

Responses of pinnipeds to acoustic disturbance are variable, but usually quite limited. Effects are expected to be limited to short-term and localized behavioral changes falling within the MMPA definition of Level B harassment.

Mitigation

For the proposed seismic operations in the Hess Deep, a 12-gun array with a total volume of 3721 in³ and a 10-gun array of 3005 in³ will be used. The airguns comprising these arrays will be spread out horizontally, so that the energy from the array will be directed mostly downward. Modeled results for the 10- and 12-gun arrays indicate received levels to the 180 dB re 1 μ Pa (rms) isopleth (the criterion applicable to cetaceans) were 830 and 880 m (2,723 and 2,887 ft), respectively. The radii around the 10- and 12-gun arrays where the received level would be 190 dB re 1 μ Pa (rms) isopleth (lines of equal pressure), the criterion (applicable to pinnipeds), were estimated as 250 and 300 m (820 and 984 ft), respectively. Vessel-based observers will monitor marine mammals in the vicinity of the arrays. A calibration study planned for late May and/or June 2003 in the Gulf of Mexico is expected to determine the actual radii corresponding to each sound level. If the modeled radii have not been verified by the time of the Hess Deep surveys, LDEO proposes to use 1.5 times the 180- (cetaceans) and 190- (pinnipeds) dB radii predicted by the model as the safety radii until the radii have been verified. Thus, during the Hess Deep cruise the proposed safety radii for cetaceans are 1,245 and 1,320 m (4,085 and 4,331 ft), respectively, for the 10- and 12-gun arrays, and the proposed safety radii for pinnipeds are 375 and 450 m (1,230 and 1,476 ft), respectively. LDEO proposes to shut 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. Ramp-up will begin with the smallest gun in the array that is being used (80 in³ for the 10- and 12-gun arrays), 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-minutes.

Operational Mitigation

The directional nature of the two alternative airgun arrays to be used in this project is an important mitigating factor, resulting in reduced 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. Also, the use of the 10- or 12-gun array of 3,005 or 3,721 in³ rather than the largest airgun array that the LDEO's source vessel can deploy (20 airguns totaling almost 8600 in³) is another significant mitigation measure.

Marine Mammal Monitoring

Vessel-based observers will monitor marine mammals near the seismic source vessel during all daylight airgun operations and during any nighttime startups of the airguns. Airgun operations will be suspended when marine mammals are observed within, or about to enter, designated safety zones where there is a possibility of significant effects on hearing or other physical effects. Vessel-based observers will watch for marine mammals near the seismic vessel during daylight periods with shooting, and for at least 30 minutes prior to the planned start of airgun operations. Observers will not be on duty during ongoing seismic operations at night; bridge personnel will watch for marine mammals during this period and will call for the airguns to be shut down if marine mammals are observed in or about to enter the safety radii. If the airguns are started up at night, two marine mammal observers will monitor marine mammals near the source vessel for 30 minutes prior to start up using night vision devices as described later (see Monitoring and Reporting).

Two observers will be stationed on the *R/V Maurice Ewing* during seismic operations in the Hess Deep area. The *R/V Maurice Ewing* is a suitable platform for marine mammal observations. The observer's eye level will be approximately 11 m (36 ft) above sea level when stationed on the bridge, allowing for good visibility within a 210° arc for each observer. The proposed monitoring plan is summarized later in this document.

Proposed Safety Radii

Received sound levels have been modeled for the 10-, 12-, and 20-air gun arrays (but the 20-gun array will not be used during the Hess Deep Project). Based on the modeling, estimates of the 190, 180, 170, and 160 dB re 1 μ Pa (rms) distances (safety radii) for these arrays have been provided previously in this document. Acoustic measurements in shallow and deep water will be taken, in order to check the modeled received sound levels from these arrays. This verification is expected to occur in June 2003 in the Gulf of Mexico. If verification of the safety radii does not occur before the start of the proposed program, then

conservative safety radii will be used during the proposed Hess Deep seismic surveys. Conservative radii will be 1.5 times the distances indicated for the 10- and 12-airgun arrays to be used in the Hess Deep area. Thus, during the Hess Deep cruise the proposed conservative safety radii for cetaceans are 1,245 and 1,320 m (4,085 and 4,331 ft), for the 10- and 12-gun arrays, respectively, and the proposed conservative safety radii for pinnipeds are 375 and 450 m (1,230 and 1,476 ft), respectively.

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 190 and 180 dB criteria are consistent with guidelines listed for pinnipeds and cetaceans 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 Hess Deep seismic survey program and the acoustic verification program, provided that doing so will not compromise operational safety requirements:

(1) Course alteration; (2) Shut-down procedures; and (3) 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, alternative ship tracks will be plotted against anticipated mammal locations. The vessel's direct course and/or speed 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.

Shutdown Procedures

Vessel-based observers will monitor marine mammals near the seismic vessel during daylight and for 30 minutes prior to start up during darkness throughout the program. Airgun operations will be suspended immediately when marine mammals are observed within, or about to enter, designated safety zones where there is a possibility of physical effects, including effects on hearing (based on the 180 and 190 dB criteria specified by NMFS). The