ATTACHMENT A

Operational Monitoring Program for the Neptune Deepwater LNG Port
Massachusetts Bay Offshore Gloucester, MA

1.0 ICHTHYOPLANKTON MONITORING STUDY DESIGN

1.1 STUDY PARAMETERS

The study is designed to collect site-specific data in the immediate port area over a pre-operational period of one year and an operational period of five years on ichthyoplankton diversity and abundance per volume of water at depths where the seawater intakes will be located. During operational period monitoring, additional collections will be made over the entire water column to ensure that impacts to species that exhibit diurnal vertical migrations are fully accounted for. These data will be analyzed in terms of likely impact to Massachusetts Bay fish populations in two ways—by comparing the population per volume withdrawn with the overall Massachusetts Bay volumes at equivalent depths, and by estimating the EA mortality implied by the entrainment.

Study parameters therefore include time of year and abundance by species of all identifiable finfish and lobster eggs and larvae. Densities of ichthyoplankton in the Port (no./1000 m^3) will be multiplied by estimated volume of water withdrawn (m^3) to estimate the number of ichthyoplankton entrained by each vessel.

Mortality rates for early life stages are generally available for the species of interest in the literature. Larval length data obtained during this monitoring program will be examined to evaluate whether they can be used to refine the mortality rates used in the Equivalent Adult modeling conducted for the Environmental Impact Statement for Northeast Gateway

1.2 STUDY LOCATIONS

One general survey area was used to represent the two buoy sites during preconstruction sampling and the same area will be used during operational monitoring as well. The laboratory methods are designed to ensure that appropriate data are available to develop life stage-specific mortality rates for numerically or ecologically important species. Long-term monitoring of ichthyoplankton for power plants with open water intakes, such as Seabrook Nuclear Power Station located in coastal New Hampshire, has demonstrated that spatial differences in the ichthyoplankton populations in the source water body can not be readily detected even with a Before-After Control-Impact (BACI) sampling design because stations well outside the zone of influence of the intake are hydrologically linked to the intake area. Given the circulation patterns in outer Massachusetts Bay, therefore, additional survey areas would provide no greater resolution of the potential impacts of the Neptune vessels.

The sampling location was defined as a polygon encompassing the two licensed buoy locations. Coordinates for the corners of the polygon are:

Corner	Longitude	Latitude
1 NW	70.3624°	42.2940°
2 SW	70.3624°	42.2630°
3 SE	70.3622°	42.2630°
4 NE	70.3622°	42.2940°

2.3 FIELD METHODS

Sampling will be conducted twice monthly and focus on two depth regimes: the depth zone (approximately 20-40 feet) where the intakes are located, and, hence, that is most vulnerable to withdrawal; and the full water column (within about 15 feet of the bottom, consistent with ECOMON protocols). The collection gear will be towed in an oblique manner through the depth zone. Three pseudo-replicate (sequential) samples will be taken in each depth zone (i.e., intake and full water column), each with a target volume of 300 m^3. Sampling will be conducted during daylight hours as well as at night. Night is defined as the period from 2+ hours after sunset to 2+ hours before sunrise. Daylight is defined as 2+ hours after sunrise to 2+ hours before sunset. Additional samples will be collected during the crepuscular period (i.e., the period from 1 hour before to 1 hour after sunrise and sunset), but will only be analyzed if results from the day and night collections are statistically different (e.g., through numerical classification), suggesting a period of significant vertical migration. The total number of samples collected annually is shown in Table 1.

Table 1. Planned Sampling Effort (number of samples) for Neptune Ichthyoplankton Monitoring Program

Diel Period	Number of Samples
Day	144
Night	144
Crepuscular	144**
TOTAL	288**

** totals exclude samples collected during crepuscular period that are to be archived and processed only if necessary.

Collection gear will be a 1.0 m^2 Tucker trawl, or a similar plankton net that can be opened or closed at depth, equipped with a 0.330 mm mesh net and a calibrated flowmeter. The net will be lowered to the target depth in a closed position and then opened with a messenger activating a double trip release mechanism (DTRM). At the end of the approximate 10- minute tow a second messenger will be sent down the wire to close the net. Pre- and post-deployment flowmeter readings will be recorded. The nets will be washed down using filtered seawater and the contents preserved in 5 to 10 percent buffered formalin. Preserved samples will be transported to the Biological Laboratory for analysis.

A detailed field log will be maintained by the Chief Scientist during each survey. All station locations (starting point of tow) will be recorded using GPS. Water depth, bottom depth for full water column tows, and tidal stage will be recorded. Samples will be logged on standard chain-of-custody forms that will accompany the samples to the laboratory.

2.4 LABORATORY METHODS

All samples collected during daytime and nighttime periods will be processed in the laboratory. Samples collected during the crepuscular periods will be archived until the data analyst determines whether it would be necessary to analyze them. In the laboratory, all eggs and larvae

will be identified to the lowest practical taxon. Subsampling will be allowed so that a minimum of 200 eggs and 100 larvae are identified. For eggs it may be necessary to group some taxa such as Labridae/yellowtail flounder, and hake/fourbeard rockling due to similarities in morphology and spawning season. Larvae are typically identified to the species level. For species that have clearly defined larval life stages (e.g., yolk sac, post-yolk sac, etc.), individuals will be assigned to the appropriate life stage. During the permitting process, 12 species of commercial or ecological importance (Table 2) were identified for impact assessment using Equivalent Adult Loss modeling techniques. Laboratory analysis will include length measurement to the nearest 0.5 mm will be made for these species, and any other abundant species, because length is a necessary parameter for estimating mortality rates for larvae. In addition, if lobster larvae are present in the samples, they will be enumerated by life stage.

Table 2. Fish species for which the Port area has been designated Essential Fish Habitat for larvae.

Common Name	Scientific Name
Atlantic cod	*Gadus morhua*
Atlantic herring	*Clupea harengus*
Atlantic mackerel	*Scomer scombrus*
Butterfish	*Peprilus triacanthus*
Cunner	*Tautogolabrus adspersus*
Haddock	*Melanogrammus aeglefinus*
Hake	*Urophycis* spp.
Pollock	*Pollachius virens*
Sand lance	*Ammodytes* spp.
Silver hake	*Merluccius bilinearis*
Winter flounder	*Pseudopleuronectes americanus*
Yellowtail flounder	*Limanda ferruginea*

Neptune shall provide a detailed QA/QC program for review and approval by EPA and NMFS.

2.5 DATA ANALYSIS

2.5.1 Community Structure

Density of eggs and larvae will be presented as twice-monthly mean abundances (no./1000 m^3). Seasonal patterns will be described using numerical classification techniques. Life history of common species will be discussed in reference to Port construction and operation.

2.5.2 Entrainment Impacts

Twice-monthly mean abundances will be used to calculate the number of individuals (by species, life stage, and size class) that are vulnerable to entrainment by multiplying abundance by intake volume. To place these numbers in perspective, however, it is important to account for the naturally high mortality rates experienced by early life stages of marine organisms. With knowledge of life stage-specific mortality rates for individual species, entrainment losses can be converted to Equivalent Adult losses. The term Equivalent Adults reflects the number of fish that would survive to adulthood (at a defined age) assuming natural mortality rates.

Length measurements obtained during sample analysis will be used to develop regressions of density versus length with the slope of this line representing the mortality rate. If the site-specific samples do not provide sufficient data to estimate mortality rates for each species, values will be derived from the literature.

Ichthyoplankton abundance data will be used to estimate the reduction in reproductive age fish populations caused by entrainment of fish eggs and larvae by Neptune. It will be assumed that 100% of the organisms entrained in the vessel will be killed.