

pinnipeds), is estimated as 300 m (984 ft).

Vessel-based observers will monitor marine mammals in the vicinity of the arrays. LDEO proposes to power-down the seismic source if marine mammals are observed within the proposed safety radii. Also, LDEO proposes to use a ramp-up procedure when commencing operations using the 20-gun array. Ramp-up will begin with the smallest gun in the array (80 in<sup>3</sup> for the standard array and 145 in<sup>3</sup> for the augmented array), and guns will be added in a sequence such that the source level of the array will increase at a rate no greater than 6 dB per 5-minute period over a total duration of about 25 minutes. Please refer to LDEO's application for more detailed information about the mitigation measures that are an integral part of the planned activity.

#### *Operational Mitigation*

The directional nature of the airgun array to be used in this project is an important mitigating factor, resulting in lower sound levels at any given horizontal distance than would be expected at that distance if the source were omnidirectional with the stated nominal source level. Because the actual seismic source is a distributed sound source rather than a single point source, the highest sound levels measurable at any location in the water will be less than the nominal source level.

#### *Proposed Safety Radii*

Received sound levels have been modeled for the 20-gun array. Based on the modeling, estimates of the 190-, 180-, 170-, and 160-dB re 1  $\mu$ Pa (rms) distances (safety radii) for these arrays have been provided previously in this document.

Airgun operations will be suspended immediately when cetaceans are seen within or about to enter the appropriate 180-dB (rms) radius, or if pinnipeds are seen within or about to enter the 190-dB (rms) radius. These 180- and 190-dB criteria are consistent with guidelines listed for cetaceans and pinnipeds by NMFS (2000) and other guidance by NMFS. A calibration study was conducted prior to these surveys to determine the actual radii corresponding to each sound level. These actual radii will be implemented for this study. Until then, or if those measurements appear defective, LDEO will use a precautionary 1.5 times the modeled 180-dB (cetaceans) and 190-dB (pinnipeds) radii predicted by the model as the safety radii.

#### *Mitigation During Operations*

The following mitigation measures, as well as marine mammal monitoring, will be adopted during the proposed seismic survey program, provided that doing so will not compromise operational safety requirements: (1) Speed or course alteration; (2) power-down procedures; (3) shut-down procedures; and (4) ramp-up procedures.

#### **Course Alteration**

If a marine mammal is detected outside the safety radius and, based on its position and the relative motion, is likely to enter the safety radius, the vessel's speed and/or direct course will be changed in a manner that also minimizes the effect to the planned science objectives. The marine mammal activities and movements relative to the seismic vessel will be closely monitored to ensure that the marine mammal does not approach within the safety radius. If the mammal appears likely to enter the safety radius, further mitigative actions will be taken, i.e., either further course alterations or power-down of the airguns.

#### **Power-down and Shut-down Procedures**

If a marine mammal is detected outside the safety radius but is likely to enter the safety radius, and if the vessel's course and/or speed cannot be changed to avoid having the marine mammal enter the safety radius, the airguns will be powered-down before the mammal is within the safety radius. Likewise, if a mammal is already within the safety zone when first detected, the airguns will be powered-down immediately. A power-down involves decreasing the number of airguns in use such that the radius of the 180-dB zone is decreased to the extent that marine mammals are not in the safety radii. A power-down may also occur when the vessel is moving from one seismic line to another.

For the power-down procedure, one airgun (either 80 or 145 in<sup>3</sup>) will be operated during the interruption of seismic survey. Airgun activity (after both power-down and shut-down procedures) will not resume until the marine mammal has cleared the safety radii. The animal has cleared the safety radii if it is visually observed to have left the safety radii, or if it has not been seen within the radii for 15 min (small odontocetes and pinnipeds) or 30 min (mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales).

If a cetacean is detected close to the airgun array during a power-down,

modeled safety radii for a single gun will be maintained. If the standard 20-gun array is used, the single gun that will be firing is 80 in<sup>3</sup>, and for the augmented array, it is 145 in<sup>3</sup>. The safety radii for the larger 145 in<sup>3</sup> gun will be used for mitigation purposes. Since no calibrations have been done to confirm the modeled safety radii for this single gun, conservative (1.5 times the safety radius) radii will be used: 48 m or 158 ft (the conservative radius is 72 m or 236 ft) for cetaceans, and 17 m or 56 ft (the conservative radius is 26 m or 85 ft) for pinnipeds. If a marine mammal is seen within the appropriate safety radius of the array while the guns are powered-down, airgun operations will be shut-down. Airgun operations will not resume until the marine mammal is outside the safety radius.

#### **Ramp-up Procedure**

A "ramp-up" procedure will be followed when the airgun array begins operating after a specified-duration period without airgun operations. Under normal operational conditions (vessel speed of about 4 knots or 7.4 km/hr), the *Maurice Ewing* would travel 900 m (3117 ft) in about 8 minutes and a ramp-up would be required after a power-down or shut-down period lasting 8 minutes or longer if the *Ewing* tows a 20-airgun array. Based on the same calculation, a ramp-up procedure would be required after a 6 minute period if the speed of the source vessel was 5 knots. During the ramp-up procedures, the safety zone for the full-gun array will be maintained.

If the airguns are started up at night, two marine mammal observers will monitor for marine mammals near the source vessel for 30 minutes prior to start up of airgun operations and during the subsequent ramp-up procedures. If the safety radius has not been visible for that 30 minute period (e.g., during darkness or fog), ramp-up will not commence unless at least one airgun was operating during the interruption of seismic survey operations.

#### **Monitoring and Reporting**

LDEO proposes to conduct marine mammal monitoring of its 2003 seismic program near Bermuda in order to satisfy the anticipated requirements of the IHA.

#### **Vessel-based Visual Monitoring**

At least two vessel-based observers dedicated to marine mammal observations will be stationed aboard LDEO's seismic survey vessel for the seismic survey near Bermuda. At least one experienced marine mammal observer will be on duty aboard the seismic vessel, and observers will be