

vertically and spaced no more than five vertical meters apart in all tide conditions. The minimum number of layers must be in accordance with water depth at the subject pile: 0-5 m = 2 layers (1263 cfm); 5-10 m = 4 layers (2526 cfm); 10-15 m = 7 layers (4420 cfm); 15-20 m = 10 layers (6314 cfm); 20-25 m = 13 layers (8208 cfm). The lowest layer of perforated aeration pipes must be designed to ensure contact at all times and tidal conditions with the mudline without sinking into the bay mud. Pipes in any layer must be arranged in a geometric pattern, which will allow for the pile driving operation to be completely enclosed by bubbles for the full depth of the water column.

To provide a uniform bubble flux, each aeration pipe must have four adjacent rows of air holes along the pipe. Air holes must be 1.6-mm diameter air holes spaced approximately 20 mm apart. The bubble curtain system will provide a bubble flux of at least two cubic meters per minute, per linear meter of pipeline in each layer. Air holes must be placed in 4 adjacent rows.

The air bubble curtain system must be composed of the following: (1) an air compressor(s), (2) supply lines to deliver the air, (3) distribution manifolds or headers, (4) perforated aeration pipes, and (5) a frame. The frame facilitates transport and placement of the system, keeps the aeration pipes stable, and provides ballast to counteract the buoyancy of the aeration pipes in operation. Meters are required to monitor the operation of the bubble curtain system. Pressure meters will be installed at all inlets to aeration pipelines and at points of lowest pressure in each branch of the aeration pipeline. Flow meters will be installed in the main line at each compressor and at each branch of the aeration pipelines at each inlet. Gauges will be installed above the water line at the supply barge for engineer's access. A manual recording device will be used to plot variations in meter readings every 30 minutes. If the pressure or flow rate in any meter falls below 90 percent of its operating value, the contractor will cease pile-driving operations until the problem is corrected and the system is tested to the satisfaction of the CALTRANS resident engineer.

Establishment of Safety/Buffer Zones

A safety zone is to be established and monitored to include all areas where the underwater SPLs are anticipated to equal or exceed 190 dB re 1 μ Pa RMS (impulse) for pinnipeds. Also, a 180-dB re 1 μ Pa RMS (impulse) safety zone for gray whales must be established for pile driving occurring during the gray whale

migration season from December through May. Prior to commencement of any pile driving, a preliminary 500-m (1,640-ft) radius safety zone for pinnipeds (California sea lions and Pacific harbor seals) will be established around the pile driving site, as it was for the PIDP. Once pile driving begins, either new safety zones can be established for the 500 kJ and 1700 kJ hammers or the 500 m (1,640 ft) safety zone can be retained. If new safety zones are established based on SPL measurements, NMFS requires that each new safety zone be based on the most conservative measurement (i.e., the largest safety zone configuration). SPLs will be recorded at the 500-m (1,640-ft) contour. The safety zone radius for pinnipeds will then be enlarged or reduced, depending on the actual recorded SPLs.

Observers on boats will survey the safety zone to ensure that no marine mammals are seen within the zone before pile driving of a pile segment begins. If marine mammals are found within the safety zone, pile driving of the segment will be delayed until they move out of the area. If a marine mammal is seen above water and then dives below, the contractor will wait 15 minutes and if no marine mammals are seen by the observer in that time it will be assumed that the animal has moved beyond the safety zone. This 15-minute criterion is based on scientific evidence that harbor seals in San Francisco Bay dive for a mean time of 0.50 minutes to 3.33 minutes (Harvey and Torok, 1994). However, due to the limitations of monitoring from a boat, there can be no assurance that the zone will be devoid of all marine mammals at all times.

Once the pile driving of a segment begins it cannot be stopped until that segment has reached its predetermined depth due to the nature of the sediments underlying San Francisco Bay. If pile driving stops and then resumes, it would potentially have to occur for a longer time and at increased energy levels. In sum, this would simply amplify impacts to marine mammals, as they would endure potentially higher SPLs for longer periods of time. Pile segment lengths and wall thickness have been specially designed so that when work is stopped between segments (but not during a single segment), the pile tip is never resting in highly resistant sediment layers. Therefore, because of this operational situation, if seals or sea lions enter the safety zone after pile driving of a segment has begun, pile driving will continue and marine mammal observers will monitor and record marine mammal numbers and behavior.

Compliance with Equipment Noise Standards

To mitigate noise levels and, therefore, impacts to California sea lions, Pacific harbor seals, and gray whales, all construction equipment will comply as much as possible with applicable equipment noise standards of the U.S. Environmental Protection Agency, and all construction equipment will have noise control devices no less effective than those provided on the original equipment.

Soft Start

It should be recognized that although marine mammals will be protected from Level A harassment by establishment of an air-bubble curtain and marine mammal observers monitoring a 190-dB safety zone for pinnipeds and 180-dB safety zone for gray whales, mitigation may not be 100 percent effective at all times in locating marine mammals. Therefore, in order to provide additional protection to marine mammals near the project area by allowing marine mammals to vacate the area prior to receiving a potential injury, CALTRANS will also "soft start" the hammer prior to operating at full capacity. A "soft start" occurs when the hammer's initial single strikes occur at 10 second intervals for 3-5 minutes, an action which produces approximately 50 percent of the maximum in-air noise level, or 45-55 dB (re 20 microPascal-m). Similar levels of noise reduction is expected underwater. Therefore, contractor will initiate hammering of both the 500-kJ and the 1,700-kJ hammers with this procedure in order to allow pinnipeds in the area to voluntarily move from the area and should expose fewer animals to loud sounds both underwater and above water noise. This would also ensure that, although not expected, any pinnipeds that are missed during safety zone monitoring will not be injured.

Monitoring

Visual Observations

Safety zone monitoring will be conducted during driving of all in-Bay, permanent piles without cofferdams. In addition, area-wide baseline monitoring will be conducted prior to commencement of work that has a potential to result in marine mammal harassment. Monitoring of the pinniped and cetacean safety zones will be conducted by a minimum of three qualified NMFS-approved observers for each safety zone. One three-observer team will be required for the safety zones around each pile-driving site, so that multiple teams will be required if