

down if marine mammals are observed in or about to enter the safety radii. If the airguns are ramped-up at night, two marine mammal observers will monitor marine mammals near the source vessel for 30 minutes prior to ramp-up using night vision devices.

Proposed Safety Radii

Received sound levels have been modeled for the 20-gun arrays. Based on the modeling, estimates of the 190-, 180-, 170- and 160-dB re 1 μ Pa (rms) distances for these arrays have been provided in the application. Airgun operations will be powered-down (or shut-down) immediately when cetaceans or pinnipeds are seen within or about to enter the appropriate 180-dB (rms) or 190-dB (rms) safety radius, respectively. These 180- and 190-dB criteria are consistent with guidelines for onset of level A harassment of cetaceans and pinnipeds by NMFS (2000) and other guidance by NMFS.

Mitigation During Operations

The following mitigation measures, as well as marine mammal monitoring, will be adopted during the proposed Mid-Atlantic seismic surveys, 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.

Airgun operations will be suspended when marine mammals are observed within, or about to enter, designated safety zones, where there is a possibility of Level A harassment.

Course Alteration

If a marine mammal is detected outside the appropriate 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 shutdown of the airguns.

Power-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. For the power-down procedure for the 20-gun array, one 80 in³ airgun 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 zone. An animal will be considered to have cleared the safety zone if it is visually observed to have left the safety zone, or if it has not been seen within the zone for 15 min (small odontocetes, including delphinidae, and pinnipeds) or 30 min (mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales).

Shut-down Procedures

If a marine mammal is detected close to the airgun array during a power-down, modeled safety radii for a single gun will be maintained. If the 20-gun array is used, the single gun that will be firing is 80 in³. 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: 54 m (177 ft) for cetaceans, and 20 m (66 ft) for pinnipeds. If a marine mammal is seen within the appropriate safety radius of the array when the air guns have already been powered-down, airgun operations will be shut-down.

Ramp-up Procedure

A "ramp-up" procedure will be followed when the airgun arrays begin operating after a specified duration without airgun operations. Under normal operational conditions (vessel speed 4 knots, or 7.4 km/hr), a ramp-up would be required after a power-down or shut-down period lasting about 8 minutes or longer if the Ewing was towing the 20-gun array. At 4 knots, the source vessel would travel 900 m (2953 ft) during an 8-minute period. If the towing speed is reduced to 3 knots or less, as sometimes required when maneuvering in shallow water, it is proposed that a ramp-up would be required after a "no shooting" period lasting 10 minutes or longer. At towing speeds not exceeding 3 knots, the source vessel would travel no more than 900 m (3117 ft) in 10 minutes. 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.

Ramp-up will not occur if the safety radius has not been visible for at least

30 min prior to the start of operations in either daylight or nighttime. 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 one airgun has been maintained during the interruption of seismic activity.

Monitoring and Reporting

LDEO proposes to conduct the following marine mammal monitoring of its 2003 SE Caribbean Sea seismic program.

Vessel-based Visual Monitoring

At least two observers will be based aboard the vessel. At least one experienced marine mammal observer will be on duty aboard the seismic vessel, and observers will be appointed by LDEO with NMFS concurrence. Observers will be on duty in shifts of duration no longer than 4 hours. The second observer will also be on watch part of the time, including the 30-minute periods preceding startup of the airguns and during ramp-ups. Use of two simultaneous observers will increase the proportion of the marine mammals present near the source vessel that are detected. LDEO bridge personnel additional to the dedicated marine mammal observers will also assist in detecting marine mammals and implementing mitigation requirements whenever possible (they will be given instruction on how to do so), especially during operations at night when designated observers will not be on duty.

The observer(s) will watch for marine mammals from the highest practical vantage point on the vessel, which is either the bridge or the flying bridge. On the bridge of the *Maurice Ewing*, the observer's eye level will be 11 m (36 ft) above sea level, allowing for good visibility within a 210° arc. If observers are station on the flying bridge, the eye level will be 14.4 m (47.2 ft) above sea level. The observer(s) systematically scan the area around the vessel with reticle binoculars (e.g., 7 X 50 Fujinon) and with the naked eye during the daytime. At night, night vision equipment will be available (ITT F500 Series Generation 3 binocular image intensifier or equivalent). Laser rangefinding binoculars (Leica LRF 1200 laser rangefinder or equivalent) will be available to assist with distance estimation. If a marine mammal is seen well outside the safety radius, the vessel may be maneuvered to avoid having the mammal come within the safety radius (see Mitigation). When mammals are detected within or about to enter the designated safety radii, the airguns will