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February 28, 2007

MEMORANDUM

To: Save the Sound
From: Drew A. Carey, Ph.D
Principal Scientist, CoastalVision
RE: Broadwater LNG Project

I have reviewed the Applications and the associated Environmental Impact Statements for three offshore Deepwater Port LNG installations (Gulf Gateway Energy Bridge, Northeast Gateway, and Neptune). These reports were available online through the associated docket numbers referenced in the respective applications.

The purpose of this review was to assess the feasibility of developing an offshore alternative to the Broadwater LNG proposal.

Qualifications

I received a Ph.D in Geology and Marine Ecology from the University of St. Andrews, Scotland in 1983, was an Assistant Professor at Wesleyan University from 1982-1989 and have worked as a marine environmental consultant since 1991. I have served as the principal author on numerous resource reports, EIS sections and monitoring for siting and management of dredged material disposal sites in Long Island Sound, Rhode Island Sound, Narragansett Bay, Buzzards Bay, Massachusetts Bay, and the Gulf of Maine. I have conducted public workshops, public outreach to fisherman and resource users, resource use surveys, scientific surveys, siting feasibility studies, geological, biological and physical oceanographic assessments in Long Island Sound and New England waters since 1982. I have been a technical manager of environmental assessments of dredged material disposal sites in the DAMOS Program as a consultant to the New England District U.S. Army Corps of Engineers since 1991. I am familiar with the processes of: scoping, conducting site assessments, determining existing conditions, predicting potential impacts, conducting alternatives analysis and recommending mitigation, monitoring and compliance.

Major Conclusions

New technologies and regulations have opened opportunities for establishing deepwater (>150 feet) LNG import facilities. Deepwater facilities offer distinct advantages in safety, minimization of disruption of commercial and recreational activities, minimization of environmental disturbance of critical inshore habitats.

Two technologies are gaining acceptance in offshore locations: floating storage and regasification units and specially built LNG carriers that provide regasification capacity onboard. Either of these technologies could be sited south of Long Island, in deep water outside of marine transit corridors, and connected to an existing underwater gas pipeline (Transco Leidy to Long Island Extension).

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Offshore Technologies

To develop an import facility for Liquefied Natural Gas (LNG) a port must be able to receive Liquefied Natural Gas Carriers (LNGC) and convert the liquefied natural gas to pressurized gas (regasification) suitable for storage or injection into a pipeline.

Offshore LNG ports have been developed in several areas of the world; commercially available technologies converge to five basic designs: seafloor structures; platforms; floating storage and regasification units (FSRU); special purpose vessels (SPV) and special purpose floating platforms. Two of these technologies offer the most feasible alternatives for offshore import facilities in the northeast: FSRU and SPV.

Offshore FSRU

An offshore FSRU has been proposed for Cabrillo Port in Southern California (http://www.cabrilloport.ene.com/description.htm). The Applicant is proposing to construct and operate an offshore floating storage and regasification unit (FSRU) that would be moored in Federal waters approximately 14 miles offshore of Ventura County, California in 2,900 feet of water (Figure 1). LNG would be delivered by LNG carrier to, and offloaded onto, the FSRU; re-gasified; and delivered onshore via two new 21.5-mile long, 24-inch-diameter natural gas pipelines laid on the ocean floor. These pipelines would come onshore near Oxnard, Ventura County. The facilities would be designed to deliver a peak of up to 800 million cubic feet (22.7 million cubic meters) per day.

The offloading facilities would be designed to accommodate LNG carriers ranging in capacity from 2.6 to 5.8 million gallons (100,000 to 220,000 m^3). The FSRU would be permanently moored, and would use a turret system. The FSRU, which would be designed for loading LNG from a side-by-side, moored LNG carrier, would be shaped like another vessel, double-sided, double-bottomed, and 938 feet (286 meters) long and 213 feet (65 meters) wide, with a displacement of approximately 190,000 deadweight tons. The FSRU would store LNG in three Moss spherical tanks. Each tank would have a 24 million gallons (91,000 m^3) LNG storage capacity, and the total FSRU LNG storage capacity would be 72 million gallons (273,000 m^3). A 200-foot- (60.9-meter-) wide right-of-way would be set aside for the construction, with permanent rights-of-way in all offshore areas in which the 24-inch pipelines would be laid. The submarine pipelines would be buried from the 42.7 foot water depth approximately 0.3 mile offshore to its landfall at Ormond Beach within the city limits of Oxnard, and would be installed using the horizontal directional drilling technique. The underground pipelines would pass beneath Ormond Beach east of the Reliant Ormond Beach Generating Station in Oxnard. Gas would be metered at a small facility located inland approximately 0.3 mile (0.48 kilometer). The facility would include a metering station, pig launcher/receiver, and odorant station.

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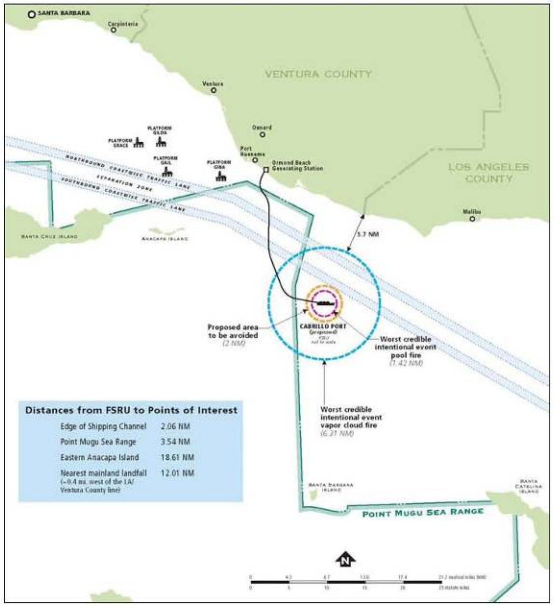

Figure 1. Location of Cabrillo Port FSRU proposal.

Offshore SPV

Several offshore facilities have been proposed to utilize special purpose vessels (SPV). One project has been built (Gulf Gateway) and two others have been approved (Northeast Gateway and Neptune) for installation in Massachusetts Bay (Figures 3 and 4).

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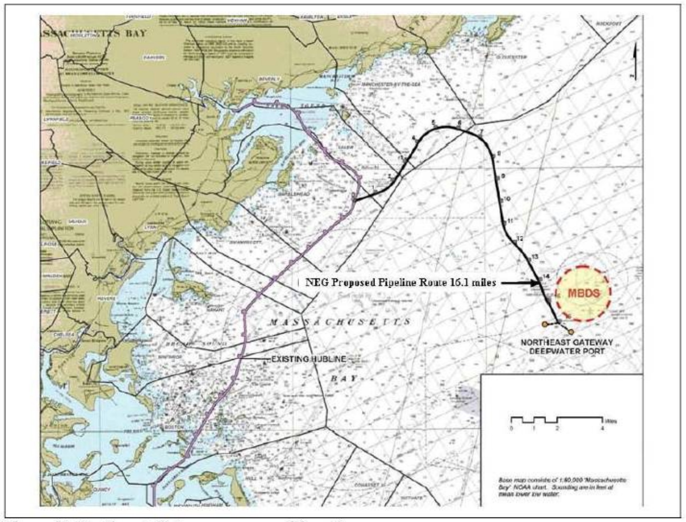

Figure 2. Northeast Gateway proposed location.

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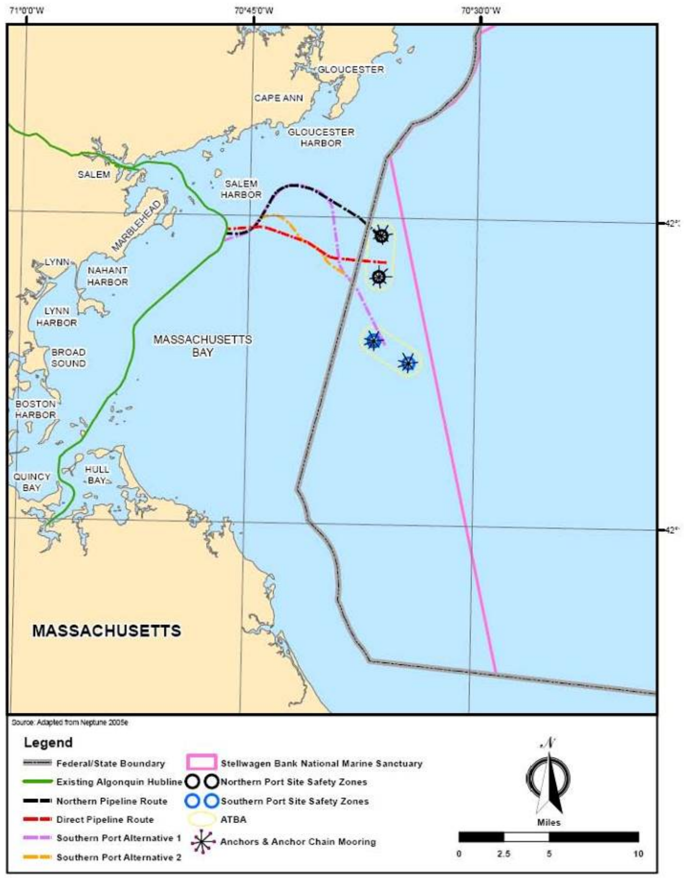

Figure 3. Neptune Project Location

Special purpose vessels (variously referred to as SPV, SRV and EBRV) are standard LNG carriers that have been built to carry equipment for the vaporization of LNG (regasification). Current SPVs are capable of transporting 138,000 m^3 of LNG, future designs could range from 150-250,000 m^3. The SPVs dock at submerged turret loading

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buoys that allow weathervane movement similar to the FSRU facilities. Both Neptune and Northeast Gateway propose two submerged turret buoys separated by 2.5 and 1 nautical mile respectively. The twin buoys permit continuous delivery of natural gas from SPVs, deliveries would be scheduled to occur consecutively. Because regasification occurs on the vessel and there is no in-place storage, offloading can take several days as opposed to the 18 hours or less required for offloading to an FSRU. Northeast Gateway estimates a new tanker every 7-8 days. Although the SPVs propose to use a closed loop heat recovery and exchange system to reduce use of seawater, each vessel will require an intake of about 40 million gallons and a discharge of about 25 million gallons (residual ballast water would be exchanged outside the 200 mile limit). With an estimated 65 arrivals per year, this represents about 2600 million gallons of intake and 1625 gallons of discharge per year.

The submerged buoys are connected with flexible risers to pipeline end manifolds and through a flowline to a pipeline lateral from the Hubline gas pipeline that transits Massachusetts Bay. The SPV operators control valves on the manifold through a control umbilical associated with the riser. The buoy installation is designed with a system of eight suction anchors, each of which disturbs about 100 m^2 of seafloor.

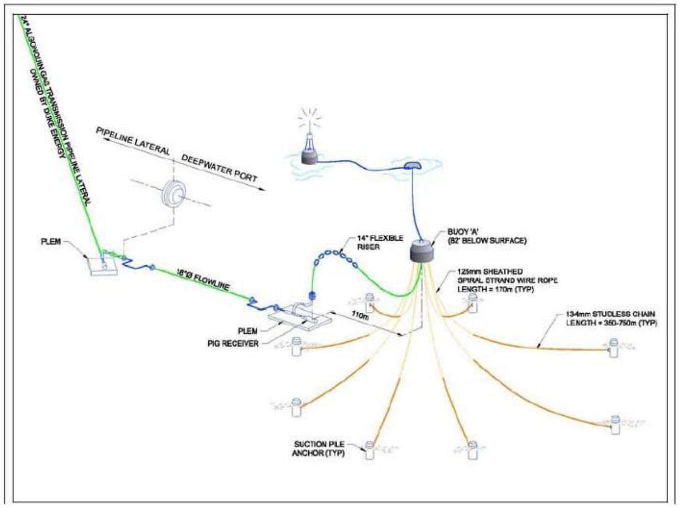

Figure 4. Submerged buoy and flowline arrangement (from NE FEIS).

Relative impacts of deepwater port options

Water depth
Both FSRUs and SRVs can be placed in deeper water due to the flexible riser technology. Optimum placement is in water deeper than 110 ft to accommodate mooring lines and the riser. This consideration is apparently the same for both types of technologies. The technology proposed for the Broadwater FSRU project is a fixed mooring tower in 90 feet of water which is likely to be less satisfactory in open ocean conditions. The fixed mooring tower permits installation in shallow water but would be less suitable in a wave-dominated environment.

With the SRV buoy technology, optimum siting depth is 200 feet; in shallower depths the buoy requires longer mooring lines causing greater impact areas from cable sweep. The operational range for sea conditions is also reduced.

Reliability
FSRUs remain on site for extended periods of time (10-20 years) and do not leave for hurricanes or northeasters. SRVs could be diverted to other ports for offloading in the case of severe storms. FSRUs are limited to 2.0 m significant wave heights for approximately 24 hours for each offloading (Neptune FEIS). SRVs can be moored to the buoys in 3.5 m significant wave heights (have successfully unloaded up to 5 m). In Massachusetts Bay, this results in greater projected downtime for FSRU facilities.

Table 2.1-2. Equivalent Days of Downtime

Operations	Significant Wave Heights	Jan – Apr	May – Aug	Sep – Dec	Annual Average
SRV weather downtime	> 3.5	2	0	1	3
SRV weather uptime	< 3.5	120	122	120	362
FSRU weather downtime	> 2.9	15	2	11	28
FSRU weather uptime	< 2.0	106	120	111	337

Pipeline
Both technologies require connection to a manifold that leads to a connection with an existing submerged gas pipeline or construction of two pipelines to a landfall (Cabrillo Port). The impact of the pipeline is directly related to the length of the pipeline and the habitats through which it must be constructed. In the deep water off California, the pipeline is laid on the surface and buried nearshore. The shelf in New England is dominated by sand and gravel with pockets of silt in depressions such as Stellwagen Basin. Offshore sand and gravel habitats are relatively mobile and under open ocean conditions would be expected to shift during storms. This can lead to burial and uncovering of buried pipelines but it also represents a habitat that is relatively adapted to disturbance. Of all potential habitats, these shelf seafloor habitats are probably the most acceptable for trenching and burial of pipelines. Creation of permanent depressions

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(borrow pits) in these environments has caused some degradation of habitats along the East Coast, but should not be associated with pipeline placement.

Facility

The Neptune SRV facility is projected to permanently affect 63.7 acres due to chain sweep and alter 0.9 acres to artificial substrate from installation of the riser manifold. The Northeast Gateway SRV facility is projected to have similar impacts on the seafloor. If a submerged buoy was sited in 110 feet of water the chain sweep area would be expected to double to 130 acres.

Water Quality

The FSRU proposed for the Broadwater Project is estimated to take in 6.6 mgd of seawater (for ballast and system requirements) except when loading LNG when ballast water would be discharged. This results in water intake and discharge of over 2030 million gallons per year. Desalinization, treated wastewater, gas scrubber, side-shell water curtain and firewater system would add another 247 million gallons for a total of 2277.4 million gallons per year. Each steam-powered LNG carrier would take in 70 million gallons and discharge 57 million gallons. At a projected 118 carriers per year, this would total 8260 million gallons of intake and 6726 million gallons of discharge. The SRV technology is estimated to intake 2600 million gallons and discharge 1625 million gallons of seawater per year. In the case of carriers and SRVs, ballast water taken in would be transported out of the area and exchanged at sea before arriving in a distant port. The potential total impact on ichthyoplankton, phytoplankton and water quality is clearly higher for the FSRU facility because of the combined impacts of carriers and FSRU. An offshore location would provide substantially less impact on planktonic communities than a location in a highly productive estuary.

Offshore Potential

An opportunity for a deepwater port similar to California and Massachusetts exists off the southern coast of Long Island. While the California shelf drops rapidly to a depth exceeding 2500 feet, the New England shelf is a much more gradual gradient, with some localized areas such as parts of Massachusetts Bay with greater depths. A facility located between 5 and 10 miles offshore of Long Island would be in 60-90 feet of water, 25 miles offshore might reach 125 - 150 feet. This means that an FSRU with a mooring tower could be sited within 5-10 miles offshore and either an FSRU or SRV facility with a submerged buoy could be sited between 15-25 miles offshore (or further). There are several locations between traffic lanes that could accommodate a fixed installation and remain well outside the metropolitan area of New York and New Jersey. An FSRU or SRV sited twenty-five miles offshore (between the Ambrose to Nantucket traffic lane and the Hudson Canyon to Ambrose traffic lane) places the facility far enough offshore to eliminate any aesthetic or safety concerns and close to the optimum depth for a submerged buoy and riser system.

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There is a submerged gas pipeline (Transco's Leidy to Long Island Extension, owned by the Williams Corporation) extending from New Jersey to Long Island (Figure 5). This pipeline runs parallel to the town of Long Beach and has a meter and regulator station on Water Street in Long Beach. An FSRU sited offshore could tie into the Transco pipeline between Long Beach and Sandy Hook, New Jersey and supply gas to the metropolitan area. The approved expansion project includes installation of a compressor station in New Jersey and heaters in Long Beach to improve gas flow to Long Island.

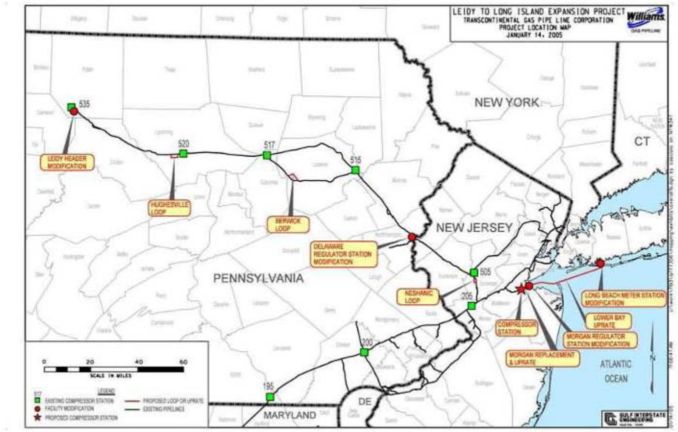

Figure 5. Transco Leidy to Long Island Expansion Project, location of offshore pipeline.

OC6-2 A SRV facility located twenty-five miles offshore of Long Island and tied into the submerged Transco pipeline would provide a feasible alternative to the Broadwater FSRU facility proposed in Long Island Sound. The offshore facility offers advantages in safety, minimal disruption of commercial and recreation marine traffic, access to marine transit lanes for LNG carriers, lower impacts on benthic resources, and lower impacts on planktonic communities.

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OC6-2 Section 4.4.1 of the final EIS addresses the use of an SRV-based system located offshore of Long Island as an alternative to the proposed Broadwater Project. We concluded that an SRV located in the Atlantic south of Long Island could cause fewer marine transportation impacts than the proposed Project but would result in greater environmental impacts than the proposed Project and would not provide LNG storage.

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