Gas on the Water
LNG makes its move. By Paul Sharke, Associate Editor

The race to bring liquefied natural gas onto America's continental shelf and from there to an energy-hungry nation met its first finisher this March. The new LNG tanker Excelsior moored to the underwater buoy of Excelerate Energy's Ener-
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Cabrillo Port: BHP Billiton
Status: Coast Guard and California State Lands Commission have requested further data from Billiton to satisfy the environmental impact statement.
Capacity: 1.5 billion cubic feet per day maximum. The port will operate at an average of 800 million cfd.
Technology: Floating storage and regasification with closed loop vaporizer. The terminal could handle two LNG carriers a week. Turnaround time for a single vessel would be about a day, with the transfer of the LNG taking about 20 hours. LNG carriers and tugs dedicated to Cabrillo Port will be powered by natural gas, as will the port itself.
Supply: LNG will be supplied from BHP Billiton's gas fields on the North West Shelf of Australia.
Location: 14 miles off the coast of Ventura County, Calif., about 21 miles from the nearest population center.
Cost: About $500 million for the port. The full project, including liquefaction facility and marine vessels, will add up to about $5 billion U.S.

Clearwater Port: Crystal Energy
Status: Filed for license, application being revised.
Capacity: 0.8 billion cubic feet per day.
Technology: Project proposes the conversion of an existing oil rig, known as Platform Grace, into a mooring for LNG tankers. Regasification process will produce 40 million gallons of water a year for California. Use of an existing platform lowers construction costs and accelerates project completion by an estimated two years. Vessels carrying LNG will burn natural gas while in the region and while moored.
Location: 14 miles off the California coast. Proposed pipeline will come ashore near Oxnard.
Cost: $300 million.
Strategy: Company has signed an agreement with Woodside Energy, an Australian oil and gas supplier.

Gulf Landing: Shell U.S. Gas & Power
Capacity: 1.0 billion cubic feet per day.
Technology: Gravity-based structure in 55 feet of water using open-rack vaporizer to regasify LNG.
Location: 38 miles off Cameron, La.
Cost: $700 million.

Beacon Port Clean Energy - ConocoPhillips
Capacity: 1.5 billion cubic feet per day.
Technology: Two concrete gravity-based LNG storage tanks.
Location: 56 miles off the Louisiana coast.

Port Pelican: ChevronTexaco
Capacity: 1.6 billion cubic feet per day.
Technology: Gravity-based terminal with open-rack vaporizer.
Supply: ChevronTexaco has supply projects in Angola, Nigeria, and Venezuela.
Location: Gulf of Mexico, 36 miles off Louisiana coast.
Northeast Gateway: Excelerate Energy
Status: Proposed.
Location: 12 miles offshore from Gloucester, Mass.
Technology: Shell and tube vaporizer aboard ship. Turret buoy system similar to that used for offshore oil operations. Buoy hangs 90 feet below surface until retrieved by special tankers. Capacity: 0.4 billion cubic feet per day.
Supply: Spot market with LNG coming from Egypt, Nigeria, Trinidad, Norway, and Qatar.

Neptune LNG: Suez LNG NA
Status: Proposed.
Location: 22 miles northeast of Boston.
Capacity: 0.4 billion cubic feet per day.
Technology: Submerged buoy system. Two buoys will ensure an uninterrupted gas flow by allowing departing and arriving vessels to overlap their deliveries.
Supply: Neptune will receive LNG from Suez’s global LNG supply portfolio.
Cost: $650 million.

Broadwater Energy: TransCanada and Shell U.S. Gas & Power
Status: Announced Nov. 2004; approval expected to take 2 years with service expected by 2010.
Technology: A 1,200-by-180-foot double-hulled floating storage and regasification unit, at its highest point, would sit 100 feet above the waterline. A single mooring would anchor the FSRU to the bottom of Long Island Sound. The FSRU would use a submersed combustion vaporization system to regasify the LNG. Connection to the existing Iroquois pipeline would be through a 10-inch, concrete-coated pipeline 25 miles long.
Supply: Options in the Atlantic basin, Nigeria, and the Middle East.
Capacity: 1.0 billion cubic feet per day.
Location: Long Island Sound midway between New York and Connecticut.
Cost: $700 million to $1 billion.

Main Pass Energy Hub: McMoRan Exploration
Status: Licensure in 330-day Coast Guard review.
Capacity: 2.5 billion cubic feet per day.
Location: 38 miles east of Venice, 16 miles offshore.
Technology: Build on existing structures of a former sulfur operation. Location adjacent to existing shipping lanes and gas pipelines. Gas storage available in 2-mile-wide salt dome beneath existing platforms—28 bcf storage planned initially. Uses soft buoys to moor vessel along existing structure and allow offloading in seas up to 15 feet.
Supply: Atlantic basin suppliers.
Cost: $440 million.

Pearl Crossing: ExxonMobil
Status: Currently working with Coast Guard to develop the draft environmental impact statement.
Capacity: 2.0 billion cubic feet per day.
Technology: Gravity-based structure with regasification facilities.
Supply: Expected to be sourced from Qatar’s North Field. Cost: around $1 billion.

Compass Port: ConocoPhillips
Status: License application filed March 2004, with an environmental impact statement now circulating and a final public hearing scheduled for May 2005.
Technology: Gravity-based structure with open-rack vaporization to regasify the LNG.
Capacity: 1.0 billion cubic feet per day.
Location: 11 miles off Dauphin Island, Ala.

Gulf Gateway Energy Bridge: Excelerate Energy
Capacity: 0.8 billion cubic feet per day.
Technology: Shell and tube vaporizer aboard ship. Turret buoy system similar to that used for offshore oil operations. Buoy hangs 90 feet below surface in water that’s 230 feet deep. Uses two special tankers designed by Exmar and built by Daewoo Shipbuilding. A ship retrieves the buoy and moors to it while releasing the vessel’s contents.
Location: Off the Louisiana coast.
Supply: Spot market with LNG coming from Egypt, Nigeria, Trinidad, Norway, and Qatar.
Cost: $700 million.
A turret loading buoy of the Energy Bridge system as it appears before being submerged in the Gulf of Mexico.

Energy Bridge and, after receiving a Coast Guard go-ahead, began regasifying its contents and injecting them into the nation's pipeline grid. The United States now has five LNG receiving terminals, one more than it had two decades ago.

Energy Bridge tops a list of nearly a dozen offshore terminals in various stages of planning or construction. It joined an even longer list of LNG terminals in various phases of planning or construction trying to do the same thing on land.

In February, the Houston Chronicle reported that Federal Energy Regulatory Commission chairman Pat Wood told a group of energy experts he expected as many as eight LNG receiving terminals would be built by 2010 and that, by 2020, the U.S. could be bringing in as much as a quarter of its gas-about 15 billion cubic feet a day—via LNG.

Offshore terminals will play a role in this total, as Energy Bridge is demonstrating. Placing terminals at sea eliminates some of the concern about transporting LNG near or through populated coastal regions.

Deepwater sites also offer inexhaustible sources of heat for warming LNG back to a gaseous state. There's some concern, however, that using seawater in this manner could jeopardize the lives of the minute sea creatures drifting along at the bottom of the food chain.

Open-rack vaporizers—essentially curtains of heat exchanger tubes—rely on seawater sprayed or flushed over the surfaces of the tubes to flash the cold liquid within them back to gas.

Closed-loop vaporizers, which use another regasifying process known as submerged combustion vaporizing, burn a small amount of natural gas to bring the liquid through a phase change. It's more expensive than the open-rack vaporizer, and mandating its use could mar the economics of LNG enough to make importing it impractical again. At least one company has said that eliminating ORV would spell the end of its plans to build a terminal.

As far as the design of the offshore terminals themselves is concerned, three styles prevail. Energy Bridge deploys a submerged turret buoy arrangement very similar to what the oil industry uses. Special tankers are needed to moor on one. The vessel Excelsior is the first of three such tankers now under way or under construction capable of using the system. Similar turret buoy arrangements have been proposed for sites off coastal New England.

In the turret buoy arrangement, the ships themselves provide LNG storage until all of a vessel's contents have been turned back to gas and sent into the pipeline. Closed-loop vaporization is the common regasifying technique for them.

More traditional proposals built around gravity-based structures are dotting the map of the Gulf of Mexico. These systems would be capable of accepting LNG shipments from any tanker in the fleet since they adapt the same off-loading technology used in terminals shoreside to an open-water environment. These terminals have typically proposed using open-rack vaporizers, and have thus come under the attack of marine biologists as being unfriendly to wildlife. Extensive use of concrete in these terminals could better withstand the chilling effects of an LNG spill than a steel structure.

California, desperate as it is for natural gas, has two terminals of its own on the drawing boards. Both are of the closed-loop vaporizer style, and make nods to the state's air quality standards by requiring the ports, the LNG vessels themselves, and any boats serving them to burn natural gas instead of other fuels while in the vicinity of a plant. One proposal calls for building a brand-new floating regasification terminal, while another proposes to build on an existing, though currently unused, platform.

According to the Coast Guard, whose jurisdiction encompasses LNG terminals in U.S. waters, three terminals have been approved for licensure, seven are under review, and a handful of others remain in the application stage.

**Worldwide Shipments**

Readers can find more information about the leading energy companies' plans and claims for LNG, at their Web sites, which are listed here. At last check, Excelerate's site was under construction.

- www.exxonmobil.com
- www.excelerateenergy.com
- www.conocophillips.com
- www.chevrontexaco.com
- www.crystalenergyllc.com
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