CALIFORNIA -- THE RESOURCES AGENCY

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CALIFORNIA COASTAL COMMISSION

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STAFF RECOMMENDATION

ON CONSISTENCY DETERMINATION

Consistency Determination No.	**CD-95-97**
Staff:	MPD-SF
File Date:	7/21/97
45th Day:	9/4/97
60th Day:	9/19/97
Commission Meeting:	8/13/97

FEDERAL AGENCY: **U.S. Navy**

DEVELOPMENT LOCATION: 10-25 nautical miles (nmi) offshore (south and west) of San Nicolas Island, Ventura County (Exhibit 1)

DEVELOPMENT DESCRIPTION: Phase I of a 3-Phase Scientific Research Program studying effects on marine resources of low frequency sound and the Navy's Low-Frequency Active (LFA) Sonar Program (Exhibits 2-6)

SUBSTANTIVE FILE DOCUMENTS: See page 18.

EXECUTIVE SUMMARY

The Navy has submitted a consistency determination for Phase I of a three-phase scientific research program investigating the potential marine resources effects of high-intensity, low-frequency sound, using the Navy's Surveillance Towed Array Sensor System Low Frequency Active ("SURTASS LFA") system. More commonly known as "LFA," this system is a sophisticated military sonar technology designed to actively detect and track submarines at longer ranges than conventional (higher frequency) active sonar systems. While LFA has been operating for a number of years, its activities were previously "classified," and only relatively recently has the public been

aware of the program or its potential adverse effects on the marine environment. Because LFA has the potential to emit sounds well in excess of those generally considered able to cause significant adverse physiological effects on marine mammals and other species, the Navy recently agreed to prepare an EIS for the LFA program. To assist this effort, and to increase scientific knowledge of the effects of human-made, low-frequency sound on marine mammals, the Navy has designed a three-phased program to study a variety of marine mammal behaviors, including: (1) feeding blue and fin whales off San Nicolas Island; (2) migrating gray whales off Big Sur; and (3) humpback breeding offshore of Hawaii.

This consistency determination is only for the first phase (the second, Big Sur phase, will also need a Commission consistency determination). This first phase will study the behavior of blue and fin whales feeding offshore of San Nicolas Island during September/October of 1997 (and, if necessary the same months in 1998). The LFA ship (the R/V Cory Chouest) will project underwater sounds at low frequencies (100-500 Hertz (Hz)), beginning with relatively low intensities and gradually increasing intensities up to a maximum of received levels not to exceed 160 decibels (dB). The Navy will monitor whale reactions using a wide spectrum of methods and will attempt to determine "... whether disturbance reactions are associated with this SURTASS LFA sound exposure, and if so, to define the acoustic exposure characteristics that elicit disturbance reactions." The maximum levels are designed to be lower than what could be expected to cause actual physiological damage, and certainly far lower than the maximum levels LFA is capable of emitting. Mitigation measures and peer review by an independent Scientific Advisory Group have been incorporated to assure protection of marine mammals and other marine species, as well as human divers. The Navy maintains:

> *If the proposed activity did create any adverse effects, then many currently unregulated activities are causing similar effects on a daily basis to these whales. The total average acoustic energy introduced into the proposed SRP area will be significantly less than that produced by ship traffic (SRP, p. 58).*

While the Commission has serious concerns over the effects of sound in the marine environment, including that of the LFA submarine detection and tracking system itself, this research will lead to an improved understanding of the effects of LFA and other underwater sound on marine resources. With the maximum limits and other mitigation measures incorporated into the research, and given its short term duration (28 days with active transmissions), the research will avoid significant adverse effects and is consistent with the marine resources, environmentally sensitive habitat, and commercial/recreational fishing/diving policies (Sections 30230, 30240, 30234, 30234.5, 30213 and 30220) of the Coastal Act.

STAFF SUMMARY AND RECOMMENDATION

I. Project Description

a. Overview. The Navy proposes to conduct Phase I of a three-phase scientific research program to investigate the potential effects of low-frequency sound produced by the Navy's Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) system. LFA is a military system designed for active detection and tracking of submarines at longer ranges than conventional (higher frequency) active sonar systems. The system uses a vertical line array of sound projectors (Exhibit 2) to broadcast specially designed low-frequency (100-500 Hertz (Hz)) sonar pulses at high power levels, and a towed horizontal line array of hydrophones to receive echoes of the pulses from distant targets. The LFA vessel (the R/V Cory Chouest) also carries specialized signal processing and display equipment, and sophisticated systems for modeling undersea sound propagation. Because of its sophisticated detection systems, the LFA is ideally suited to monitor marine mammal responses to low frequency sound.

This first phase will study the behavior of blue and fin whales feeding off San Nicolas Island in the Southern California Bight (SCB) during Sept./Oct. of 1997 and/or 1998. The Navy selected this area for the following reasons:

> *There were a number of reasons for selecting the SCB as the specific study area. A major factor was the relatively substantial baseline of knowledge about marine mammals and ongoing research activities in the area. This includes information on seasonal abundances and densities of marine mammals (e.g., Barlow et al. 1995), movements and identifications of animals based on photo-ID research (e.g., Calambokidis and Steiger 1995), and diving patterns for blue and fin whales based on TDR tagging research (Croll et al. 1995), as well as the expected availability of sufficient numbers of blue and fin whales to obtain meaningful results. (SRP, p. 22)*

Under this phase, the LFA ship will be located approximately 10-25 nautical miles (nmi) offshore of San Nicolas Island (Exhibit 1). The proposed research involves two different playback conditions: "bottom-bounce" and "direct-path" which are depicted on Exhibits 2-3 and further described below. Monitoring whale responses will include acoustic devices collecting whale vocalizations, aerial surveys, and photo-identification to test for changes in the distribution, vocal behavior, and travel patterns of whales over the course of the study. Over the shorter time-scales of days or less, changes in foraging, dive and vocal behavior, orientation, and movement patterns of individual photo-identified whales will be studied using vessel-based visual observations, acoustic tracking, and tags.

b. Research Goals. The Navy states:

> *The goal of these observations will be to test whether disturbance reactions are associated with this SURTASS LFA sound exposure, and if so, to define the acoustic exposure characteristics that elicit disturbance reactions. The experimental approach is motivated both by the specific need for information on LFA transmissions, and by the general need to increase scientific knowledge on the possible impact of human-made, low-frequency sound (e.g., ship noise, navigational sonars) on marine mammals. (SRP, p. 5)*

The primary objectives of the Phase I effort are to:

> *1) determine minimum exposure conditions for which blue or fin whales display initial responses to LFA-type signals;*
>
> *2) compare responses of blue and fin whales to the same Received Level (RL) from a distant, an approaching, and a nearby source;*
>
> *3) if disruption of feeding of blue or fin whales is observed, evaluate the biological significance of such a response. (NMFS Draft EA, p. 6)*

c. Research Schedule and Methodology. The Navy intends to conduct the research during the September-October time period. Initially scheduled for 1997, the Navy has expanded the time period into Sept/Oct 1998, to cover the possibility that El Nino events or other contingencies may alter whale prey (and therefore whale concentrations themselves) or otherwise inhibit completion of the research in 1997. The timeline and schedule are shown graphically in Exhibits 4-5. As shown in these exhibits, the Navy has divided the research into four stages. The first is a 2-4 day period referred to as "Shakedown/calibration" during which the LFA will be used to empirically verify sound propagation models and calibrate the horizontal line array on the observation vessel. The actual research will consist of three stages, referred to as Ia, Ib, and Ic. Stages Ia and Ic are control periods during which pre- and post-experimental playback (i.e., active sound transmission) data are collected; Phase Ia will last 10-14 days in September, and Phase Ic will extend for 4-7 days after the end of the playback experiments. Only during Phase Ib will the LFA source be used for playback (active transmissions).

The stage Phase Ib playback experiments will occur over an approximately four week period starting in September (immediately following the 20-22 Sept. shakedown/calibration Phase) and ending sometime in late-October. During this phase,

there will be at least four repetitions of the 5-6 day control and experimental time blocks, as shown in Exhibit 4, Figures 3A, 3B, and 3C. Figure 3A depicts the overall schedule, Figure 3B covers the playback period, and Figure 3C diagrams the playback transmission schedule for one day.

The smallest unit of this schedule is an individual playback transmission, which lasts one minute and consists of a sequence of LFA sonar signals. An experimental period consists of a series of playback transmissions repeated at 10-minute intervals for 2.5 hours. The 28-day experimental period will be divided into a series of 5 to 6-day blocks. Each block will include 2 days without LFA playback (control days) and 2-5 days with LFA playback (experimental days) (see Fig. 3B). The order of control and experimental days within a block will be "pseudo-randomized" such that the number of contiguous days with playback will vary between 2-5 days. Within any day with playback experiments, there will be a 2-3 hour pre-exposure control period, a 1-2 hour midday control period, and a 1-3 hour post-exposure control period (see Fig. 3C).

The Navy proposes to use two research modes, a "distant" and an "approach" mode will be used. For distant mode operations, the playback condition is "bottom bounce," where the LFA system forms a downward beam of sound to simulate distant LFA exposure (Exhibit 2). The approach mode will employ a "direct path" condition, simulating exposure to the direct approach of the LFA source (Exhibit 3). NMFS Draft EA describes these modes as follows:

> *In the distant mode, the playback vessel (PBV), or source ship, will be located 8-12 nm from a concentration of feeding whales. The sound source will be beamed to reflect off the bottom, so as to expose a focal group within a roughly 2 nm radius to a predetermined RL ["received level"]. Signal intensity will be initiated at a low RL at the focal group and slowly increase through source repetitions. The TRL for the initial two transmission in a series is proposed to be 115 dB with subsequent transmissions resulting in RLs of 125 dB (3rd and 4th transmissions), 135 dB (5th through 8th transmissions) and so on up to 155 dB for the 13th - 16th transmissions. Throughout the protocol (including both modes), the playback wavetrain series lasts 1 minute and is repeated every 10 min. Thus, the entire bottom bounce mode will take 160 minutes.*
>
> *The second technique is the approach mode, where the PBV moves toward the whales, ultimately exposing animals to a direct acoustic path. The concept is to operate at a relatively constant source level, to match the slow increase in level that whales would experience from a typical approaching source. Received level would not exceed 155 dB at the*

closest point of approach to the group (approx. 1 nm). The approach mode involves 2 ½ hours of playbacks (1m[inute] on/9m off), or 16 transmissions. (NMFS Draft EA, p. 6-8)

The Navy states that if no marine mammal response is detected after 3-4 days of playbacks, including the maximum received level of 155dB (± 5 dB), "the research leaders will discuss the situation with the Scientific Advisory Group[1] and NMFS to determine whether it is advisable to raise the TRL [target received level] to a level exceeding 155dB."

d. Monitoring Methodology. The Navy proposes to use a wide spectrum of monitoring devices to monitor marine mammal reactions, including aerial surveys, passive acoustics, tagging, and photo-identification. Reactions the monitoring efforts focus on are discussed further on page 12. The aerial survey efforts (Exhibit 10) will be used to determine distribution patterns of blue and fin whales to aid in selection of an optimum research site and for examining changes in whale distribution and density between control and experimental periods. This will be supplemented by passive "acoustic localization" devices which will monitor whale vocalizations; these devises include a combination of SOund SUrveillance System (SOSUS) sea floor arrays, autonomous acoustic arrays ("pop-ups"), horizontal line arrays (HLA) on both the playback vessel (PBV) and observation vessel (OV). In addition, tagging will be used to follow individual whales and observe their behavior, photo-identification work will be used to establish re-sighting rates and locations of exposed vs. non-exposed animals, and, finally, visual observations will be maintained on both the playback and observation vessels.

II. Status of Local Coastal Program. The standard of review for federal consistency determinations is the policies of Chapter 3 of the Coastal Act, and not the Local Coastal Program (LCP) of the affected area. If the LCP has been certified by the Commission and incorporated into the CCMP, it can provide guidance in applying Chapter 3 policies in light of local circumstances. If the LCP has not been incorporated into the CCMP, it cannot be used to guide the Commission's decision, but it can be used as background information. San Nicolas Island is within Ventura County. The Ventura County LCP has not been incorporated into the CCMP.

III. Federal Agency's Consistency Determination. The Navy has determined the project consistent to the maximum extent practicable with the California Coastal Management Program.

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[1] A Scientific Advisory Group has been formed to advise, review and participate in the interpretation of the results of all phases of the proposed research. The members of this group are Dr. John Buck, Dr. Philip Clapham, Dr. W. John Richardson, Dr. Darlene Ketten, and Dr. Henrik Schmitt.

IV. Staff Recommendation:

The staff recommends that the Commission adopt the following motion:

MOTION. I move that the Commission concur with the Navy's consistency determination.

The staff recommends a **YES** vote on this motion. A majority vote in the affirmative will result in adoption of the following resolution:

Concurrence

The Commission hereby **concurs** with the consistency determination made by the Navy for the proposed project, finding that the project is consistent to the maximum extent practicable with the California Coastal Management Program.

V. Findings and Declarations:

The Commission finds and declares as follows:

A. Marine Resources/Environmentally Sensitive Habitat.

1. Coastal Act Policies. Section 30230 of the Coastal Act provides:

Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.

Section 30240 provides:

(a) Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on such resources shall be allowed within such areas.

(b) Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade such areas, and shall be compatible with the continuance of such habitat areas.

2. Marine Resources in Project Area. The National Marine Fisheries Service's Draft EA (Section 3.1, Biological Environment) contains a thorough description of the types and concentrations of marine resources in the project vicinity. To summarize very briefly, the area contains the following marine mammal species:

Baleen whales, or mysticetes, which may be encountered offshore California include blue whales (Balaenoptera musculus), fin whales (B. physalus), humpback whales (Megaptera novaeangliae), gray whales (Eschrichtius robustus), minke whales (B. acutorostrata), sei (B. borealis), Bryde's whale (B. edeni), and northern right whales (Eubalaena glacialis). Of these mysticetes, all but the minke, Bryde's, and gray whale are listed as federal endangered species.

Toothed whales and other odontocetes which may be encountered in the offshore California research area include: sperm whale (Physeter macrocephalus), pygmy sperm whale (Kogia breviceps), dwarf sperm whale (Kogia simus), beaked whales (Ziphius cavirostris, Berardius bairdi, and Mesoplodon spp.), striped dolphin (Stenella coeruleoalba), Risso's dolphin (Grampus griseus), Pacific white-sided dolphin (Lagenorhyncus obliquidens), bottlenose dolphin (Tursiops truncatus), killer whale (Orcinus orca), Dall's porpoise (Phocoenoides dalli), northern right whale dolphin (Lissodelphis borealis), and common dolphins (Delphinus delphis, D. capensis). Estimates of toothed whale abundances are drawn from the winter/spring 1991-92 aerial surveys conducted offshore California (Forney and Barlow, 1993) and the summer/fall ship surveys (Barlow, 1993a). Of these species, the sperm whale is federally listed as endangered and the harbor porpoise is proposed for listing (ESA).

Pinniped species found in the research area include: California sea lions (Zalophus californianus), northern elephant seals (Mirounga angustirostris), northern fur seals (Callorhinus ursinus), and harbor seals (Phoca vitulina). The Farallon Islands are among the most important pinniped haul-out grounds in central California (Bonnell et al., 1983). The primary pinniped foraging grounds are the shallow shelf waters from Pt. Reyes south in summer and fall, and deeper continental slope waters in winter and spring. California sea lions and northern fur seals are present seasonally either along the coast or offshore, and the northern elephant seal and harbor seal breed in the area. A small number of Guadalupe fur seals (Arctocephalus townsendii) are found seasonally at San Miguel Island.

> *The only Pacific fissiped, the southern sea otter (Enhydra lutris), was federally listed as threatened in 1977. This animal is common to the general research area, occurring primarily within a few kilometers of the coast south of Pt. Año Nuevo to Pt. Conception (Bonnell et al., 1983), although their southern range extends as far as Santa Barbara. Sea otters are considered common visitors to the Gulf of the Farallones (Ainley and Allen, 1992), though recent sightings have been rare.*

Other, non-mammal species of significance noted in the Draft EA are various species of sea turtles, seabirds, invertebrates and plankton. The sea turtles include: federally listed as endangered Leatherback sea turtles (Dermochelys coriacea) and Hawksbill sea turtles (Eretmochelys imbricata), and federally listed as threatened green (Chelonia mydas), olive ridley (Lepidochelys olivacea) and loggerhead sea turtles (Caretta caretta). None of these sea turtle species nests in the research areas; sea turtles are most often observed foraging within central California waters, especially during summer and fall months when water temperatures are warmest.

3. <u>Current Knowledge/Assumptions About Underwater Noise Impacts.</u>

There is growing evidence that man-made sounds can disturb marine mammals (Richardson et al 1995). Observed responses include silencing, disruption of activity, and movement away from the source. Sound carries so well underwater that animals have been shown to be affected many tens of kilometers away from a loud acoustic source, and there is no reason to rule out effects of low-frequency sources at even greater ranges. Marine mammals rely on sound for communication, orientation, and detection of predators and prey. While existing studies have only begun to be able to lead to predictions of marine mammal responses to various underwater sounds, the studies that have been performed have led to some at least general consensuses. According to NMFS:

> *In past research activities focused directly on large whales, acoustic source levels have been limited to less than 172 dB re 1 µPa with the result that the sound as received at an animal has rarely been greater than 130 dB re 1 µPa (Frankel and Clark, submitted to CJZ). Statistically significant differences in behaviors have been observed for continuous sounds at levels as low as 115-125 dB, corresponding to ranges usually <100m, but none of the responses were evident in the field and none can be considered biologically significant. (NMFS Draft EA, p. 11)*

Ambient ocean noise levels during moderate sea states is approximately 70 dB. A number of factors need to be taken into account in attempting to predict impacts, including individual species frequency sensitivities, water temperature, and an understanding of the difference between sounds in air and sounds in water (see Exhibit

8 for comparison chart). In analyzing whether the proposed research would trigger "takes by harassment"[2] due to potential annoyance and/or temporary threshold shift (TTS), the National Marine Fisheries (NMFS) suggests a value of 80-100 dB above best hearing threshold as the "take" threshold. NMFS' Draft EA states:

> *A key component of whether or not a hearing loss occurs is an animal's ability to hear the frequencies of that sound source. Virtually all studies show that the extent of a hearing loss depends on the frequency sensitivity of the animal. Any hearing impairment is proportional to an animal's sensitivity (Ketten, 1994). For most species, based on human tests, NMFS believes that a signal must have an intensity 80-100 dB over the hearing threshold of the animal, at best frequency, to produce annoyance (or a temporary threshold shift). The duration of a threshold shift is generally correlated with both the length of time and the intensity of exposure. If the exposure is short (<1 hr), hearing is usually recoverable (i.e., TTS occurs); if great (>8 hr/day or the sound is very loud), hearing is more prone to permanent degradation (PTS [permanent threshold shift]) (ARPA and NMFS, 1995a, 1995b).*
>
> *NMFS believes that it is unlikely that any of the mysticetes would experience significant effects, such as PTS, based on the fact that their exposure to low frequency sound would be brief, and that visual observers and acoustic tracking are in place to ensure that no marine mammals display overt indications of acute response or distress. (NMFS Draft EA, p. 30)*

The Navy assumes that 130 dB over ambient conditions, or a maximum of 200 dB, could lead to severe, or acute, effects. However the Navy also cites a recent scientific workshop (High Energy Seismic Survey (HESS), 12-13 June 1997), stating: "Discussions at the HESS workshop reached a general consensus that 180dB re 1μPa was a reasonable estimate for the level at which potential physiological injury could occur for marine animals." Based on this discussion, the Navy is relying on the assumption that 80 dB above best hearing threshold is the threshold for estimating takes by harassment due to potential annoyance, and 180dB is the level at which potential physiological injury could occur.

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[2] For purposes of NMFS review under The Marine Mammal Protection Act of 1973 (MMPA) and, for endangered marine mammals, the Endangered Species Act (ESA) of 1973, and their respective amendments, which prohibit taking (including harm and mortality), unless under permit or authorization or exempted from the provisions of these Acts.

4. Research Program Effects/Mitigation Measures. Attempting to further explore impacts in the area in between threshold and acute effects, the Navy intends to begin its active transmissions at low levels and gradually increase the to the point that reactions are observable (such as those shown on Exhibit 6), while staying below a received level of 160 dB (the target maximum will actually be 155 dB, with a potential $\pm$ 5 dB uncertainty). The research will be short term (approximately 3-4 weeks), will be focused within a limited area, will not include nighttime transmissions, will have a duty cycle less than 20%, and will be closely and continuously monitored, particularly that area within 3 nm of the source vessel where the sound field will occasionally exceed 160 dB. While designed to elicit some reaction, (see Exhibit 7 for an estimate by NFMS of the potential "takes by harassment" that may occur), the Navy believes these conditions should ensure that any potential effect of the proposed action will be negligible. The Navy states:

> *While the proposed research is designed to test what kinds of acoustic exposure lead to behavioral disturbance reactions, there is no evidence that the research will cause stress, pain, or suffering. Only short-term behavioral effects have been demonstrated from playback experiments similar to the proposed activity. ... Preliminary estimates based upon best available evidence regarding hearing and upon sound propagation models for each of the research areas and sound fields, suggest that no temporary or permanent injury will result from the proposed activity. The received levels for the whales have been set to a level <160 dB, which currently is thought to be unlikely to lead to hearing damage. (SRP, p. 57-58)*

Again, sound production will not begin at full volume but instead at reduced volume to observe if there are responses at lower levels. Any playback at full volume, when it does occur, will last no more than 60 seconds. Whales reactions will be closely monitored, and if acute responses occur, the source will be turned off. The Navy believes it will be able to detect reactions and to quantify acoustic exposure conditions that elicit them, without exposing whales to any harm. The Navy states:

> *If these playbacks do evoke consistent responses whose biological significance can be estimated, we will tailor exposure levels in the playbacks to maximize our ability to determine the acoustic exposure that elicits the response(s), while minimizing any further exposure to whales. For example, if a clear response has been observed, the PBV will be instructed not to increase the received level of playback at the whale. If any reaction is noted that raises the possibility of any deleterious effect on the whale subjects, the playback experiment will be terminated, and we will discuss the response with NMFS and with the Scientific Advisory Group. (SRP, p. 20)*

Examples of distress or behavioral modification include unusual, repeated or prolonged activity such as vocalizations, blowing, breaching, time on surface, as well as potential injurious activity such as charging the source vessel or other nearby animals, including:

> ***Disruptions in feeding behavior,*** *which are likely indications of response, since feeding is a primary activity of blue and fin whales in the SCB. Furthermore, disruptions in feeding would be biologically important.*
>
> ***Disruptions of vocal behavior,*** *which are likely responses, since the increase in noise may interfere with the whales' ability to use their own sounds for their normal functions, or cause whales to change their normal patterns of vocal activity.*
>
> ***Avoidance reactions,*** *which are likely reactions, since the increase in noise exposure could cause whales to leave or avoid an area, as has been observed in previous studies of whale reactions to noise. (SRP, p. 34-36)*

The Navy has also committed to cessation or suspension of transmission in the event, during any transmission period, a marine animal is detected and localized, visually or acoustically, within 100m of the source vessel, or at a location such that if it dove from that location to its usual dive depth, it would be exposed to a level greater than 160 dB. Transmissions would not be resumed until the area within 100m had been observed clear of any marine animals.

Thus, the goal of the playback experiments is to expose animals to a carefully controlled received levels, designed to prevent animals from exposure above 160 dB. Mitigation procedures will include cessation of a playback if any marine animal (marine mammals, sharks, and sea turtles) is detected within 100m of the playback vessel or at a location such that if it dove from its present location to its usual dive depth it would be exposed to a level (as estimated by validated sound propagation models) >180 dB. To further reduce the likelihood that a marine mammal could be exposed to a level >180 dB if it were very close (<100m) to the source when it is first turned on, the Navy will begin transmissions at a low level of 150 dB. This level will be maintained for one minute, after which it will be increased by 10 dB each successive minute until the desired received level is reached.

While the Navy anticipates no "intentional lethal take," the research proposal will also include funding for Darlene Ketten, an expert in the anatomy of the auditory system of marine mammals, to come to any of the field sites should a whale strand in the area

during the playbacks. If a necropsy indicates any sign of auditory damage, the playbacks will be stopped "unless and until it is concluded that the playbacks could not have been responsible for any injury."

The Navy's proposal also includes provisions for peer review and independent observers. The Navy has extended an invitation to "independent observers, scientists or environmental group representatives to attend various portions of the research phases in order to observe experimental operation of the LFA system and the research procedures." The Navy "has made a commitment of making this research as open as possible in order to help guarantee its independence." The Navy has also established a Scientific Advisory Group of experts in the field of marine mammal acoustics which will serve as independent peer review committee. This group will assist in key decisions, for example:

> *If after the first 3-4 day block with playbacks a response has been observed, we propose to communicate with the Scientific Advisory Group to discuss any refinements to the research protocols. If no response has been observed using any of the research methods (acoustic, aerial, tagging, and visual) to the maximum TRL of 155dB re 1 μPa, this would also provide the opportunity to discuss whether it is advisable to raise the maximum TRL to a level exceeding 155 dB re 1 μPa. (SRP, p. 34-36)*

In maintaining that noise levels are unlikely to harm marine resources, the Navy states that:

> *If the proposed activity did create any adverse effects, then many currently unregulated activities are causing similar effects on a daily basis to these whales. The total average acoustic energy introduced into the proposed SRP area will be significantly less than that produced by ship traffic. (SRP, p. 58).*

To support this point, the Navy notes that noise from large, fast vessels, in some cases with poorly-maintained marine engines: "... may range from 150-160 dB for outboards and other small vessels, to 185-200 dB for supertankers and large container ships (Richardson et. al., 1991) which can cause potentially disturbing noise for many kilometers (Tyack, 1989)." (Note: See Exhibit 9 for a comparison of natural and human-induced underwater sounds.)

Finally, the Navy states:

> *It must be strongly emphasized that the proposed research does not anticipate use of the full source level of LFA. Rather, the protocol is designed to emulate the exposure whales may experience from normal operation of LFA, but in a way designed to optimize detection of disturbance at the lowest exposure conditions which may cause a disturbance response. (SRP, p. 15)*

5. Commission Conclusion. The proposed research has been designed to help determine the potential risk to marine animals imposed by low-frequency sound of the sort that is already being introduced into the marine environment by the LFA program and other human activities. The proposed research is likely to be helpful in understanding human-induced noise impacts and developing future programs to regulate and/or reduce any such adverse effects of noise on marine mammals. Furthermore, given its short term nature (up to 28 days of transmissions), maximum sound levels that will not be exceeded, commitments to cease transmissions if acute responses are observed, and the other mitigation measures described above, the project will avoid significant adverse effects on marine resources. Due to the scientific complexity of the issues raised, the Commission is also heartened by the inclusion in the program of a Scientific Advisory Group to serve as independent peer review committee. Hopefully, the Navy's proposed research will also assist in the understanding of the LFA program itself, over which the Commission remains greatly concerned.

To reiterate this concern, which the Commission staff stated in an August 28, 1996, letter to the Navy commenting on the Navy's decision to prepare an EIS for the overall LFA program, the Commission notes:

> *We applaud the Navy for agreeing to examine the environmental effects of its program involving the development and deployment of a low-frequency, high-power density sonar system, which is designed to detect submarines throughout the world. At the same time, we wish to express grave concerns over the effects this program may have on marine resources and hope the Navy will undertake serious efforts to fully disclose the activity's effects. ...*
>
> *Unlike the 195 dB (decibel) maximum ATOC[3] sound sources, where there was some uncertainty as to its effects, it appears that the LFA program*

[3] Scripps Institution of Oceanography, Acoustic Thermometry of Ocean Climate (ATOC) Project and Marine Mammal Research Program (MMRP).

poses a substantial risk of significant harm to the marine environment. The Navy's LFA sources are expected to be louder and of much greater duration than ATOC. Based on contractor reports (see "Low-Frequency, High-Power-Density, Active Sonars," Sea Technology, May 1995), past Navy LFA testing has been in the range of 235 dB, which is 40 dB louder than the ATOC source. This intensity is over ten thousand times louder than ATOC. This level is also louder than any natural sound emitted by any marine mammals, and it may well be loud enough to cause actual physiological damage to marine organisms. Moreover, we have reviewed reports that indicate, based on the Navy's own research, that such sounds can cause serious adverse effects on human divers (see "Exposure Guidelines for Navy Divers Exposed to Low-Frequency Active Sonar," Pestorius and Curley, May 14, 1996). ...

We are also, as we were with the ATOC program, greatly concerned over potential cumulative effects, including the combined effects from: (1) oil drilling and exploration, construction, and production activities, including well drilling, platform installation, platform removal, pipeline construction and repairs, and seismic surveys; (2) ongoing shipping activities; (3) other military activities (e.g., Navy "Ship Shock" detonations); and (4) scientific research. One of the few consensuses reached by all parties involved in the ATOC program was that the extent of human-introduced noises into the marine environment, worldwide, has increased exponentially in recent decades, with virtually no information available or ongoing monitoring to determine the ability of the marine environment to accommodate such noises. Given the worldwide scope of the LFA program, it is incumbent on the Navy to understand the effects of this program to the degree possible prior to implementing it on a regular basis.

Having expressed these concerns over normal LFA operations, the Commission believes that the proposed research will help evaluate these issues and will improve our understanding of, and hopefully our ability to protect, marine resources. With the commitments discussed above provided by the Navy as an integral part of this research effort to monitor and protect marine resources, the Commission concludes that the proposed research will avoid significant adverse effects on marine resources and environmentally sensitive habitat and will be consistent with Sections 30230 and 30240 of the Coastal Act.

B. Commercial and Recreational Fishing and Diving.

Section 30230 of the Coastal Act, quoted on page 7 above, provides for the protection of economically (as well as biologically) significant marine species. Section 30234 provides: "Facilities serving the commercial fishing and recreational boating industries shall be protected and, where feasible, upgraded." Section 30234.5 provides that: "The economic, commercial, and recreational importance of fishing activities shall be recognized and protected." Section 30213 provides that "Lower cost visitor and recreational facilities shall be protected, encouraged, and, where feasible, provided." Section 30220 of the Coastal Act provides that: "Coastal areas suited for water-oriented recreational activities that cannot readily be provided at inland water areas shall be protected for such uses."

The Navy believes that impacts on commercial and recreational fishing and diving will be minimal, citing NMFS draft EA, which states:

> *POTENTIAL FOR EFFECTS ON THE SOCIOECONOMIC ENVIRONMENT*
>
> *The continental shelf off California supports an economically valuable range of commercial fisheries utilizing a variety of retrieval methods. ... The SRP should have minimal potential impact on commercial fishing. The moored "pop-up" systems would afford no obstacle to bottom trawling as they are minimally anchored and do not project upward into the water column to any distance. The location of the exercise vessels and activity would not impact on recreational water use, including diving or boating. The short, 3-4 week period of the research period, the limited geographic area, controlled sound levels and the mitigation measures proposed define a brief, narrow period with no impact on the socioeconomic environment of the proposed offshore area. . (NMFS Draft EA, p. 30)*

Specifically addressing potential effects on human divers, the Navy acknowledges that the project area is popular and heavily used for diving. NMFS draft EA states:

> *The SCB and offshore Channel Islands support a number of recreational dive sites. In addition to coastal California beaches, some preferred diver locations include San Miguel Island, Santa Rosa Island, Santa Cruz, Northwest Harbor on San Clemente Island, Bishop Rock, Beggs Rock and Cathedral Cove on Anacapa Island. Since the majority of all recreational diving occurs at depths less than 100 feet, the maximum*

distance from shore for these activities is approximately 1 nm. (NMFS Draft EA, p. 22)

To protect divers, the Navy has committed to the following mitigation:

Visual observation techniques will be in force where there might be a possibility of human diver activity in the vicinity. Whenever diver underwater activity is known to be occurring within the predicted 130 dB sound field of the vessel, transmissions will be suspended until such time as divers are known to be out of the water. Diver activity is normally marked by flagged surface buoys, and in the case of offshore diving, by the presence of a support vessel which will be visible from the LFA source vessel. (NMFS Draft EA, p. 44)

Attempting to determine thresholds for divers, the Navy has relied on its Bureau of Medicine and Surgery, which has issued interim guidance for operation of low frequency sound sources. Based on consultation with this division, the Navy states the following guidance for exposure of Navy-certified divers to low frequency waterborne sound is recommended:

Maximum SPL	160 dB re 1 μPa
Frequency range	160-320 Hz
Continuous exposure limit	100 s
Maximum duty cycle	50%
Cumulative exposure limit	15 min/dive day (no more than 9 days exposure per 2- week period)

(Source: NMFS Draft Environmental Assessment Table 4.5-1: Navy interim guidelines for exposure of Navy-certified divers to waterborne low frequency sound)

The Navy further assumes that non-Navy certified divers need additional protection beyond the 160 dB maximum. The Navy has therefore committed to assuring that sound level at diver sites will not exceed 130 dB. The Navy states:

The closest potential dive sites in proximity to the experimental area are Begg Rock, approximately 8 nm northwest of San Nicolas Island and Bishop Rock, approximately 50 nm to the southeast of San Nicolas Island. Information from the Diver Alert Network indicates that these are rarely used dive sites owing to long travel time from the coast and frequent high

swell/sea state conditions. The location of Cory Chouest within the experimental area during both Phase 0 and I will place it at least 10 nm from Begg Rock or Bishop Rock at all times. There are no other dive sites closer than 75 nm in the area. The SRP's Principal Investigator or Mission Director will ensure that neither potential dive site is ever exposed to a sound field greater than 130 dB, by decreasing the system source level and/or relocating the ship, if necessary, and by conducting sound field monitoring via onboard acoustic modeling using in situ measured sound speed profiles, and by limiting LFA source operations to source levels determined by pre-assessment and in situ analyses. No other potential dive sites in the SCB would be susceptible to sound fields greater than 130 dB, due to the high transmission loss associated with sound energy traveling upslope toward the coast, and the added ameliorating factor of the acoustic blockage afforded by San Nicolas and the other Channel Islands, between the Phase 0/I experimental area and the coast. (NMFS Draft EA, p. 40)

The Commission concludes that given the short term nature of the research, combined with the maximum sound levels committed to described in the marine resources section above, and the Navy's active coordination with diver networks and the commitment to avoid exposing any diver to sound intensities greater than 130 dB, the project will avoid adverse effects on commercial and recreational fishing and diving in the area. The Commission therefore concludes that the project is consistent with Sections 30230, 30234, 30234.5, 30213 and 30220 of the Coastal Act.

VI. SUBSTANTIVE FILE DOCUMENTS:

1. Application for Permit for Scientific Research under the Marine Mammal Protection Act, and Scientific Purposes under the Endangered Species Act, U.S. Navy, June 26, 1997.

2. Draft Environmental Assessment for Low-Frequency Sound Scientific Research Program in the Southern California Bight, September/October 1997, National Marine Fisheries Service, June 1997.

3. Consistency Certification CC-110-94/Coastal Development Permit Application 3-95-40 Scripps Institution of Oceanography, Acoustic Thermometry of Ocean Climate (ATOC) Project and Marine Mammal Research Program (MMRP).

4. Low-frequency Sound and Marine Mammals: Current Knowledge and Research Needs, Committee on Low-frequency Sound and Marine Mammals, Ocean Studies Board, Commission on Geosciences, Environment, and Resources, National Research Council, March 21, 1994.

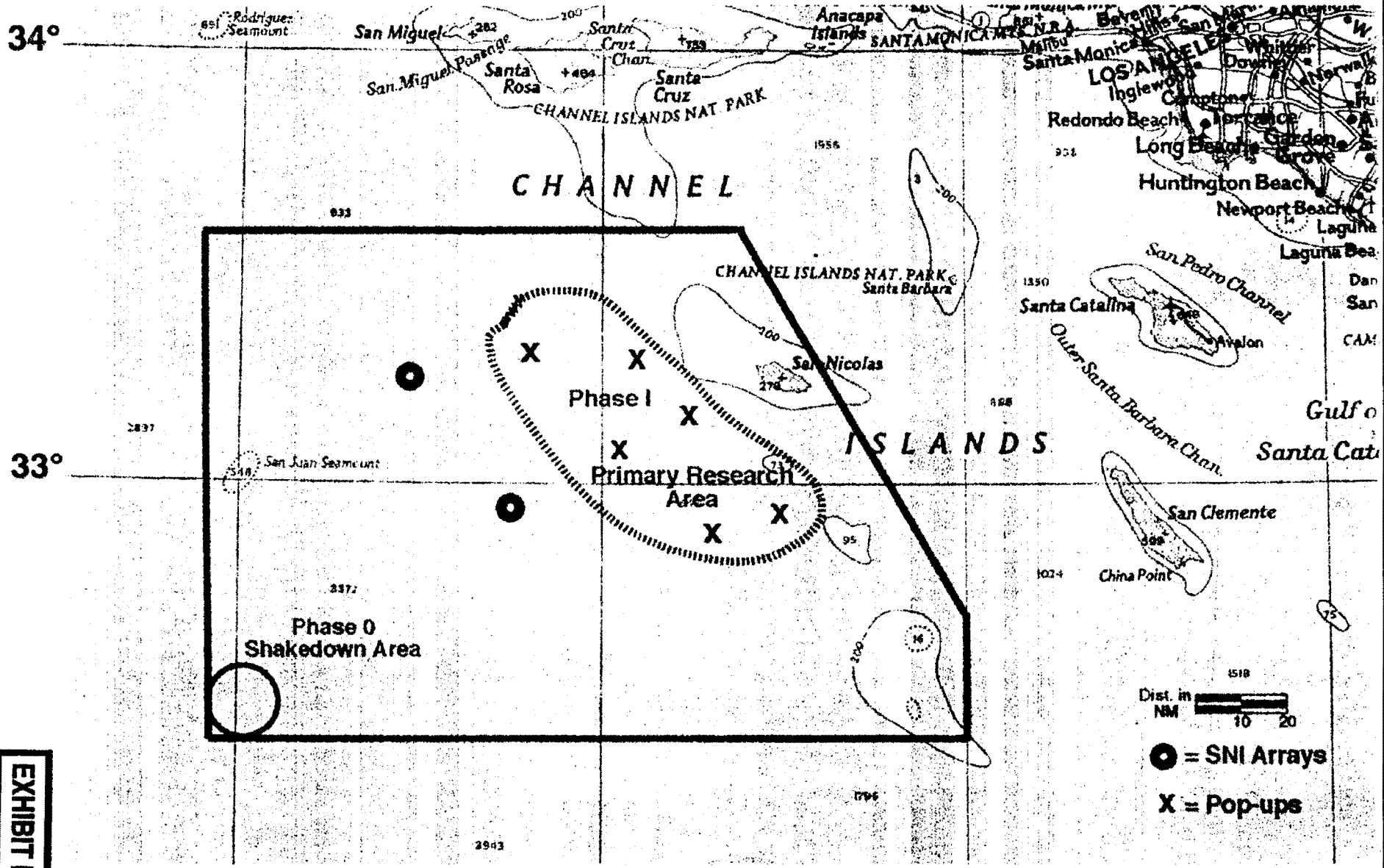


Figure 1. Chart of southern California region and the research area where shakedown/calibration and playback experiments will take place during Sept./Oct. 1997.

EXHIBIT NO. 1
APPLICATION NO. CD-65-95
Navy LFA

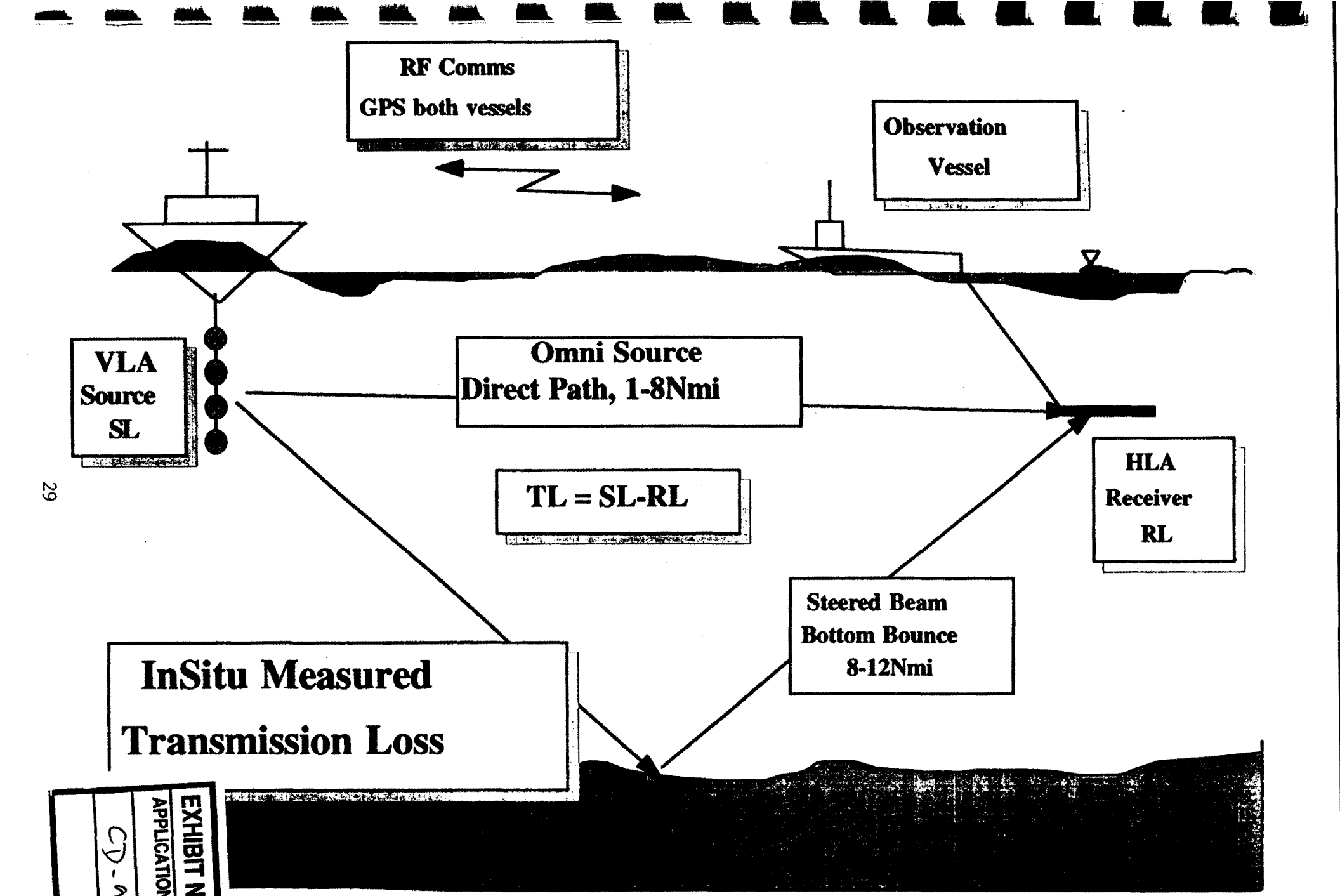


EXHIBIT NO. 2
APPLICATION NO.
CD-95-95

Figure 4. Schematic diagram of the two playback conditions (bottom-bounce and direct-path) used in the experiments.

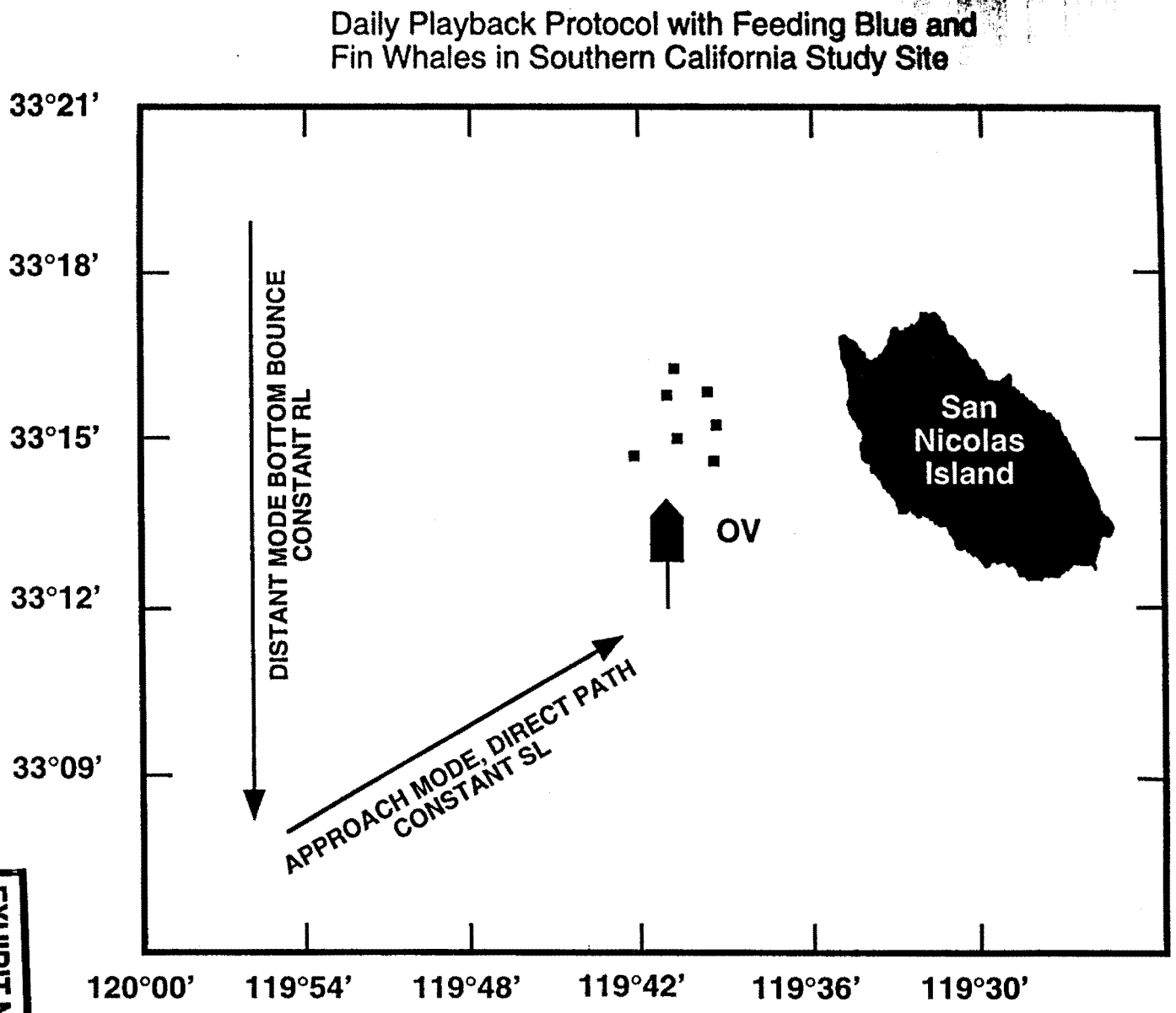


Figure 9. Diagram of distant and approach modes for Southern California playback experiments off San Nicolas Island.

EXHIBIT NO. 3
APPLICATION NO. 6-95-45

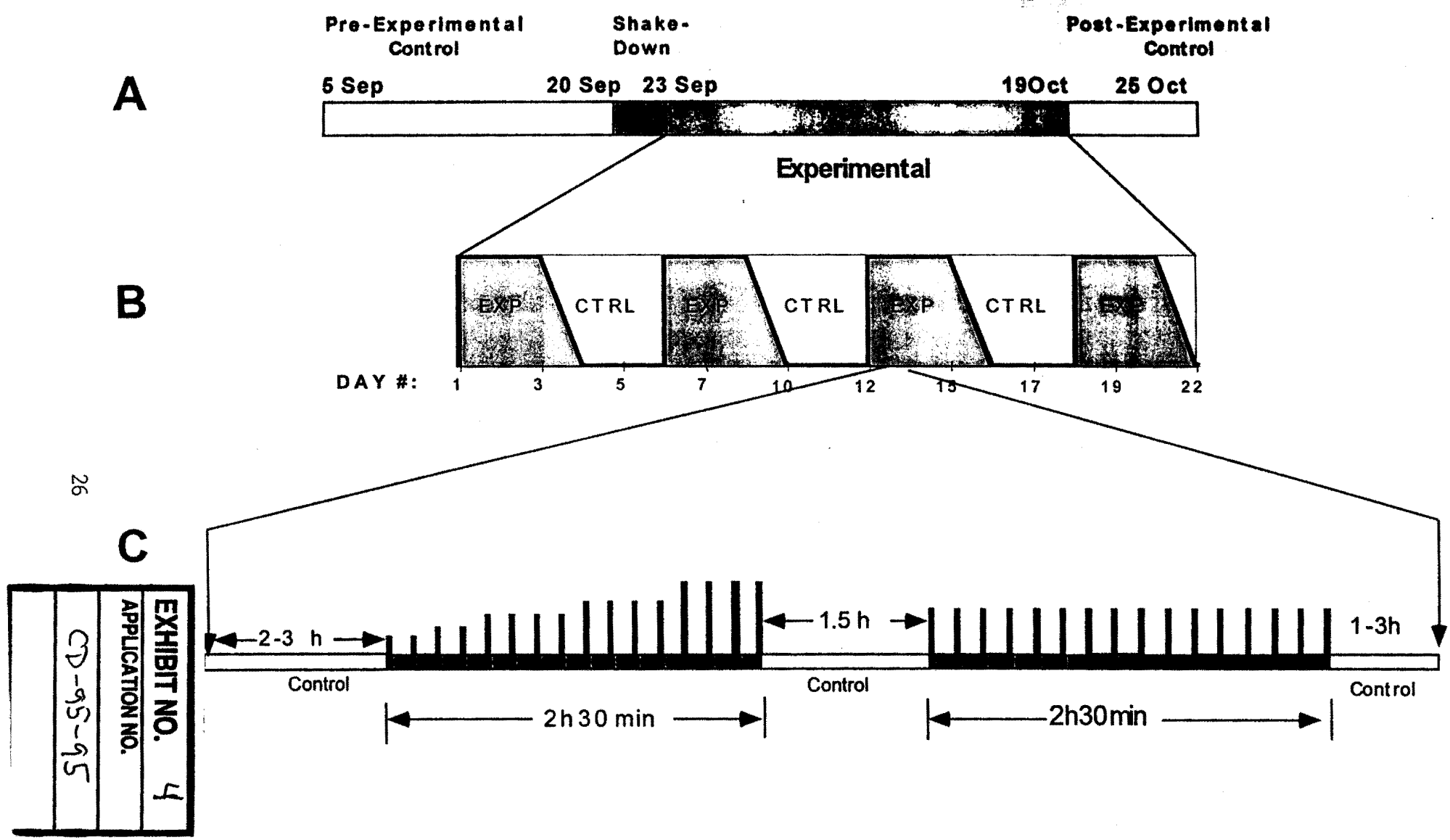
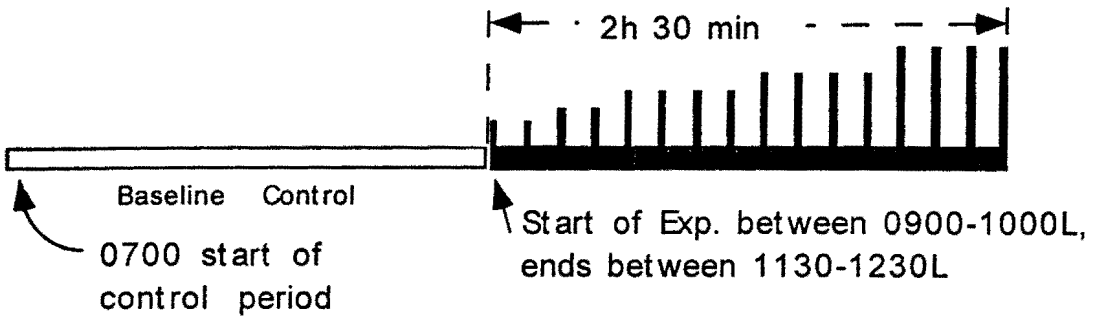


EXHIBIT NO. 4
APPLICATION NO. CD-95-95

Figure 3. A) Proposed schedule for entire research project showing different phases of the project (see Table 2). B) Schedule for Experimental Phase showing alternating blocks with experimental (2-5 days) and control (2 days) conditions. C) Proposed schedule for one day during an experimental block showing portions of the day with control and LFA playback. During the experimental playback periods, a 1 minute sequence of LFA sounds will be played back once every 10 minutes. Durations of control and playback periods are approximate since daily field conditions will vary.

Playback Protocol

Distant Mode, Bottom-Bounce Condition
Source Level increasing so that
Received level is increasing from 115dB to155dB re 1 µPa



Approach Mode, Direct-Path Condition
Constant source level, increasing received level

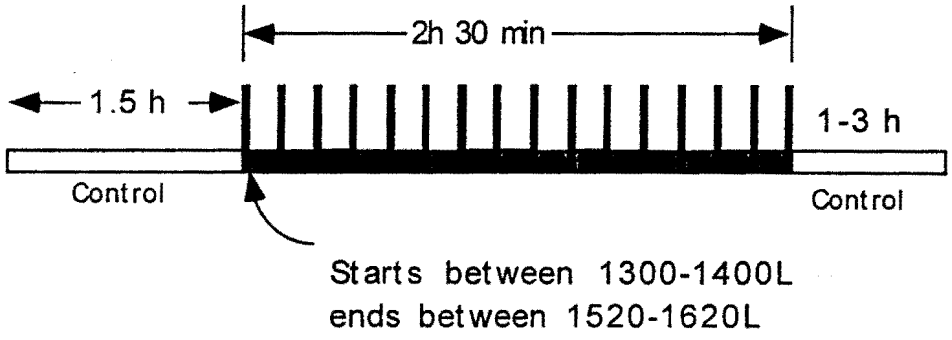


Figure 12. Schedule of daily playback protocols.

EXHIBIT NO. 5
APPLICATION NO.
CD-95-95

Table 3. Response measures for behavioral disruption at different scales of observation.

Type of reaction	Large spatial and temporal scales	Small spatial and temporal scales
Disruption of feeding behavior	Measure: Changes in aggregations of feeding whales. Method: Aerial survey estimates of group structure.	Measure: Dive and respiration pattern, surface behaviors. Methods: 1) TDR tag and 2) OV focal follow of identified whale Measure: Group synchrony/spacing. Methods: 1) OV focal follow of identified or tagged whale and 2) ad lib sampling by follow of a group of whales.
Disruption of vocal behavior	Measure: Changes in rates and spatial distribution of calls. Method: Bottom-mounted acoustic monitoring systems (SOSUS, Pop-ups).	Measure: Changes in characteristics of calls and calling rates of individual whales Method: Tracks of vocalizing whales from bottom-mounted systems or HLAs towed on vessels.
Avoidance reactions	Measure: Changes in distribution or relative abundance of whales. Method: Aerial survey.	Measure: orientation of whale, Methods: 1) focal follow of identified or tagged whale and 2) ad lib sampling from follow of group of whales. Measure: track of whale, speed and linearity of travel. Method: focal follow of identified or tagged whale.

D.6.4.4 Analysis of whale responses

Three different levels of analyses will be performed. The first analysis will involve behavioral data from individual animals over time periods of < 1 day. The second level of analysis will test for the significance of differences for periods of time of 2-5 days to test for the significance of differences for periods before, during and after exposure to controlled playback, and the duration of the experimental and control blocks. The third level of analysis will test for the significance of differences for periods of time of weeks, the duration of the pre-experimental, experimental and post-experimental portions of the research project. If clear cut responses to playback are identified, then particular emphasis will be given to relating changes in behavior to changes in the acoustic field to which an animal was exposed. Most previous studies investigate responses of whales the first time they hear a sound produced by a relatively faint playback source that is nearby. Green et al. (1994) suggested using "sound sources capable of producing sounds of various sorts, including sounds of high intensity and low frequency." in order to design studies on received levels and responses of whales to stimuli that are repeated many times as the source approaches and moves away, producing the appropriate source level to reach a subjects . The protocols of this research are designed to address this recommen changes in any behavioral measures will be related to the acoustic exposure of

EXHIBIT NO. 6
APPLICATION NO.
CD-95-95

Table 1. Estimated incidental takes by harassment of mysticetes, odontocetes, pinnipeds, and sea turtles during LFA playback experiments in the Southern California Bight study area. There will be a maximum of 20 days with LFA playback using a number of different TRLs on focal animals, with a maximum TRL of 155dB re 1 μPa. For non-focal mysticetes, no significant numbers of gray, right, Bryde's and sei whales are expected in the period of the experiment. Density values were compiled from existing NMFS reports, and a pending SRP application from Gerald D'Spain. See text for further explanation of how estimates were derived.

Southern California Bight (Sept/Oct)		Est.	Takes Per	Total
Species	Density n/km^2	Correct. Factor	Day with Playback	Est. Taken by Harassment
Bryde's whale (B. edeni)	0.0001			5
Sei whale (B. borealis)	0.0001			5
Minke whale (B. acutorostrata)	0.0006	n/a	n/a	263
Humpback whale (M. novaeangliae)	0.0008	n/a	n/a	382
Gray whale (E. robustus)	--			5
Right whale (E. glacialis)	--			5
Striped Dolphin (S. coeruleoalba)	0.025	2	8.1	162
Bottlenose Dolphin (T. truncatus)	0.002	2	0.6	13
Killer whale (Orsinus orca)	0.0004	2	0.1	3
Sperm whale (P. macrocephalus)	0.0009	10	1.5	29
Beaked whale (B. bairdii, Mesoplodon spp., Z. cavirostris)	0.0039	10	6.3	126
Pygmy Sperm whale (K. breviceps)	0.0011	5	0.9	18
Dwarf Sperm whale (K. simus)	0	5	0.0	0
Risso's Dolphin (G. griseus)	0.011	2	3.6	71
Pac. Wh.-Sided Dolphin (L. obliq.)	0.012	2	3.9	78
Harbor Porpoise (P. phocoena)	0.069	2	22.3	447
Dall's Porpoise (P. dalli)	0.096	2	31.1	621
Common Dolphin (D. delphis, D. capensis)	0.301	2	97.4	1948
Northern Right whale dolphin (L. borealis)	0.012	2	3.9	78
Pilot whale (G. macrorhynchus, 1993 est.)	0.0012	5	1.0	19
N. Elephant Seal (M. angustirostris)	0.0625	4	40.5	7281
N. Fur Seal (C. ursinus)	0.0049	2	1.6	32
California Sea Lion (Z. californianus)	0.0535	2	17.3	346
Harbor seal (P. vitulina)	--	n/a	n/a	338
Guadalupe Fur seal (A. towsendi)	--	n/a	n/a	10
Leatherback sea turtle (D. coriacea)	--	n/a	n/a	200

EXHIBIT NO. 7
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Range from ATOC Source	dB (water standard)	dB (air standard)	Comparable Sounds
1 m (approximately 3 ft)	195	133.5	Container ship at comparable distance. Very high powered loudspeaker system at comparable distance. Ambulance siren at comparable distance.
30 m (approximately 100 ft)	165	103.5	Large ship at comparable distance. Rock concert (comparable to sounds 200-400 ft from ATOC source). Jet airliner (10 m) Ambulance siren (somewhat closer than 34 m). "Very loud"
1000 m (sea surface above ATOC source)	135	73.5	Small power boat. Freeway 34 m away. Beluga whale threshold (1000 Hz). "Moderately loud"
12-18 km (7-10 nm)	120	58.5	Sea sounds (wind and wave action) during storm. Normal speech (1 m)
50-60 km (27-32 nm)	110	48.5	Symphony orchestra at 6 m (20 ft) Heavy surf on beach at 1 m (3 ft) Heavy truck (64 km/hr) at 15 m (50 ft)

Table ES-1. Relationship of sound level of common sounds in air and water (20-1000 Hz)

Source: ATOC EIS

EXHIBIT NO. 3
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CD-95-95

NOISE SOURCE	MAXIMUM SOURCE LEVEL	REMARKS	REFERENCE
UNDERSEA EARTHQUAKE	272 dB	Magnitude 4.0 on Richter scale (energy integrated over 50 Hz bandwidth)	Wenz, 1962.
SEAFLOOR VOLCANO ERUPTION	255+ dB	Massive steam explosions	Dietz and Sheehy, 1954; Kibblewhite, 1965; Northrop, 1974; Shepard and Robson, 1967; Nishimura, NRL-DC, pers. comm., 1995.
AIRGUN ARRAY (SEISMIC)	255 dB	Compressed air discharged into piston assembly	Johnston and Cain, 1981; Barger and Hamblen, 1980; Kramer et al., 1968.
LIGHTNING STRIKE ON WATER SURFACE	250 dB	Random events during storms at sea	Hill, 1985; Nishimura, NRL-DC, pers. com., 1995.
SEISMIC EXPLORATION DEVICES	212-230 dB	Includes vibroseis, sparker, gas sleeve, exploder, water gun and boomer seismic profiling methods.	Johnston and Cain, 1981; Holiday et al., 1984.
FIN WHALE	200 dB (avg. 155-186)	Vocalizations: Pulses, Moans	Watkins, 1981b; Cummings et al., 1986; Edds, 1988.
CONTAINER SHIP	198 dB	Length 274 meters; Speed 23 knots	Buck and Chalfant, 1972; Ross, 1976; Brown, 1982b; Thiele and Ødegaard, 1983.
ATOC SOURCE	**195 dB**	**Depth 980 m; Average duty cycle 2-8%**	**DEIS/EIR for the California ATOC Project and MMRP, 1994.**
HUMPBACK WHALE	192 dB (avg. 175-190)	Fluke and flipper slaps	Thompson et al., 1986.
SUPERTANKER	190 dB	Length 340 meters; Speed 20 knots	Buck and Chalfant, 1972; Ross, 1976; Brown, 1982b; Thiele and Ødegaard, 1983.
BOWHEAD WHALE	189 dB (avg. 152-185)	Vocalizations: Songs	Cummings and Holiday, 1987.
BLUE WHALE	188 dB (avg. 145-172)	Vocalizations: Low frequency moans	Cummings and Thompson, 1971a; Edds, 1982.
RIGHT WHALE	187 dB (avg. 172-185)	Vocalizations: Pulsive signal	Cummings et al., 1972; Clark 1983.
GRAY WHALE	185 dB (avg. 185)	Vocalizations: Moans	Cummings et al., 1968; Fish et al., 1974; Swartz and Cummings, 1978.
OFFSHORE DRILL RIG	185 dB	Motor Vessel KULLUK; oil/gas exploration	Greene, 1987b.
OFFSHORE DREDGE	185 dB	Motor Vessel AQUARIUS	Greene, 1987b.
OPEN OCEAN AMBIENT NOISE	74-100 dB (71-97dB in deep sound channel)	Estimate for offshore central Calif. sea state 3-5; expected to be higher (≥ 120 dB) when vessels present.	Urick, 1983, 1986.

Note: Except where noted, all the above are nominal total broadband power levels in 20-1000 Hz band. These are the levels that would be measured by a single hydrophone (reference 1 µPa @ 1 m) in the water.

Table 1.1.3-1 Natural and human-made source noise comparisons.

SOURCE: ATOC EIS

1-12

EXHIBIT NO. 9
APPLICATION NO.
CD-95-95

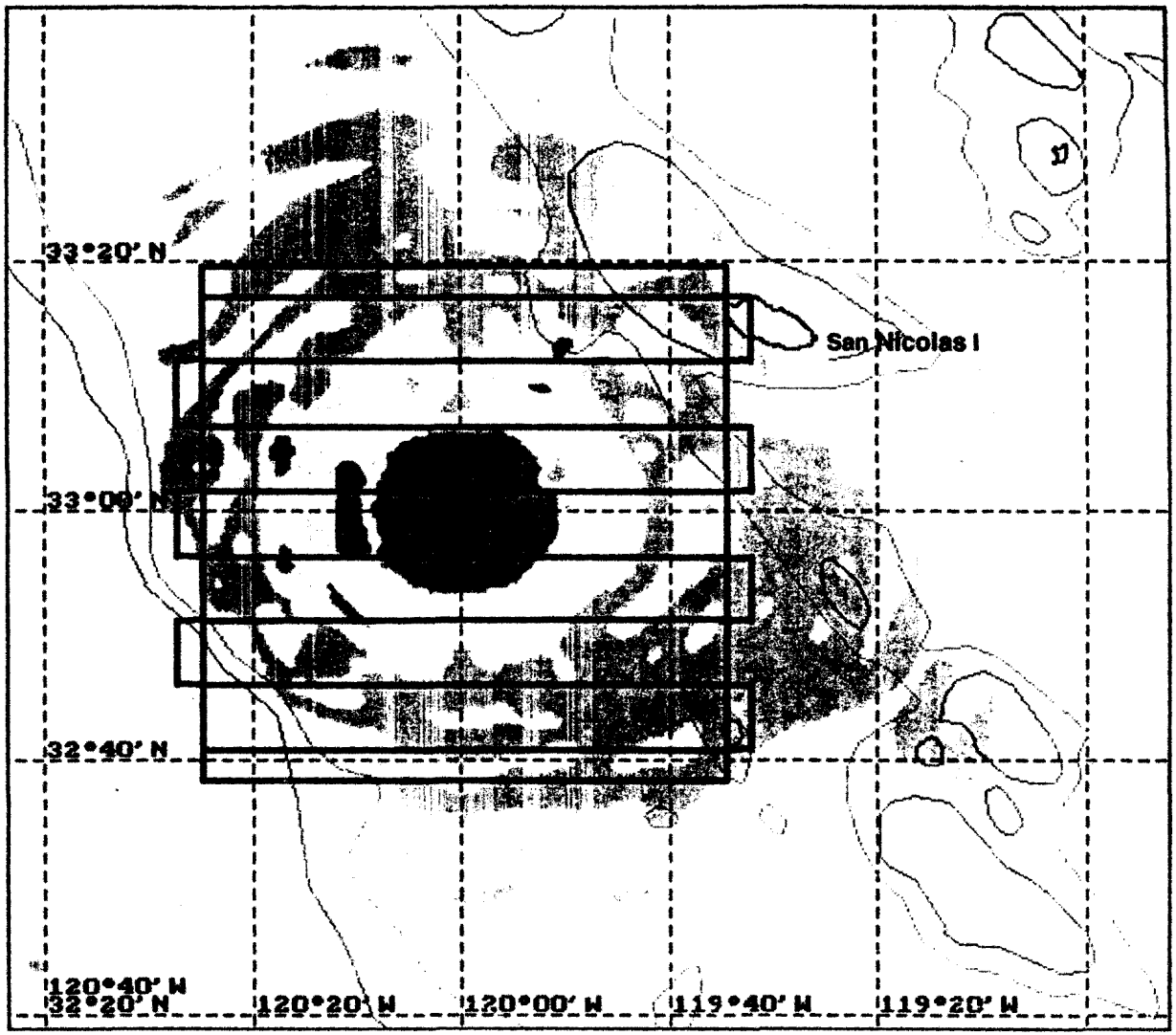

Figure 11. Schematic of aerial survey grid superimposed on the Southern California study area

EXHIBIT NO. 10
APPLICATION NO.
CD-95-95