on the dictionary, the adjective “littoral” pertains to, or existing on a shore. In the noun form, the word means a shore or coastal region. The Navy’s meaning differs because it is based on a tactical, not geographic, perspective relating to overall coastal operations including all assets supporting a particular operation regardless of how close, or far, from the shore it may be operating. The Navy defines littoral as the region that horizontally encompasses the land/watermass interface from fifty (50) statute miles (80 kilometers [km]) ashore to two hundred (200) nautical miles (370 km) at sea; extends vertically from the bottom of the ocean to the top of the atmosphere and from the land surface to the top of the atmosphere (Naval Oceanographic Office, 1999).

A prime example of the importance of littoral areas is in the waters of Eastern Asia, including the South China Sea, East China Sea, Sea of Japan, and Philippine Sea. Many of the world’s busiest sea-lanes pass through these waters.

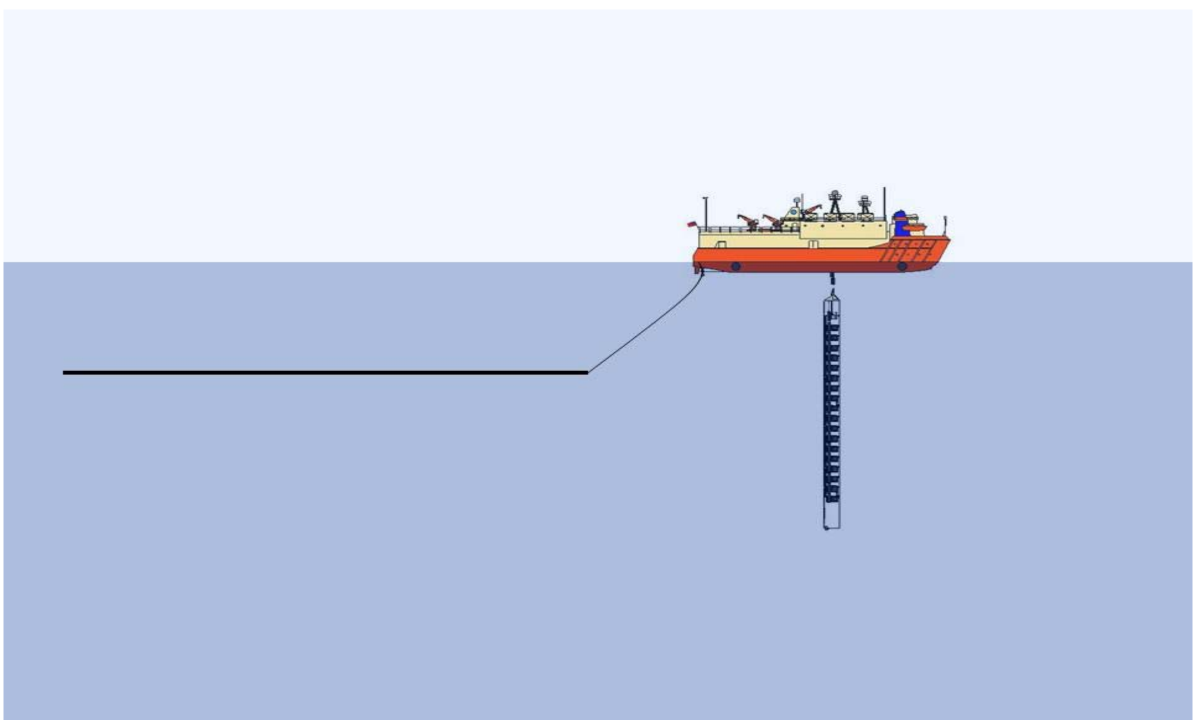

Figure 1-1 SURTASS LFA Sonar Systems

At present, there are two existing SURTASS LFA sonar systems, onboard the R/V *Cory Chouest* and USNS IMPECCABLE (T-AGOS 23). Three additional CLFA systems are planned for the T-AGOS 19, 21, and 22. Figure 1-2 shows the projected availability of these systems. With the R/V *Cory Chouest* retiring in FY 2008, only two or three systems will be operational through FY 2010. Early in FY 2011 the potential exists for four vessels to be operational. At no point are there expected to be more than four systems in use, and thus this application considers the employment of up to four systems.

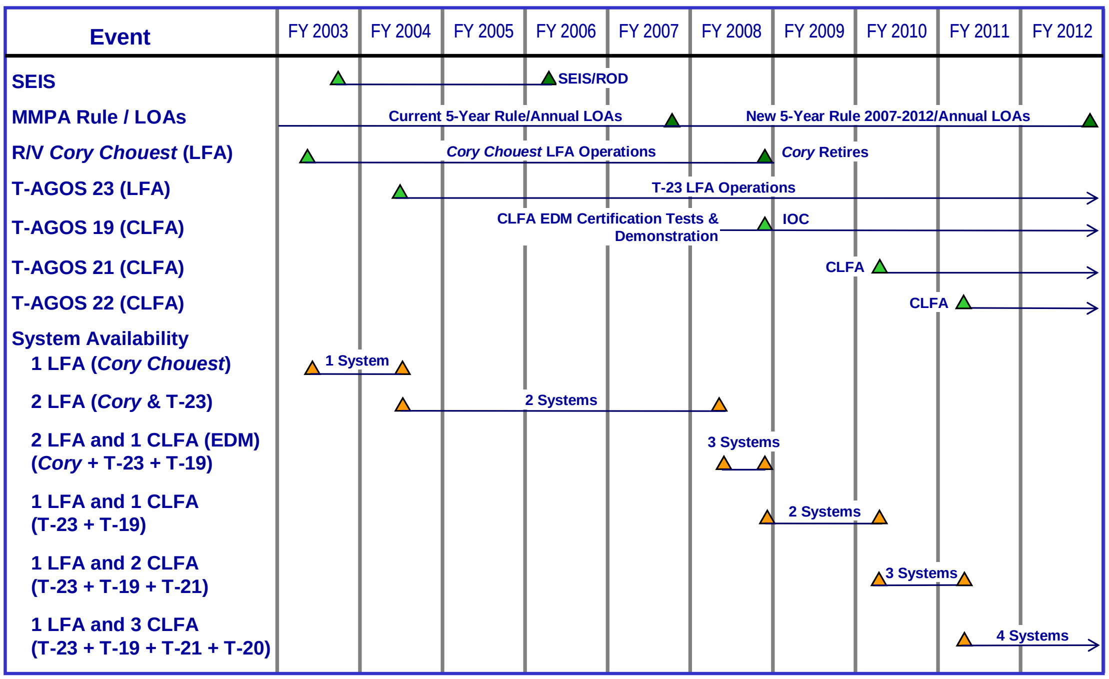

Figure 1-2 Projected LFA and CLFA Sonar Systems Availability

Active System Component

The active component of the existing SURTASS LFA sonar system, LFA, is an active adjunct to the SURTASS passive capability and is planned for use when passive system performance is inadequate. LFA complements SURTASS passive operations by actively acquiring and tracking submarines when they are in quiet operating modes, measuring accurate target range, and re-acquiring lost contacts.

LFA is a set of acoustic transmitting source elements suspended by cable under an ocean surveillance vessel, such as the R/V *Cory Chouest*, USNS IMPECCABLE (T-AGOS 23), and the VICTORIOUS Class (T-AGOS 19 Class) (Figure 1-1). These elements, called projectors, are devices that produce the active sound pulse, or ping. The projectors transform electrical energy to mechanical energy that set up vibrations or pressure disturbances within the water to produce a ping.

The characteristics and operating features of the active component (LFA) are:

- The source is a vertical line array (VLA) of up to 18 source projectors suspended below the vessel. LFA's transmitted beam is omnidirectional (360 degrees) in the horizontal, with a narrow vertical beamwidth that can be steered above or below the horizontal.
- The source frequency is between 100 and 500 Hertz (Hz). A variety of signal types can be used, including continuous wave (CW) and frequency-modulated (FM) signals.
- The source level (SL) of an individual source projector of the SURTASS LFA sonar array is approximately 215 dB or less. The sound field of the array can never be higher than the SL of an individual source projector.
- The typical LFA signal is not a constant tone, but rather a transmission of various waveforms that vary in frequency and duration. A complete sequence of sound transmissions is referred to as a wavetrain (also known as a "ping"). These wavetrains last between 6 and 100 seconds with an average length of 60 seconds. Within each wavetrain the duration of each continuous frequency sound transmission is never longer than 18 seconds.
- Average duty cycle (ratio of sound "on" time to total time) is less than 20 percent. The typical duty cycle, based on historical LFA operational parameters, is nominally 7.5 percent.
- The time between wavetrain transmissions is typically from 6 to 15 minutes.

Passive System Component

The passive, or listening, part of the system is SURTASS. SURTASS detects returning echoes from submerged objects, such as threat submarines, through the use of hydrophones. These devices transform mechanical energy (received acoustic sound wave) to an electrical signal that can be analyzed by the processing system of the sonar. The SURTASS hydrophones are mounted on a receive array (horizontal line array [HLA]) that is towed astern of the vessel (Figure 1-1). The SURTASS LFA sonar vessel tows the hydrophone array at a minimum speed of 5.6 kilometers per hour (kph) (3 knots [kt]) through the water in order to maintain the proper towed array geometry for maximum sonar system performance. The return signals, which are usually below background or ambient noise level, are then processed and evaluated to identify and classify potential underwater threats.

The general characteristics of the SURTASS passive HLA are:

- Array length: 1,500 m (4,920 ft);
- Operational depth: 152 m (500 ft) to 457 m (1,500 ft);
- Minimum speed for deployment: 5.6 kph (3 kt); and
- Frequency: 0 to 500 Hz.

1.4 SURTASS LFA Sonar Deployment

Because of uncertainties in the world's political climate, a detailed account of future operating locations and conditions cannot be predicted. However, for analytical purposes, a nominal annual deployment schedule and operational concept have been developed, based on current LFA operations since January 2003 and projected Fleet requirements. As shown in Table 1-2, a SURTASS LFA sonar deployment schedule for a single vessel could involve up to 294 days per year at sea (underway). A nominal at-sea mission will occur over a 49-day period, with 40 days of operations and 9 days transit. Based on a 7.5 percent duty cycle (from historical LFA operating parameters), the system will actually be transmitting for a maximum of 72 hours per 49-day mission and 432 hours per year for each SURTASS LFA sonar system in operation. The SURTASS LFA sonar vessel will operate independently of, or in conjunction with, other naval air, surface or submarine assets. The vessel will generally travel in straight lines or racetrack patterns depending on the operational scenario.

Annually, each vessel will be expected to spend approximately 54 days in transit and 240 days performing active operations. Between missions, an estimated 71 days will be spent in port for upkeep and repair in order to maintain both the material condition of the vessel and its systems, and the morale of the crew.

1.5 Regulatory Requirements

The SURTASS LFA sonar may be employed in oceanic areas that are populated by marine mammals, which are protected under the provisions of the MMPA in both U.S. territories and on the high seas. In addition, certain species of marine mammals are listed as threatened or endangered under the Endangered Species Act (ESA).

Operation of the system would introduce acoustic signals into the water column that could potentially cause reactions by marine mammals. These reactions could be as simple as the animals moving away from the source of the signal. However, where the signals could cause harassment or, in extremely remote cases, injury, these disruptions could constitute incidental but unintentional "takings" under the MMPA.

Upon request, NMFS shall prescribe regulations for incidental taking for all persons subject to the jurisdiction of the U.S. or for vessels or other conveyances subject to the jurisdiction of the U.S. or on the high seas if a finding is made that takings are not having more than a negligible impact[2] on affected marine mammal stocks and not having an unmitigable adverse impact on subsistence uses of marine mammals. The prescribed regulations would cover a period of not more than five years, which sets forth, "…(I) 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; and (II) requirements pertaining to the monitoring of and reporting of such

[2] Negligible impact is defined by 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.

taking." Annual LOAs can be issued provided NMFS has determined that the total taking by the activity (i.e. SURTASS LFA sonar) has no more than a negligible impact on the affected species or stocks of marine mammals.

Issuance of an MMPA authorization by NMFS is considered a federal action, which requires appropriate EO 12114/NEPA determinations and documentation. Accordingly, NMFS has joined with the Navy as a cooperating agency, as defined by 40 CFR 1501.6, in the development of a Draft SEIS (DON, 2005c), which supplements the FOEIS/EIS (DON, 2001). The Draft SEIS supplements information contained in this MMPA application and ensures that all information needed for the NMFS permitting process is available. The authorization being sought by the U.S. Navy under the MMPA is for five years.

Table 1-2 Nominal SURTASS LFA Sonar Annual and 49-Day Deployment Schedule—Single Ship

I. Nominal Annual Deployment

6 Days	49 Days			6 Days	49 Days			16 Days	49 Days		
In-Port Upkeep	T	Mission Operations Active	T	In-Port Upkeep	T	Mission Operations Active	T	In-Port Upkeep	T	Mission Operations Active	T

6 Days	49 Days			6 Days	49 Days			31 Days	49 Days		
In-Port Upkeep	T	Mission Operations Active	T	In-Port Upkeep	T	Mission Operations Active	T	Regular Overhaul	T	Mission Operations Active	T
Notes: “T” denotes transit periods when there would be no active transmissions											

II. Nominal 49-Day Mission

Transit	LFA Operations	Transit
4.5 Days	40 Days (72 hours active sonar transmissions at 7.5% duty cycle*)	4.5 Days

*Note: 7.5% duty cycle is based on historical LFA operating parameters, which include downtime for:
- Corrective maintenance (equipment casualties or system failures)
- Preventive maintenance (database maintenance, daily archive, tow-point changes, etc.)
- Ship re-positioning
- De-confliction of mutual interference with other naval sensor systems
- EMCON (emission control) restrictions during naval operations and exercises

III. Nominal Annual Summary

Underway on Mission	Days	Not Underway	Days
Transit	54	In-Port Upkeep	40
Active Operations (432 hours transmissions based on 7.5% duty cycle*)	240	Regular Overhaul	31
Total Underway	294	Total Not Underway	71
Total Underway & Not Underway			365

2.0 POTENTIAL OPERATING AREAS

Because of uncertainties in the world's political climate, a detailed account of future operating locations and conditions cannot be delineated over the next five years. SURTASS LFA sonar operations, including testing of new systems as they come on line, will not be concentrated in specific sites, but will take place within any of the potential operational areas defined in Chapter 1 (Figure 1-1) in the FOEIS/EIS. Polar Regions are excluded because of the inherent inclement weather conditions, including the danger of icebergs. To reduce adverse effects on the marine environment, areas will also be excluded as necessary to prevent 180-dB sound pressure level (SPL) or greater within specific geographic range of land, in offshore biologically important areas during biologically important seasons, and in areas necessary to prevent greater than 145-dB SPL at known recreational and commercial dive sites.

As an integral part of the MMPA permitting process, as well as the Draft SEIS, the Navy must anticipate, or predict, where they have to operate in the next five years or so. Naval forces are presently operating in several areas strategic to U.S. national and international interests, including areas in the Mediterranean Sea, the Indian Ocean and Persian Gulf, and the Pacific Rim. National Security needs may dictate that many of these operational areas will be close to ports and choke points, such as entrances to straits, channels, and canals. It is anticipated that many future naval conflicts are likely to occur within littoral or coastal areas. The Navy must balance National Security needs with environmental requirements and impacts, while protecting both our freedom and the world's natural resources.

It is infeasible to analyze all potential mission areas for all species' stocks for all seasons. The FOEIS/EIS acoustic modeling analysis for 31 worldwide sites (Figure 4.2-1 of the FOEIS/EIS) remains valid, and deals with potential SURTASS LFA operating areas adequately. In addition, the Navy is required to develop an annual process, in consultation with NMFS, that identifies, through LOA application procedures, the locations that the Navy intends to operate within that year. Additional analysis (including acoustic modeling, if needed) is undertaken if it is deemed necessary (e.g., updated marine mammal distribution or density data available for potential operating areas).

LFA must operate near our potential ASW adversaries, so a process to minimize the potential for environmental effects from these operations must be overlaid with the process for identifying the operations areas themselves. The determination of where and when the Navy will operate LFA in the future is a joint, scientifically-based process involving the Navy and NMFS, culminating in NMFS's issuance of annual LOAs.

2.1 Geographic Restrictions

Based on the preferred alternative in the Draft SEIS (DON, 2005c), the following geographic restrictions limit the ocean areas in which the Navy may deploy SURTASS LFA sonar such that the sound field does not exceed:

- 180 dB within 22 km (12 nm) of any coastline, nor in the offshore biologically important areas that exist outside the 22-km (12-nm) zone during the biologically important season for that particular area.
- 145 dB in the vicinity of known human dive sites. Sites frequented by recreational divers are generally defined as from the shoreline out to the 40-m (130-ft) depth contour.

Geographic Restrictions Protect Human Divers and Marine Mammals
Although the 145-dB geographic restriction known for human dive sites is intended to protect human divers, its imposition will also reduce the low frequency sound levels received by marine mammals that are located in the vicinity of known dive sites.

Operators of SURTASS LFA sonar would assess SPL prior to and during sonar transmissions by using near real time environmental data. This would provide the information necessary for the operators not to exceed sound field criteria established for the geographically restricted areas.

2.2 Offshore Biologically Important Areas

Offshore biologically important areas are defined as those areas of the world's oceans where marine mammals congregate in high densities to carry out biologically important activities. Biologically important activities are those behaviors essential to the continued existence of these species, such as the following:

- Surfacing;
- Sheltering;
- Nursing.

Many of these concentrations occur within 22 km (12 nm) of a coastline. Details on these offshore biologically important areas are provided in Subchapter 2.3 of the FOEIS/EIS.

The list of offshore biologically important areas may be expanded by the Navy in coordination with NMFS. Additional offshore biologically important areas may also be proposed and reviewed during the Draft SEIS review process, and later during the Long Term Monitoring (LTM) Program.

3.0 MARINE MAMMALS LIKELY TO BE FOUND WITHIN THE POTENTIAL OPERATING AREAS

The marine mammals expected to be present in the SURTASS LFA proposed operating areas include: blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), Bryde's whale (*Balaenoptera edeni*), minke whale (*Balaenoptera acutorostrata*), humpback whale (*Megaptera novaeangliae*), north Atlantic right whale (*Eubalaena glacialis*), north Pacific right whale (*Eubalaena japonica*), southern right whale (*Eubalaena australis*), pygmy right whale (*Caperea marginata*), gray whale (*Eschrichtius robustus*), sperm whale (*Phyester macrocephalus*), pygmy and dwarf sperm whales (*Kogia spp*.), Baird's and Arnoux's beaked whales (*Beradius spp.*), Shepherd's beaked whale (*Tasmacetus sherherdi*), Cuvier's beaked whale (*Ziphius cavirostris*), northern and southern bottlenose whales (*Hyperoodon spp*.), Longman's beaked whale (*Indopacetus pacificus*), *Mesoplodon spp*., Beluga whale (*Delphinapterus leucas)*, killer whale (*Orcinus orca*), false killer whale (*Pseudorca crassidens*), pygmy killer whale (*Feresa attenuata*), melon-headed whale (*Peponocephala electra*), long-finned pilot whale (*Globicephala melas*), short-finned pilot whale (*Globicephala macrorhynchus*), Risso's dolphin (*Grampus griseus*), short-beaked common dolphin (*Delphinus delphis*), long-beaked common dolphin (*Delphinus capensis*), very long-beaked common dolphin (*Delphinus tropicalis*), Fraser's dolphin (*Langenodelphis hosei*), bottlenose dolphin (*Tursiops truncatus*), *Stenella spp.*, *Langenorhynchus spp*., rough-toothed dolphin (*Steno bredanensis*), northern right whale dolphin (*Lissodelphis borealis*), southern right whale dolphin (*Lissodelphis peronii*), *Cephalorhynchus spp*., harbor porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), spectacled porpoise (*Phocoena dioptrica*), South American fur seal (*Arctocephalus australis*), New Zealand fur seal (*Arctocephalus forsteri*), Galapagos fur seal (*Arctocephalus galapagoensis*), Juan Fernandez fur seal (*Arctocephalus philippii*), South African fur seal (*Arctocephalus pusillus pusillus*), Australia fur seal (*Arctocephalus pusillus doriferus*), Guadalupe fur seal (*Arctocephalus townsendi*), Sub-Antarctic fur seal (*Arctocephalus tropicalis*), northern fur seal (*Callorhinus ursinus*), northern sea lion (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*), Australian sea lion (*Neophoca cinerea*), New Zealand sea lion (*Phocarctos hookeri*), Galapagos sea lion (*Zalophus californianus wollebaeki*), Japanese sea lion (*Zalophus californianus japonicus*), South American sea lion (*Otaria byronia*), Mediterranean monk seal (*Monachus monachus*), Hawaiian monk seal (*Monachus schauinslandi*), northern elephant seal (*Mirounga angustirostris*), southern elephant seal (*Mirounga leonina*), ribbon seal (*Phoca fasciata*), spotted seal (*Phoca largha*), harbor seal (*Phoca vitulina*), gray seal (*Halichoerus grypus*), harp seal (*Phoca groenlandica*) and hooded seal (*Cystophora cristata*).

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4.0 MARINE MAMMAL STATUS, DISTRIBUTION, AND SEASONAL DISTRIBUTION

4.1 Marine Mammal Screening

An animal must be able to hear low frequency (LF) sound, and/or some organ or tissue must be capable of changing sound energy into mechanical effects in order to be affected by LF sound. In order for there to be an effect by LF sound, the organ or tissue must have an acoustic impedance different from water, where impedance is the product of density (kg/m^3 [lb/yd^3]) and sound speed (m/sec [ft/sec]). Thus, many organisms would be unaffected, even if they were in areas of LF sound, because they do not have an organ or tissue with acoustic impedance different from water. These factors immediately limit the types of organisms that could be adversely affected by LF sound.

Based on these considerations, a detailed analysis of only those organisms in the world's oceans that meet the following criteria has been undertaken:

- Does the proposed SURTASS LFA sonar geographical sphere of acoustic influence overlap the distribution of this species? If so,
- Is the species capable of being physically affected by LF sound? Are acoustic impedance mismatches large enough to enable LF sound to have a physical effect?
- Can the species hear LF sound? If so, at what thresholds?

In other words, to be evaluated for potential impact, the species must: 1) occur within the same ocean region and during the same time of year as the SURTASS LFA sonar operation, and 2) possess some sensory mechanism that allows it to perceive the LF sounds and/or 3) possess tissue with sufficient acoustic impedance mismatch to be affected by LF sounds. Species that did not meet these criteria were excluded from consideration. The evaluation process is summarized visually in Figure 3.2-1 (Species Selection Rationale) in the FOEIS/EIS.

References to Underwater Sound Levels

- References to underwater sound pressure level (SPL) in the Draft SEIS and this document are values given in decibels (dBs), and are assumed to be standardized at 1 microPascal at 1 m (dB re 1 µPa at 1 m [rms]) for Source Level (SL) and dB re 1 µPa [rms] for Received Level (RL), unless otherwise stated.
- References to underwater Sound Exposure Level (SEL) in the Draft SEIS are the measure of sound energy flow per unit area expressed in dB, and are assumed to be standardized at dB re 1 μPa^2-s, unless otherwise stated.

In cases where direct evidence of acoustic sensitivity is lacking for a species, reasonable indirect evidence was used to support the evaluation (e.g., there is no direct evidence that a species hears LF sound but good evidence exists that the species produces LF sound). In cases where important biological information was not available or was insufficient for one species, but data were available for a related species, the comparable data were used. Additional attention was given to species with either special protected stock status or limited potential for reproductive replacement in the event of mortality.

Baleen Whales (Mysticetes)

All 11 species of baleen whales (mysticetes) produce LF sounds. Sounds may be used as contact calls, for courtship displays and possibly for navigation and food finding. Although there are no direct data on auditory thresholds for any mysticete species, anatomical evidence strongly suggests that their inner ears are well adapted for LF hearing. Therefore, sound perception and production are assumed to be critical for mysticete survival. For this reason all mysticete species are considered sensitive to LF sound. However, only those that occur within the latitudes of proposed SURTASS LFA sonar operations are considered. This excludes the bowhead whale (*Balaena mysticetus*) that occurs only in Arctic waters, north of the area where the system would operate. Included for consideration are the remaining eleven baleen whale species: blue (*Balaenoptera musculus*), fin (*Balaenoptera physalus*), minke (*Balaenoptera acutorostrata*), Bryde's (*Balaenoptera edeni*), sei (*Balaenoptera borealis*), humpback (*Megaptera novaeangliae*), north Atlantic right (*Eubalaena glacialis*), north Pacific right (*Eubalaena japonica*), southern right (*Eubalaena australis*), pygmy right (*Caperea marginata*), and gray (*Eschrichtius robustus*) whales.

Toothed Whales (Odontocetes)

There are at least 70 species of odontocetes (some species classifications are under study, and the exact number of species of beaked whales is not known) including dolphins, porpoises, beaked whales, long-finned pilot, short-finned pilot, pygmy killer, false killer, melon-headed whales, killer whales, and sperm whales. A number of these species inhabit ocean areas where SURTASS LFA sonar might operate. Many species are known to use HF clicks for echolocation. All odontocete species studied to date hear best in the mid- to high-frequency range, and so are less likely to be affected by exposure to LF sounds than mysticetes. Like mysticetes, odontocetes depend on acoustic perception and production for communication, food finding, and probably for navigation and orientation.

The following species of odontocetes do not meet the screening criteria described at the beginning of this subchapter, and thus are eliminated from further evaluation:

- Arctic specialists in the family Monodontidae including narwhal (*Monodon monoceros)*, because SURTASS LFA sonar would not be employed in their range in the Arctic.
- Some porpoise species because they are coastal species with ranges well inshore of the areas where SURTASS LFA sonar would be employed, including: Burmeister’s porpoise *(P. spinipinnis*), vaquita (*P. sinus)*, and finless porpoise (*Neophocaena phocaenoides)*.
- Dolphin species in the following families: Pontoporiidae (Chinese River dolphin [*Lipotes vexillifer]*, fanciscana [*Pontoporia blainvillei]*); Iniidae (boto/Amazon River dolphin [*Inia geoffrensis]*); and Platanistidae (Ganges river dolphin [*Platanista gangetica]* and Indus River dolphin [*P. minor*]). They are eliminated

because they are river dolphins that may enter coastal waters, but their ranges are well inshore of the areas where SURTASS LFA sonar would be employed.

- Dolphin species in the family Delphinidae that occur in shallow, coastal waters well inshore of the areas where SURTASS LFA sonar would be employed and are not known to hear sounds in the range of the system. This group includes Tucuxi/boto (*Sotalia fluviatilis)*, Irrawaddy dolphin (*Oracella brevirostris),* Indo-Pacific humpbacked dolphin (*Sousa chinensis)*, Atlantic humpbacked dolphin (S*ousa teuszii)*, and humpback dolphin (*Sousa plumbea)*.

Odontocetes that are further analyzed in this document are those species that have the potential to be found in waters where SURTASS LFA sonar might operate. This includes pelagic dolphins, coastal dolphin species that also occur in deep water, beaked whales, killer whales, sperm whales, long-finned and short-finned pilot whales, pygmy killer whales, false killer whales, melon-headed whales, and belugas.

Seals, Sea Lions, and Walruses (Pinnipeds)

The suborder of Pinnipedia consists of "eared" seals (family Otariidae), "true" seals (family Phocidae), and walruses (family Odobenidae).

There are 16 species of otariids including sea lions and fur seals. They are found in temperate or sub-polar waters. Several of these species are listed as special status (northern sea lion, northern fur seal, and Guadalupe fur seal). All 16 species are further analyzed in this document and in the Draft SEIS (DON, 2005c).

There are 18 species of phocids, or "true" seals, nine of which occur in polar oceans or inland lakes and can therefore be excluded. The remaining ten phocid species, including two monk seal species that are listed as endangered, merit further evaluation. These include the Hawaiian and Mediterranean monk seals (*Monochas monachus* and *M. schauinslandi*); the northern and southern elephant seals (*Mirounga angustirostris* and *M. leonina*); the gray seal (*Halichoerus grypus*); four species in the genus *Phoca*: the ribbon, harbor, harp, and spotted seals (*P. fasciata, P. vitulina, P. groenlandica* and *P. largha*); and the hooded seal (*Cystophora csistata*).

The walrus can be excluded from further analysis since it is a polar species.

Phocids Excluded from Further Analysis

ringed (*Phoca hispida*)	
baikal (*P. sibirica)*	crabeater (*Lobodon carcinophagus*)
Caspian (*P. caspica*)	Ross (*Ommatophoca rosii*)
bearded (*Erignathus barbatus*)	leopard (*Hydrurga leptonyx*)
	Weddell (*Leptonychotes weddelli*)

Ursids

A marine mammal, the polar bear (*Ursus maritimus*) can be excluded from further analysis since it is a polar species.

Mustelids

Two of the six species of otters in the world inhabit ocean waters: the sea otter (*Enhydra lutris*) and the chungungo (*Lutra felina*). The activities of both species occur almost exclusively in shallow waters. Sea otters occupy soft- and hard-sediment marine habitats, including protected bays and exposed outer coasts. They extend from the littoral zone to depths of less than 100 m (330 ft). Most sea otters occur between shore and the 20-m (65-ft) depth contour (USFWS, 2003).

The minimum operating depth for SURTASS LFA is 100 m (328 ft) and the minimum operating depth for CLFA is expected to be 115 m (278 ft). Therefore, mustelids will not be affected by SURTASS LFA sonar and are not considered for further evaluation.

Sirenians

The world has three manatee species, West Indian (*Trichechus manatus*), Amazonian (*T. inunguis*]) and West African *T. senegalensis*) and one dugong species (*Dugong dugon*). The manatees are primarily a fresh water and estuarine species. Therefore, they are eliminated from further evaluation.

Dugongs are usually found in calm, sheltered, nutrient-rich water less than 5-m (16.4 ft) deep, generally in bays, shallow island and reef areas which are protected against strong winds and heavy seas and which contain extensive sea grass beds. However, they are not confined to inshore waters. There have been sightings near reefs up to 80 km (43.2 nm) offshore in waters up to 37 m (121.4 ft) deep. The average minimum water depth that the SURTASS LFA vessel will operate is 200 m (656.2 ft). The shallowest depth that it can operate is 100 m (328 ft) and the minimum operating depth for CLFA is expected to be 115 m (278 ft). As a result of sound attenuation in shallow and shoaling water, dugongs are unlikely to be affected and are eliminated from further evaluation.

4.2 Marine Mammal Species, Status, and Seasonal Distribution

The summary information and tables on the protected status, distribution, abundance, diving behavior, and hearing/sound production for potentially affected species of mysticetes, odontocetes, and pinnipeds is in the SURTASS LFA Sonar Draft SEIS. Please refer to Subchapter 3.2 of the SURTASS LFA Sonar Draft SEIS (DON, 2005c), which is incorporated here by reference.

5.0 TYPE OF INCIDENTAL TAKE AUTHORIZATION REQUESTED

Marine mammals will be harassed due to noise disturbance incidental to the employment of the U.S. Navy's Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar system during training, testing, and routine military operations. The U.S. Navy is requesting authorization under Section 101(a)(5)(A) of the MMPA for taking by harassment incidental to the employment of SURTASAS LFA sonar systems (up to four) for training, testing, and routine military operations within the world's oceans except for Arctic and Antarctic waters, and issuance of regulations governing such takes for a period of five years.

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6.0 IMPACTS OF PROPOSED ACTION AND ALTERNATIVES

For SURTASS LFA sonar alternatives, potential impacts should be reviewed in the context of the basic operational characteristics of the system. It should be recognized that this application summarizes the more detailed information in the Draft SEIS (DON, 2005c) which should be considered to be a part of this application and is incorporated by reference.

- A maximum of four systems would be deployed in the Pacific-Indian ocean area and in the Atlantic-Mediterranean Sea area.
- The R/V *Cory Chouest* and the USNS IMPECCABLE are presently the only vessels equipped with a SURTASS LFA sonar system. Both vessels are U.S. Coast Guard-certified for operations. In addition, they operate in accordance with all applicable federal and U.S. Navy rules and regulations related to environmental compliance. All future vessels to be equipped with SURTASS LFA sonar systems would also be U.S. Coast Guard-certified and compliant with all applicable federal and U.S. Navy environmental rules and regulations. SURTASS LFA sonar vessel movements are not unusual or extraordinary and are part of routine operations of seagoing vessels. Therefore, there should be no unregulated environmental impacts from the operation of the SURTASS LFA sonar vessels.
- At-sea missions would be temporary in nature. Of an estimated maximum 294 underway days per year, the SURTASS LFA sonar would be operated in the active mode about 240 days. During these 240 days, active transmissions would occur for a maximum of 432 hours per year per vessel. The original planned 432 hours of active transmissions per vessel per year was analyzed in the FOEIS/EIS and also proposed in the Draft SEIS. Applications for annual LOAs under the new five-year rule will denote the number of LFA transmit hours per vessel from the prior year, and total hours for all vessels from the prior year. Any adjustments to maximum LFA transmit hours per vessel and/or total maximum hours for all vessels will be coordinated with NMFS.

The types of potential effects on marine mammals from SURTASS LFA sonar operations can be broken down into several categories:

- **Non-auditory injury**: This includes the potential for resonance of the lungs/organs, tissue damage, and mortality. For the purposes of the SURTASS LFA sonar analyses presented in this application, all marine mammals exposed to $\geq$ 180 dB Received Level (RL) are evaluated as if they are injured.
- **Permanent threshold shift (PTS)**: A severe situation occurs when sound intensity is very high or of such long duration that the result is a permanent threshold shift (PTS) or permanent hearing loss on the part of the listener. This constitutes Level A "harassment" under the MMPA, as does any other injury to a marine mammal. The intensity and duration of a sound that will cause PTS varies across species and even between individual animals. PTS is a consequence of the death of the sensory hair cells of the auditory epithelia of the ear and a resultant loss of hearing ability in the

general vicinity of the frequencies of stimulation (Salvi et al., 1986; Myrberg, 1990; Richardson et al., 1995).

- **Temporary threshold shift (TTS)**: Sounds of sufficient loudness can cause a temporary condition in which an animal's hearing is impaired for a period of time—called TTS. After termination of the sound, normal hearing ability returns over a period that may range anywhere from minutes to days, depending on many factors including the intensity and duration of exposure to the intense sound. Hair cells may be temporarily affected by exposure to the sound but they are not permanently damaged or killed. Thus, TTS is not considered to be an injury (Richardson et al., 1995), although during a period of TTS, animals may be at some disadvantage in terms of detecting predators or prey and thus potentially harmed.
- **Behavioral change**: For military readiness activities, like use of SURTASS LFA sonar, Level B “harassment” under the MMPA is defined as any act that disturbs or is likely to disturb a marine mammal by causing disruption of natural behavioral patterns to a point where the patterns are abandoned or significantly altered. Behaviors include migration, surfacing, nursing, breeding, feeding, and sheltering. The National Research Council (NRC, 2005) discusses biologically significant behaviors and possible effects. It states that an action or activity becomes biologically significant to an individual animal when it affects the ability of the animal to grow, survive, and reproduce. These are the effects on individuals that can have population-level consequences and affect the viability of the species (NRC, 2005).
- **Masking**: The presence of intense sounds in the environment can potentially interfere with an animal’s ability to hear sounds of relevance to it. This effect, known as “auditory masking;” could interfere with the animal's ability to detect biologically relevant sounds, such as those produced by predators or prey, thus increasing the likelihood of the animal not finding food or being preyed upon.

6.1 Potential Impacts on Marine Mammal Stocks

The types of potential effects on marine mammals from SURTASS LFA sonar operations can be broken down into non-auditory injury, permanent loss of hearing, temporary loss of hearing, behavioral change, and masking. The analyses of these potential impacts were presented in the SURTASS LFA sonar FOEIS/EIS. Updated literature reviews and research results indicate that there are no new data that contradict the assumptions or conclusions in the FOEIS/EIS; thus, its findings regarding potential impacts on marine mammals remain valid and are incorporated by reference herein. The updated literature review in the Draft SEIS is also incorporated by reference. The types of potential effects on marine mammals are discussed in the following subchapters.

6.1.1 Non-Auditory Injury

There are several potential areas for non-auditory injury to marine mammals from SURTASS LFA sonar transmissions. These include direct acoustic impact on tissue, indirect acoustic impact on tissue surrounding a structure, and acoustically-mediated bubble growth within tissues from supersaturated, dissolved nitrogen gas.

Tissue Damage

In response to the resonance issue raised by letters and comments to NMFS's 2001 Proposed Rule, Cudahy and Ellison (2002) analyzed the potential for injury related to resonance from SURTASS LFA sonar signals. Their analysis did not support the claim that resonance from SURTASS LFA sonar will cause injury. Physical injury due to resonance will not occur unless it will increase stress on tissue to the point of damage. Therefore, the issue is not whether resonance occurs in air/gas cavities, but whether tissue damage occurs. Cudahy and Ellison (2002) indicate that the potential for *in vivo* tissue damage to marine mammals from exposure to underwater low frequency sound will occur at a damage threshold on the order of 180 to 190 dB RL or higher. These include: 1) transluminal (hydraulic) damage to tissues at intensities on the order of 190 dB RL or greater; 2) vascular damage thresholds from cavitation at intensities in the 240-dB RL regime; 3) tissue shear damage at intensities on the order of 190 dB RL or greater; and 4) tissue damage in air-filled spaces at intensities above 180 dB RL.

In a NOAA/NMFS workshop held April 24 and 25, 2002, an international group of 32 scientists with expertise in acoustics met at NMFS Headquarters in Silver Spring, Maryland, to consider the question of acoustic resonance and its possible role in tissue damage in marine mammals. The group concluded that it is not likely that acoustic resonance in air spaces plays a primary role in tissue damage in marine mammals exposed to intense acoustic sources. Tissue displacements are too small to cause damage, and the resonant frequencies of marine mammal air spaces are too low to be excited by most sounds produced by humans. However, resonance of non-air containing tissues was not ruled out. While tissue trauma from resonance in air spaces seems highly unlikely, the group agreed that resonance in non-air-containing tissues cannot be considered negated until certain experiments are performed (NOAA/NMFS, 2002).

In summary, the best available scientific information shows that, while resonance can occur in marine animals, this resonance does not necessarily cause injury, and any such injury is not expected to occur below a sound pressure level of 180 dB RL. Because the Draft and FOEIS/EISs used 180 dB RL as the criterion for the determination of the potential for injury to marine life and for the implementation of geographic and monitoring mitigation measures, any non-auditory physiological impacts associated with resonance were accounted for. The 145-dB RL restriction for known recreational and commercial dive sites will provide an additional level of protection to marine mammals in these areas.

Additionally, it has been claimed that air space resonance impacts can cause damage to the lungs and large sinus cavities of cetaceans; that low frequency sound could induce panic and subsequent problems with equalization; and that low frequency sound could cause bubble growth in blood vessels. With regard to the specific impacts to lungs and sinus cavities, there is abundant anatomical evidence that marine mammals have evolved and adapted to dramatic fluctuations in pressure during long, deep dives that seem to exceed their aerobic capacities (Williams et al., in *Science*, 2000; Environmental Network News, 2000). For example, marine mammal lungs are reinforced with more extensive connective tissues than their terrestrial relatives. These extensive connective tissues, combined with the probable collapse of the alveoli at the depths at which significant SURTASS LFA sonar signals can be heard, make it very unlikely that significant lung resonance effects could be realized.

Acoustically Mediated Bubble Growth

Presently, there is controversy among researchers on whether or not marine mammals can suffer from a form of decompression sickness. It is theorized that this may be caused by diving and then surfacing too quickly, forcing nitrogen bubbles to form in the bloodstream and tissues. In 2002, NMFS held "The Workshop on Acoustic Resonance as a Source of Tissue Trauma in Cetaceans," focusing on the March 2000 Bahamas strandings. The purpose of the workshop was to present any evidence for the possible mechanisms by which mid-frequency active sonar could lead to strandings of beaked whales. The November 2002 report on this workshop discussed needed research on acoustically mediated bubble growth and listed the major issues surrounding the hypothesis (NOAA/NMFS, 2002). The issues listed included:

- Using trained animals to test the theory of bubble growth;
- Studying the tissues damaged by bubble growth/decompression sickness and comparing this with the injuries in beaked whales already studied;
- Obtaining needed information on the rise of acoustic waves in enhancing bubble nucleation and activation in tissues that are supersaturated to upwards of 300 percent;
- Devising methods to acquire, preserve, and test tissue samples from stranded animals so that the presence of bubbles in tissues can be investigated; and
- If beaked whales are shown to have bubble growth from any cause, then determining the lowest sound pressure level at which bubble growth can be triggered, and which sonars have transmission characteristics most likely to trigger this bubble growth.

Jepson et al. (including Fernandez) (2003) (P. D. Jepson of the School of Geography and the Environment, University of Oxford, UK) published a brief communication in *Nature* on gas-bubble lesions found in stranded cetaceans (Canary Islands stranding, 2002). They presented findings of acute and chronic tissue damage in stranded cetaceans that they believe resulted from the formation of *in vivo* (in the living body) gas bubbles, and stated that the animals showed severe, diffuse vascular congestion and marked, disseminated microvascular hemorrhages associated with widespread fat emboli in vital organs, particularly the liver. They also stated that the lesions were consistent with acute trauma due to *in vivo* bubble formation that results from rapid decompression, which occurs in decompression sickness. A response to this article was posted in *Nature* by Piantadosi and Thalmann (2004) of the Duke University Medical Center and Divers Alert Network (DAN) stating that whales do not develop sufficient gas supersaturation in the tissues on ascent to cause extensive bubble formation in the liver. The gas that would be available for supersaturation is located in the lungs at the onset of each held breath. According to Piantadosi and Thalmann (2004), during descent the thorax is compressed and the residual gas volume in the compliant lungs is forced (by Boyle's law contraction and alveolar collapse) into non-respiratory conducting airways, where it is sequestered from circulation. They explain that not enough gas is taken up to produce bubbles, except possibly during multiple rapid dives to depths approaching the lung's closing volume. Fernandez et al. (including Jepson) (2004) stated in their own brief communication that they did not present their findings as conclusive evidence of decompression sickness. All communications agree, though, that further investigation is needed, including an analysis of the composition of the gas in the bubbles (Jepson et al., 2003; Piantadosi and Thalmann, 2004; Fernandez et al., 2004).

Scientists from the Woods Hole Oceanographic Institution (WHOI) have documented bone lesions in the rib and chevron bones of sperm whales, which may have been caused by tissue damage from nitrogen bubbles (Moore and Early, 2004). They studied 16 partial or complete skeletons that died up to 111 years ago from both the Atlantic and Pacific Oceans. Studying the skeletons, they noted a series of changes in bones attached to the backbone, mainly the rib bones, and other small bones in the tail region. The changes are patches where the bone died due to an obstructed blood supply to the joint surfaces of the bone. One theory suggests that the lesions were caused by a decompression-like sickness (Dawicki, 2004).

The issue of bubble growth via rectified diffusion was evaluated in the FOEIS/EIS, Record of Decision and Final Rule. Crum and Mao (1996) stated that RL would have to exceed 190 dB in order for there to be the possibility of significant bubble growth via rectified diffusion (one form of the growth of gas bubbles in liquids) due to supersaturation of gases in the blood.

6.1.2 Permanent Loss of Hearing

Permanent hearing loss is a consequence of the death of the sensory hair cells of the auditory epithelia of the ear and a resultant loss of hearing ability in the general vicinity of the frequencies of stimulation (Salvi et al., 1986; Myrberg, 1990; Richardson et al., 1995). A severe situation occurs when sound intensity is very high or of such long duration that the result is a permanent threshold shift (PTS) or permanent hearing loss on the part of the listener. This constitutes Level A "harassment" under the MMPA, as does any other injury to a marine mammal. The intensity and duration of a sound that will cause PTS varies across species and even between individual animals. PTS effectively raises an animals hearing threshold and thus reducing his ability to hear.

The updated literature reviews and research results noted in the preceding subchapters indicate that there are no new data that contradict the assumptions or conclusions in the FOEIS/EIS, the Draft SEIS and the 1999 application; thus, its findings regarding the potential for permanent loss of hearing from SURTASS LFA sonar operations remains valid. That is, that the potential impact on any stock of marine mammals from injury (such as permanent loss of hearing) is considered negligible.

6.1.3 Temporary Loss of Hearing

Sound may cause temporary threshold shift (TTS), a temporary and reversible loss of hearing that may last for minutes to hours. TTS is quite common in humans and often occurs after being exposed to loud music, such as at a rock concert. The precise physiological mechanism for TTS is not understood. It may result from fatigue of the sensory hair cells as a result of their being over-stimulated or from some small damage to the cells, which is repaired over time. The duration of TTS depends on a variety of factors including intensity and duration of the stimulus, and recovery can take minutes, hours, or even days. Therefore, animals suffering from TTS over longer time periods, such as hours or days, may be considered to have a change in a biologically significant behavior, as they could be prevented from detecting sounds that are biologically relevant, including communication sounds, sounds of prey, or sounds of predators.

There have been no substantial changes to the knowledge or understanding for the potential effects of LF sound to cause temporary loss of hearing in marine mammals. The information in the FOEIS/EIS Subchapters 1.4.2 and 4.2.7, taken in the context of temporary loss of hearing (i.e., TTS), remains valid, and the contents are incorporated by reference herein.

6.1.4 Behavioral Change

Biologically Significant Behavior

The primary potential deleterious effect from SURTASS LFA sonar is change in a biologically significant behavior. An activity is biologically significant when it affects an animal's ability to grow, survive, and reproduce (NRC, 2005).

The Low Frequency Sound Scientific Research Program (LFS SRP) field research in 1997-98 provided important results on types of responses and insights as to the types of responses whales have to SURTASS LFA sonar signals and how those responses scaled relative to RL and context. The results of the LFS SRP confirmed that some portion of the whales exposed to the SURTASS LFA sonar responded behaviorally by changing their vocal activity, moving away from the source vessel, or both, but the responses were short-lived (Clark et al., 2001)

In a 1998 SURTASS LFA sonar playback experiment, migrating gray whales avoided exposure to LFA signals (source levels of 170 and 178 dB) when the source was placed within their migration corridor. Responses were similar for the 170-dB SL LFA stimuli and for the 170-dB SL one-third octave band-limited pseudo-random noise with timing and frequency band similar to the LFA stimulus. However, during the SURTASS LFA sonar playback experiments, in all cases, whales resumed their normal activities within tens of minutes after the initial exposure to the LFA signal (Clark et al., 2001). Essentially, the whales made minor course changes to go around the source. When the source was relocated outside of the migration corridor, but with SL increased so as to reproduce the same sound field inside the corridor, the whales continued their migration unabated. This result stresses the importance of context in interpreting animals' responses to underwater sounds.

Prey fish within the 180-dB sound field of the SURTASS LFA sonar source could potentially be affected, which would suggest that this could presumably affect the foraging potential for some localized marine mammals to some extent. However, recent results from low frequency sonar exposure studies conducted on trout and channel catfish indicated that the impact from low frequency sonar is likely to be minimal[3], if not negligible; and certainly there is no potential for any measurable fish stock mortalities from SURTASS LFA sonar operations. Therefore, marine mammal foraging will not be affected.

[3] Minimal is defined by Webster's New World College Dictionary as "smallest or least possible."

Eight weekly aerial surveys of humpback whales were flown north of the Hawaiian Island of Kauai each year when the North Pacific Acoustic Laboratory (NPAL) source was not transmitting in 2001 and when it was transmitting in 2002 and 2003 during the peak residency period of humpback whales (February through March) (Mobley, 2005). The goal of the NPAL program was to extend the earlier thermometry findings of the Acoustic Thermometry of Ocean Climate (ATOC) experiment over a longer time to determine ocean-basin scale trends in temperature. The results of these surveys suggest that exposure to the NPAL source during the two years sampled with the source on, did not change the numbers of whales north of Kauai. It did not produce any noticeable distributional changes as measured by distance from the source or from shore, nor did it produce any noticeable changes in the depths of sighting locations. These results contrast somewhat with the results from the ATOC and marine mammal research program (MMRP) studies, which found a slight change in distribution and behavior, although no change in abundance (Frankel and Clark, 2000; 2002). After four years of exposure to the ATOC/NPAL transmissions, the humpback whales continue to return to their wintering grounds near Kauai and show little changes in their normal pattern of distribution (Mobley, 2005).

6.1.5 Masking

There have been no substantial changes to the knowledge or understanding for the potential effects of LF sound on masking with regard to marine mammals. The information in Subchapter 4.2.7.7 of the FOEIS/EIS remains valid, and the contents are incorporated by reference herein. Two papers have been published fairly recently on low frequency masking in three pinniped species (northern elephant seal, harbor seal, California sea lion) that focused specifically on comparative amphibious capabilities, and revealed some LF characteristics of masking that bear on cochlear mechanics (Southall, 2000; 2003). The first paper used behavioral techniques to determine underwater masked hearing thresholds for the three test animals. The second Southall paper reported on direct measurements of critical bandwidth at low frequencies and basically concluded that results are directly relevant to underwater masking because both arise from common cochlear processes in either media (air or water). Results indicate that LF signals can be masked by LF noise. However, combined data suggest that LF critical masking ratios are relatively low in both media for pinnipeds (as in much of the other marine mammal data), which would suggest less potential for masking at low frequencies.

6.1.6 Conclusions

The potential effects from SURTASS LFA sonar operations on any stock of marine mammals from injury (non-auditory or permanent loss of hearing) are considered negligible, and the potential effects on the stock of any marine mammal from temporary loss of hearing or behavioral change (significant change in a biologically important behavior) are considered minimal. Any auditory masking in marine mammals due to SURTASS LFA sonar signal transmissions is not expected to be severe and would be temporary.

6.2 Analysis of SURTASS LFA Sonar Operations under Current MMPA Rule

As a requirement of the regulations for the taking of marine mammals incidental to Navy operations of Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar, 50 CFR 216 Subpart Q (67 *Federal Register* [FR] 46785-89), the Navy must provide annual reports with an unclassified summary of the classified quarterly reports of SURTASS LFA operations onboard the USNS IMPECCABLE (T-AGOS 23) and R/V *Cory Chouest* in accordance with the requirements of the Letters of Authorization (LOAs) issued by the United States Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), and the National Marine Fisheries Service (NMFS). The primary purpose of this annual report is to provide NMFS with unclassified SURTASS LFA sonar operations information to assist them in their evaluation of future Navy LOA applications.

6.2.1 Risk Assessment Approach

The Draft SEIS was developed based on the analyses in the SURTASS LFA sonar FOEIS/EIS (DON, 2001), the Applications for Letters of Authorization (DON, 2002; 2003b; 2004b; 2005b), updated literature reviews, and additional underwater acoustical modeling. The analytical process is summarized below. The FOEIS/EIS provided detailed risk assessments of potential impacts to marine mammals covering the major ocean regions of the world: North and South Pacific Oceans, Indian Ocean, North and South Atlantic Oceans, and the Mediterranean Sea.

The 31 acoustic modeling sites are shown in Figure 4.2-1 and Table 4.2-1 of the FOEIS/EIS. Marine mammal data were developed from the most recent NMFS stock assessment reports at the time and pertinent multinational scientific literature containing marine mammal distribution, abundance and/or density datasets. The locations were selected to represent reasonable sites for each of the three major underwater sound propagation regimes where SURTASS LFA sonar could be employed and included:

- Deep water convergence zone (CZ) propagation;
- Near surface duct propagation; and
- Shallow water bottom interaction propagation.

These sites were selected to model the highest potential for effects of SURTASS LFA use and represent the upper bound of impacts (both in terms of possible acoustic propagation conditions, and in terms of marine mammal population and density) that can be expected from operation of the SURTASS LFA sonar system. Thus, if SURTASS LFA sonar operations were conducted in an area that was not acoustically modeled in the FOEIS/EIS, the potential effects would most likely be less than those obtained from the most similar site in the analyses presented.

Effectively, the conservative assumptions of the FOEIS/EIS are still valid. Moreover, there are no new data that contradict the assumptions or conclusions made in Subchapter 4.2 (Potential Impacts on Marine Mammals) of the FOEIS/EIS. Thus, it is not necessary to reanalyze the potential acoustic impacts in the Draft SEIS and this MMPA application. Under the current MMPA Rule (50 CFR 216 Subpart Q), the Navy must apply for annual LOAs. In these applications, the Navy projects where it intends to operate for the period of the next annual LOAs and provides NMFS with reasonable and realistic risk estimates for marine mammal stocks in the proposed areas of operation. The LOA application's analytical process is described below with an actual sensitivity/risk analysis that was performed for the fourth-year LOA application (DON, 2005b), which is provided as a sample case study for this authorization application. It utilizes a conservative approach by integrating mission planning needs and a cautious assessment of the limited data available on specific marine mammal populations, and seasonal habitat and activity. Because of the incorporation of conservative assumptions, it is likely that the aggregate effect of such assumptions was an overestimation of risk—a prudent approach for environmental conservation when there are data gaps and other sources of uncertainty. This approach for estimating risk to marine mammal stocks was not intended to forecast the expected outcome from SURTASS LFA sonar operations but, rather, to determine reasonable upper bounds. If this type of practical analysis presented an outcome that was acceptable, then the activity would clearly satisfy the regulatory requirement to assess environmental risk. The total annual risk for each stock of marine mammal species was estimated by summing a particular species' risk estimates within that stock, across mission areas. Each stock, for a given species, was then examined. Based on this approach, the highest total annual estimated risk (upper bound) for any marine mammal species' stock was provided in the fourth year application for LOAs (DON, 2005b) under the initial 5-year authorization for the incidental taking of marine mammals (67 FR 46785).

Figure 6-1 provides a flowchart that depicts the sensitivity/risk process. The left side of the flowchart illustrates the process that is initially carried out for all potential mission areas, which starts with the Navy's antisubmarine warfare (ASW) requirements to be met by SURTASS LFA sonar. Based on this information, mission areas are proposed by the Chief of Naval Operations (CNO) and fleet commands. Thereupon, available published data are collected, collated, reduced and analyzed with respect to marine mammal populations and stocks, marine mammal habitat and seasonal activities, and marine mammal behavioral activities. Where data are unavailable, best scientific estimates are made by highly qualified marine biologists, based on known data for like species and/or geographic areas, and known marine mammal seasonal activity.

The right side of the flowchart portrays the process that was applied to each mission site in the application. A similar process is proposed for missions during the upcoming 5-year period. The individual generic steps of this process are summarized as follows:

- Based on results from the initial process for all potential mission areas, there are three possible alternatives, which are indicated in the flow chart. If, for one or more of the proposed mission areas, seasonal densities prove to be high and/or sensitive animal activities are expected there, those mission areas are changed and/or refined and the process is re-initiated, as shown in the flow chart.

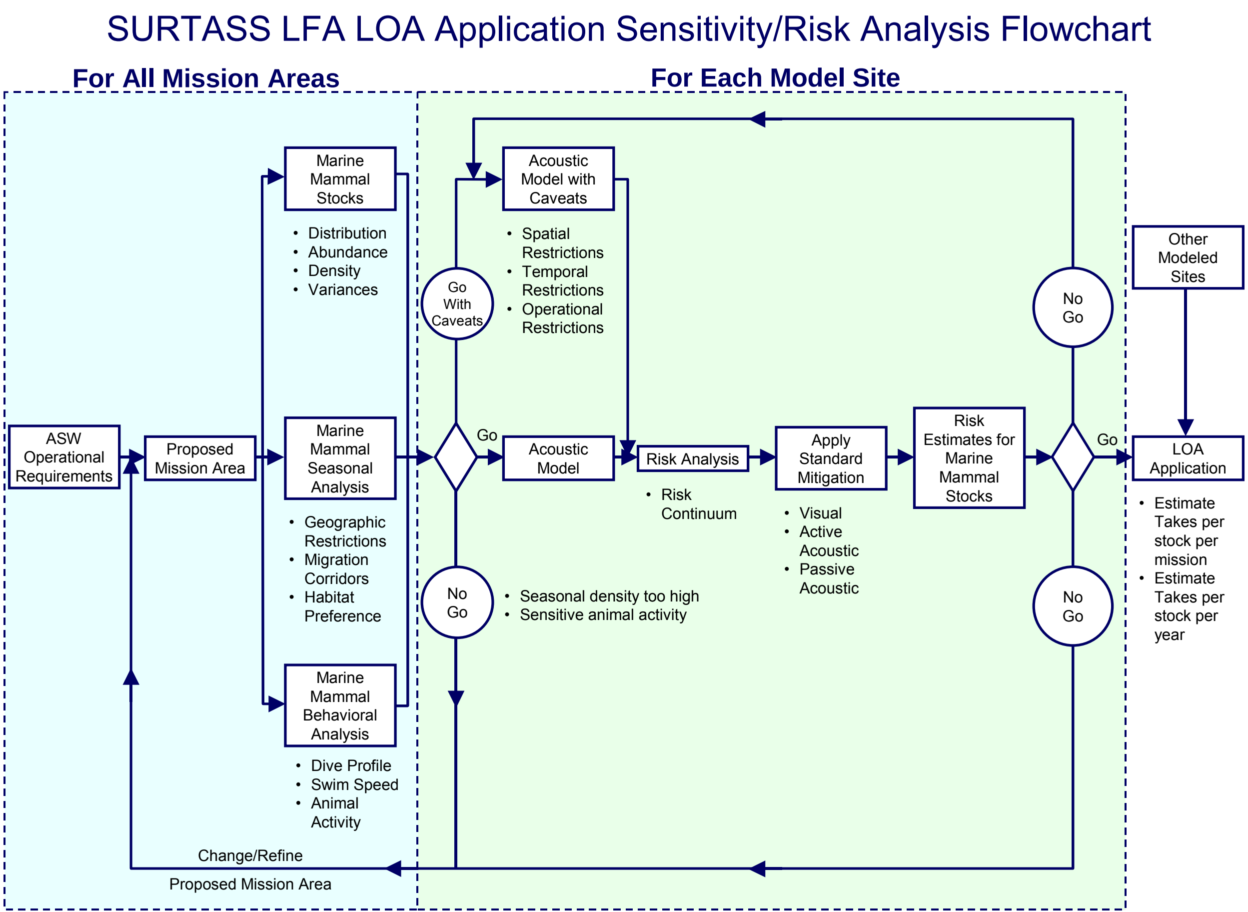

Figure 6-1 SURTASS LFA Sonar LOA Application Sensitivity/Risk Analysis Flowchart

- The other two alternatives are: 1) standard acoustic modeling is performed, or 2) acoustic modeling with caveats (e.g., spatial, temporal or operational restrictions) is performed.
- After acoustic modeling, risk analysis is undertaken, using the risk continuum.
- Standard mitigation is applied.
- Risk estimates for marine mammal stocks are calculated.
- Based on these estimates, the next decision point is reached. Again, there are three possible alternatives, two of which are: 1) more acoustic modeling with changed or refined caveats is performed and the "each model site" process is re-initiated, or 2) the proposed mission area is changed or refined and the entire process is re-initiated.
- The other alternative is to move to the next step and input the risk estimates for marine mammal stocks to the LOA application, which are also combined with the estimates derived from the same process for all other modeled mission areas/sites to derive the risk estimates for marine mammal stocks for the entire LOA period of applicability (one year).

6.2.2 Risk Assessment Case Study

It is not feasible to analyze all potential mission areas throughout the oceanic regions pertinent to this application (Atlantic, Mediterranean, Pacific, and Indian), for all species' stocks for all seasons. Therefore the application for the fourth year LOAs (DON, 2005b) can be utilized as a case study to demonstrate that the results of the risk assessment approach are reasonable and realistic estimates of the potential effects to marine mammal stocks specific to the potential mission areas. In the case study, sites and seasons are based on reasonable and realistic choices for SURTASS sonar operations proposed in the LOA annual application. The CNO's mission for SURTASS sonar operations to be conducted under the requested LOAs is to train the Navy crews manning the vessels and to test and operate the SURTASS LFA sonar systems in as many and varied at-sea environments as possible.

In its annual LOA applications, the Navy provides estimates of the percentage of marine mammals potentially affected in the biogeographic regions of the proposed LFA operations for the 12-month period of the LOA(s). The application for the fourth year LOA (DON, 2005b) provided annual estimates of potential effects to marine mammal stocks for 16 missions (regardless of which vessel is performing the mission) at nine mission sites for various seasons. The results are provided in Enclosure (3) of the fourth year LOA application (DON, 2005b) and are incorporated by reference. The values in the tables support the conclusion that estimates of potential effects to marine mammal stocks are below the criteria delineated by NMFS in its current authorization.

Information on how the density and stock/abundance estimates are derived for the selected mission sites is also given in the LOA applications. These data are derived from current, available published source documentation, and provide general area information for each mission area with species-specific information on the animals that could potentially occur in that area, including estimates for their stock/abundance and density. This information is provided in Enclosure (2) of the fourth year LOA application (DON, 2005b) and is incorporated by reference.

6.2.3 Marine Mammal Strandings

6.2.3.1 Cetacean Stranding Events

Marine mammal strandings are not a rare occurrence. The Cetacean Stranding Database (www.strandings.net) registers that over a hundred strandings occurred worldwide in the year 2004. However, mass strandings, particularly multi-species mass strandings, are relatively rare. Acoustic systems are becoming increasingly implicated with marine mammal strandings. Many theories exist as to why noise may be a factor in marine mammal strandings. It is theorized that they become disoriented, or that the noise forces them to surface too quickly which may cause symptoms similar to decompression sickness, or that they are physically injured by the sound pressure.

A review of historical data (mostly anecdotal) maintained by the Marine Mammal Program in the National Museum of Natural History, Smithsonian Institution reports 49 beaked whale mass stranding events between 1838 and 1999. The largest beaked whale mass stranding occurred in the 1870s in New Zealand when 28 Gray's beaked whales (*Mesoplodon grayi*) stranded. Blainsville's beaked whale (*Mesoplodon densirostris*) strandings are rare, and records show that they were involved in one mass stranding in 1989 in the Canary Islands. Cuvier's beaked whales (*Ziphius cavirostris*) are the most frequently reported beaked whale to strand, with at least 19 stranding events from 1804 through 2000 (DOC and DON, 2001; Smithsonian Institution, 2000). By the nature of the data, much of the information on strandings over the years is anecdotal, which has been condensed in various reports, and some of the data have been altered or possibly misquoted.

Strandings within the western Pacific region have been compiled from various, mostly uncorroborated, public sources. Uncertainties exist in many cases as to exact location, and species identification, due to the anecdotal nature of these reports. The paucity of independent scientific verification of strandings in this region can partly be explained by regional language differences between conservation programs and publications, cultural preferences, and some inherent media restrictions. The best source of stranding information for Japan, the Marine Mammal Standing Database from the Natural History Museum of Tokyo, currently has only made data publicly available through 2001 (Natural History Museum of Tokyo, 2005).

Strandings related to natural causes

There are many known causes for strandings. Stranded marine mammals may be ill. They could have a disease or parasites, or pollution could cause illness. They may follow prey and get too close to shore or they could follow a sick member of the pod and strand. Climatic cycles may also change the ecological composition of species in a region, bringing in new species, which could lead to more strandings of the new species. Strandings can also be caused by animal disorientation with respect to geomagnetic fields when they are used as a source of directional information.

Between March 10 and April 13, 2004, 107 bottlenose dolphins stranded dead along the Florida Panhandle. In addition to the dolphins, many fish and invertebrates were also found dead. An "Interim Report on the Bottlenose Dolphin (*Tursiops turncatus*) Unusual Mortality Event Along the Panhandle of Florida, March-April 2004" has been released by the National Oceanic and Atmospheric Administration and the Florida Fish and Wildlife Conservation Commission (NOAA and USFWS, 2004). The interim report outlines the initial findings and the ongoing analyses of the investigation on the unusual mortality event. The analyses conducted found brevetoxins, naturally occurring neurotoxins produced by *Karenia brevis*, the Florida red tide, at high levels in the stomach contents of all dolphins examined to the date of the publication of the Interim Report. The concentrations of the brevetoxins in the subsamples of the stomach contents were greater than or equal to those observed in previous marine mammal mortality events associated with Florida red tides in the Gulf of Mexico. Military exercises were being conducted off the coast of the Florida Panhandle in March 2004, but were a significant distance from the stranded animals. From the examination of 22 of these dolphins, no physical evidence of blast or acoustic trauma was found, and based on the stomach contents of the stranded animals, brevetoxins are believed to have caused this unusual mortality event.

On November 28, 2004, 73 long-finned pilot whales and 25 bottlenose dolphins stranded on a beach on King Island in Tasmania. On November 29, 2004, 53 long-finned pilot whales stranded at Maria in Tasmania and 55 long-finned pilot whales stranded on the Coramandle Peninsula in New Zealand (WDCS, 2004a). Statements were made in newspapers that strandings are fairly frequent in Tasmania, the Bass Strait, and in New Zealand during that time of year (ECBC, 2004). The Whale and Dolphin Conservation Society (WDCS) of Australia released a statement that Tasmanian researchers reported on research in July 2004 at the Australian Marine Science Association's conference linking a series of whale stranding in southern Australia to climatic cycles (WDCS, 2004b). Some scientists believe that the cyclical winds were pushing sub-Antarctic cold, nutrient-rich waters closer to the surface which may have led the whales and dolphins to strand in November (ECBC, 2004).

MacLeod et al. (2005) investigated whether recent oceanic climate change had been significant enough to alter the local cetacean community off northwest Scotland and what it could mean for the conservation of the cetaceans. Since 1981, there has been an increase in temperature of local waters of 0.2 to 0.4 degrees C per decade. Based on this study, the authors suggest that the warming of local waters has led to changes in the cetacean community, increasing the occurrence of warm-water species, the common dolphin (*Delphinis delphis*), and the addition of new warm-water species, the striped dolphin (*Stenella coeruleoalba*). There has also been a decline in occurrence of a cold-water species, such as the white-beaked dolphin (*Lagenorhynchus albirostris*). This change in the cetacean community has led to a decline of strandings of white-beaked dolphins and an increase in common and striped dolphin strandings (MacLeod et al., 2005).

Strandings potentially related to anthropogenic sound

As stated above, there have been recent stranding events that have been publicly reported and which may, or may not, have been attributed to anthropogenic sound. Several of these are discussed in the following paragraphs. SURTASS LFA sonar has not been implicated in any of these events and, in fact, there is no record of it ever being implicated in any stranding event since LFA prototype systems were first operated in the late 1980s.

In May 1996, 12 or 13 Cuvier's beaked whales stranded on the Greek coast. Seven of the whales were examined, all of them adolescents with fresh food in their stomachs. They were tested for viruses with negative results, but there was no investigation of their inner ears. NATO was conducting Shallow Water Acoustic Classification exercises, using low- and mid-frequency sonar, in the Kyparissiakos Gulf in the area of the strandings. The frequencies of the sources were between 450 and 3,300 Hz. Since the inner ears were not examined, an acoustic link could not be established or eliminated (NATO, 1998).

From 15 to 17 March 2000, 17 cetaceans stranded in the Bahamian islands of Grand Bahama, Abaco, and smaller surrounding islands. Four species were involved, including Cuvier's beaked whales, Blainville's beaked whales, minke whales (*Balaenoptera acutorostrata*), and spotted dolphins (*Stenella ssp.).* Seven animals died and ten animals were returned to the water alive. In November 2005 the Beaked Whale Necropsy Findings for Strandings in the Bahamas, Puerto Rico, and Madeira, 1999-2000 by Darlene R. Ketten, Ph.D. were approved for distribution

(Ketten, 2005). To summarize, the beaked whale heads examined to date were found to have hemorrhaging in the inner ears and some cranial spaces. These pathologies were considered to be consistent with trauma that may have compromised the animal's hearing but was not immediately lethal. There were also hemorrhages and contusions in the jaw fats and mandibles in some of the animals. The damage patterns were consistent with acoustic trauma but a number of other causes are equally possible and cannot be ruled out. Additional analyses would be valuable. (Ketten, 2005).

The Department of Commerce and the Department of the Navy (DOC and DON) published a Joint Interim Report on the Bahamas Marine Mammal Stranding (DOC and DON, 2001). This Report concluded:

> "A combination of specific physical oceanographic features, bathymetry, presence of beaked whales, and specific sound sources were present. Six of the whales and one dolphin (unassociated) died after stranding on beaches. Ten whales returned to the sea alive. The four dead whales from which specimen samples could be collected showed signs of inner ear damage and one showed signs of brain tissue damage. While the precise causal mechanisms of tissue damage are unknown, all evidence points to acoustic or impulse trauma. Review of passive acoustic data ruled out volcanic eruptions, landslides, other seismic events, and explosive blasts, leaving mid-range tactical Navy sonars operating in the area as the most plausible source of the acoustic or impulse trauma. This sound source was active in a complex environment that, as noted above, included the presence of a surface duct, unusual underwater bathymetry, constricted channel with limited egress, intensive use of multiple active sonar units over an extended period of time, and the presence of beaked whales that appear to be sensitive to the frequencies produced by these sonars. The investigation team concludes that the cause of this stranding event was the confluence of the Navy tactical mid-range frequency sonar and the contributory factors noted above acting together." (DOC and DON, 2001)

On September 24, 2002, 14 animals of multiple species of beaked whales stranded in the Canary Islands of Spain. This event coincided with a Spanish-led Navy maneuver in nearby waters. Five animals were found dead, three were found alive, but later died, and six animals were returned to the sea. On September 25, two dead beaked whales appeared, and on September 26, two more dead beaked whales appeared. Specimens from September 24 underwent a necropsy by members of the Veterinary University of Las Palmas as well as the Society for the Study of Cetaceans of the Canaries Archipelago (Martin et al., 2004). Efforts to study the whale specimens from this incident continue and a report has not yet been published.

6.2.3.2 Pinniped Stranding Events

There are many causes for pinniped strandings, such as disease, climatic conditions, injuries and domoic acid[4]. One study focused on the causes of live strandings of California sea lions along

[4] Domoic acid is produced by a neurotoxic phytoplankton by the name of *Pseudo-nitzschia australis*, which occurs naturally in California's waters. When there is a significant algal bloom, which has happened every spring for the

the central California coast from 1991 to 2000 (Greig et al., 2005). Diseases may reflect environmental changes such as pollution, a shift in prey, and global warming. Natural environmental changes, such as storm surges and El Niňo events have been correlated to the number of pinniped strandings. However, detection rate is also dependent upon human effort, better public awareness, and the accessibility to stranded animals. Data collection from strandings are opportunistic and can vary based on season, weather conditions, and the number of people on the beach. According to this study, malnutrition was the most common reason for pinniped strandings (32 percent); followed by leptospirosis (a bacterial disease that affects humans and animals) (27 percent); trauma (e.g., gunshot wounds, entanglement, shark bites, propeller wounds) (18 percent); domoic acid intoxication (9 percent); and cancer (3 percent). In past surveys conducted by The Marine Mammal Center from 1975 to 1990, the major causes of strandings were malnutrition, renal disease, and pneumonia. In the 1991 to 2000 study, the causes of the strandings were determined from clinical experimentations, hematology and serum biochemistry parameters, radiographs, gross necropsy, histopathologic examination of tissues, fecal sedimentation for parasites, bacterial culture, and biotoxin assays. The results of this study showed that the annual number of live California sea lion strandings along the central California coast increased since 1975. Furthermore, a greater number of strandings occurred during the El Niňo events of 1983/1984, 1991/1992, and 1997/1998 (Greig et al., 2005).

6.2.3.3 Conclusion

Although much of the public currently have the impression that military sonar usage is a principal cause of marine mammal strandings, the facts that are available indicate otherwise. In a recently released report entitled "Ad-Hoc Group on the Impact of Sonar on Cetaceans," the International Council for the Exploration of the Sea (ICES, 2005) concluded, "It appears that sonar is not a major current threat to marine mammal populations generally, nor will it ever be likely to form a major part of ocean noise." They went on to state that shipping accounts for more than 75 percent of all human sound in the oceans, that sonar amounts to no more than 10 percent or so and shipping noise is projected to increase, where sonar is not (ICES, 2005). The biological mechanisms for these effects must be determined through scientific research, while recognizing that there is an ongoing issue with public perception of the cause that must be dealt with (Clark, pers. comm., 2006).

The important point here is that there is no record of SURTASS LFA sonar ever being implicated in any stranding event since LFA prototype systems were first operated in the late 1980s. Moreover, the system acoustic characteristics differ between LF and MF sonars: the former use frequencies generally below 1,000 Hz, with relatively long signal wavetrains of 60 seconds or more and consisting of several types of CW and HFM pulses on the order of 10 to 18 seconds long; while the latter use frequencies greater than 1,000 Hz, with relatively short signals (pings) on the order of 1 sec.

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last several years, an abundant amount of the poisonous domoic acid is produced. The toxin then amasses within the bodies of the sardines and anchovies that feed on the poisonous phytoplankton. The acid accumulates as it climbs the food chain into progressively larger animals like the sea lions and dolphins. As the toxin is absorbed into the body, it affects the neural pathways of sea mammals and inhibits the neurochemical processes of those it afflicts.

6.2.4 Multiple Systems Analysis

It should be recognized that this application summarizes the more detailed information in the Draft SEIS (DON, 2005c), which should be considered to be a part of this application and is incorporated by reference. Given that there are no new data that contradict the assumptions or conclusions presented in Subchapter 4.2.7.4 of the FOEIS/EIS relating to the operation of two LFA systems within proximity of each other, its contents are incorporated by reference herein. In summary, simply adding the potential impacts from each of the sources conservatively bounds the effect of multiple systems being employed in proximity. This conclusion includes the assessment of whether two sonars could transmit such that their sound fields would converge, thus creating a sound field of greater intensity. The potential for this occurring is negligible. Even in the unlikely event that multiple systems are transmitted in the same phase (time, depth, vertical steering angle, waveform, wavetrain, pulse length, pulse repetition rate, duty cycle) and in such proximity that the transmitted sound fields were trapped within the same transmission path, the resultant sound field could only be as intense as the addition of both sound fields.

6.3 Evaluation of Alternatives and Relation to This Application

It should be recognized that this application summarizes the more detailed information in the Draft SEIS (DON, 2005c), which should be considered to be a part of this application and is incorporated by reference. NEPA requires federal agencies to prepare an EIS that discusses the environmental effects of a reasonable range of alternatives (including the No Action Alternative). Reasonable alternatives are those that will accomplish the purpose and meet the need of the proposed action, and those that are practical and feasible from a technical and economic standpoint. In the FOEIS/EIS, alternatives included the No Action Alternative, Alternative 1 (employment with geographic restrictions and monitoring mitigation), and Alternative 2 (unrestricted operation). Alternative 1 was the Navy's preferred alternative in the FOEIS/EIS.

The FOEIS/EIS also considered alternatives to LFA, such as other passive acoustic and non-acoustic technologies, as discussed in FOEIS/EIS Subchapters 1.1.2, 1.1.3, and 1.2.1; Table 1-1; and Responses to Comments (RTCs) 1-1.3, 1-2.1, 1-2.2, and 1-2.3. These were also addressed in the NMFS Final Rule and the ROD (67 FR 48152). These alternatives were eliminated from detailed study in the FOEIS/EIS in accordance with CEQ Regulation §1502.14 (a). These acoustic and non-acoustic detection methods included radar, laser, magnetic, infrared, electronic, electric, hydrodynamic, and biological technologies, and high- or mid-frequency sonar. It was concluded in the FOEIS/EIS that these technologies did not meet the purpose and need of the proposed action to provide Naval forces with reliable long-range detection and, thus, did not provide adequate reaction time to counter potential threats. Furthermore, they were not considered to be practical and/or feasible for technical and economic reasons.

Subchapter 4.7 of the Draft SEIS provides descriptions and analyses of the proposed alternatives for the employment of SURTASS LFA sonar, as summarized in Table 6-1. In addition to the No Action Alternative, four alternatives were analyzed to satisfy the Court's findings and to determine the potential effects of changes to the proposed action. These alternatives incorporate coastline standoff restrictions of 22 and 46 km (12 and 25 nm), seasonal variations, additional offshore biologically important areas (OBIAs), and the possibility of employing shutdown procedures for schools of fish. These alternatives include:

- No Action Alternative
- Alternative 1—Same as the FOEIS/EIS Alternative 1;
- Alternative 2—Alternative 1 with additional OBIAs;
- Alternative 3—Alternative 1 with extended coastal standoff distance to 46 km (25 nm); and
- Alternative 4—Alternative 1 with additional OBIAs, extended coastal standoff distance to 46 km (25 nm), and shutdown procedures for fish schools.

Detailed discussions and analyses of these alternatives are provided in the Draft SEIS, Subchapter 4.7, and are incorporated by reference. Alternative 2 was identified as the Navy's preferred alternative.

Table 6-1 SURTASS LFA sonar system alternatives matrix.

Proposed Restrictions/ Monitoring	No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Dive Sites (RL)	145 dB	145 dB	145 dB dB	145 dB dB	145 dB dB
Coastline Restrictions (RL)	NA	<180 dB at 12 nm	<180 dB at 12 nm	<180 dB at 25 nm	<180 dB at 25 nm
Seasonal Variations	NA	Yes	Yes	Yes	Yes
Original OBIAs	NA	Yes	Yes	Yes [1]	Yes[1]
Additional OBIAs	NA	No	Yes	No	Yes
Shutdown procedures for fish schools	NA	No	No	No	Yes
Visual Monitoring	NA	Yes	Yes	Yes	Yes
Passive Acoustic Monitoring	NA	Yes	Yes	Yes	Yes
Active Acoustic Monitoring	NA	Yes	Yes	Yes	Yes
Reporting	NA	Yes	Yes	Yes	Yes

Note 1: Only those OBIAs, or a portion thereof, which are outside of 46 km (25 nm) are analyzed in Alternatives 3 and 4.

6.3.1 Preferred Alternative

Alternative 2 is the Navy's preferred alternative. It is the same as Alternative 1 of the FOEIS/EIS except for additional OBIAs. This alternative proposes employment of SURTASS LFA sonar technology with geographical restrictions to include maintaining sound pressure level below 180 dB RL within 22 km (12 nm) of any coastline and additional OBIAs, including seasonal restrictions as listed in Table 6-2. The bold area numbers in Table 6-2 denote recently added OBIAs. Restrictions for OBIAs are year-round or seasonal, as dictated by marine animal abundances. SURTASS LFA sonar sound fields will not exceed 145 dB RL within known recreational and commercial dive sites. Monitoring mitigation includes visual, passive acoustic, and active acoustic (HF/M3 sonar) to prevent injury to marine animals when employing SURTASS LFA sonar by providing methods to detect these animals within the LFA mitigation zone. Under Alternative 1 of the FOEIS/EIS, the potential impact on any stock of marine mammals from injury was considered to be negligible, and the effect on the stock of any marine mammal from significant change in a biologically important behavior was considered to be minimal. Any momentary behavioral responses and possible indirect impacts to marine mammals due to potential impacts on prey species were considered not to be biologically significant effects. Any auditory masking in mysticetes, odontocetes, or pinnipeds was not expected to be severe and would be temporary. Further, the potential impact on any stock of fish, sharks or sea turtles from injury was also considered to be negligible, and the effect on the stock of any fish, sharks or sea turtles from significant change in a biologically important behavior was considered to be negligible to minimal. Any auditory masking in fish, sharks or sea turtles was expected to be of minimal significance and, if occurring, would be temporary. These potential impacts and effects are also applicable to the Draft SEIS preferred alternative.

6.3.2 Interim Operational Restrictions

Due to concerns with the potential effects of resonance and tissue damage on marine mammals, NMFS included two interim operational restrictions to be part of the LOAs and under the present rule. In order to ensure, to the greatest extent practicable, that marine mammals do not receive an SPL equal to, or greater than 180 dB, NMFS amended the mitigation measures to incorporate two interim operational restrictions during the first five-year Rule (67 FR 46785). The first restriction included a SURTASS LFA sonar system shutdown if marine mammals are detected within a buffer zone that extends 1 km (0.54 nm) from the outer limit of the 180-dB safety zone (SURTASS LFA mitigation zone). This may extend up to 2 km (1.1 nm) from the vessel, depending on oceanographic conditions. At this distance, SPLs will be significantly less intense than 180 dB.

The original LFA rule making process under the MMPA commenced in 1999 and ended when the LFA Rule was promulgated in July 2002. During this period, the potential for LFA, and sonar in general, to cause resonance-related injury in marine mammals above 330 Hz was an open issue. NMFS, therefore, added a second interim operational restriction to the LFA Rule and associated LOAs restricting LFA operations to 330 Hz and below. For the SURTASS LFA sonar systems installed onboard the R/V *Cory Chouest* and USNS IMPECCABLE, this change was feasible. However, the frequency requirements for the Compact LFA (CLFA) to be installed onboard the smaller VICTORIOUS Class (T-AGOS 19 Class) are somewhat higher, but still below 500 Hz.

Table 6-2 Proposed Offshore Biologically Important Areas

Area Number	Name of Area	Location of Area	Months of Importance
1	200 m isobath of North American East Coast[1]	From 28°N to 50°N west of 40°W	Year Round
2	Costa Rica Dome	Centered at 9°N and 88°W	Year Round; no resident stock
3	Antarctic Convergence Zone	30°E to 80°E: 45°S. 80°E to 150°E: 55°S 150°E to 50°W: 60°S 50°W to 30°E: 50°S	October through March
4	Hawaiian Island Humpback Whale NMS—Penguin Bank[2]	Centered at 21°N and 157° 30"W	November 1 through May 1
5	Cordell Bank NMS[2]		Year Round
6	Gulf of the Farallones NMS[2]		Year Round
7	Monterey Bay NMS[2]		Year Round
8	Olympic Coast NMS[2]	Within 23 nm of coast	December, January, March and May
9	Flower Garden Banks (NMS)[2]		Year Round
10	NW Hawaiian Islands Coral Reef Ecosystem Reserve (Proposed NMS)[3]	Within 12 or 25 nm	Year Round

Note:
1. OBIA boundaries encompass Northern Right Whale Critical Habitat, Stellwagen Bank NMS, Monitor NMS, and Gray's Reef NMS.
2. Office of National Marine Sanctuaries, National Ocean Service, NOAA, letter dated 15 May 2001.
3. Presidential EO 13178—Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve.

In April 2002, NMFS sponsored a workshop of over 30 scientists on acoustic resonance as a source of tissue trauma in cetaceans. In November 2002, NMFS provided its "Report of the Workshop on Acoustic Resonance as a Source of Tissue Trauma in Cetaceans" (NOAA/NMFS, 2002). The report concluded that the tissue-lined air spaces most susceptible to resonance are too large in marine mammals to have resonance frequencies in the range used by either mid or low frequency sonar. Cudahy and Ellison (2002) reached the same conclusion. NOAA/NMFS (2002) and Cudahy and Ellison (2002) provide the empirical and documentary evidence that resonance and/or tissue damage from LFA transmissions are unlikely to occur in marine mammals at levels less than 190 dB for the frequency range 330 to 500 Hz. Therefore, the previous interim operational frequency restriction is not required.

Cudahy and Ellison (2002) stated that each of their *in vivo* and theoretical studies relating to tissue damage from underwater sound support a damage threshold on the order of 180 to 190 dB (RL). Despite this, the buffer zone that extends 1 km (0.54 nm) from the outer limit of the 180-dB safety zone will be maintained to ensure that marine animals are detected prior to entering the LFA 180-dB sound field.

6.3.3 Monitoring and Mitigation

Monitoring and mitigation measures proposed for this application are discussed in Chapter 13.0. They are based on the Draft SEIS preferred alternative with the addition of the 1-km buffer zone extending from the outer limit of the 180-dB safety zone. If during the NEPA process, a different alternative is selected, this application will be modified accordingly.

7.0 POTENTIAL IMPACT ON SPECIES OR STOCKS

7.1 Potential Impacts

It should be recognized that this application summarizes the more detailed information in the Draft SEIS (DON, 2005c), which should be considered to be a part of this application and is incorporated by reference. The types of potential impacts on marine mammals from SURTASS LFA sonar operations can be broken down into non-auditory injury, permanent loss of hearing, temporary loss of hearing, behavioral change, and masking. The analyses of these potential impacts were presented in the SURTASS LFA FOEIS/EIS (DON, 2001) with further analyses presented in the latest LOA application (DON, 2005b). Updated literature reviews and research results indicate that there are no new data that contradict the assumptions or conclusions in the FOEIS/EIS. Therefore, the findings regarding the potential impacts on marine mammals remain valid and are incorporated by reference. The findings regarding the potential impact on marine mammal species or stocks are summarized below.

7.1.1 Biological Context

This Subchapter highlights the more detailed information in Subchapter 4.2.7.5 of the FOEIS/EIS (DON, 2001), which is incorporated by reference. In order to understand the significance of the percentages of stock population estimated at risk, it is necessary to determine how this risk might affect an animal's life cycle. In a breeding area, some fraction of the animals at risk might have a reduced probability of breeding during the nominal 40 days of active transmissions in a mission (based on actual LFA missions during the past 3 years, average number of days of active transmissions was less than 5 days per mission). As a hypothetical example, if half of the animals at risk lose about one quarter of their breeding season, this would represent a loss of between 5 percent and 1 percent of their lifetime reproductive potential. The larger fraction would be associated with some of the smaller marine mammals; however, the potential severity of this effect is mitigated at the population level by their larger stock sizes and shorter generation times. Thus, the percentage of the population affected biologically would be a small fraction of the percentage from the overall species or stock risk estimate.

The impact on animals in foraging areas might be comparable to that in breeding areas (as discussed above). Here, the impact would involve reduced foraging efficiency for at most 40 days out of a foraging season of perhaps 90 days (based on actual LFA missions during the past 3 years, average number of days of active transmissions was less than 5 days per mission). Even with a 25 percent reduction in foraging efficiency for all of the 40 days, this would represent only a 10 percent reduction in food intake for that season. In both cases, 40 days of exposure is certainly an overestimate of the duration, because most of the SPE exposure for individuals with high risk values takes place during a small fraction of the SURTASS LFA sonar mission, when the individuals happen to pass close to the ship.

The preceding discussion assumes that animals at risk do not move away from the SURTASS LFA sonar source to lessen its effects. Richardson et al. (1995b) stated that it would be unlikely that any marine mammal would remain for long in areas where there was continuous underwater noise exceeding 140 dB re 1μPa rms. However, no anomalous reduction in sighting rates or acoustic detection were found within the vicinity of the SURTASS LFA sonar source vessel during and after the 1997-98 LFS SRP projects. Thus, avoidance of the >140 dB re 1μPa rms zone of exposure was not as Richardson et al. (1995b) predicted.

Potential Biological Removal (PBR) Level

The MMPA defines PBR as the "maximum number of animals, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." Similarly, the MMPA defines optimum sustainable population as follows: "with respect to any population stock, the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they are a constituent element."

The potential effects on marine mammals from the operation of SURTASS LFA sonar will not cause the direct removal of any animal from marine mammal stocks. Based on the modeling results, the primary effects are disruption of a biologically important behavior. In terms of estimating the overall effect of the risk estimates on PBR, the challenge is in translating this disruption into the equivalent of a removal. In this case, removal is not mortality but the reduction of an individual's reproductive success. This removal equivalent would be a very small fraction of the PBR. For example, given the risk estimates of 14 percent during for a blue whale (mysticete), 6 percent for a pelagic dolphin (odontocete), and 13 percent for an elephant seal (pinniped); and assuming a 1 percent reduction in lifetime reproductive success for the mysticete and 5 percent for the odontocete and pinniped, then the equivalent removal would be on the order of a fraction of a percent of the population (even if the risk were accumulated over 5 years, the equivalent removal would still be less than 1 percent of the population).

Neither the acoustic modeling nor the risk function discussed in the FOEIS/EIS addressed risk beyond injury. At RLs above 180 dB, it was assumed that the risk of injury reached one. Richardson et al. (1995b) suggested that injury (i.e., PTS) seems to occur at 155 dB above hearing thresholds. If the most sensitive marine mammal hearing thresholds range from 40 to 70 dB, this suggested that injury would occur at received levels of 195 to 225 dB. In order for a marine mammal to be exposed to received levels of this magnitude from operation of SURTASS LFA sonar, it would have to be within 100 m (330 ft) of the sound source. The next level of risk is tissue damage, then mortality, which would require even higher exposure levels. The potential for SURTASS LFA sonar to cause these risk levels is negligible.

7.1.2 Potential for Indirect Effects

Pelagic fish are food for many marine mammals. If SURTASS LFA sonar operations occur in proximity to fish stocks, members of some fish species could potentially be affected by LF sounds. Even then, the impact on fish is likely to be minimal to negligible, since only an inconsequential portion of any fish stock would be present within the 180-dB sound field at any given time. Moreover, recent results from direct studies (controlled exposure experiments) of the effects of LFA sounds on fish (Popper et al., in prep.), which are further discussed in the Draft SEIS (DON, 2005c) and APPENDIX D of this document, provide evidence that SURTASS LFA sonar sounds at relatively high levels (up to 193 dB RL) have minimal impact on at least the species of fish that have been studied. Nevertheless, the 180-dB criterion is maintained for the analyses presented in the Draft SEIS, with emphasis that this value is *highly conservative* and protective of fish. Therefore, it is unlikely that prey availability (for mysticetes, odontocetes, and pinnipeds) would be altered for more than a few hours. Given the geographic restrictions and mitigation measures incorporated into all SURTASS LFA sonar employments, and the fact that operations would not occur close to offshore biologically important areas during biologically important seasons for marine mammals (e.g., recognized feeding grounds), the potential for significant indirect effects is negligible.

7.2 Summary of Effects on Stocks Under the Current Rule

In the Annual Reports, the Navy provides a post-operational assessment of any incidental harassments that have occurred within the LFA mitigation and buffer zones and estimates of the percentages of marine mammal stocks possibly harassed incidentally using predictive modeling based on dates/times/location of operations, system characteristics, oceanographic/environmental conditions, and animal demographics. As of May 2005, three annual reports have been submitted to NMFS (DON, 2003a; 2004a; 2005a). Table 7-1 summarizes these operations by LOA.

Tables 7-2 through 7-8 provide post-operational risk estimates for marine mammal stocks as reported in the first three Annual Reports (DON, 2003a; 2004a; 2005a). The durations of each mission were based on actual transmission times, and oceanographic environmental conditions were based on the date/time/location of the actual operations. Animal density and stock/abundance estimates were updated based on current literature reviews of the operational areas. ESA-listed species are shown in bold italics. These analyses demonstrate that the estimated percent risk for exposure of 180 dB or greater received levels (RL) with mitigation was zero and the estimated percent risk for exposure of 120 to 180 dB RL with mitigation was minimal.

Table 7-1 Summary of SURTASS LFA sonar operations.

	Mission Number	Site[1]	Season	Length of Mission (days)	Active Transmission Time (hours)	Mitigation Protocol Suspensions/ delays
LOA 1						
R/V *Cory Chouest*	1	2	Winter	1.6	3.8	0
R/V *Cory Chouest*	2	2	Winter	5.9	14.4	0
R/V *Cory Chouest*	3	2	Spring	0.7	1.6	0
R/V *Cory Chouest*	4	4	Spring	13.2	31.7	0
R/V *Cory Chouest*	5	4	Summer	2.7	6.5	0
R/V *Cory Chouest*	6	4	Summer	1.7	4.1	2
R/V *Cory Chouest*	7	4	Summer	8.4	20.1	1
LOA 2						
R/V *Cory Chouest*	1	3	Fall	7.3	17.4	
R/V *Cory Chouest*	2	3	Winter	17.0	40.7	2
R/V *Cory Chouest*	3	3	Winter	4.9	11.7	1
R/V *Cory Chouest*	4	3	Spring	3.6	8.7	2
R/V *Cory Chouest*	5	3	Spring	13.4	32.2	2
USNS IMPECCABLE	1	2	Spring	8.2	19.7	1
USNS IMPECCABLE	2	1	Spring	3.5	8.4	2
USNS IMPECCABLE	3	1	Spring	9.0	21.5	2
USNS IMPECCABLE	4	2	Summer	3.1	7.4	0
USNS IMPECCABLE	5	3	Summer	2.5	6.0	0
LOA No. 3						
R/V *Cory Chouest*	1	4	Summer	0.8	1.8	0
R/V *Cory Chouest*	2	4	Summer	8.9	21.5	11
R/V *Cory Chouest*	3	7	Summer	3.4	8.1	1
USNS IMPECCABLE	1	2	Winter	7.5	18.1	0
USNS IMPECCABLE	2	2	Winter	1.9	4.6	1

[1]See Figure 7-1

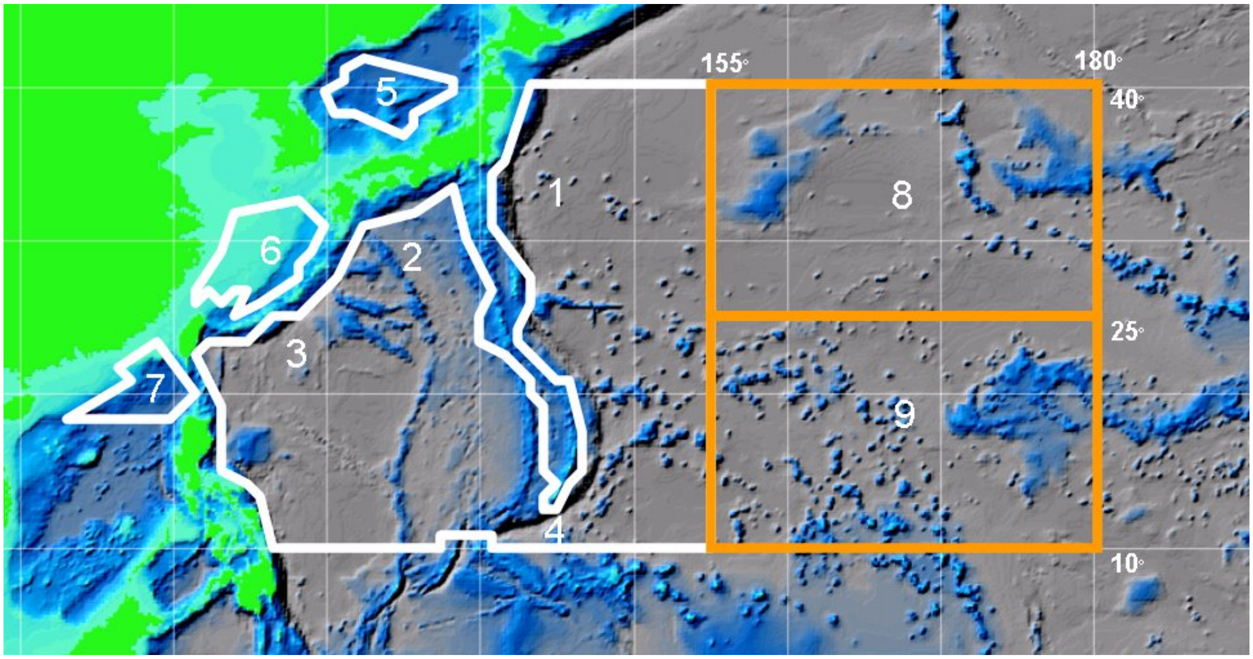

Figure 7-1 SURTASS LFA Sonar Western Pacific Operational Areas

Table 7-2. ANNUAL REPORT 1: Post-operational estimates of marine mammal stocks potentially affected for Site 2.

North Philippine Sea (1 Mission)					
Site 2	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Risk (w/mit) 120-180 dB**	**% Risk (w/mit) ≥ 180 dB**
	Minke whale	1080	25000	0.12	0.00
	Bryde's whale	180	22000	0.03	0.00
	Sperm whale	300	102112	0.01	0.00
	Kogia	30	3000	0.03	0.00
	Ginko-toothed beaked whale	240	10000	0.07	0.00
	Hubb's beaked whale	0	10000	0.00	0.00
	Cuvier's beaked whale	360	10000	0.10	0.00
	Blainvill'e beaked whale	240	10000	0.07	0.00
	Killer whale	30	8500	0.01	0.00
	Pygmy killer whale	30	15000	0.01	0.00
	False killer whale	870	16668	0.16	0.00
	Short-finned pilot whale	4590	53608	0.26	0.00
	Bottlenose dolphin	4380	168791	0.10	0.00
	Risso's dolphin	3180	83289	0.14	0.00
	Pantropical dolphin	4110	438064	0.03	0.00
	Striped dolphin	9870	570038	0.06	0.00

Table 7-3. ANNUAL REPORT 2: Post-operational estimates of marine mammal stocks potentially affected for Site 2.

North Philippine Sea (2 Missions)					
Site 2	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Risk (w/mit) 120-180 dB**	**% Risk (w/mit) ≥ 180 dB**
	Minke whale	1080	25000	0.27	0.00
	Bryde's whale	180	22000	0.05	0.00
	Sperm whale	300	102112	0.02	0.00
	Kogia	930	166553	0.03	0.00
	Ginkgo-toothed beaked whale	240	10000	0.15	0.00
	Blainville's beaked whale	240	10000	0.15	0.00
	Cuvier's beaked whale	360	10000	0.22	0.00
	Killer whale	120	12256	0.07	0.00
	Pygmy killer whale	630	30214	0.14	0.00
	False killer whale	870	16668	0.34	0.00
	Short-finned pilot whale	4590	53608	0.56	0.00
	Bottlenosed dolphin	4380	168791	0.20	0.00
	Risso's dolphin	3180	83289	0.30	0.00
	Pantropical spotted dolphin	4110	438064	0.07	0.00
	Striped dolphin	9870	570038	0.12	0.00

Table 7-4. ANNUAL REPORT 2: Post-operational estimates of marine mammal stocks potentially affected for Site 3

West Philippine Sea (1 Mission)					
Site 3	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Risk (w/mit) 120-180 dB**	**% Risk (w/mit) ≥ 180 dB**
	Fin whale	60	9250	0.06	0.00
	Bryde's whale	180	22000	0.08	0.00
	Minke whale	540	25000	0.20	0.00
	Humpback whale (winter only)	0	394	0.00	0.00
	Sperm whale	300	102112	0.02	0.00
	Kogia	510	166553	0.02	0.00
	Ginkgo-toothed beaked whale	240	10000	0.15	0.00
	Cuvier's beaked whale	360	10000	0.29	0.00
	Blainville's beaked whale	240	10000	0.19	0.00
	False killer whale	870	16668	0.49	0.00
	Pygmy killer whale	630	30214	0.20	0.00
	Melon-headed whale	630	36770	0.16	0.00
	Short-finned pilot whale	2280	53608	0.40	0.00
	Spinner dolphin	2070	219032	0.10	0.00
	Fraser's dolphin	4110	219032	0.19	0.00
	Common dolphin	3180	83289	0.40	0.00
	Bottlenose dolphin	4380	168791	0.29	0.00
	Pantropical spotted dolphin	4110	438064	0.24	0.00
	Rough-toothed dolphin	510	145900	0.04	0.00
	Striped dolphin	4920	570038	0.09	0.00
	Risso's dolphin	3180	83289	0.42	0.00
	Pacific white-sided dolphin	3180	83289	0.40	0.00

Table 7-5. ANNUAL REPORT 2: Post-operational estimates of marine mammal stocks potentially affected for Site 4.

Guam (4 Missions)					
Site 4	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Risk (w/mit) 120-180 dB**	**% Risk (w/mit) ≥ 180 dB**
	Blue whale	*60*	*4048*	*0.25*	*0.00*
	Fin whale	60	1898	0.56	0.00
	Bryde's whale	270	5765	0.88	0.00
	Humpback whale (winter only)	0	4005	0.00	0.00
	Minke whale	60	25000	0.05	0.00
	Sperm whale	300	39200	0.12	0.00
	Cuvier's beaked whale	360	90725	0.06	0.00
	Blainville's beaked whale	240	8032	0.47	0.00
	Kogia	510	166553	0.05	0.00
	Spinner dolphin	13290	1015059	0.36	0.00
	Spotted dolphin	12210	2195353	0.16	0.00
	Striped dolphin	480	1820958	0.01	0.00
	Bottlenose dolphin	3090	299434	0.31	0.00
	Rough-toothed dolphin	510	145729	0.10	0.00
	Risso's dolphin	210	258084	0.02	0.00
	False killer whale	510	35132	0.34	0.00
	Melon-headed whale	630	36770	0.40	0.00
	Short-finned pilot whale	7110	89334	1.85	0.00

Table 7-6. ANNUAL REPORT 3: Post-operational estimates of marine mammal stocks potentially affected for Site 1.

East of Japan 2 Missions					
Site 1	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Affected 120-180 dB**	**% Affected (w/mit) ≥ 180 dB**
	Blue whale	60	9250	0.14	0.00
	Fin whale	60	9250	0.14	0.00
	Sei whale	180	37000	0.10	0.00
	Bryde's whale	180	22000	0.17	0.00
	Minke whale	1080	25000	0.94	0.00
	N. Pacific right whale	3	922	0.07	0.00
	Sperm whale	300	102112	0.05	0.00
	Kogia	930	350553	0.05	0.00
	Ginkgo-toothed beaked whale	150	22799	0.13	0.00
	Cuvier's beaked whale	1620	90725	0.35	0.00
	Baird's beaked whale	87	8000	0.14	0.00
	Hubbs' beaked whale	150	22799	0.13	0.00
	False killer whale	1080	16668	1.58	0.00
	Pygmy killer whale	630	30214	0.51	0.00
	Melon-headed whale	60	15000	0.19	0.00
	Short-finned pilot whale	3840	53608	1.67	0.00
	Spinner dolphin	150	1015059	0.00	0.00
	Fraser's dolphin	1200	220789	0.15	0.00
	Common dolphin	22830	3286163	0.19	0.00
	Bottlenose dolphin	5130	168791	0.86	0.00
	Pantropical spotted dolphin	7770	438064	0.48	0.00
	Rough-toothed dolphin	1770	145729	0.33	0.00
	Striped dolphin	3330	570038	0.15	0.00
	Risso's dolphin	2910	83289	0.99	0.00
	Pacific white-sided dolphin	2460	67769	0.99	0.00

Table 7-7. ANNUAL REPORT 3: Post-operational estimates of marine mammal stocks potentially affected for Site 2.

North Philippine Sea 2 Missions					
Site 2	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Affected 120-180 dB**	**% Affected (w/mit) ≥ 180 dB**
	Minke whale	1080	25000	0.70	0.00
	Bryde's whale	180	22000	0.14	0.00
	N. Pacific right whale	3	922	0.05	0.00
	Sperm whale	300	102112	0.04	0.00
	Kogia	930	166553	0.07	0.00
	Ginkgo-toothed beaked whale	150	22799	0.11	0.00
	Blainville's beaked whale	150	8032	0.30	0.00
	Cuvier's beaked whale	1620	90725	0.29	0.00
	Killer whale	120	12256	0.17	0.00
	Pygmy killer whale	630	30241	0.37	0.00
	False killer whale	870	16668	0.92	0.00
	Short-finned pilot whale	4590	53608	1.50	0.00
	Bottlenose dolphin	4380	168791	0.55	0.00
	Risso's dolphin	3180	83289	0.80	0.00
	Pantropical spotted dolphin	4110	438064	0.18	0.00
	Striped dolphin	9870	570038	0.33	0.00
	Melon-headed	360	36770	0.17	0.00
	Common dolphin	16860	3286163	0.10	0.00
	Spinner dolphin	150	1015059	0.00	0.00
	Rough-toothed dolphin	1770	145729	0.23	0.00
	Fraser’s dolphin	1200	220789	0.10	0.00
	Pacific white-sided dolphin	3570	67769	0.99	0.00

Table 7-8. ANNUAL REPORT 3: Post-operational estimates of marine mammal stocks potentially affected for Site 3.

West Philippine Sea 5 Missions					
Site 3	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Affected 120-180 dB**	**% Affected (w/mit) ≥ 180 dB**
	Fin whale	60	9250	0.53	0.00
	Bryde's whale	180	22000	0.67	0.00
	Minke whale	540	25000	1.75	0.00
	Humpback whale (winter only)	0	394	3.27	0.00
	Sperm whale	300	102112	0.19	0.00
	Kogia	510	350553	0.09	0.00
	Ginkgo-toothed beaked whale	150	22799	0.44	0.00
	Cuvier's beaked whale	90	90725	0.07	0.00
	Blainville's beaked whale	150	8032	1.27	0.00
	False killer whale	870	16668	4.22	0.00
	Pygmy killer whale	630	30241	1.69	0.00
	Melon-headed whale	4290	36770	9.46	0.00
	Short-finned pilot whale	2280	53608	3.46	0.00
	Spinner dolphin	150	1015059	0.01	0.00
	Fraser's dolphin	1200	220789	0.49	0.00
	Common dolphin	16860	3286163	0.46	0.00
	Bottlenose dolphin	4380	168791	2.45	0.00
	Pantropical spotted dolphin	4110	438064	0.84	0.00
	Rough-toothed dolphin	1770	145729	1.10	0.00
	Striped dolphin	4920	570038	0.77	0.00
	Risso's dolphin	3180	83289	3.60	0.00
	Pacific white-sided dolphin	7350	100757	9.72	0.00

7.3 Summary and Conclusions

The determinations for whether the SURTASS LFA sonar could be safely employed was that any potential for MMPA Level A harassment (injury) to marine mammals had to be negligible, and there would be negligible marine mammal population consequences from any Level B harassment caused by SURTASS LFA sonar operations. The SURTASS LFA FOEIS/EIS (DON, 2001) concluded that the potential effects from SURTASS LFA sonar operations on any stock of marine mammals from injury (non-auditory or permanent loss of hearing) are considered negligible, and the potential effects on the stock of any marine mammal from temporary loss of hearing or behavioral change (significant change in a biologically important behavior) are considered minimal. The data provided in Tables 7-2 through 7-8 are consistent with the above determinations and the conclusions of the FOEIS/EIS (DON, 2001).

The risk of Level B harassment by LF sound requires that 1) the sound be within the hearing range of the animal, 2) the animal must incur a prolonged reaction to the LF sound, and 3) the effects must involve a significant behavioral change in a biologically important activity. Congress codified this latter criterion via the National Defense Authorization Act (NDAA) for Fiscal Year 2004 (NDAA FY04), which was signed into law on 24 November 2003. More recently, the National Research Council of the National Academy of Sciences (NRC, 2005) published the finding, "As opposed to the definition of biologically significant activities, whose disruption can constitute harassment, the crucial determination is of when behavioral or physiological responses result in deleterious effects on the individual animals and population." The FOEIS/EIS (DON, 2001) and Draft SEIS (DON, 2005c) echo this finding.

The post-operational incidental harassment assessments in Tables 7-2 through 7-8 demonstrate that there were no marine mammal exposures to received levels at or above 180 dB re 1 μPa rms. These results are supported by the results from the visual, passive acoustic and active acoustic monitoring efforts, which are discussed in Chapter 13.0. In addition, a review of recent stranding data from the National Science Museum of Tokyo, Japan and Internet sources did not indicate any stranding events associated with the times and locations of SURTASS LFA sonar operations.

The original Request for Letter of Authorization for the Incidental Take of Marine Mammals Associated with the Employment of SURTASS LFA Sonar (DON, 1999) provided details on estimating the potential risk to marine mammals from SURTASS LFA sonar operations, including: 1) marine mammal screening; 2) acoustic model scenarios; 3) use of the parabolic equation (PE) transmission loss model, and the acoustic integration model (AIM); 4) definition of biological risk and determination of risk function; 5) effects of repeated exposure; 6) risk continuum analysis; and 7) sample model run, including PE and AIM input parameters and data, and processing AIM results using the risk continuum. Those calculations and analyses remain valid and are incorporated by reference.

Conclusions

Under the present LOAs, LFA sonar has had a negligible impact on species and stocks of marine mammals and no impact on availability of stocks for subsistence use. The statement of purpose and need from the FOEIS/EIS (DON, 2001) remains valid and may be even more compelling now, as discussed in Subchapter 1.2 of this application. With the Cold War ending more than a decade ago, the Navy is now faced with growing numbers of quiet diesel submarines, particularly in Asia's key waterways. Thus, the operational tempo for the SURTASS LFA sonar platforms (up to four) could be expected to increase to counter these potential threats during the five-year period of new LOAs. It can also be expected that these operations may be concentrated in the areas of highest threat, specifically the northwestern Pacific Ocean.

8.0 POTENTIAL IMPACT ON AVAILABILITY OF SPECIES OR STOCKS FOR SUBSISTENCE USES

There is no anticipated impact on subsistence use of marine mammals. Polar regions are excluded because of the inherent inclement weather conditions, including the danger of icebergs and, therefore, subsistence hunting in Polar Regions will not be affected.

Based on extensive evaluation in both the Draft SEIS and the FOEIS/EIS, the operation of SURTASS LFA sonar with monitoring and mitigation will result in no lethal takes. This is supported by the fact that SURTASS LFA sonar has been operating since 2003 in the northwestern Pacific Ocean with no reported Level A (MMPA) harassment takes or strandings associated with its operations. Moreover, there has been no new information or data that contradict the FOEIS/EIS finding that the potential effect from SURTASS LFA sonar operations on any stock of marine mammals from injury (non-auditory or permanent loss of hearing) is considered negligible.

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9.0 POTENTIAL IMPACT ON THE HABITAT OF MARINE MAMMAL POPULATIONS

The proposed SURTASS LFA sonar operations may have disturbance effects on marine mammals but would not affect their habitat. ESA designated critical habits and National Marine Sanctuaries (NMSs) were reviewed for potential impacts from SURTASS LFA sonar operations. Where applicable, these areas are designated as offshore biologically important areas (OBIAs) and LFA transmission were restricted.

9.1 Critical Habitats

ESA designated critical habitats were reviewed with the determination that they were not likely to be destroyed or adversely modified by the operation of the SURTASS LFA sonar. There are four listed species (north Atlantic right whale, north Pacific right whale, Hawaiian monk seal, and northern (Steller) sea lion) that have designated critical habitats with the potential of interaction with SURTASS LFA sonar operations (DON, 2005c).

North Atlantic and north Pacific right whales

Critical habitats for the north Atlantic and north Pacific right whales are considered to be biologically important areas; no sound transmissions would exceed 180 dB within these areas year round. Critical habitat is designated for the right whales in five locations: 1) coastal Florida and Georgia; 2) the Great South Channel, east of Cape Cod; 3) Cape Cod and Massachusetts bays; 4) Bay of Fundy; and 5) Browns and Baccaro Banks, south of Nova Scotia. Offshore Biologically Important Area (OBIA) Number 1 (Table 6-2) is defined by the 200-m isobath of the North American East Coast. The OBIA boundaries encompass the right whale critical habitats. SURTASS LFA sonar sound fields are restricted to no greater than 180 dB RL year round in this large OBIA.

Hawaiian monk seal

The critical habitats for the Hawaiian monk seal are located within geographically restricted areas of SURTASS LFA sonar sound fields no greater than 180 dB RL within 12 nm (22 km) of any coast. Additional protection is provided by the proposed addition of the NW Hawaiian Islands Coral Reef Ecosystem Reserve (Proposed NMS) as an OBIA. General boundary is 50 nm from the centerline of the island chain, which are within the potential operating area of SURTASS LFA sonar.

Northern sea lion

More than 100 northern (Steller) sea lion rookeries and haulout sites have been identified. Critical habitats have been established to protect the northern (Steller) sea lion's rookeries, haulouts, and foraging areas in the Bering Sea, Gulf of Alaska, and the California and Oregon Coast (50 CFR 226.12). The critical habitats in the Bering Sea would not be affected by SURTASS LFA sonar because the system would not be operated in that area. The three designated foraging areas (Shelikof Strait area, Bogoslof area in the Bering Sea, and Seguam Pass area) would not be affected by SURTASS LFA sonar transmissions because they are either within the limitations of the geographic restrictions and/or in the Bering Sea. Those designated areas in the Gulf of Alaska east of 144°W longitude and on the California and Oregon Coasts have aquatic zones that extend 3,000 ft (0.9 km) seaward in State and Federal managed waters from the baseline or basepoint of each major rookery and/or haulout. These areas are inside of the geographic restrictions on operation of the LFA system and, therefore, would not be affected by SURTASS LFA sonar transmissions. Those designated areas in the Gulf of Alaska and the North Pacific Ocean west of 144°W longitude have aquatic zones that extend 20 nm (37 km) seaward in State and Federally managed waters from the baseline or basepoint of each major rookery and/or haulout. This includes most of the Aleutian Islands from Attu Island in the west to Cape St. Elias in the Gulf of Alaska. These areas are within the potential operating area of SURTASS LFA sonar. However, the operation of SURTASS LFA sonar would not be expected to affect or alter the critical habitat and would not be expected to affect prey species.

9.2 National Marine Sanctuaries

National Marine Sanctuaries are protected under the Marine Protection, Research and Sanctuaries Act of 1972. National Marine Sanctuaries are designated based on their national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or aesthetic qualities. Certain of these areas are biologically important to marine mammals and sea turtles. Because the majority of the NMSs exist within the coastal exclusion zone, SURTASS LFA sonar sound fields would be below 180 dB RL. Portions of the Hawaiian Islands Humpback Whale NMS (Penguin Bank), Cordell Bank NMS, Gulf of the Farallones NMS, Monterey Bay NMS, Olympic Coast NMS, and Flower Garden Bank NMS extend beyond the coastal exclusion zones and have been proposed in the Draft SEIS as additional OBIAs (See Table 6-2). .

9.3 Summary

Operation of SURTASS LFA sonar with the proposed mitigation measures will generally be restricted in habitats critical to marine mammals. In the few instances where these habitats have the potential to overlap LFA operations, the Navy will address these issues with NMFS in its annual LOA applications. Operations to date have produced no indications of any effects from SURTASS LFA sonar to the habitat of marine mammals in the Northwestern Pacific Ocean.

10.0 POTENTIAL IMPACT OF LOSS OR MODIFICATION OF HABITAT ON MARINE MAMMAL POPULATIONS

The proposed SURTASS LFA sonar operations may have disturbance effects on marine mammals but is not expected to cause the loss or modification of habitat, to include causing habitat abandonment.

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11.0 AVAILABILITY AND FEASIBILITY OF EQUIPMENT, METHODS, AND MANNER OF CONDUCTING THE ACTIVITY OR OTHER MEANS OF EFFECTING THE LEAST PRACTICABLE ADVERSE IMPACT ON AFFECTED SPECIES OR STOCKS, THEIR HABITAT, AND ON THEIR AVAILABILITY FOR SUBSISTENCE USES

Mitigation, as defined by the Council on Environmental Quality (CEQ), includes measures to minimize impacts by limiting the degree or magnitude of a proposed action and its implementation. The preferred alternative was presented in Chapter 2 and analyzed in Chapter 4 of the Draft SEIS for the employment of SURTASS LFA sonar. This alternative meets the Navy's purpose and need, and reduces potential impacts through the mitigation measures discussed in this chapter. The mitigation measures presented for SURTASS LFA sonar are similar to those in the FOEIS/EIS and authorized in the Record of Decision (ROD) (67 FR 48145). The primary difference is additional offshore biologically important areas. It should be recognized that this application summarizes the more detailed information in the Draft SEIS (DON, 2005c), which should be considered to be a part of this application and is incorporated by reference. The monitoring and mitigation measures presented in this subchapter are based on the Draft SEIS preferred alternative. If during the NEPA process, a different alternative is selected, this application will be modified accordingly.

The objective of these mitigation measures is to avoid risk of injury to marine mammals, sea turtles, and human divers. This objective is met by:

- Ensuring that coastal waters within 22 km (12 nm) are not exposed to SURTASS LFA sonar signal levels $\geq$ 180 dB RL;
- Ensuring that no offshore biologically important areas are exposed to SURTASS LFA sonar signal levels $\geq$ 180 dB RL during critical seasons;
- Minimizing exposure of marine mammals and sea turtles to SURTASS LFA sonar signal levels below 180 dB RL by monitoring for their presence and suspending transmissions when one of these organisms enters this zone; and
- Ensuring that no known recreational or commercial dive sites are subjected to LF sound pressure levels greater than 145 dB RL.

Information on monitoring and mitigation measures is further described in Chapter 5 of the Draft SEIS (DON, 2005c) and Chapter 13.0 of this application. Strict adherence to these measures will ensure that there will be no significant impact on marine mammal stocks, sea turtle stocks, and recreational or commercial divers.

There is no anticipated impact from SURTASS LFA sonar operations on subsistence use of marine mammals as discussed in Chapter 8.0 of this application.

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12.0 PLAN OF COOPERATION OR INFORMATION IDENTIFYING MEASURES TAKEN TO MINIMIZE ANY ADVERSE EFFECTS ON AVAILABILITY OF MARINE MAMMALS FOR SUBSISTENCE USES

Because there is no anticipated impact from SURTASS LFA sonar operations on subsistence use of marine mammals, plans for coordination and identification of information are not applicable.

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13.0 MONITORING AND MITIGATION

Mitigation, as defined by the Council on Environmental Quality (CEQ), includes measures to minimize impacts by limiting the degree or magnitude of a proposed action and its implementation. The preferred alternative was presented in Chapter 2 and analyzed in Chapter 4 of the Draft SEIS for the employment of SURTASS LFA sonar. This alternative meets the Navy's purpose and need, and reduces potential impacts through the mitigation measures discussed in this chapter. The mitigation measures presented for SURTASS LFA sonar are similar to those in the FOEIS/EIS and authorized in the Record of Decision (ROD) (67 FR 48145). The primary difference is additional offshore biologically important areas. It should be recognized that this application summarizes the more detailed information in the Draft SEIS (DON, 2005c), which should be considered to be a part of this application and is incorporated by reference. The monitoring and mitigation measures presented in this chapter are based on the Draft SEIS preferred alternative. If during the NEPA process, a different alternative is selected, this application will be modified accordingly.

The objective of these mitigation measures is to avoid risk of injury to marine mammals, sea turtles, and human divers. This objective is met by:

- Ensuring that coastal waters within 22 km (12 nm) of shore (depending on the determination made in the ROD) are not exposed to SURTASS LFA sonar signal levels ≥ 180 dB RL;
- Ensuring that no offshore biologically important areas are exposed to SURTASS LFA sonar signal levels ≥ 180 dB RL during critical seasons;
- Minimizing exposure of marine mammals and sea turtles to SURTASS LFA sonar signal levels below 180 dB RL by monitoring for their presence and suspending transmissions when one of these organisms approached the SURTASS LFA mitigation (safety) and buffer zones; and
- Ensuring that no known recreational or commercial dive sites are subjected to LF sound pressure levels greater than 145 dB RL.

Strict adherence to these measures will ensure that there will be no significant impact on marine mammal stocks, sea turtle stocks, and recreational or commercial divers.

Table 13-1 is a summary of the proposed mitigation, the criteria for each, and the actions required.

Table 13-1 Summary of Mitigation

Mitigation	Criteria	Actions
Geographic Restrictions		
22 km (12 nm) from coastline and offshore biologically important areas during biologically important seasons outside of 22 km (12 nm)	Sound field below 180 dB RL, based on SPL modeling.	Delay/suspend SURTASS LFA sonar operations.
Recreational and commercial dive sites (known)	Sound field not to exceed 145 dB RL, based on SPL modeling.	Delay/suspend SURTASS LFA sonar operations.
Monitoring to Prevent Injury to Marine Mammals and Sea Turtles		
Visual Monitoring	Potentially affected species near the vessel but outside of the LFA mitigation and buffer zones.	Notify OIC.
	Potentially affected species sighted within the LFA mitigation and buffer zones.	Delay/suspend SURTASS LFA sonar operations.
Passive Acoustic Monitoring	Potentially affected species detected.	Notify OIC.
Active Acoustic Monitoring	Contact detected and determined to have a track that would pass within the LFA mitigation and buffer zones.	Notify OIC.
	Potentially affected species detected inside of the LFA mitigation and buffer zones.	Delay/suspend SURTASS LFA sonar operations.

13.1 Geographic Restrictions

The following geographic restrictions apply to the employment of SURTASS LFA sonar:

- SURTASS LFA sonar-generated sound field will be below 180 dB RL within 22 km (12 nm) of any coastlines and in offshore areas outside this zone that have been determined by NMFS and the Navy to be biologically important;
- When in the vicinity of known recreational or commercial dive sites, SURTASS LFA sonar will be operated such that the sound fields at those sites will not exceed 145 dB RL; and
- SURTASS LFA sonar operators will estimate sound pressure levels (SPL) prior to and during operations to provide the information necessary to modify operations, including the delay or suspension of transmissions, in order not to exceed the 180-dB and 145-dB RL sound field criteria cited previously.

13.1.1 Offshore Biologically Important Areas

There are certain areas of the world's oceans that are biologically important to marine mammals and sea turtles as determined in the ROD. Because the majority of these areas exist within the coastal zone, SURTASS LFA sonar operations will be conducted such that the sound field is below 180 dB RL within 22 km (12 nm) of any coastline and in any designated offshore biologically important areas that are outside these zones during the biologically important season for that particular area. The 22 km (12 nm) restriction, depending on the determination made in the ROD, includes many marine-related critical habitats and sanctuaries (e.g., Hawaiian Islands Humpback Whale National Marine Sanctuary). The SURTASS LFA sonar sound field will be estimated in accordance with the guidelines below. The list of proposed OBIAs can be found in Table 6-2 of this application.

13.1.2 Recreational and Commercial Dive Sites

SURTASS LFA sonar operations are constrained in the vicinity of known recreational and commercial dive sites to ensure that the sound field at such sites does not exceed 145 dB RL. Recreational dive sites are generally defined as coastal areas from the shoreline out to the 40-m (130-ft) depth contour, which are frequented by recreational divers; but it is recognized that there are other sites that may be outside this boundary.

13.1.3 Sound Field Modeling

SURTASS LFA sonar operators will estimate SPL prior to and during operations to provide the information necessary to modify operations, including the delay or suspension of transmissions, in order not to exceed the 180-dB and 145-dB RL sound field criteria cited above. Sound field limits are estimated using near-real-time environmental data and underwater acoustic performance prediction models. These models are an integral part of the SURTASS LFA sonar processing system. The acoustic models help determine the sound field by predicting the SPLs, or RLs, at various distances from the SURTASS LFA sonar source location. Acoustic model updates are nominally made every 12 hours, or more frequently when meteorological or oceanographic conditions change.

If the sound field criteria listed above were exceeded, the sonar operator would notify the Officer in Charge (OIC), who would order the delay or suspension of transmissions. If it were predicted that the SPLs would exceed the criteria within the next 12 hours, the OIC would also be notified in order to take the necessary action to ensure that the sound field criteria would not be exceeded.

13.2 Monitoring to Prevent Injury to Marine Animals

The following monitoring to prevent injury to marine animals is required when employing SURTASS LFA sonar:

- **Visual monitoring** for marine mammals and sea turtles from the vessel during daylight hours by personnel trained to detect and identify marine mammals and sea turtles;

- **Passive acoustic monitoring** using the passive (low frequency) SURTASS array to listen for sounds generated by marine mammals as an indicator of their presence; and
- **Active acoustic monitoring** using the High Frequency Marine Mammal Monitoring (HF/M3) sonar, which is a Navy-developed, enhanced HF commercial sonar, to detect, locate, and track marine mammals and, to some extent, sea turtles, that may pass close enough to the SURTASS LFA sonar's transmit array to enter the LFA mitigation and buffer zones.

13.2.1 Visual Monitoring

Visual monitoring includes daytime observations for marine mammals and sea turtles from the vessel. Daytime is defined as 30 min before sunrise until 30 min after sunset. Visual monitoring begins 30 min before sunrise or 30 min before the SURTASS LFA sonar is deployed. Monitoring continues until 30 min after sunset or until the SURTASS LFA sonar is recovered. Observations are made by personnel trained in detecting and identifying marine mammals and sea turtles. Marine mammal biologists qualified in conducting at-sea marine mammal visual monitoring from surface vessels train and qualify designated ship personnel to conduct at-sea visual monitoring. The objective of these observations is to maintain a track of marine mammals and/or sea turtles observed and to ensure that none approach the source close enough to enter the LFA mitigation zone.

These personnel maintain a topside watch and marine mammal/sea turtle observation log during operations that employ SURTASS LFA sonar in the active mode. The numbers and identification of marine mammals/sea turtles sighted, as well as any unusual behavior, is entered into the log. A designated ship's officer monitors the conduct of the visual watches and periodically reviews the log entries. There are two potential visual monitoring scenarios.

First, if a potentially affected marine mammal or sea turtle is sighted outside of the LFA mitigation zone, the observer notifies the OIC. The OIC then notifies the HF/M3 sonar operator to determine the range and projected track of the animal. If it is determined that the animal will pass within the LFA mitigation zone, the OIC orders the delay or suspension of SURTASS LFA sonar transmissions when the animal enters the LFA mitigation zone. If the animal is visually observed within 1-km buffer zone outside of the LFA mitigation zone, the OIC orders the immediate delay or suspension of SURTASS LFA sonar transmissions. The observer continues visual monitoring/recording until the animal is no longer seen.

Second, if the potentially affected animal is sighted anywhere within the LFA mitigation or buffer zones, the observer notifies the OIC who orders the immediate delay or suspension of SURTASS LFA sonar transmissions.

All sightings are recorded in the log and provided as part of the Long Term Monitoring (LTM) Program as discussed in FOEIS/EIS Subchapter 2.4.2 to monitor for potential long-term environmental effects.

13.2.2 Passive Acoustic Monitoring

Passive acoustic monitoring is conducted when SURTASS is deployed, using the SURTASS towed horizontal line array (HLA) to listen for vocalizing marine mammals as an indicator of their presence. If the sound is estimated to be from a marine mammal that may be potentially affected by SURTASS LFA sonar, the technician notifies the OIC who alerts the HF/M3 sonar operator and visual observers. If prior to or during transmissions, the OIC then orders the delay or suspension of SURTASS LFA sonar transmissions when the animal enters the LFA mitigation and buffer zones.

All contacts are recorded in the log and provided as part of the LTM Program to monitor for potential long-term environmental effects.

13.2.3 Active Acoustic Monitoring

HF active acoustic monitoring uses the HF/M3 sonar to detect, locate, and track marine mammals (and possibly sea turtles) that could pass close enough to the SURTASS LFA sonar array to enter the LFA mitigation zone. HF acoustic monitoring begins 30 min before the first SURTASS LFA sonar transmission of a given mission is scheduled to commence and continues until transmissions are terminated. Prior to full-power operations, the HF/M3 sonar power level is ramped up over a period of 5 min from 180 dB SL in 10-dB increments until full power (if required) is attained to ensure that there are no inadvertent exposures of local animals to RLs ≥ 180 dB from the HF/M3 sonar. There are two potential scenarios for mitigation via active acoustic monitoring.

First, if a contact is detected outside the LFA mitigation and buffer zones, the HF/M3 sonar operator determines the range and projected track of the animal. If it is determined that the animal will pass within the LFA mitigation and buffer zones, the sonar operator notifies the OIC. The OIC then orders the delay or suspension of transmissions when the animal is predicted to enter the LFA mitigation and buffer zones.

Second, if a contact is detected by the HF/M3 sonar within the LFA mitigation or buffer zones, the observer notifies the OIC who orders the immediate delay or suspension of transmissions.

All contacts are recorded in the log and provided as part of the LTM Program.

13.2.4 Resumption of SURTASS LFA Sonar Transmissions

SURTASS LFA sonar transmissions can commence/resume 15 minutes after there is no further detection by the HF/M3 sonar and there is no further visual observation of the animal within the LFA mitigation and buffer zones.

13.3 Mitigation Effectiveness

Under LOA Condition 8(b)(i), the following assessment of the effectiveness of the mitigation measures is provided based on the first three annual reports.

13.3.1 LFA Mitigation and Buffer Zones

During the missions reported in the first three annual reports, the radial distance to the safety zone from the LFA array was 1 km (0.54 nm). Therefore, the safety and buffer zones comprised a 2-km (1.08-nm) radius.

13.3.2 Visual Monitoring

Visual observers, trained in marine mammal identification, were posted as specified in LOA Condition 7(a)(i) and CNO executive directives. Prior to the commencement of SURTASS LFA operations, the personnel responsible for marine animal visual monitoring were formally trained in the proper methods, procedures, and protocols required to detect and to identify marine animals.

During the seventeen missions reported in the three annual reports, there were no sightings of marine mammals during the periods of LFA transmissions.

13.3.3 Passive Acoustic Monitoring

The embarked military detachment (MILDET) and system support engineers monitored the SURTASS passive displays for marine mammal vocalizations as specified in LOA Condition 7(a)(ii). During sixteen of the missions reported in the three annual reports, no marine mammal vocalizations were identified on the SURTASS passive sonar displays.

While participating in FBE Kilo (Fleet Battle Experiment) during the summer of 2003 long-range vocalizations from humpback, blue, and fin whales were identified on the SURTASS passive sonar displays. However, none of the marine mammals identified during transmissions were located in the vicinity of the SURTASS LFA operations area and never approached the SURTASS LFA mitigation (safety) and buffer zones.

13.3.4 Active Acoustic Monitoring

The HF/M3 sonar was operated continuously during the course of all LFA operations in accordance with LOA Conditions 6(c) and 7(a)(iii). The HF/M3 sonar was "ramped-up" prior to operations (as required). During ten of the seventeen missions, there were HF/M3 alerts that were identified as possible marine mammal or sea turtle detections. No additional correlating data were available to further verify, identify, or clarify these detections. Because these detections met the minimum shutdown criterion for identification of a marine animal, the requisite protocols were followed and LFA transmissions were suspended or delayed.

13.3.5 Delay/Suspension of Operations

Under LOA Condition 6(b), if a marine mammal is detected by any of the above monitoring measures within the 180-dB or greater safety zone or within the 1-km (0.5-nm) buffer zone, SURTASS LFA sonar transmissions will be immediately delayed or suspended.

Because the HF/M3 sonar detections noted above met the minimum shutdown criteria (two HF/M3 detection alerts within six seconds), the requisite protocols were followed under LOA Condition 6(b). LFA transmissions were suspended on sixteen occasions. In addition, during one mission there were two suspensions of operations due to HF/M3 sonar software failures.

13.3.6 Summary of Mitigation Effectiveness

The SURTASS LFA Sonar FOEIS/EIS (Subchapter 2.3.2.2 and 4.2.7.1) discussed the effectiveness of the three types on monitoring mitigation utilized during SURTASS LFA operations to prevent injurious harassment of marine mammals. The general conclusion was that, although desired, the effectiveness of both visual and passive monitoring were limited by such factors as daylight, sea state, acoustic activity of marine mammals, and dive patterns. To raise the probability of detection to near 100 percent and to protect marine mammals (animals) from injury, the Navy developed the HF/M3 sonar to detect marine mammals as they approached the 180-dB safety zone. The summary of the mitigation from the first three annual reports supports that conclusion. The active acoustic monitoring (HF/M3 sonar) resulted in a total of sixteen suspensions of operations in accordance with Condition 6(b) protocol. There was no visual or passive acoustic confirmation of these contacts. As no contacts were reported within the 180-dB safety zone or the 1-km (0.5nm) buffer zone during transmissions, no marine mammals were subjected to injurious levels of LFA sound. Thus there was no Level A harassment. The conclusion is that the mitigation measures are effective.

13.4 Assessment of Long-Term Effects and Estimated Cumulative Impacts

Because the impacts that were encountered during the period of the first three annual reports are consistent with what was projected in the FOEIS/EIS and supporting documentation, the Navy's assessment of the long-term and cumulative impact of employment of SURTASS LFA remain consistent with the analysis of such impacts in the FOEIS/EIS.

13.5 Reporting

During the routine operations of the SURTASS LFA sonar system, the Navy records technical and environmental data from visual and acoustic monitoring, ocean environmental measurements (SSP, ambient noise, etc.), and technical and operational inputs. This information becomes part of the Long Term Monitoring Program, as discussed in Chapter 6 of the 1999 application (DON, 1999), which is incorporated by reference.

Further, the Navy will submit quarterly, classified mission reports to the Director, Office of Protected Resources, National Marine Fisheries Service no later than 30 days after the end of the quarter beginning on August 16, 2007. Each quarterly, classified mission report will include all active-mode missions that have been completed during the quarter. Specifically, these reports will include dates/times of exercises, location of vessel, LOA province, location of the safety and buffer zones in relation to the LFA sonar array, marine mammal observations, and records of any delays or suspensions of operations. Marine mammal observations will include animal type and/or species, number of animals sighted, date and time of observations, type of detection (visual, passive acoustic, HF/M3 sonar), bearing and range from the vessel, abnormal behavior (if any), and remarks/narrative (as necessary). The report will include the Navy's assessment of whether any taking occurred within the SURTASS LFA sonar safety and buffer zones and estimates of the percentage of marine mammals stocks affected by SURTASS LFA sonar operations (both within and outside the safety and buffer zones), using predictive modeling based on operating locations, dates/times of operations, system characteristics, oceanographic environmental conditions, and animal demographics.

The Navy will also submit an annual, unclassified report to the Director, Office of Protected Resources, National Marine Fisheries Service. This report will provide the National Marine Fisheries Service with an unclassified summary of the year's quarterly reports and will include the Navy's assessment of whether any taking occurred within the SURTASS LFA sonar mitigation and buffer zones and estimates of the percentage of marine mammal stocks affected by SURTASS LFA sonar operations (both within and outside the safety and buffer zones), using predictive modeling based on operating locations, dates/times of operations, system characteristics, oceanographic environmental conditions, and animal demographics. The annual report will also include an analysis of the effectiveness of the mitigation measures with recommendations for improvements where applicable, an assessment of any long-term effects from SURTASS LFA sonar operations, and any discernible or estimated cumulative impacts from SURTASS LFA sonar operations.

14.0 COORDINATING RESEARCH OPPORTUNITIES, PLANS, AND ACTIVITIES

The Navy has been instrumental in advancing scientific understanding of the potential effects of LF sound on the marine environment through its 18-month Low Frequency Sound Scientific Research Program (LFS SRP) during 1997-98. Today in particular, many of the scientific issues dealing with LF sound in the marine environment are dealt with on the basis of real at-sea measured data from the LFS SRP, whereas in the past, much of the dialogue centered on hypothetical problems. The LFS SRP is discussed in more detail in the FOEIS/EIS (DON, 2001) and Technical Report #1 of the FOEIS/EIS (Clark et al., 2001).

Although findings from the LFS SRP did not reveal any significant disruption of marine mammal behavior in response to operations, the Navy and NMFS considered it prudent to continue monitoring of potential effects of the SURTASS LFA sonar. This monitoring provides data to support anticipated reporting requirements. It should be recognized that this application summarizes the more detailed information in the Draft SEIS (DON, 2005c), which should be considered to be a part of this application and is incorporated by reference.

14.1 Objectives

The principal objectives of the LTM Program for the SURTASS LFA sonar system are to:

- Analyze and assess the effectiveness of proposed mitigation measures, and make recommendations for improvements where applicable, to incorporate them as early as possible, with NMFS concurrence;
- Provide the necessary input data for reports on estimates of percentages of marine mammal populations affected by SURTASS LFA sonar operations, using predictive modeling based on operating location, system characteristics, and animal demographics;
- Study the potential effects of Navy SURTASS LFA sonar-generated underwater sound on long-term ecological processes relative to LF sound-sensitive marine animals, focusing on the application of Navy technology for the detection, classification, localization, and tracking of these animals; and
- Collaborate, as feasible, with pertinent Navy, academic, and industry laboratories and research organizations, and where applicable, with Allied navy and academic laboratories.

14.2 Research

NMFS's original Letter of Authorization (67 FR 55818) and Final Rule (67 FR 46785) included the conduct of additional research involving the topics listed in Table 14-1 below. According to the first LOA, the U.S. Navy must conduct research in at least one of these areas. The research activities listed would help to increase the knowledge of marine mammal species and the determination of levels of impacts from potential takes.

14.2.1 Research Status

Table 14-1 below provides the status of research that has been conducted, is underway or is planned to address NMFS's research topics.

Table 14-1 Research Status

NMFS Research Topics	Status
Behavioral reactions of whales to sound levels that were not tested during the research phase, specifically between 155 and 180 dB.	Preliminary assessment of the feasibility of conducting such research indicates that a Scientific Research Permit (SRP) under the Marine Mammal Protection Act, backed up with a National Environmental Protection Act environmental assessment would be required. The potential for acquiring authorization to intentionally expose marine mammals to received levels up to 180 dB would be expected to be extremely low. Moreover, it should be noted that for the Low Frequency Sound SRP conducted in 1997-98, where the goal was to expose blue, fin, gray and humpback whales to received levels up to 160 dB, even with total control of placement of the LFA source in relation to known animal locations and movements, it was rare to achieve received levels at the animals greater than 150 dB. Intentions are to hold discussions with NMFS on the practicability of future research of this nature.
Responses of sperm and beaked whales to LF sonar signals.	• Expert marine bio-acousticians agree that the conduct of controlled exposure experiments (CEEs) with sperm and/or beaked whales will prove to be extremely complicated and expensive. Nevertheless, the Navy is going forward with sponsoring the planning for beaked whale CEEs. • An April 2004 Beaked Whale Workshop organized by the Marine Mammal Commission in Baltimore, MD where there was unanimous support for CEEs as the top research priority to be used to gather critical information on beaked whale responses to sound. It was agreed that a workshop, involving scientists across several disciplines, should be held to coordinate and design CEEs that would obtain the most useful information possible. A Summary report of this workshop is available at: http://www.mmc.gov/sound/. • A November 2004 Beaked Whale Research Planning Workshop at St. Andrews University, UK, jointly funded by the University's Sea Mammal Research Unit (SMRU) and the UK Ministry of Defence (MoD); where SMRU provided a strawman proposal for conducting CEEs with beaked whales; and included discussions on: 1) sites for CEEs; 2) general requirements for conducting CEEs; and 3) interpretation of the results of CEEs. The Revised Report from this workshop is provided as APPENDIX A. • A second SMRU/MoD meeting in October 2005 of the leading scientists in the fields of marine bio-acoustics and beaked whale research, in Oxford UK, produced a draft research strategy on The Effects of Anthropogenic Sound on Marine Mammals, which focuses on a risk assessment framework of 5 steps: 1) Hazard identification; 2) Animal exposure assessment; 3) Animal dose-response assessment; 4) Risk characterization; and 5) Risk management. The final research strategy report should be available in 2006. Navy funding supported this research effort. • The Navy is funding SMRU and QinetiQ (UK) to provide the framework for future national and international research (e.g., CEE) on the responses of beaked whales to LF sonar signals. QinetiQ's initial report on Recent Advances in the Knowledge of beaked whales is summarized in APPENDIX B. • The Navy's goal for 2006 is to develop an agreed-upon experimental plan for follow-on field research (e.g., CEEs) with beaked whales in 2007. The Navy has scheduled an ad hoc scientific working group meeting for April 2006 to concentrate on the details of a 2007 beaked whale CEE; independent scientists from Cornell University, Woods Hole Oceanographic Institution, and St. Andrews University will attend, with the projected outcome to be a plan of action with milestones for the 2007 experiment. Navy funding is supporting this research effort.

Habitat preferences of beaked whales.	A Navy-funded draft planning document from SMRU has identified three “top-tier,” three “second-tier” and eight “third-tier” sites (i.e., habitat preferences of beaked whales), including discussion for each on: 1) scientific impact; 2) logistics and cost; 3) team qualifications; and 4) permits and politics. • Top Tier: Bahamas, Azores, Canaries. • Second Tier: Bay of Biscay, Hawaii, Ligurian Sea (Genoa Canyon). • Third Tier: Alboran Sea, Baja California, Western Greece, New Zealand, Tazmania, Japan (Yokosuka Bay), Washington State (Quinalt Canyon), Caribbean Sea (esp. eastern Puerto Rico and Virgin Islands). These data will be further examined and beaked whale experts consulted in determining the oceanic area and specific sites for the conduct of the proposed 2007 field research effort. Navy funding supports this research effort.
Passive acoustic monitoring for the possible silencing of calls of large whales using bottom-mounted hydrophones.	Two research efforts in the North Atlantic (NORLANT, 2004, 2005) have addressed this topic. The research reports for both tasks are classified, but unclassified summaries are provided at APPENDIX C. At least one and possibly two further research efforts are scheduled in the same North Atlantic vicinity for 2006. Navy funding has supported and continues to support these research efforts.
Long-term, cumulative effects on a stock of marine mammals that is expected to be regularly exposed to LFA and monitor it for population changes throughout the five-year period.	This topic will be addressed in the final report for the first five-year Rule.

14.2.2 Navy-Sponsored Research

The Office of Naval Research sponsors significant research to study the potential effects of its activities on marine mammals. The Navy spends nearly $10M annually on marine mammal research at universities, research institutions, federal laboratories, and private companies. In 2004 and 2005, Navy-funded research produced approximately 65 peer-reviewed articles in professional journals. Publication in open professional literature thorough peer review is the benchmark for the quality of the research. This ongoing marine mammal research includes hearing and hearing sensitivity, auditory effects, dive and behavioral response models, noise impacts, beaked whale global distribution, modeling of beaked whale hearing and response, tagging of free ranging marine animals at-sea, and radar-based detection of marine mammals from ships. These studies, though not specifically related to LFA operations, are crucial to the overall knowledge base on marine mammals and the potential effects from anthropogenic noise.

14.2.3 Research on Fish

Dr. Arthur Popper (University of Maryland), an internationally recognized fish acoustics expert, investigated the effects of exposure to LFA sonar on rainbow trout (a hearing non-specialist related to several endangered salmonids) and channel catfish (a hearing specialist) using an element of the standard SURTASS LFA source array. Hearing sensitivity was measured using auditory brainstem response (ABR), effects on inner ear structure were examined using scanning electron microscopy, effects on non-auditory tissues were analyzed using general pathology and histopathology, and behavioral effects were observed with video monitoring. Exposure to 193 dB re 1 µPa rms received level in the LFA frequency band for 324 seconds resulted in a TTS of 20 dB at 400 Hz in rainbow trout, with less TTS at 100 and 200 Hz. TTS in catfish ranged from 6 to

12 dB at frequencies from 200 to 1000 Hz. Both species recovered from hearing loss in several days. Inner ear sensory tissues appeared unaffected by acoustic exposure. Gross pathology indicated no damage to non-auditory tissues, including the swim bladder. Both species showed consistent startle responses at sound onsets and changed position relative to the sound source during exposures. There was no fish death attributable to sound exposure even up to four days post-exposure. The presentation made by Dr. Popper at the May 2005 Vancouver Acoustical Society of America (ASA) meeting is provided at Appendix D.

14.2.4 Incident Monitoring

This LTM Program element comprises two parts: (1) recreational or commercial diver incident monitoring, and (2) marine mammal and sea turtle stranding incident monitoring. The Navy coordinates with the principal clearinghouse for information on diver-related incidents, Divers Alert Network (DAN). The Navy also monitors and reviews data on strandings from federal, state, and international organizations.

15.0 SUMMARY

The Navy submits this Request for a 5-year Final Rule and subsequent Letters of Authorization (LOAs) for the taking of marine mammals incidental to the employment of the U.S. Navy's Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) sonar system in accordance with 15 CFR Part 902 and 50 CFR Parts 216 and 228. Based on the scientific analyses detailed herein and further supported by the associated FOEIS/EIS (DON, 2001) and the Draft SEIS for SURTASS LFA sonar operations (DON, 2005c), the Navy concludes that the incidental taking of marine mammals due to SURTASS LFA sonar operations would have no more than a negligible impact on the affected stocks or habitats. This conclusion is supported by the operations completed to date as well as the mitigation measures that are implemented for SURTASS LFA sonar operations, including geographic restrictions, monitoring and reporting, that result in increased knowledge of marine mammal species.

The mitigation and monitoring measures proposed for this 5-Year Rule include geographic restrictions of 22 km (12 nm) from the coastline and offshore biologically important areas during biologically important seasons outside of 22 km (12 nm). In addition, the sound field would not exceed 145 dB RL, based on SPL modeling, at known recreational and commercial dive sites. Visual, passive acoustic, and active acoustic monitoring of marine mammals (and sea turtles) will be carried out.

Therefore, the Navy requests a Final Rule and Letters of Authorization for the incidental taking of marine mammals associated with the employment of SURTASS LFA sonar for a period of five years, beginning 16 August 2007, for the geographic operating regions cited in this application in which SURTASS LFA sonar could potentially operate (Chapter 2.0). The LOAs will cover employment of the system during training, testing, and routine military operations. The LOAs will not address use of the system in armed conflict or direct combat support operations, nor during periods of heightened national threat conditions, as determined by the President and Secretary of Defense or their duly designated alternates or successors, as assisted by the Joint Chiefs of Staff (JCS).

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