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STAFF REPORT AND RECOMMENDATION

ON CONSISTENCY DETERMINATION

Consistency Determination No.	**CD-102-99**
Staff:	JRR-SF
File Date:	10/6/99
45th Day:	11/20/99
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Commission Meeting:	11/2/99

FEDERAL AGENCY: **NATIONAL MARINE FISHERIES SERVICE**

DEVELOPMENT LOCATION: Offshore of the Cities of San Diego and Imperial Beach (Exhibit 1)

DEVELOPMENT DESCRIPTION: Small-scale test of a pulse-power device used to deter sea lions' depredation on fish caught on sport fishing vessels

EXECUTIVE SUMMARY

The National Marine Fisheries Service (NMFS) has submitted a consistency determination for a small-scale test of a pulse power device used to deter sea lions depredation on charter fishing vessels. The tests would be conducted offshore of the cities of San Diego and Imperial Beach, in southern California. The test would take place over a series of approximately 327 vessel cruises over a period not to exceed five months. The test is designed to investigate the effectiveness of the pulse power device to deter sea lions from approaching the chartered fishing vessel. The pulsed power device produces a discharge that includes a compressed wave (shock wave) and an acoustic wave. NMFS believes that the combination of

acoustic and compressed waves may be more effective at deterring sea lion depredation.

The proposed test has the potential to adversely affect marine mammals, sea turtles, and other marine species. The device would emit a sound and shock wave that may deter sea lions from coming too close to the vessel. NMFS proposes to monitor for non-target marine mammals and other species to prevent exposing any non-target organism to sound levels greater then 180 dB re 1µPa. In addition, NMFS proposes to turn off the device if a sea lion approaches close enough to be exposed to sound levels greater than 205 dB re 1µPa. The sound level that the sea lions would be exposed to is significantly higher than the 180 dB re 1µPa, which NMFS believes to be the threshold for temporary damage to marine mammal hearing. Therefore, the proposed project may adversely affect the sea lions.

In addition, the proposed project may not provide enough protection to non-target animals. In its environmental assessment, NMFS proposes to monitor for non-target species. However, the Commission is concerned that the monitoring would not be adequate to prevent harmful exposure to both target and non-target species. Therefore, the proposed project does not protect biologically significant or environmentally sensitive species and it is inconsistent with Sections 30230 and 30240 of the California Coastal Act.

The purpose of the device is to protect recreational fishing on chartered vessels. According to the NMFS, sea lion depredation is having both an economic and social economic effect on this fishing resource. However, NMFS did not provide adequate evidence to demonstrate that there is an economic effect on the recreational fishing industry (protected under Sections 30234 and 30234.5 of the Coastal Act). There is enough information to conclude that sea lions are affecting the recreational value of the fishing (protected under Sections 30220 and 30234.5 of the Coastal Act) and that the device could improve this recreational resource.

The proposed project, however, has the potential to affect recreational diving (Section 30220 of the Coastal Act). Although NMFS proposes mitigation for this potential impact, the mitigation is not adequate to ensure protection of this resource. Therefore, the project is not consistent with the recreational resource policy of the California Coastal Management Program (CCMP).

SUBSTANTIVE FILE DOCUMENTS:

1. Environmental Assessment for testing a pulse power generator to reduce California sea lion depredation of gear and catch aboard an actively fishing charter boat off southern California, October 5, 1999.

2. Letter Dated June 11, 1999, from Joel R. Reynolds, Natural Resources Defense Council to Sara Wan, Chair, California Coastal Commission (Exhibit 2).

3. *Marine Mammals and Noise*, W. John Richardson, Charles R. Greene, Jr., Charles I. Malme, Denis H. Thomson, 1995.

4. *Behavioral Responses and Temporary Shift in masked Hearing Threshold of Bottlenose Dolphins,* Tursiops truncatus, to 1-second Tones of 141 to 201dB re 1μPa, Sam H Ridgeway, et al., July 1997.

5. Consistency Determinations: CD-110-94, CD-95-97, CD153-97, CD-109-98, and CD-32-99.

6. High Energy Seismic Survey Review Process and Interim Operational Guidelines for Marine Surveys Offshore Southern California, the High Energy Seismic Survey Team, for the California State Lands Commission and the U.S. Minerals Management Service Pacific OCS Region, September 1996 – February 1999 (Exhibit 3)

STAFF SUMMARY AND RECOMMENDATION:

I. Project Description

The NMFS proposes a small-scale test of a pulse power device intended to deter sea lion depredation on sport fishing charter boats. The test would occur offshore of the cities of San Diego and Imperial Beach and last for a period not to exceed five months. NMFS describes the proposed project as follows:

> *Under this alternative, a limited experimental test of the PPD* [Pulse Power Device] *would be conducted aboard an actively fishing CPFV* [commercial passenger fishing vessel] *off southern California. The test would take place over a series of approximately 327 vessel cruises: one-third of the cruises would involve a vessel with the PPD installed (~109 trips) and the other two-thirds would be aboard control vessels (~218 trips), operating in the same area but without the PPD. Trained field technicians on the test vessel would operate the PPD and serve as on-board observers to collect data on shipboard fishing activities and effectiveness of the device. The duration of the test period would be limited to several months (not more than 5 months) with primary focus on peak sea lion interaction periods (March-May and/or July-September).*

Experimental protocols will test and evaluate the effectiveness of the PPD at deterring California sea lions from CPFVs and the device's effect on angler catch rate. Specifically, the study is designed to investigate the PPD's effectiveness at driving sea lions away from CPFV operations and preventing their return, evaluate whether the sea lions habituate or avoid the pulsed power transmissions over time (if funds and time permit), and determine if there is a fish catch rate difference between the experimental and the control trials. In addition, mitigation measures provided in the protocols are designed to ensure that during the experiments, no marine mammals (or sea turtles) will be injured. These tests will allow the contractor to collect data to compare measurable rates of angler catch (number of fish caught) and rate of interaction (number of times a sea lion comes within 100m of the boat), from experimental trials (with the PPD "on") and control trials (without the device, or in the "off" position).

The pulse power device consists of a deck transmitter unit and an underwater unit. The deck unit is a rectangular box with a cable storage reel and is 28 inches high, 24 inches long, and 18 inches deep. It weighs 60 pounds (lbs), without cables. The underwater unit is 8 inches in diameter, and 88 inches long, with a lifting eye hook. With the current stainless steel housing, the underwater unit weighs 215 lbs. The device operator can adjust the pulse rate and output energy level.

The pulse power device can either be manually pulsed or cycled automatically. When manually pulsed, a single pulse can be produced at a rate of no more than that set by the operator. For example, in the single-shot mode, if the timer is set for 10 seconds (6 pulses per minute (ppm)), the start cycle pushbutton, when depressed, would produce one energy discharge, but activating the pushbutton again before the 10 second interval has timed out would not produce another discharge. In the automatic mode, the device would fire a single output wave every 10 seconds (if this interval is selected) and would stop when the cycle knob is turned off.

The device discharges an electric arc between two electrodes immersed in the water column to generate the pulse signal and is capable of a minimum energy output of approximately 1 kilojoules (kJ) and a maximum output of 3 kJ. Although this pulse power device is capable of outputting 3 kJ of energy, NMFS would not test the device at this energy level, because a very large safety zone would need to be monitored for marine species (~450m). In addition, should this prototype become available to fishermen, after the proposed feasibility and further analysis in

a laboratory setting have been completed, NMFS would ensure that the device could not be operated at the 3 kJ power setting. The pulse rate of the device is 12 ppm at 1 kJ, and 3 ppm at 3 kJ. The arc creates an omni-directional pulse wave. The pulse frequency ranges from 2.43 kHz to 98 kHz, with a median value of 11.2 kHz. (At these levels, the sound is considered to be high frequency.)

In developing its alternatives, NMFS estimated exposure levels at various distances from the source in order to determine the distance from the source where received levels would reach 180 dB_{RMS} re 1µPa (the "safety zone"). The 180 dB level was recommended by acoustic experts as the maximum level of exposure for marine mammals exposed to high energy impulsive sound sources (airguns) during seismic exploration surveys. The volume of the pulse would be at the 180 dB re1µPa level at 200 meters (656.2 Feet) using the 1.34 kJ power setting on the device. At the 1.8 kJ power setting, the safety zone of 180 dB re 1µPa would be reached at 262 meters (859.6 feet) from the source. The NMFS provides the following table to illustrate the sound pressure levels and energy flux density of the pulse at various distances:

Table 1. Sound pressure levels (dB_{RMS} re 1µPa) and energy flux density (dB re 1µPa ^{2}-sec) calculated for source energy versus distance.

Meters from Source	SPL @1.34 kJ (dB_{RMS} re 1µPa)[1]	SPL @1.8 kJ (dB_{RMS} re 1µPa)[2]	Energy flux density @1.34kJ (dB re 1 Pa^2-sec)[3]	Energy flux density @1.8kJ (dB re 1µPa ^{2}-sec)[4]
1	235	233	199	190
5	218	219	179	176
10	211	213	171	169
15	207	210	166	166
20	204	207	163	163
30	200	204	158	159
50	194	199	152	154
70	191	196	148	151
90	188	193	145	148
100	187	192	143	147

[1]From Equation 8 in Greeneridge (1998a)
[2]From Equation 6 in Greeneridge (1998a)
[3]From Equation 4 in Greeneridge (1998a)
[4]From Equation 2 in Greeneridge (1998a)

The 180 dB re 1µPa protective buffer would be used for all non-target marine mammals and sea turtles. In other words, if any marine mammal, other then sea lions, comes within 200 meters (656.2 feet) at the 1.34 kJ power level or 262 meters (859.6 feet) at the 1.8 kJ power level, NMFS would turn off the device. The sea lions, however, would be exposed to significantly higher volumes. The sea lions would be exposed to a sound pressure level of 205 dB re 1µPa, 18 meters (59.1 feet) from the device at the 1.34 kJ power level and 26 meters (85.3 feet) at 1.8 kJ.

In order to protect marine species, NMFS proposes to hire two technicians to operate the pulse power device and function as marine mammal observers. The observers would also gather data for the experimental trial, including vessel position, time of day, ambient weather conditions, water depth, water temperature, sea state, and other appropriate environmental and physical parameters of the fishing location. In addition, observers would record the number of anglers participating, the time spent fishing at the location, and the number and species of fish caught by anglers. Observers would also record the number and time of sea lions seen farther than 100 meters from the boat and within 100 meters of the boat (defined as an "interaction"). Additionally, the observers would note the number and time of sea lions seen within the protective buffer zone. Observers would record "depredation," defined as a sea lion removing a fish from a fishing line or a sea lion consuming or destroying a fish at the surface following a suspected depredation event. If possible, the observer would record the number and species of fish lost to sea lions.

In order to mitigate any potential effects, NMFS proposes the following measures:

1. The device will be turned off when sea lions come within the pre-determined protective buffer zone;

2. The device will be turned off when any non-target marine mammals or sea turtles are within their pre-determined protective zone;

3. The device will not be turned on near marine mammal rookeries or when weather conditions do not permit adequate monitoring of marine mammal protective buffer zones or collection of data (a Beaufort rating of 4 or greater);

4. The device will not be turned on if dive flags are in the vicinity.

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 Commission certified the LCP and incorporated it into the

CCMP, the LCP can provide guidance in applying Chapter 3 policies in light of local circumstances. If the Commission has not incorporated the LCP into the CCMP, it cannot guide the Commission's decision, but it can provide background information. The Commission has partially incorporated the City of San Diego's LCP and fully incorporated the city of Imperial Beach's LCP into the CCMP.

III. Federal Agency's Consistency Determination

The National Marine Fisheries Service has determined the project to be consistent to the maximum extent practicable with the California Coastal Management Program.

IV. Staff Recommendation

The staff recommends that the Commission adopt the following motion:

MOTION. I move that the Commission concur with the National Marine Fisheries Service' consistency determination.

The staff recommends a NO vote on this motion. Failure to receive a majority vote in the affirmative will result in adoption of the following resolution:

A. Objection

The Commission hereby **objects** to the consistency determination made by the National Marine Fisheries Service for the proposed project, finding that the project is not consistent to the maximum extent practicable with the California Coastal Management Program.

V. Consistent to the Maximum Extent Practicable

Section 930.32 of the federal consistency regulations provide that:

> *The term "consistent to the maximum extent practicable" describes the requirement for Federal activities including development projects directly affecting the coastal zone of States with approved management programs to be fully consistent with such programs unless compliance is prohibited based upon the requirements of existing law applicable to the Federal agency's operations. If a Federal agency asserts that compliance with the management program is prohibited, it must clearly describe to the State agency the statutory provisions, legislative history, or other legal authority which limits the Federal agency's discretion to comply with the provisions of the management program.*

The Commission recognizes that the standard for approval of Federal projects is that the activity must be "consistent to the maximum extent practicable" (Coastal Zone Management Act Section 307(c)(1)). This standard allows a federal activity that is not fully consistent with the CCMP to proceed, if compliance with the CCMP is "*prohibited [by] existing Federal law applicable to the Federal agency's operations*" (15 C.F.R. § 930.32). The NMFS has not demonstrated that this project is consistent to the maximum extent practicable with the CCMP by citing and "statutory provision, legislative history, or other legal authority which limits [their] ... discretion to comply with the provisions of the" CCMP (15 C.F.R. § 930.32(a). Therefore, there is no basis for the Commission to conclude that although the proposed project is inconsistent with the CCMP, it is consistent to maximum extent practicable.

VI. Alternatives that bring the project in compliance with the CCMP

Section 930.42(a) of the federal consistency regulations (15 CFR § 930.42(a)) requires that, if the Commission's objection is based on a finding that the proposed activity is inconsistent with the CCMP, the Commission must identify measures, if they exist, that would bring the project into conformance with the CCMP. That section states that:

> *In the event the State agency disagrees with the Federal agency's consistency determination, the State agency shall accompany its response to the Federal agency with its reasons for the disagreement and supporting information. The State agency response must describe (1) how the proposed activity will be inconsistent with specific elements of the management program, and (2) alternative measures (if they exist) which, if adopted by the Federal agency, would allow the activity to proceed in a manner consistent to the maximum extent practicable with the management program.*

As described in the Habitat and Marine Resources section below, the proposed project is inconsistent with the CCMP. Pursuant to the requirements of Section 930.42 of the federal regulations implementing the CZMA, the Commission is responsible to identify measures, if they exist, that would bring the project into compliance with the CCMP. The Commission believes that it may be possible to bring this project into compliance with the CCMP if the NMFS implements the following measures:

A. **Buffer Zone.** Increase the buffer zone for the sea lions to prevent that animal from exposure to sound pressure levels greater than 180 dB re 1µPa from the pulse power device.

B. **Monitoring**. Revise the monitoring plan to include:

1. The use of at least two people to monitor for marine animals at any one time, in addition to the person responsible for equipment operation and the person responsible for data collection.

2. The use of equipment, such as passive sonar, underwater cameras, and aerial surveys, to supplement the visual monitoring.

C. Timing. The testing of the pulse power device should not occur during nights or in weather conditions where visibility is less than the minimum distance need to view the entire marine mammal buffer zone.

D. Recreational Diving. Provide maps identifying the location of any regularly used dive area and commit to avoiding testing the pulse power device in the vicinity of those dive areas or at any time when divers maybe present.

VII. Federal Agency Responsibility

Section C(a)(i) of Chapter 11 of the CCMP requires federal agencies to inform the Commission of their response to a Commission objection. This section provides that:

> *If the Coastal Commission finds that the Federal activity or development project ... is not consistent with the management program, and the federal agency disagrees and decides to go forward with the action, it will be expected to (a) advise the Coastal Commission in writing that the action is consistent, to the maximum extent practicable, with the coastal management program, and (b) set forth in detail the reasons for its decision. In the event the Coastal Commission seriously disagrees with the Federal agency's consistency determination, it may request that the Secretary of Commerce seek to mediate the serious disagreement as provided by Section 307(h) of the CZMA, or it may seek judicial review of the dispute.*

VIII. Findings and Declarations:

The Commission finds and declares as follows:

A. Marine Resources/Environmentally Sensitive Habitat. 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.

1. **Marine Mammals.** Marine mammals rely on sound for communication, orientation, and detection of predators and prey. In reviewing the Navy's "LFA" research (Phases I and II, CD-95-97 and CD-153-97 respectively), the Commission noted: (1) the growing evidence that anthropogenic sounds can disturb marine mammals (Richardson et al. 1995); (2) that observed mammal responses to such sounds include silencing, disruption of activity and movement away from the source; and (3) that sound carries so well underwater that animals "... have been shown to be affected many tens of kilometers away from a loud acoustic source." The Commission agreed with the Navy in reviewing those research projects that there was a critical need for continuing research to expand the knowledge base concerning human noise impacts on marine mammals.

In its consistency determination the NMFS analyzed potential acoustic effects on a variety of marine mammals and sea turtles in the Southern California Bight. The NMFS describes the types of species that can be found in the area as follows:

*At least 26 species of odontocetes have been identified from sightings or strandings in southern California (Bonnell and Dailey, 1993). Of this total, eight species can generally be found in moderate or high numbers either year-round or during annual migrations into or through the area. These include the Dall's porpoise (*Phocoenoides dalli*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Risso's dolphin (*Grampus griseus*), bottlenose dolphin offshore stock (*Tursiops truncatus*), short-beaked and long-beaked common dolphins (*Delphinus delphis *and* D. capensis*), the northern right whale dolphin (*Lissodelphis borealis*), and the Cuvier's beaked whale (*Ziphius cavirostris*).*

...

Of the total number of cetaceans that have been identified from strandings and sightings in southern California, there are seven species of mysticetes [Blue whale *(Balaenoptera musculus)*, Fin whale (*Balaenoptera physalus*), Gray whale (*Eschrichtius robustus*), Humpback whale *(Megaptera novaeangliae)*, Minke whale *(Balaenoptera acutorostrata)*, Northern right whale *(Eubalaena glacialis)*, and Sei whale (*Balaenoptera borealis*). *Only one of these species, the gray whale (*Eschrichtius robustus*) has been found in moderate to high numbers and is the only one of the mysticetes that is not listed as a strategic stock under the MMPA.*

...

*Four pinniped species are found regularly in southern California, and one additional species, the Guadalupe fur seal (*Arctocephalus townsendi*), is seen occasionally. Of the four regularly-occurring species, only one species, the California sea lion, is common throughout offshore waters throughout the year. Large numbers of northern elephant seals (*Mirounga angustirostris*) pass through offshore waters four times a year as they travel to and from breeding, pupping and molting areas on the Channel Islands. Northern fur seals (*Callorhinus ursinus*) may also be found in offshore waters during the winter and spring when animals from northern populations may feed there. During the rest of the year, moderate numbers of fur seals are found in offshore waters and include only the animals that breed and raise their young on San Miguel Island. Moderate numbers of harbor seals (*Phoca vitulina richardsi*) are found hauled out on land and in coastal waters, but because of their preference for shallow coastal waters, few are found in offshore waters.*

Most of the marine mammals found in these waters are listed as either threatened or endangered under the federal Endangered Species Act. Although not listed as an endangered species, the gray whale migrates through this area. During the early spring, when NMFS proposes to test its pulse power device, gray whales migrate northward with their calves.

2. **California Sea Lion.** The purpose of the pulse power device is to deter sea lion depredation of fish from chartered fishing vessels. As described above, the device would emit both a sound wave and a shock wave, which NMFS believes may be more effect at deterring sea lion depredation and preventing habituation, then other acoustic harassment devices (which only use acoustic

energy). NMFS proposes to use a safety buffer around the source so that no sea lion is exposed to sound pressure levels higher then 205 dB re 1µPa. This sound pressure level is higher than is generally considered safe for exposure to marine mammals. Marine mammals rely on sound for communication, orientation, and detection of predators and prey. In recent years, the Commission's and the public's awareness of the effects of underwater noise, particularly low frequency noise, has increased significantly. In reviewing the Scripps' ATOC[1] and the Navy's LFA[2] research efforts, the Commission noted: (1) the growing evidence that anthropogenic sounds can disturb marine mammals (Richardson et al. 1995); and (2) that observed mammal responses to such sounds include silencing, disruption of activity and movement away from the source.

Additionally, the Commission recently objected to a consistency determination by the U.S. Geological Survey (USGS). In objecting to that USGS project, the Commission used the High Energy Seismic Survey (HESS) guidelines for its review of potential impacts to marine mammals (Exhibit 3). In the findings for the USGS project, the Commission stated that:

> *Nevertheless, as noted in the HESS guidelines mentioned above (and attached as Exhibit 3], any received level above 180 dB may raise cause for concern and warrant the need for monitoring and avoidance measures. In addition, the fact that the proposed survey is partly located within the coastal zone, combined with the fact that it triggers the need for National Marine Fisheries Service (NMFS) "take" permit under the Marine Mammal Protection Act (MMPA),[3] mean that the survey would clearly affect the coastal zone and needs to be carefully reviewed by the Commission for marine resource impacts.*

The pulse power device would discharge a brief sound pulse that is in the order 235 dB re 1µPa at its sources. In order to protect the sea lions from temporary or permanent hearing impairment (known as temporary threshold shift or TTS and

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[1] Scripps Institution of Oceanography, Acoustic Thermometry of Ocean Climate (ATOC) Project and Marine Mammal Research Program (MMRP), CC-110-94/CDP 3-95-40.

2 Consistency Determinations No. CD-95-97 and CD-153-97 (Navy, Low-Frequency Active (LFA) Sonar, Phases I and II).

[3] 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 harassment, harm, and mortality), unless under permit or authorization or exempted from the provisions of these Acts.

permanent threshold shift or PTS), NMFS proposes a zone around the sound source that would trigger turning off the device if a sea lion enters it. The zone would protect the sea lions from being exposed to sound pressure levels above 205 dB re 1µPa. This protective sound pressure level is higher than the 180 dB re 1µPa level recommended in the HESS guidelines and that which has been generally accepted by the Commission. In other words, the sea lions may be exposed to sound pressure level that may cause temporary and possibly permanent hearing damage.

In its environmental assessment, NMFS justifies this sound pressure level exposure in this case because it believes that the pulse nature of the sound increases the pressure level at which temporary or permanent damage is caused. Specifically, in its environmental assessment, NMFS states that:

> *Many studies of the effects of strong airborne noise pulses on human hearing have been done (Kryter, 1985* in *Richardson* et al., *1995) and most were based on TTS, assuming that noise pulses causing substantial TTS have some risk of causing PTS. From these data, human Damage Risk Criteria (DRC) were developed for airborne impulse noise. The basic criterion specifies the maximum permissible peak pressure during exposure to 100 impulses over an interval of at least 4 minutes on one day. The study found that the DRC diminished by 2 dB re 20µPa for each doubling of pulse duration. In addition, a study by Johnson (1968) investigated the effect of signal duration on detection of tones by a bottlenose dolphin. With shorter pulses, thresholds increased as pulse duration decreased. Thus, very brief pulses, such as those that would be generated by the PPD (<500µsec), would be significantly less damaging than pulses that were more prolonged, such as those used in the Ridgway* et al. *(1997) study (1 second tone).*
>
> *The number of pulses generated per minute, or per day, will also affect the criteria used to assess potential impacts on the hearing of odontocetes by the PPD. At 1 kJ, the PPD emits 12 pulses per minute (ppm); at 3 kJ, it emits 3 ppm (Ayers, R., PPTI, Spring Valley, CA, personal communication, October, 1998). This cycle rate can be controlled by the operator simply by turning the device on and off or by changing the output power level. Airborne studies show that the DRC adjusts upward or downward by 5 dB per 10-fold change in the number of pulses per day and allows levels 5 dB higher if pulses arrive at a grazing rather than a normal angle (*in *Richardson* et al. *(1995)). Thus, for a ten-fold increase in pulses per day, arriving at normal*

incidence, the DRC would decrease by 5 dB; an animal's hearing is at greater risk when exposed to an increased frequency of pulses.

Damage risk criteria may also be taken as the number of dB by which the peak pressure must exceed threshold in order to produce some risk of hearing damage (TTS). The human DRCs for airborne impulses are all in dB re 20μPa, and the human auditory threshold in these units is near 0 dB. In the range of best hearing (10 kHz-90 kHz) odontocetes have a thresholds in the range of 40 to 60 dB re 1μPa. Thus, DRCs for these animals might be on the order of 40-60 dB higher than DRCs for humans in air (in dB re 20μPa). If so, the DRC for an odontocete exposed to 100 pulses in one day emitted by the pulsed power generator might be 204-224 dB_{RMS} re 1μPa. (The DRC for humans in air exposed to 100 very brief (25 μs) pulses in one day is 164 dB re 20μPa; 164 dB+ 40-60 dB re 1μPa (hearing threshold for odontocetes) = 204-224 dB_{RMS} re 1μPa). Richardson et al. *(1995) emphasized that such derived values were speculative, given the unknown relevance of human in-air data to marine mammals underwater, but such studies have been used to analyze impacts of sound on marine mammals, in the absence of data (e.g. Department of the Navy, 1998a).*

...

For pinnipeds in water, transient events, such as the pulsed sound emitted from the PPD, should be considered to have a significant impact on individual animal(s) if there is potential for TTS. Momentary alert or startle reactions in response to a single transient sound should not be considered significant. TTS thresholds for pinnipeds in water have most recently been reported by Kastak, et al., *(1999), who exposed one harbor seal, two California sea lions, and one northern elephant seal to pure tone signals (500 ms duration) that lasted a total of 20-22 minutes. Test frequencies ranged from 100 Hz to 2000 Hz and octave-band exposure levels were approximately 60-75 dB sensation level (at center frequency). Following exposure, the harbor seal showed an average threshold shift of 4.8 dB, one sea lion showed an average threshold shift of 4.9 dB, and the elephant seal experienced an average threshold shift of 4.6 dB. Recovery to baseline threshold levels was observed within 24 hours. Because the PPD emits shorter sound signals (<500 μsec versus 500 msec) with less duration (one pulse every 10 seconds versus many pulses in a 20-22 minute period) and has different sound specifications (higher frequencies, non-pure tone) than those used in the Kastak* et al.

(1999) experiment, it would be difficult to extrapolate the results to the proposed PPD test. The only other information on noise-induced TTS or PTS for pinnipeds is for a harbor seal, who was intermittently exposed to an airborne noise and suffered TTS for one week (Kastak and Schusterman, 1996). Since the PPD will be operated underwater, the results and sound characteristics used would be difficult to extrapolate.

*For seismic surveys, NMFS (1995) concluded that there would be no hearing damage or TTS to pinnipeds in the water if the received level of seismic pulses did not exceed 190 dB re 1µPa. This criterion was based on exposure to low frequency sound signals, and has been used in several recent seismic monitoring and mitigation programs (e.g. NMFS, 1995, 1997). In addition, this 190 dB re 1µPa criterion for pinnipeds was supported by marine mammal and acoustics experts at NMFS' 1998 acoustic criteria workshop. Pinnipeds, like odontocetes, hear better at higher frequencies (the elephant seal is an exception - it hears better at low frequencies). Seals and sea lions have thresholds of roughly 60 to 80 dB (re 1µPa) in the range of best hearing. In particular, phocids have lower thresholds and a wider frequency range of hearing than otariids. Below about 30-50 kHz, the hearing threshold of phocid seals is essentially flat down to at least 1 kHz, and ranges between 60 and 85 dB re 1µPa. The high frequency cut-off for these true seals is around 60 kHz, based on the species tested. In contrast, the high frequency cut-off for eared seals is 36-40 kHz. The fur seal hearing is most sensitive, ~60 dB re 1µPa, between 4 and 17-28 kHz, where as the California sea lion is apparently the most sensitive, ~80 dB, at 2 and 16 kHz (*in *Richardson* et al., *1995).*

Using the DRC developed for hearing on humans in air, as described above for odontocetes, the DRC for pinnipeds exposed to 100 pulses in one day emitted by the pulsed power generator might be 224-244 dB_{RMS} re 1µPa (164 dB+ 60-80 dB re 1µPa (hearing threshold for pinnipeds at moderate to high frequencies) = 224-244 dB re 1µPa).

In short, NMFS argues that the exposure of sea lions to a sound pressure level of 205 dB re 1µPa would not cause temporary or permanent damage to the animals because the threshold for damage increases as the duration of the pulse decreases. The theory and basis for calculating the increase in the threshold sound level is based on a study done on human hearing in the air (dB re 20µPa) as opposed to aquatic hearing (dB re 1µPa).

The Commission has several concerns about NMFS conclusions. First, NMFS proposes an initial threshold for damage to the sea lions of 190 dB re 1µPa. The Commission specifically rejected this threshold in its review of the USGS seismic survey (CD-32-99) in favor of a 180 dB re 1µPa threshold. In addition, 190 dB re 1µPa threshold was developed for evaluating impacts from low frequency sound. Since sea lions are more sensitive to high frequency sound (which is emitted by the pulse power device), it seems likely that the threshold for damage from high frequency sound would be lower then that from low frequency sound. Finally, the use of a study of impacts to human hearing in air is inappropriate for making conclusions about sound pressure levels for sea lions underwater. The NMFS's analysis is based on a discussion within Richardson, et al. Book, **Marine Mammals and Noise**. However, Richardson qualifies the use of his analysis as a basis for making conclusions:

> ***We emphasize that these values are all extremely speculative, given the unknown relevance of human in-air data to marine mammals underwater.*** *As noted earlier, the dynamic range of human hearing may be narrower underwater than in air (Hollien 1993). One should not assume that marine mammals exposed to somewhat lower levels of pulsed underwater sound than those mentioned above would necessarily be "safe" or, on the contrary, that those exposed to somewhat higher levels would necessarily suffer auditory damage. The speculation in the preceding paragraphs is useful not to identify "safe" levels and distances, but rather to identify situations worthy of concern, mitigative action, and further study. (Emphasis in original)*

In other words, the author of the analysis that NMFS uses to justify exposing sea lions to sounds greater than 180 dB re 1µPa states that the analysis should not be used to determine safe sound pressure levels. Therefore, NMFS does not have a basis to conclude that exposing sea lions to the pulse power device with sound pressure levels as high as 205 dB re 1µPa would not temporarily or permanently damage their hearing. Therefore, the Commission cannot conclude that the proposed project is consistent with marine resource policies of the Coastal Act. Although the Commission does not have the data to demonstrate that the project would adversely affect sea lions, the Commission must err on the side of protecting the resource. The Commission does not have adequate information to conclude that the project would adequately protect the sea lions. Therefore, the Commission finds that the proposed project would not protect biologically significant marine resources as required by Section 30230 of the Coastal Act.

3. **Non-Target Marine Mammals and Sea Turtles.** NMFS proposes to protect non-target marine mammals and sea turtles by creating a safety buffer around the device that would prevent these animals from exposure to pulses with

sound pressure levels above 180 dB re 1:Pa. If a non-target species enters the buffer zone, the pulse power device would be turned off. In past projects (CD-109-98 (Navy ADS) and CD-32-99 (USGS Seismic testing)), the Commission has accepted buffer zones to protect these sensitive species provided that there was adequate monitoring to ensure protection of the animals. In this case, however, the proposed monitoring is inadequate to ensure that the animals would be identified and the equipment turned off before they are exposed to damaging sound levels. It appears that NMFS proposes to use visual monitoring as the only tool to detect non-target animals within the buffer area. Specifically, NMFS proposes to place two trained persons on the vessel. On of those people would be responsible for operating the pulse power device and the other's duties include monitoring for non-target species, monitoring for sea lions, identifying the number, type, and condition of the fish species that are caught, and collecting data on weather, sea state, and location. It is not possible for one person to simultaneously complete all of these tasks. In order to supplement the on board professionals, NMFS proposes to use the clients of the fishing vessel to help monitor for animals. However, the clients are untrained and may have a vested interest in keeping the device on.

The HESS guidelines recommend the marine mammal monitoring to be conducted by at least two people or three people if they are also responsible for collecting other data. The HESS report also recommends the use of other equipment to monitor for these animals. These monitoring protocols were developed for geologic surveys where the sound source is towed behind the boat and one person can see the entire buffer zone from the stern of the boat.

With respect to the proposed project, NMFS would use one monitor without any additional equipment to supplement the visual monitoring. That monitor would also be responsible for several other tasks that would compete with its responsibility to monitor for marine mammals. In addition, the monitor would not be using any equipment to detect non-target (or even target) species underwater. Additionally, the sound source is under the boat and the vessel is in the center of the buffer zone. The pulse power device could be used while an undetected animal is underwater and within the 180 dB re 1μPa range. In addition, although NMFS has made a commitment not to use the pulse power device when weather conditions effect visibility, it defines such a state through the use of a Beaufort rating. However, a Beaufort rating is a description of the sea state and does not reflect visual conditions. Therefore, NMFS could test the device when visibility is poor and still be consistent with their commitment. Finally, NMFS does not make any commitment to avoid testing the device during the nighttime. Although the Commission believes that it is unlikely that these chartered fishing boats to fish at night, without a commitment from the NMFS, there is always a possibility that the device would be operated at night. Therefore, the Commission finds that the NMFS has not made

sufficient commitments to monitor during the testing of the pulse power device. Without such commitments, the Commission cannot find that the activity protects sensitive marine species in a manner required by Sections 30230 and 30240 of the Coastal Act.

4. **Shock Waves.** The pulse power device produces a shock wave in addition to the sound wave. The NMFS describes the shock wave as follows:

> *When operated, the PPD emits a pulse with a very fast rise time and a combination of a shock wave followed by an acoustic wave. Because of this unique pulse signature, pulses from the PPD, though much less intense (see section 4.3.4), can be compared to the pressure pulses of a small explosive.*
>
> ...
>
> *The shock from an explosion shows an instantaneous rise in pressure to a maximum value and then decays exponentially. The shock wave carries about half the energy of the explosion and propagates spherically at speeds greater than the conventional 1500 m/s (Medwin and Clay, 1998). The shock front, however, always travels more slowly than the acoustic wave immediately following it, causing the shock front to be overtaken continuously by the acoustic wave during propagation (Rogers, 1977, in Richardson* et al., *1995). The shock wave, in principal, never dissipates to the point of extinction; in fact, it continually sharpens up, although at long enough ranges, the shock wave is lost in the ambient noise (Gaspin, J., NWSC, Indian Head, MD, July, 1999). In addition, the rise time of the pulse is extremely brief compared to that of an airgun array or other nonexplosive seismic source. The rapidity of the pressure increase (change in amplitude as a function of time) is related to the extent of biological injury (Richardson* et al., *1995) and must be considered in any analysis of shock wave impacts.*

The biological impact from such a pressure wave occurs from the interaction of soft tissue and hard tissue (i.e. muscle and bone) and to gas filled organs, such as lungs and air blabbers. In evaluating this impact, NMFS concludes that the shock wave pulse power device would not affect fish, marine mammals, birds, or sea turtles. In its environmental assessment, NMFS states that:

> *...the impulse pressures produced by the PPD would be lower, at a given distance, than the impulse pressures produced by a standard seal bomb and substantially below the impulse pressure produced by*

> *a seismic airgun. Furthermore, the impulse pressure produced by the PPD at the 1.8 kJ setting (17 Pa·sec) would fall well below the 35 Pa·sec criteria considered to be safe as estimated for terrestrial animals exposed to underwater blasts (Yelverton 1981). (Yelverton* et al. *(1981) estimates that a safe level (i.e. no injury) for source impulse strength to range from 26 Pa·s for a very small mammal to 210 Pa·s for a large mammal.)*

Based on the information submitted by NMFS, it appears that the shock wave discharged by the pulse power device would not significantly harm marine organisms.

5. **Conclusion**. In conclusion, the Commission finds that the proposed project could expose California sea lions to sound pressure levels that could cause temporary and permanent damage to the hearing of these marine mammals. In addition, the Commission finds that the NMFS has not incorporated sufficient protections for non-target marine mammals and sea turtles into its proposed study. Therefore, the proposed project does not maintain marine resources, protect species of special significance, or protect the habitat from significant disruption, and the Commission finds that the proposed project is not consistent with the Marine Resource Policies of the CCMP.

B. Recreational Fishing Resources. The Coastal Act protects the recreational fishing. 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.*

Section 30234 provides that:

> *Facilities serving the commercial fishing and recreational boating industries shall be protected and, where feasible, upgraded. Existing commercial fishing and recreational boating harbor space shall not be reduced unless the demand for those facilities no longer exists or adequate substitute space has been provided. Proposed recreational boating facilities shall, where feasible, be designed and located in such a fashion as not to interfere with the needs of the commercial fishing industry.*

Section 30234.5 provides that:

> *The economic, commercial, and recreational importance of fishing activities shall be recognized and protected.*

The purpose of the proposed project is to protect chartered fishing boat activities from economic impacts associated with sea lion depredation of caught fish and bait. The NMFS proposes to investigate the pulse power device as a non-lethal deterrent. The NMFS describes the current effect that sea lions are having on the chartered fishing boats as follows:

> *The recreational marine fishing industry is an important economic asset in California, estimated to be a $536 million business in southern California, according to the CDFG* [California Department of Fish and Game] *(Beeson and Hanan, 1996). Anglers fish year-round from jetties, piers, beaches, shores, private boats and CPFVs* [commercial passenger fishing vessel]. *Sport anglers pay a fee to ride and fish from CPFVs because these vessels provide the best opportunity for the average angler to catch a variety of fish species.*
>
> *Interviews with fishers, reports from state fishing logbooks, and reports to NMFS indicate that California sea lions are negatively impacting CPFV fishing operations, both economically, and socio-economically. Sea lions directly affect CPFV fishing by consuming bait and chum and depredating fish (partially eating fish, rendering them useless for selling or consumption purposes) that have been hooked and are being reeled in (Miller* et al., *1983). Typically, during sea lion depredation, the angler rarely sees the sea lion take the fish. Instead, sea lions surface at some distance from the boat, then submerge and swim under it to take a fish or a portion of a fish when the angler has a hook-up (Beeson and Hanan, 1996). The sea lions resurface again at some distance from the boat to consume their catch. The presence of sea lions in the vicinity of a CPFV often stops target fish from feeding on baited hooks and scares fish away, thus reducing angler catch rate. Skippers report that they must frequently move their boats from one fishing area to another because of interactions with sea lions, which results in additional fuel costs and loss of fishing time. (Hanan* et al., *1989). Many times with soft bodied fish species, such as the California barracuda (*Sphyraena argentea*), the sea lions simply eat the belly meat and discard the remainder of the fish. Passengers become frustrated when fish cannot be landed because a sea lion has taken or damaged their hooked fish. These interactions occur throughout the year on CPFVs in California that target a variety of fish species, such as, salmon (*Oncorhynchus *spp.), rockfish (*Sebastes

*spp.), California barracuda, white seabass (*Atractoscion nobilis*), etc. (Beeson and Hanan, 1996).*

Miller et al. *(1983) reported that between 1979 and 1981 there were few observed or reported pinniped interactions with charterboat trips in northern California, and depredation in southern California was rare, except in the San Diego area, where pinnipeds adversely affected the halibut gill net and CPFV fisheries. At that time, the California sea lion was the major species involved in fish and gear loss. In 1980, the total economic loss from depredation by this species in southern California CPFV operations targeting all non-salmonids was estimated to be approximately $38,000. Counts of California sea lions have at least doubled since this study (Barlow* et al. *1995), and the rate of pinniped-fishery interactions has also increased substantially.*

Beeson and Hanan (1996) analyzed CDFG charterboat fishing logs for January-July 1995 and concluded that 26,138 non-salmonids were taken by pinnipeds during this period. Of this total, 97 percent were taken in southern California, with a fresh-fish market value exceeding $145,200. The San Diego area CPFV fleet fishes rockfish, ocean whitefish, and sheephead in the fall and the winter, whereas California barracuda and white seabass are targeted in the spring and summer, and basses (kelp and sand) are targeted during the summer months and into the fall. Sea lion depredation occurs during all months. In 1994, the San Diego charterboat fleet experienced sea lion depredation (at least one fish taken by a sea lion per trip) throughout the year, ranging from 7 % in February to a high of 38 % of the trips taken in April. The highest percentage of depredated trips occurred from March through May. California barracuda comprised the highest percentage of fish species taken by sea lions, generally during the spring and summer, although rockfish, mackerel, kelp fish and barred seabass were also taken (Beeson and Hanan, 1996).

From the evidence submitted by the NMFS and second-hand information, it appears that sea lions present a significant impact to this type of recreational fishing. If the proposed device deters sea lions, prevents habituation, and does not harm the sea lions, it would provide an acceptable non-lethal method for improving recreational fishing. However, the significance of the impact that sea lions have on recreation fishing is questionable. According to NMFS, recreational fishing is a $536 million industry. The NMFS uses the commercial value of the fish to estimate the economic impact from the sea lions. The NMFS estimates this impact to be $145 thousand or 0.03% of the recreational fishing industry. Based on these figures, it does not appear that the sea lions are having a significant economic impact. However, the

Commission believes that the use of the commercial value of the fish caught on the charter boats does not represent the economic cost of the sea lions. Since the fish caught on these vessels are not sold commercially, the NMFS must show that the sea lions are causing a reduction in charter boat passengers in order to demonstrate an economic impact. Without this type of evidence, the Commission cannot conclude that the proposed project is necessary to protect the recreational fishing industry.

However, the data provided by NMFS indicates that the sea lions are interfering with the recreational activity. If the proposed device is effective and the sea lions do not habituate to it, the pulse power device would benefit this recreational resource. Therefore, the Commission finds that the proposed project would protect recreational fishing activities in a matter consistent with the CCMP.

C. Recreational Diving. The proposed experiment would occur in an area that is also popular for recreational scuba diving. The Coastal Act protects this resource. 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.*

In its environmental assessment, the NMFS proposes the following mitigation for potential impacts to recreational diving:

> *Although the likelihood that human divers will be in the test area is extremely small, the PPD* [pulse power device] *will not be discharged if any dive flags are sighted in the vicinity.*

The proposed pulse power device would be tested in nearshore waters of the coast of San Diego and Imperial Beach, which is an area that is also used for recreational diving. In review the Navy's ADS project (CD-109-98), the Commission raised similar concerns about impacts to recreational diving. In that concurrence, the Commission found that:

> *In reviewing LFA Phase I research (CD-95-97), the Commission concluded that Navy avoidance of exposing divers to sounds exceeding 130 dB would be adequate, based in part on advice and research from the Navy's Bureau of Medicine and Surgery. Concerns have been raised to the Commission that a swimmer exposed to sound levels around 125 dB during Navy LFA acoustic research in Hawaii experienced adverse reactions.*

Because recreational fishing and diving are likely to occur in similar areas, near underwater reefs, the Commission believes that there is a possibility for a conflict between the testing of the device and recreational diving activities. At a minimum, the sounds from the device would annoy divers. There is also a possibility that any divers exposed to sound pressure levels above 130 dB re 1µPa would suffer some hearing damage or interfere with recreation. The NMFS commitment to not discharge the device when dive flags are in the vicinity does not provide the Commission with the necessary assurances that the proposed test would not interfere with recreational diving. If the device is tested in an area also used by recreational divers, they may be underwater and near the fishing boat when the device is discharged, even though their dive boat is not in the vicinity of the fishing boat. Therefore, the proposed project has the potential to interfere with recreational diving and harm or deter divers. The Commission finds that the proposed project does not protect recreational diving in a manner consistent with Section 30220 of the Coastal Act, and therefore, the project is inconsistent with the Recreational Resource policy of the CCMP.

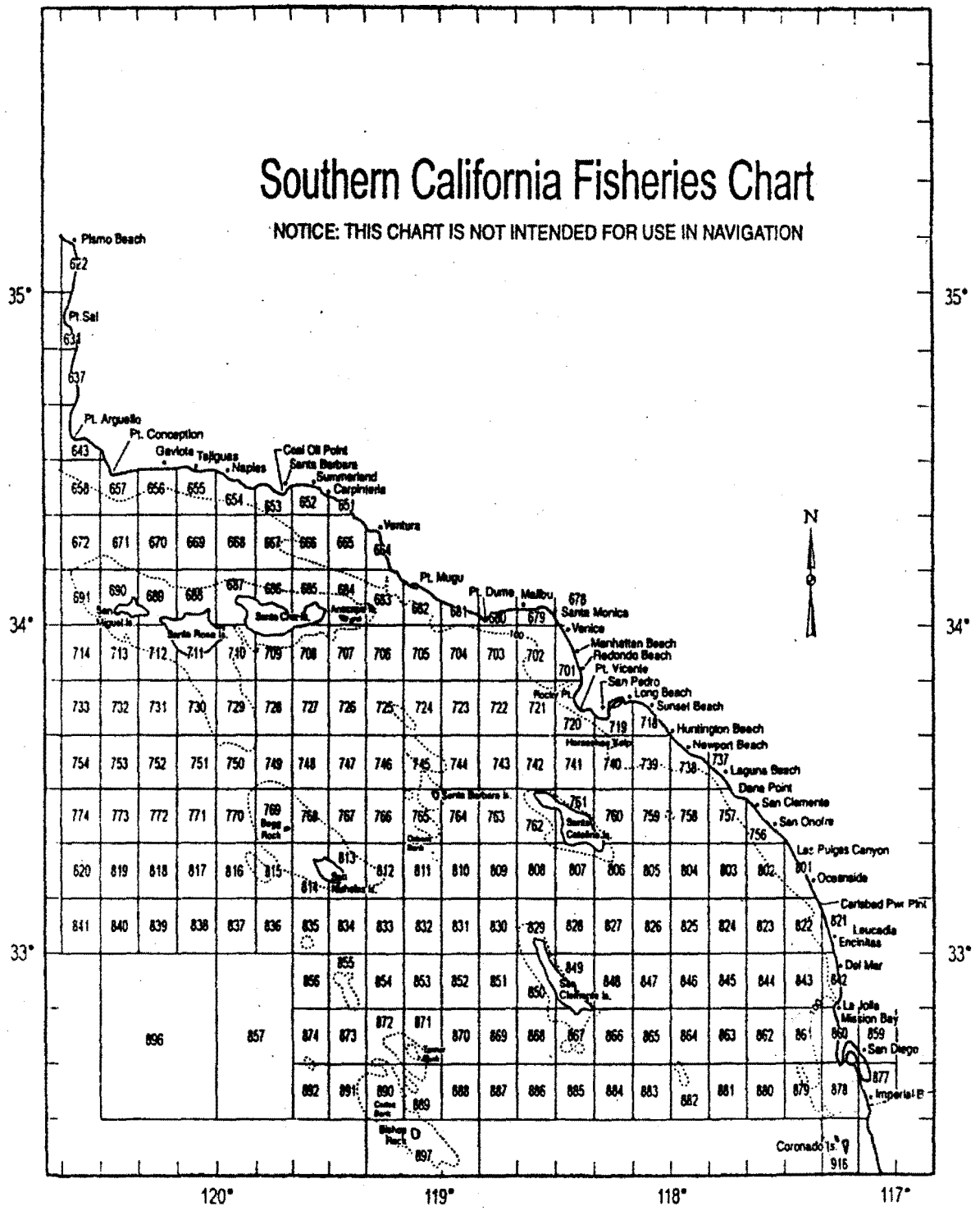

Figure 1 The small scale testing of the pulsed power device will occur in California Fish and Game blocks 860, 861, 878.

NATURAL RESOURCES DEFENSE COUNCIL

EXHIBIT NO. 2
APPLICATION NO. CD-102-99
California Coastal Commission

June 11, 1999

Sara Wan
Chair, California Coastal Commission
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Re: *California Coastal Commission's Approval of Proposed Testing of Pulsed Power Generator in Southern California Bight*

Dear Madam Chairperson and Members of the Commission:

On behalf of the Natural Resources Defense Council ("NRDC"), the Humane Society of the United States ("HSUS"), and our over seven million members and constituents, we write to draw your attention to the National Marine Fisheries Service ("NMFS") proposed testing and deployment of a "pulsed power" generator off the southern California coast and to urge the California Coastal Commission ("Commission") to find that such testing and deployment is inconsistent with the California Coastal Act. It is our understanding that NMFS intends to proceed with the project, perhaps this summer, apparently without notice to this Commission, and in clear violation of the California Coastal Act.

"Pulsed power" technology is the latest entry in a line of increasingly intrusive devices used to deter marine mammal predation of commercial and recreational catch by subjecting them to painful acoustic stimuli. The first acoustic harassment devices ("AHD's") were deployed in American fisheries and aquaculture farms during the 1980's with limited success. Sea lions and seals subjected to AHD's were initially deterred, but within several weeks of use were found to have habituated themselves to the signal and, in some cases, begun treating it as a kind of "dinner bell" announcing the presence of fish.[1] The response of manufacturers has generally been to boost the acoustic intensity of their product: AHD's currently on the market can produce sounds exceeding 180 dB re 1

[1] B. Mate & J. Harvey, eds., Acoustical deterrents in marine mammal conflicts with fisheries: Report on a workshop held February 17-18, 1986 in Newport, Oregon (Corvallis: Oregon State, 1987) (Doc. No. ORESU-86-001).

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μPa, a level believed to induce hearing loss in many marine species.[2] Even these devices, however, have proven to be of limited utility. The "pulsed power" system differs from previous AHD's because it produces a shock wave along with an acoustic signal, thereby widening the range of that signal to include higher frequencies than have been used in the past (ranging from 2.5 kHz to 114 kHz), and making its signal over one thousand times more intense than that of the typical AHD, over 230 dB re 1 μPa at maximum output.[3]

We recently learned that in 1997 NMFS contracted with the designer of the generator, Pacific States Marine Fisheries Commission ("PSMFC"), to undertake a five-phase program of design and development, culminating in an extended field test off the coast of San Diego around Point Loma, in California Fish and Game blocks 860, 861, and 878. The purpose of the program is to determine whether the generator, by emitting shock waves and high-intensity pulses of sound, can effectively drive California sea lions from fishing vessels and lower their predation on fishing bait and catch. The first four phases have already been completed; the fifth, now under consideration, would test whether the generator affects rates of animal-vessel interaction (the number of times sea lions approach an active boat), rates of depredation (the number of fish lost to sea lions), and rates of angler catch (the number of fish caught).[4] Tests would begin at the system's lowest output. The data would then be analyzed

> to determine whether the current energy level affected a change in interaction or depredation rates. If a significant difference is detected between experimental and control depredation, it would be assumed that this is the minimum power required for deterrence, and tests would continue at that power level to evaluate habituation over time. If the data show no significant difference between experimental and control depredation, experimental trials would continue at the next highest level ("ramping up").[5]

As currently designed, the test would thus not end when evidence of habituation is found. On the contrary, power would be ramped up to the next highest energy level and the study of habituation continued -- and so on, until either the maximum permitted

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[2] Randall R. Reeves, Robert J. Hofman, *et al.*, eds., Acoustic deterrence of harmful marine mammal-fishery interactions: Proceedings of a workshop held in Seattle, Washington, 20-22 March 1996 (Washington, D.C.: U.S. Department of Commerce, 1996) (NOAA Tech. Memo. NMFS-OPR-10), p. 7.

[3] NMFS, Draft environmental assessment on the testing of a pulsed power generator to reduce California sea lion depredation of gear and catch in the southern California charter boat industry, sec. 1.3.1 (reporting peak frequencies for direct and reflected waves); Greeneridge Sciences, Inc., Safety zones for marine mammals exposed to sounds from devices designed to repel pinnipeds from the vicinity of commercial fishing vessels (Dec. 1997), p. 2 (estimating source level at 231 dB re 1 μPa).

[4] PSMFC, Response to questions for 52ABNF-7-00039—PSMFC, qu. 3.

[5] NMFS, Draft environmental assessment, sec. 2.2 ("Alternative 2"). This protocol is also applicable to the preferred Alternative 3. Ibid., sec. 2.3.

output has been reached or the time allotted for testing, which we understand to be four months, has expired.[6]

We urge you to find that the testing and deployment of pulsed power generators is inconsistent with the policies of the California Coastal Act. As you know, the Coastal Zone Management Act ("CZMA"), 16 U.S.C. § 1456(c)(1), requires NMFS and the U.S. Fish and Wildlife Service to comport their activities with state laws enacted to protect marine resources and to provide a consistency determination to the relevant state agency when their activities are liable to affect any natural resource or water use of the state's coastal zone. Federal projects set in California waters must abide by the standards and procedures of the California Coastal Act, which mandates, *inter alia*, that activities be conducted in a manner that will sustain biological productivity, maintain healthy populations of all marine species, and protect environmentally sensitive habitats from "any significant disruption of habitat values." Cal. Fish & Game Code §§ 30230, 30240. This project will not only cause immediate death and injury to many protected species, but will also lead to long term damage to these species and the marine habitat.

Under the protocol submitted by PSMFC, California sea lions may be intentionally subjected to noise levels of 205 dB re 1 μPa, a degree of exposure that is unprecedented and unsupported by the best available scientific evidence, expert opinion, or prior NMFS policy. PSMFC's own subcontractor, Greeneridge Sciences, Inc., recommended a "safety zone" of 180 dB re 1 μPa, citing data that Dr. Darlene Ketten of Harvard Medical School and Woods Hole Oceanographic Institution presented in June 1997 before an expert panel -- a level that has since been accepted as a working standard for some types of impulsive noise.[7]

To our knowledge, neither NMFS nor PSMFC has presented any evidence to justify a higher level of exposure for any species. In fact, even the 180 dB threshold has not been demonstrated to be safe in the context of this proposed technology, and, in any case, it is doubtful that a 180 dB safety zone could be effectively monitored, since sea lions forage for catch by swimming *under* fishing vessels and resurfacing some distance away.[8] Moreover, NMFS and PSMFC have apparently not even considered how non-target species like the Guadeloupe fur seal, the Southern sea otter, or other cetaceans, pinnipeds, otters, fish, and sea turtles would respond to such a source.

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[6] Ibid., sec. 2.2. A four-month schedule was proposed by PSMFC. PSMFC, Response to questions for 52ABNF-7-00039—PSMFC, qu. 8.

[7] Greeneridge Sciences, Inc., Safety zones for marine mammals exposed to sounds from devices designed to repel pinnipeds from the vicinity of commercial fishing vessels (Dec. 8, 1997) (prepared for PSMFC), p. 1. That figure has become the standard adopted for all seismic surveys off the southern California coast. Southern California Task Force on High Energy Seismic Surveys, Mitigation Guidelines (Feb. 1999), sec. 1(A).

[8] M.J. Beeson & D.A. Hanan, An evaluation of pinniped-fishery interactions in California: A report to the Pacific States Marine Fisheries Commission, Marine Resources Division, California Department of Fish and Game (CDFG) (1996) (describing typical sea lion depredation).

In addition to being inconsistent with the California Coastal Act, NMFS's proposed testing and deployment of pulsed power generators clearly violates the administrative process of a number of federal laws by not following proper evaluation procedures. For example, NMFS has sought to authorize its tests -- that in form, design, and membership is geared toward research -- under an exemption to the Marine Mammal Protection Act ("MMPA") 16 U.S.C. §§ 1361 *et seq.*, accorded to commercial fisheries. NMFS proposes to do so despite evidence and expert opinion that the sound levels to be used may cause serious injury in marine mammals, a result expressly prohibited by law.[9] It should be noted that the Scientific Program Director of the Marine Mammal Commission's Committee of Scientific Advisors, who reviewed the environmental assessment, has concluded that a scientific research permit "with opportunity for public review and comment of the permit application" is required in this case.[10] Yet the project's first four phases, including a transmission loss experiment that involved two days of sea tests, were completed without a permit, without public notification, and, even more disturbingly, without any approval from the Commission.

We believe that in addition to the legal issues presented above, NMFS's proposal also violates a number of other federal laws:

First, MMPA requires NMFS and the U.S. Fish and Wildlife Service to issue a permit or other authorization prior to any "take" of marine mammals. *Natural Resources Defense Council v. United States Department of the Navy*, 857 F. Supp. 734 (C.D. Ca. 1994). The Act's 1994 Amendments grant an exemption to fisheries, but are not applicable to measures that are likely to result in the death or serious injury of marine mammals, as would be the case with pulsed power generators. 16 U.S.C. §§ 1371(a)(4)(A).

Second, the Endangered Species Act ("ESA"), 16 U.S.C. §§ 1531 *et seq.*, requires NMFS and the U.S. Fish and Wildlife Service to conduct a formal consultation and issue a legally valid Biological Opinion prior to their own "take" of any endangered or threatened marine mammals or other threatened or endangered species, including fish, sea turtles, or birds, 16 U.S.C. 1536(a)(2); *Romero-Barcelo v. Brown*, 643 F. 2d 835 (1st Cir. 1981), *rev'd on other grounds, Weinberger v. Romero-Barcelo*, 456 U.S. 313, 102 S. Ct. 1798 (1982).

Third, the National Environmental Policy Act ("NEPA"), 42 U.S.C. § 102(2)(C) and (E), establishes mandatory procedures for preparing an environmental impact statement, which includes an objective disclosure and analysis of a project's individual and cumulative impacts, consideration of alternatives, and identification of feasible mitigation to ensure that the project will not needlessly or carelessly destroy or harm the affected environment or species. *Tongass Conservation Society v. Cheney*, 924 F. 2d 1137 (D.C. Cir. 1991); *Natural Resources Defense Council*, 857 F. Supp. at 738-39.

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[9] Marine Mammal Protection Act, 16 U.S.C. § 1361(a)(4)(A).

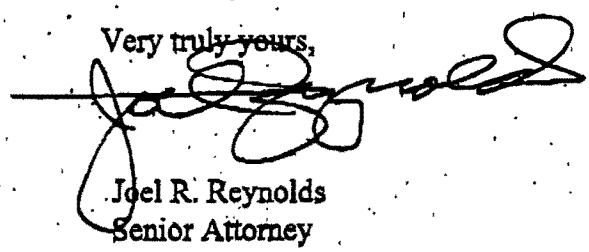
[10] Letter from Dr. Robert J. Hofman, MMC, to P. Michael Payne, NMFS (Feb. 23, 1999), p. 1.

NEPA mandates such consideration *before* the project proceeds, either in testing or full-scale deployment.

Accordingly, NRDC and HSUS hereby request that you find NMFS's testing and subsequent deployment of the pulsed power system not in compliance with the California Coastal Act, thereby forcing PSMFC and NMFS to cease such testing and development until all required permits have been obtained, legally adequate Biological Opinions have been issued, and a full environmental impact statement (including an analysis of reasonable alternatives and feasible mitigation) has been prepared and certified.

We would welcome the opportunity to meet with you or your staff to discuss this matter at any time or provide further information.

Very truly yours,



Joel R. Reynolds
Senior Attorney
Director, Marine Mammal Protection Program
Natural Resources Defense Council

INTERIM OPERATIONAL GUIDELINES FOR HIGH-ENERGY SEISMIC SURVEYS OFF SOUTHERN CALIFORNIA

Section 4

Prepared By:
The High Energy Seismic Survey Team

For:
The California State Lands Commission
and
The U.S. Minerals Management Service,
Pacific Outer Continental Shelf Region

4.1 Introduction

The following interim operational guidelines were developed based on the recommendation by the HESS Team that a Programmatic EIS/EIR would be prepared for the study area as defined. Now that the decision to prepare the PEIS/EIR has been deferred for future consideration, it is important to emphasize that these guidelines are interim and will be reviewed and may be modified when a PEIS/EIR addressing the unique resources of the study area is completed, or a project specific NEPA and/or CEQA analysis is completed. These guidelines will be subject to project-specific environmental review. Moreover, these guidelines are focused on potential impacts to marine mammals and may not address the full array of potential impacts that may be generated by a proposed survey. Finally, these guidelines shall be reviewed and updated by the HESS Executive Committee as new information becomes available, but no less than annually. To insure that you have the most recent version, contact either MMS or the California State Lands Commission.

This document is intended as a protocol for identifying mitigation measures to be applied to high-energy seismic surveys conducted in Federal and State waters off southern California. It was developed by a subcommittee of the Pacific OCS Region High-Energy Seismic Survey (HESS) Team with input from the Team as a whole. It is understood that these guidelines are advisory. Reviewing agencies will make decisions on appropriate mitigation based on the best current information available during project-specific reviews.

The identified measures incorporate the best available current information on the potential effects of high-energy seismic sound on marine mammals, the biology of marine mammals in southern California waters, and mitigation and monitoring techniques specific to southern California waters. Much of this information is derived from the recommendations made by a panel of nationally recognized experts on marine mammals and acoustics, which was convened at an MMS-sponsored workshop in June 1997 (Appendix 5). The measures recommended are keyed to two major factors: 1) the seasonal occurrence and distribution of marine mammals believed to be most sensitive to the potential effects of seismic sound (Appendix 6), and 2) the projected duration of proposed seismic surveys.

4.2 Mitigation and Monitoring Measures

4.2.1 Safety Zones and Zones of Potential Harassment

Background. While it is still unknown whether marine mammals that are very close to an airgun array would be at risk of temporary or permanent hearing impairment, it is recognized that there is a potential for such impacts within a few hundred meters of a seismic source (Richardson et al., 1995). In order to avoid exposing marine mammals close to a seismic source to sound levels that could cause hearing or other damage, safety zones have been designed (see Section 4.2.4.1 for safety zone monitoring requirements). For a number of seismic surveys conducted in U.S. waters, NMFS (1995, 1997, 1998) has established safety zones to prevent harm to marine mammals from exposure to impulsive devices with peak amplitudes at frequencies below 250 Hz.

4.2.1.1 Safety Zones

Safety zones are defined by the radius of received sound levels believed to have the potential for at least temporary hearing impairment.

The HESS workshop panel, while recognizing differences among species in hearing sensitivity to low frequency sounds, concluded that they were "apprehensive" about levels above 180 dB re 1 μPa (rms) with respect to overt behavioral, physiological, and hearing effects on marine mammals

in general. Therefore, the 180-dB radius, as initially defined by transmission loss model and verified on-site, is recommended as the safety zone distance to be used for all seismic surveys within the southern California study area.

4.2.1.2 Zones of Potential Harassment

The zone of potential harassment will be defined in applicable permits as the area beyond the safety zone in which marine mammals are subject to acoustic disturbance and, thus, subject to "take" by level B harassment as defined by the Marine Mammal Protection Act (MMPA).[5]

The expert panel convened at the HESS workshop (Appendix 5) concluded that behavioral responses by marine mammals to seismic sounds would most likely occur at received levels above 140 dB re 1 μPa (rms). As discussed in Richardson et al. (1995), however, the limited evidence available indicates that there are differences in responsiveness to seismic sounds among marine mammal groups, with baleen whales, and perhaps sperm whales, being the most sensitive and eared seals the least. Since the 140-dB isopleth generally will be tens of kilometers from the seismic source, only a small portion of such an area can be visually monitored from a vessel; monitoring will merely sample the populations of marine mammals subject to acoustic harassment by this definition.

4.2.2 Source Array and Transmission Loss Models

Proposals for seismic surveys should identify the specific transmission loss model to be used. Such state of the art models should take into account the array geometry. Modeling should be based upon previous applicable sound propagation studies for the area, if they exist. If they do not exist, then a more conservative approach should be taken (Local propagation is not as critical when assessing dB levels of 180+. It is more important for assessing the distances related to 160 dB and 140 dB).

4.2.2.1 Model Verification

As recommended by the workshop panel, pre-survey verification of transmission loss models will not be required. Instead, verification should be performed at commencement of the survey. Verification may not be required if previous analysis of data from the same airgun array operated in the same location has validated the transmission loss model to be used. The applicant can demonstrate that they qualify for this exception based upon a review by an expert. The field verification report should be submitted within 72 hours after the verification test end. Should unforeseen circumstances make this impossible, e.g. equipment failure, bad weather, an extension of the verification report period could be requested from MMS, in consultation with NMFS.

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[5]On April 30, 1994, the President signed Public Law 103-238, the Marine Mammal Protection Act (MMPA) Amendments of 1994. One part of this law added a new subsection 101(a)(5)(D) to the MMPA to establish an expedited process by which citizens of the United States can apply for an authorization to incidentally take small numbers of marine mammals by harassment. The MMPA defines harassment as:

> "...any act of pursuit, torment, or annoyance which (a) has the potential to injure a marine mammal or marine mammal stock in the wild; or (b) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering."

The verification procedure is intended to be relatively small-scale in area, focusing on the accuracy of the applied transmission-loss model over sound levels down to approximately 160 dB. Two acceptable methods for verifying the transmission loss model have been identified. The first is that described in Greeneridge Sciences (1998) (Appendix 7). This level of effort employs a small vessel, a vertical hydrophone array, shipboard recording/analyzing equipment, and conductivity-temperature-depth (CDT) measuring instruments. The second acceptable method for verifying the transmission loss model could be conducted by the geophysical contractor using the seismic vessel's hydrophone array and recording/analyzing equipment.

4.2.3 Ramp-Up

Background. Ramp-up has become a standard mitigation measure for seismic operations in many areas (NMFS, 1995, 1997, 1998; Richardson, 1997; JNCC, 1998), as well as for other activities involving high-energy sound sources such as the Acoustic Thermometry of Ocean Climate (ATOC) study (Richardson et al., 1995) and the U.S. Navy's low-frequency active (LFA) sonar research (Marine Acoustics, Inc., 1997). This has occurred in recognition of the potential risk that immediate hearing damage could occur to a nearby marine mammal if a high-energy sound source, such as an airgun array, were turned on suddenly. The ramp-up procedure generally involves the gradual increase in intensity of a sound source from some basal level to full operating intensity over a period of several minutes. It is assumed that marine mammals will find the sound aversive and will move away before hearing damage or physiological effects occur (Richardson et al., 1995; Richardson, 1997).

This has primarily been a common sense measure, since there have been no comprehensive studies of the effectiveness of ramp-up procedures (Richardson et al., 1995; Richardson, 1997). Richardson et al. (1995) and the HESS workshop panel have recommended that the effectiveness of ramp-up be studied, and such a study is currently being considered by MMS.

Recognizing this, the following ramp-up protocol is recommended (after NMFS, 1998):

At the commencement of operations or anytime that the array has been powered down, the airgun array should be ramped up to full operating levels starting with the smallest airgun and adding power at a rate of approximately 6 dB per minute.

4.2.4 Shipboard Monitoring

In general, ship-based observers employed during seismic survey operations serve one or both of two functions: 1) monitoring designated safety zones around the seismic airgun array during ramp-up and full operation, and providing the basis for real-time mitigation (airgun shutdown); and 2) collecting data on the species, numbers, and behavior of marine mammals observed in both identified zones, the estimated number of animals that may have been "taken" by harassment, and any behavioral responses to the seismic survey activities.

Each of these functions requires a different level of effort. Table 1 summarizes the levels of shipboard monitoring recommended for four identified seismic survey scenarios. These scenarios include small (0-6 days), medium (7-15 days), large (16-30 days), and multiple (31+ days) surveys.

4.2.4.1 Safety Zone Monitoring

Safety zone monitoring, at a minimum, should be conducted during surveys of all four scenario levels. This level of effort will include the following requirements:

1) A minimum of two observers. All observers should be certified by NMFS as marine mammal observers. Additionally, NMFS suggests that a third person, possibly a crew member, should be made available to serve as data-logger and short-term relief.

2) One observer on duty whenever the airgun array is operating, day or night, and beginning at least 30 minutes prior to ramp-up of the array. Individual watches should not last longer than 4 hours.

3) From the vantage point on the vessel with the best view of the safety zones, the observer scans the water immediately around the vessel, concentrating on the area within the safety zones. Data on all observations made within these areas should be recorded.

4) Observers have authority to require shut down of the airgun array whenever marine mammals are observed in a safety zone.

5) For daylight observations, provide observers with 7x50 reticulated binoculars. Conduct nighttime observations using equipment previously demonstrated to be effective in monitoring the presence of marine mammals in the safety zone at night.

The HESS workshop panel indicated that *"continuous operation (24 hours a day) of the survey would serve to complete the survey as quickly as possible. However, operations at night involve a trade-off regarding the ability to visually detect animals in the study area and the advantages of achieving continuous operation. There is a possibility that night vision could be enhanced through thermal and acoustical recognition. Night operation requires a case-by-case evaluation. Factors to consider include seasonality (hours of daylight, weather, migration patterns), priority of animals of concern, air quality, fishing impacts, and economics."*

6) When operating under conditions of reduced visibility due to adverse weather conditions, operations may continue unless, in the judgement of the shipboard observers, the safety zone cannot be adequately monitored and observed marine mammals densities have been high enough to warrant concern that an animal is likely to enter the safety zone. Observers have the authority to permit operations to resume or continue under reduced visibility conditions, based on periodic reevaluation that takes into account the densities of observed marine mammals and variations in visibility allowing for intermittent monitoring of the safety zone

To strengthen the authority of observers to require shutdown, more specific guidance regarding shutdown criteria to be applied in any specific project should be specified by the National Marine Fisheries Service in the proposed authorization. Such project-specific criteria may include the probabilities that individuals of particular species may enter the safety zone.

To address the ongoing concerns about the adequacy of existing equipments and its ability to monitor in the safety zone at all times (nighttime and reduced visibility) efforts should be made to test and determine the efficacy of available state-of-the-art equipment. By the next meeting of the

Executive Committee, MMS will report on the efforts to obtain access to and to test equipment that should assist in monitoring for marine mammals during nighttime operations and under conditions of reduced visibility. Examples may include advanced infrared equipment and millimeter waves radar. Consistent with the Approach for Handling New Information Post-HESS Team Process, the Executive Committee would make recommendations to the HESS Team regarding revisions to the protocols.

Conversely, if information becomes available that demonstrates that marine mammals of concern will avoid the safety zone when the vessel is shooting steadily, or that ramp-up methods are effective in moving marine mammals of concern away from the safety zone, it may be possible to remove the conditional requirements that an array be shut down at times of reduced visibility.

4.2.4.2 Safety Zone Monitoring Plus Data Collection

In addition to safety zone monitoring, data collection should be conducted during seismic surveys lasting 7 days or longer (medium to multiple surveys; Table 1) or whenever first- or second-priority species (except for the elephant seal) are present in or near the survey area (Appendix 5). Data collection would involve the recording of observational data on all marine mammals sighted from the seismic vessel, both within and beyond the safety zone(s). This would include information on the species, numbers, and behavior of the observed animals; any behavioral responses to the seismic survey activities; and, if required by the conditions of an Incidental Harassment Authorization (IHA), estimates of the numbers of animals "taken" by harassment. This level of effort will include the following requirements:

1) A minimum of three observers. All observers should be certified by NMFS as marine mammal observers.

2) One observer on duty at all times during daylight hours and at night whenever the airgun array is operating, beginning at least 30 minutes prior to scheduled ramp-up of the array (4-hour watches).

3) During daylight, the observer scans the area around the vessel from the highest practical vantage point; at night, the observer scans the area in and near the safety zones. The information collected should include data such as species, numbers, behavior, distance from the seismic vessel, and direction of movement. NMFS is currently standardizing its methodology for shipboard data collection. When available, this standard methodology should be adopted for ship-based observations during seismic operations. A copy of the observation database should be provided to MMS for analysis and archival.

4) Observers have authority to require shut down of the airgun array whenever marine mammals are observed in a safety zone.

5) For daylight observations, provide observers with 7x50 reticulated binoculars. Conduct nighttime observations using equipment previously demonstrated to be effective in monitoring the presence of marine mammals in the safety zone at night.

The HESS workshop panel indicated that *"continuous operation (24 hours a day) of the survey would serve to complete the survey as quickly as possible. However, operations at night involve a trade-off regarding the ability to visually detect animals in the study area and the advantages of achieving continuous operation. There is a possibility that night*

vision could be enhanced through thermal and acoustical recognition. Night operation requires a case-by-case evaluation. Factors to consider include seasonality (hours of daylight, weather, migration patterns), priority of animals of concern, air quality, fishing impacts, and economics."

6) When operating under conditions of reduced visibility due to adverse weather conditions, operations may continue unless, in the judgement of the shipboard observers, the safety zone cannot be adequately monitored and observed marine mammals densities have been high enough to warrant concern that an animal is likely to enter the safety zone. Observers have the authority to permit operations to resume or continue under reduced visibility conditions, based on periodic reevaluation that takes into account the densities of observed marine mammals and variations in visibility allowing for intermittent monitoring of the safety zone

To strengthen the authority of observers to require shutdown, more specific guidance regarding shutdown criteria to be applied in any specific project should be specified by the National Marine Fisheries Service in the proposed authorization. Such project-specific criteria may include the probabilities that individuals of particular species may enter the safety zone.

To address the ongoing concerns about the adequacy of existing equipments and its ability to monitor in the safety zone at all times (nighttime and reduced visibility) efforts should be made to test and determine the efficacy of available state-of-the-art equipment. By the next meeting of the Executive Committee, MMS will report on the efforts to obtain access to and to test equipment that should assist in monitoring for marine mammals during nighttime operations and under conditions of reduced visibility. Examples may include advanced infrared equipment and millimeter waves radar. Consistent with the Approach for Handling New Information Post-HESS Team Process, the Executive Committee would make recommendations to the HESS Team regarding revisions to the protocols.

Conversely, if information becomes available that demonstrates that marine mammals of concern will avoid the safety zone when the vessel is shooting steadily, or that ramp-up methods are effective in moving marine mammals of concern away from the safety zone, it may be possible to remove the conditional requirements that an array be shut down at times of reduced visibility.

4.2.4.3 Additional Data Collection

Under certain circumstances, such as during longer, more extensive surveys, it may be considered advisable to provide for a second observer boat. Depending on the circumstances, this could be done as part of the a monitoring and data collection aerial survey effort (see Section 4.2.5.2). This measure is recommended for consideration under these circumstances, rather than as a standard monitoring measure.

This provision could involve deployment of two additional observers aboard a second vessel to conduct daylight observations in the vicinity of the seismic operations (area, search pattern, duration of observations, and frequency to be determined). This could involve either the scout boat or a separate, designated vessel.

4.2.5 Aerial Surveys

In general, the objectives of aerial surveys conducted in conjunction with seismic operations are: 1) to obtain pre-survey information on the numbers and distribution of marine mammals in the seismic survey area; 2) to document changes in the behavior and distribution of marine mammals in the area during seismic operations; and, in some cases, 3) to obtain post-survey information on marine mammals in the survey area to document whether detectable changes in numbers and distribution have occurred in response to the seismic operations.

For seismic surveys off southern California, two types of aerial surveys, identified as monitoring and research surveys, are recommended. Table 2 summarizes the types of aerial surveys that are recommended for four identified seismic survey scenarios. These scenarios include small (0-6 days), medium (7-15 days), large (16-30 days), and multiple (31+ days) surveys. Aerial survey types are described as follows:

1) Monitoring - Conducted to determine if seismic operations are having a detectable, negative effect on marine mammal populations. Examples might include disruption of a species' migration, or exclusion of a species from an important feeding area. This type of survey would focus on a specific area where sensitive species were known to be present. Animals within the zone of harassment would also be documented.

Thus, such aerial surveys are the most effective when the marine mammal species of interest are: a) migrating along a more-or-less well-defined corridor (e.g., gray whales along Pacific coast); or b) seasonally concentrated in an area for important biological purposes, such as feeding or reproduction (e.g., blue and humpback whales off southern California).

2) Monitoring and Data Collection - Conducted to document the numbers and distributions of marine mammals in an area of seismic operations, in order to obtain information on changes in behavior and distribution of species in the area and to estimate the number of animals "taken" within the entire seismic survey area.

All aerial surveys should be flown in a two-engine, fixed-wing aircraft. At a minimum, the survey crew should consist of two observers, one data recorder/observer, and a pilot. Surveys should be flown at an altitude of 1000' ASL and a speed of 100 kts. Standard equipment should include a GPS navigational system tied to an onboard computer and an intercom system connecting all crew members.

NMFS is currently standardizing its methodology for data collection during aerial surveys. When available, this standard methodology should be adopted for aerial surveys flown in conjunction with seismic operations. All observers should be certified by NMFS as marine mammal observers.

The aerial survey grid to be flown will be specific to each seismic survey operation. The pattern of transect lines should maximize the area within the seismic study area that can be searched effectively for marine mammals during a one-day flight series.

4.2.5.1 Monitoring Surveys

For future seismic surveys in the southern California study area, aerial monitoring surveys could most profitably be undertaken and are recommended for seismic surveys lasting 7 days or longer

(medium to multiple surveys; Table 2) when marine mammals that have been identified as first- and second-priority species of concern (except for the elephant seal; see below) are known to be present in substantial numbers in or near the survey area. These periods include, but are not restricted to:

1) during the gray whale migration period (approximately mid-December through mid-May); and

2) when blue and humpback whales are present and foraging in the Santa Barbara Channel and Santa Maria Basin (roughly June to October). This probably would also be the period of greatest fin whale abundance in these waters.

Monitoring surveys of elephant seals and third-priority species would be less productive. Elephant seals, identified as second-priority species, are abundant in local waters, but their behavior at sea (diving deeply and spending up to 90 percent of their time submerged) makes them very difficult to survey from the air. The third-priority odontocetes and pinnipeds are generally common and widely distributed through area waters during most months of the year. It is unlikely that aerial surveys would be able to detect significant changes in numbers and distribution of these species, thus, aerial surveys targeting these populations would not be recommended. Thus, aerial surveys targeting third-priority species would not be recommended unless indicated by future information on numbers and distribution in the area of interest.

In summary, although termed monitoring surveys, these flights also would provide a mechanism for mitigating potential effects on marine mammals; would focus on specific, first- or second priority species; and would be conducted over a limited area.

Monitoring survey design should include the following:

1) At least one aerial survey would be flown prior to the beginning of seismic operations (within one week of start-up of pre-testing of airguns and streamers on-site). This survey would establish a baseline for the numbers and distribution of the species of concern in the area, and, possibly, identify areas of particular sensitivity.

2) One or more surveys would be flown during the seismic operations and the actual survey grid should be determined on a case-by-case basis, depending on factors such as the length of the planned seismic operations, the timing and location of the initial survey activities, the numbers and distribution of priority species in the survey area, and the results of the pre- and first surveys. Surveys would focus on areas where sensitive species were known or predicted to be present.

The protocol for these surveys could also include pre-determined thresholds for changes in the behavior of the target species, which could trigger additional survey effort or suspension of seismic operations.

4.2.5.2 Monitoring and Data Collection Surveys

In contrast to the straight monitoring aerial surveys described in section 4.2.5.1, the primary purpose of monitoring and data collection aerial surveys would be research--the collection of information intended to aid in the assessment of potential, large-scale effects on the relative distribution and abundance of marine mammals in the ensonified area. As a result, these surveys

would be designed to detect statistically significant changes in those parameters. Such surveys could be flown when seismic operations are conducted during periods and in areas where first- and second-priority species are not expected to be present, but where the length of the planned activities would make it difficult to predict changes in marine mammal distribution and abundance in the area over the course of operations (i.e, during multiple surveys lasting 60 days or longer; Table 2). Rather than focus on specific species, these surveys would encompass all marine mammals in the area. They would also involve coverage of a wider area than monitoring surveys, including the area of seismic operations and, for comparison, a control area of similar size and species composition, located outside the zone of potential harassment defined for that seismic survey.

The basic monitoring and data collection aerial survey design would be similar to that of the monitoring surveys and would include:

1) At least one aerial survey would be flown prior to the beginning of seismic operations (within one week of start-up of pre-testing of airguns and streamers on-site) and one following (within one week after the end of operations).

2) Several surveys would be flown during the seismic operations, with the number and survey grid to be determined on a case-by-case basis, depending on factors such as the overall length of the planned seismic operations, the timing and location of survey activities, and the results of previous surveys.

4.2.6 Passive Acoustic Monitoring

Considering the current development of passive acoustic monitoring technology, and the substantial expenses involved in deploying such systems, passive acoustic monitoring is not recommended for inclusion in the mitigation protocol. However, it is recognized that passive acoustic monitoring methods may be incorporated into the protocol in the future, as more feasible systems become available.

There is one partial exception to this recommendation. A recent study (Barlow and Taylor, 1997) indicates that sperm whales may be detected much more effectively by a towed passive acoustic array than by shipboard observers. Thus, if there is evidence indicating that sperm whales may be present in substantial numbers in an area proposed for a seismic survey, the use of passive acoustic monitoring should be considered.

4.2.7 Other Recommendations

No other mitigation or monitoring methods are recommended for inclusion in the protocol at this time. Again, this may change as new information and/or monitoring technology becomes available.

Table 1. Levels of shipboard monitoring recommended for seismic surveys conducted off southern California.

Scenario Type	Duration	*Monitoring Type*	*Monitoring Trigger*
Small Survey	0-6 days	Safety Zone Monitoring	All surveys.
		Data Collection	If first- or second-priority species are present.[1]
Medium Survey	7-15 days	Safety Zone Monitoring and Data Collection	All surveys.
		Passive Acoustic Monitoring	If sperm whales are present.[2]
Large Survey	16-30 days	Safety Zone Monitoring and Data Collection	All surveys.
		Passive Acoustic Monitoring	If sperm whales are present.[2]
Multiple Surveys	31+ days	Safety Zone Monitoring and Data Collection	All surveys.
		Passive Acoustic Monitoring	If sperm whales are present.[2]

[1]First-priority species currently are identified as gray, blue, humpback, and fin whales. The second-priority species to be considered include the sperm whale and the remaining baleen whale species (but exclude elephant seals).

[2]Passive acoustic monitoring is not generally recommended. However, if sperm whales are known to be present in substantial numbers in the seismic survey area, the use of passive acoustic equipment for monitoring should be considered.

Table 2. Types of aerial surveys recommended for seismic surveys conducted off southern California.

Scenario Type	Duration	Monitoring Type	Monitoring Trigger
Small Survey	0-6 days	None	
Medium Survey	7-15 days	Monitoring	If first- or second-priority species are present.[1]
Large Survey	16-30 days	Monitoring	If first- or second-priority species are present.[1]
Multiple Surveys	31+ days	Monitoring and Data Collection	

[1]First-priority species currently are identified as gray, blue, humpback, and fin whales. The second-priority species to be considered include the sperm whale and the remaining baleen whale species (but exclude elephant seals).