around the world, countries that have large amounts of stranded natural gas are building liquefaction terminals to ship liquefied natural gas (LNG) to growing markets in Europe, Asia and North America. Currently in North America, five regasification terminals have the capacity to import 4.2 billion ft³/d of natural gas. In the USA alone, natural gas demand is expected to increase by 1.5%/y between 2003 - 2025, reaching 30.7 trillion ft³/y in 2025. During the same period, natural gas production in the USA is expected to grow at only 0.6%/y, reaching 21.8 trillion ft³/y by 2025, leaving a significant shortfall. To bridge the widening gap, the USA is expected to increase LNG imports to 8.9 trillion ft³ by 2025. As a result, the percentage of the US natural gas supply provided by LNG is projected to increase from just over 2% in 2003 to more than 20% in 2025.

However, before LNG imports can grow to the level required in 2025, the regasification capacity in North America needs to increase significantly. Numerous projects have been proposed to regulatory authorities throughout North America to meet this growing need. At the beginning of July 2005, 13 regasification projects had been approved in the USA, two projects in Canada, and three more by the government of Mexico. In addition to the 18 approved LNG projects, 21 additional proposals were pending approval. Many more projects are currently in the planning stages, but it is unknown how many of these facilities will actually be built or where they will be sited. As the regulatory process continues its evaluation of these proposals, the demand for natural gas in North America today continues to grow.

history of lng imports into north america

The UK became the first country to receive a shipment of LNG when a converted World War II freighter carried an LNG cargo from Lake Charles, Louisiana, in the USA to Canvey Island in the UK. Then in 1964, the UK began importing LNG from Algeria. Following this success, other import and export terminals were built around the world, including four import terminals in the continental USA and one export terminal in Alaska. Until 2005, when the first offshore facility commenced operations in the Gulf of Mexico, North America still only had these four import terminals, all of which were built between 1971 and 1980. These terminals had a combined peak capacity of 1.2 trillion ft³/y and baseload capacity of 880 billion ft³/y. Following 1979, when peak loads were imported into these facilities, import volumes declined dramatically. The terminals were either mothballed or underutilised for most of the next two decades. In 1999, the opening of an LNG liquefaction plant in Trinidad and Tobago, along with growing demand for natural gas in North America, triggered a resurgence of interest in these terminals. Terminals that had been mothballed were reactivated and expansion projects were planned. As
they were expansions to existing facilities, these projects were on a faster track to obtain the necessary approvals and reach completion well in advance of most of the greenfield projects that began to hit drawing boards throughout North America. This article profiles one of these projects: the Elba Island expansion project.

The Elba Island Expansion Project

The location of the Elba Island terminal is well situated as a hub to markets in the Southeast region of the USA. Most of the LNG currently received at the terminal is exported from Trinidad and Tobago. By increasing sendout and storage capacity, the terminal will have additional flexibility in maintaining a steady flow of natural gas as LNG is regasified and sent into the main pipeline system. In addition to meeting the supply needs of the rapidly growing natural gas demand in the Southeast, Elba Island's imports can also play a key role in providing natural gas to the mid Atlantic, Northeast and Midwest US markets through its access to the interstate pipeline grid.

The Elba Island facility is located near Savannah, Georgia. The terminal is unique in its location on a private 840 acre island in the Savannah River, 15 miles before the river flows into the Atlantic Ocean. LNG ships can access the terminal via a deepwater channel that extends from the ocean to the Port of Savannah. The facility is owned by Southern LNG, a business unit of El Paso Corporation. Access to the island is restricted by a private bridge and the highest level of security is maintained.

The Elba Island expansion project, currently under construction, will increase both the storage capacity and the send out rate of the current import terminal. The current terminal has a baseload capacity of 446 million ft³/d and a peak sendout capacity of 675 million ft³/d. The facility also has 4 billion ft³ of storage capacity. The expansion project will increase baseload capacity by 360 million ft³/d to reach a total baseload capacity of just over 800 million ft³/d. Peakload capacity is being increased by 540 million ft³/d to 1215 million ft³/d. Storage capacity is being increased by approximately 80%, adding 3.3 billion ft³ to reach a total storage capacity of 7.3 billion ft³. The expansion project, which was awarded on a lump sum turnkey basis to CB&I in June 2003, is scheduled to be completed by the end of 2005.

In addition to the storage tank and the sendout system, the scope of the project includes additional boil off compression and recondensing capacity, two LNG ship unloading stations and related civil, mechanical, electrical, control, instrumentation and insulation works. The expansion project includes tie-ins to the existing facilities. Using the lump sum turnkey approach eliminates the hand offs and redundancies that often occur when multiple contractors are engaged on the same project. The result is an integrated project with consistent, safe and reliable performance.

An area of the island was excavated to create room off the river for new docking facilities, creating a more flexible transit passage on the Savannah

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River. The facilities can hold two ships at once and will maximise safety and security while the cargo is unloaded.

**Meeting the schedule**

Due to the growing demand for natural gas in North America, meeting the schedule for this project is critical. One of the key ways to achieve this is for the owner and contractor to work together to develop ways to complete the project safely and reliably on an accelerated schedule. In April 2003, two months before the final contract was signed, Southern LNG gave CB&I early release of engineering so that design work on the tank and mechanical processes could begin even as the final contract was being prepared. In July 2003, as the engineering work continued, CB&I moved onsite and began excavation for the tank foundation. Throughout the project, parallel work was carried out whenever possible, always carefully coordinated so that schedule savings could be realised at every opportunity.

Some other ways of saving time included: using CB&I’s patented Automated Ultrasonic Testing (UT) system to perform weld examinations for the tank’s inner shell; taking advantage of its global procurement capabilities; use of local crews; and teamwork with Southern LNG to identify and resolve issues that could impede the schedule.

**UT weld examinations**

The inner shell of an LNG storage tank is usually constructed from 9% nickel steel, a material that remains ductile at cryogenic temperatures. To construct the inner shell, large plates of 9% nickel steel are welded together. These welds are inspected using a nondestructive examination technique to determine if the welds are acceptable. For LNG tanks, radiographic examination is the nondestructive method typically used to inspect inner tank vertical and horizontal shell weld seams and, until recently, the only method that met code requirements. Austenitic materials have a structure that tends to scatter sound waves, which causes distortions that interfere with ultrasonic results. Recent advances in ultrasonic technology (UT), however, have made it possible to develop a semi automated process designed specifically for the purpose of inspecting austenitic welds, allowing UT to be used as an alternative to radiographic examination.

UT weld inspection has advantages over radiography in the three critical areas of construction: safety, schedule and quality. Safety is improved because UT eliminates the radiation hazards associated with radiography. Schedule and quality are improved as UT provides ‘real time’ results. The UT inspection can commence as soon as the welding is completed and cooled, whereas radiographic inspection does not generally occur until a second shift comes in during the evening or weekends, due to safety concerns for the crew. Once a radiographic examination is performed, the film must be developed and then analysed. The results of the UT process are immediate. If any weld issues surface, they can be addressed immediately.

In the USA, the NFPA 59A code for LNG facilities and the Federal LNG facility standard, 49CFR Part 193, require 100% nondestructive examination of horizontal and vertical inner tank shell weld seams for LNG tanks. Using the UT process for the Elba Island project helped the project stay on schedule and, at the same time, reliably verify the quality of each weld seam. The welding crew achieved a 99.6% acceptance rate for all inner shell welds.

**Global procurement**

Equipment and supplies were purchased from global sources to keep this project on schedule. Having the
resources to locate the necessary materials and equipment and the logistical expertise to ensure on time delivery were essential to the success of this project. Of particular importance was the purchase of sufficient 9% nickel to build the inner shell. This material, which was purchased in Japan, is becoming critically short in supply, and delays or supply shortfalls can impede LNG project schedules. Equipment for this project was purchased throughout the world, such as the ship unloading arms purchased in Germany, valves from Italy and the compressors from Japan. All material and equipment delivery is carefully coordinated to arrive as needed for the phased implementation of the construction schedule.

Local crews
Crews that are familiar with and comfortable in their surroundings can greatly help to expedite a fast track project. The majority of the systems and mechanical crews on the Elba project were local to the Georgia area and, as a result, were able to quickly mobilise onsite. The CB&I model is to use direct hire labour instead of subcontractors, and self perform as much of the work as practical. This approach gives greater control over the safety, quality and schedule of projects. Long term employment opportunities are provided to employees who remain with the company and move from project to project, thus transferring knowledge and experience. Ongoing training and safety programmes keep employee skills tuned. This combination of factors helped keep the Elba Island project on schedule without compromising either safe work practices or the quality of the build.

Addressing potential schedule impediments
Solutions for problems encountered were jointly sought, found and implemented. One situation unique to this project was the poor soil conditions and resulting substantial settlement of structures. The tank, in particular, had to be designed and constructed to allow for the settlement. An elevated pile foundation was designed for this project. Pre-auguring was required for every pile before it could be installed due to the soil. A total of 1600 piles were installed under the tank, creating a foundation suitable to support a tank with 7.3 billion ft³ of LNG in the conditions on the island.

The LNG solution
To date, all major project milestones have been achieved and the project remains on schedule as the final year of the construction activity draws to a conclusion. Electrical power was installed in 2003, the roof of the tank was air raised in October 2004 and by January 2005, all the major pieces of equipment were in place, tested and commissioned. This project, one of many that will increase the amount of LNG that can be imported into North America, is leading the way to provide a solution, not just for North America, where energy is needed, but also for countries that have abundant supplies of natural gas without access to a traditional market via a pipeline grid. As this project reaches its end, LNG is becoming the critical link in providing a global solution to energy supply/demand imbalances around the world.

References