

LNG Peak Shaving



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Engineering Solutions . . . Delivering Results

Comprehensive LNG Peak Shaving Capabilities



For more than 50 years, CB&I has been a leading provider of engineering, procurement and construction services for the liquefied natural gas (LNG) industry encompassing LNG storage, liquefaction, vaporization, and all related equipment, systems and infrastructure. Using a unique, true EPC approach, we provide our customers complete solutions from feasibility studies through commissioning. Our integrated EPC services include:

- Feasibility Studies
- Overall Systems Integration
- Detailed Engineering and Design
- Equipment Specification
- Equipment and Material Supply
- Project Management
- Fabrication
- Modularization
- Construction
- Pre-commissioning
- Plant Start-up
- Operator Training

With more experience than any other contractor, CB&I has become a world leader in the design and construction of LNG peak shaving facilities. Since our first peak shaving facility in 1965, we have been engaged in more than 90 peak shaving related projects.

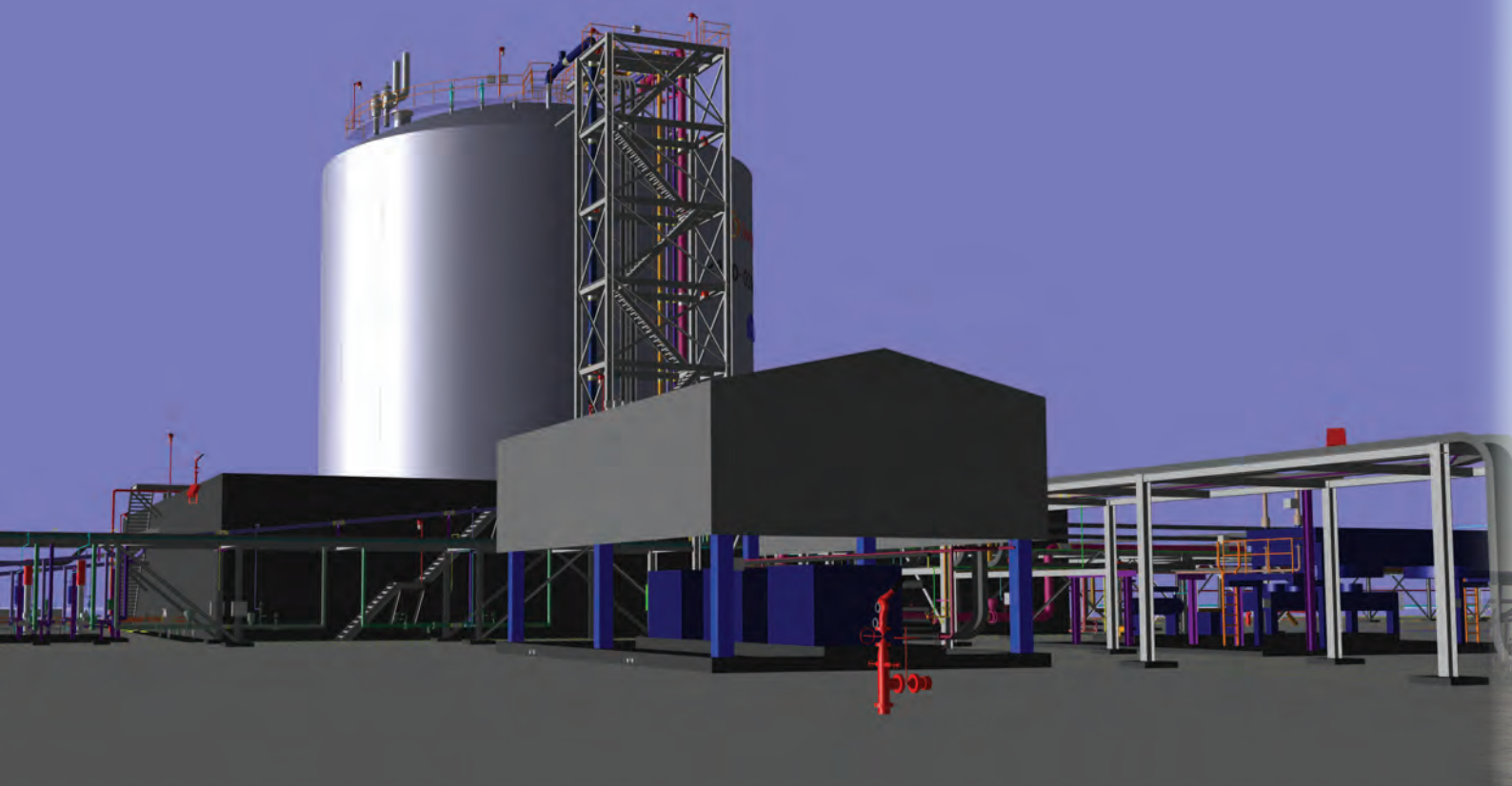
CB&I has experienced and dedicated in-house personnel available to efficiently develop liquefier designs, procure equipment and materials, and execute installation and start-up. By self-performing our own work, we can control costs and shorten project schedules — leading to a reduction in our client's risk while ensuring a cost-competitive project.

CB&I is recognized for having the resources to design and build LNG projects anywhere in the world. We direct-hire and train local field personnel whenever possible, providing a pool of skilled craftsmen who understand our systems and work processes. CB&I is committed to safe work practices and maintains one of the best safety records in the industry. CB&I participates in more than 25 national and international code committees and LNG industry organizations. We also work closely with national regulatory agencies, such as the United States Federal Energy Regulatory Commission, to ensure compliance with applicable codes and standards including NFPA 59A, CSA Z276, EN1473, EN 14620, API 620, and US DOT 49 CFR Part 193.





From Concept...



Capabilities and Capacities

CB&I has designed and built more than 50 LNG peak shaving plants, ranging in liquefaction capacity from 2-20 million standard cubic feet per day (MMSCFD) or 56.6 to 566 thousand standard cubic meters per day ($10^3\text{Sm}^3/\text{d}$), including the largest peak shaving plant in North America with liquefaction capacity of 20 MMSCFD (566 $10^3\text{Sm}^3/\text{d}$), LNG storage capacity of 4 billion standard cubic feet of gas (187,000 m^3 liquid) and sendout capacity of 400 MMSCFD (11,320 $10^3\text{Sm}^3/\text{d}$). Satellite facilities with sendout capacity up to 150 MMSCFD (4,245 $10^3\text{Sm}^3/\text{d}$) have also been successfully built to meet local needs.

Our full scope of capabilities for LNG peak shaving includes:

- Feasibility and FEED studies
- Permitting and siting assistance
- Solutions for gas pretreatment and conditioning
- Liquefaction, LNG storage
- Vaporization and send-out systems
- Self-perform turnkey EPC
- Retrofits, upgrades and expansions
- Truck stations and satellite facilities

to Completion.



Comprehensive Process Engineering Expertise

CB&I's process design group has particular expertise in refrigeration and heat transfer and uses state of the art process simulation tools to optimize engineered solutions. In addition, we have developed a number of proprietary processes and technologies that benefit our LNG customers. The development of effective heat and mass balances and process flow diagrams is assisted by more than 30 in-house design programs. A variety of design and off-design fluid properties are modeled to ensure the selected equipment and process characteristics meet the client's performance expectations.

Development of Piping & Instrumentation Diagrams (P&IDs) is facilitated through software which acts as a single-point entry system where process data can be transferred directly from the designer into the P&ID database. This data is used by downstream disciplines for mechanical, piping and instrumentation design and eventually the client's enterprise management systems. Data as process parameters for equipment and instrumentation is specified to insure performance requirements are met or exceeded.

CB&I's process design group is also responsible for ensuring a plant meets or exceeds environmental and safety requirements. Environmental simulation tools, such as vapor dispersion and thermal radiation modeling software, are used to assist with plant siting and permitting that are instrumental in determining the LNG tank configuration and orientation. Process hazard analysis, including HAZOP and HAZID studies, are embedded in the design methodology resulting in a continuous safety review throughout the design phase.

Innovations/Trends

CB&I's engineering group is staffed with experienced engineers averaging more than 20 years of LNG industry knowledge and who have consistently developed innovative cost effective solutions to meet client needs.

CB&I's LNG milestones include:

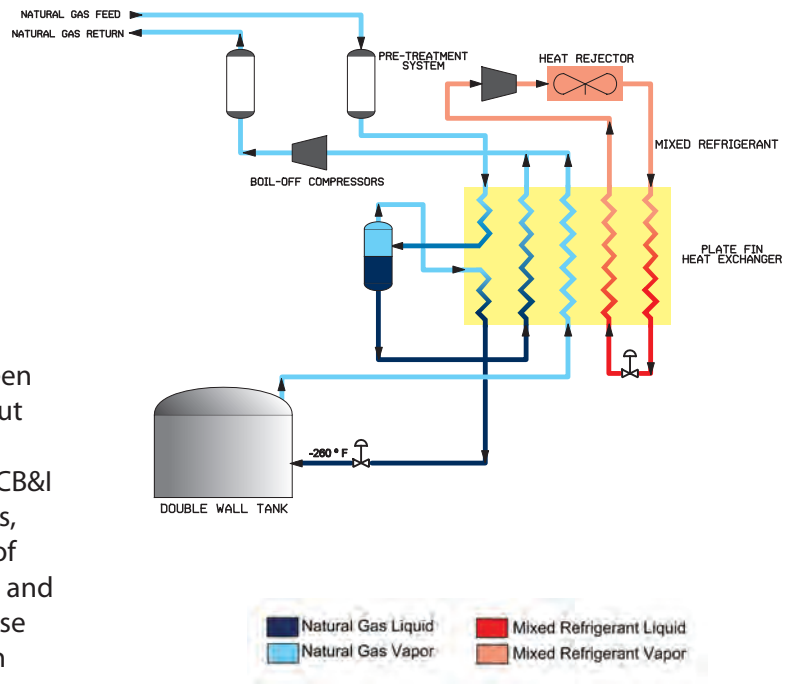
- Designed and built first LNG peak shaving facility in North America
- Designed and built first marine LNG import terminal in North America
- Designed and built the largest peak shaver in North America
- Designed and built the first double wall LNG storage tank
- Designed and built the first full containment LNG storage tank
- Pioneered the use of load bearing foamglass insulation barrier for inner tank
- Pioneered the use of suspended deck insulation system
- Pioneered the use of resilient blanket to reduce perlite compression
- Pioneered the use of an automatic welder for girth welds
- Pioneered the use of Semi-Austenitic UT in lieu of radiographic testing
- Pioneered the technique of dome air-raising of LNG tanks roofs
- Developed proprietary Mixed Refrigerant Loop (MRL®) liquefaction process



CB&I has been in the forefront of recent trends in the LNG industry requiring engineering solutions that include:

- Feed gas conditioning for high levels of CO₂, O₂, and C6+ heavy hydrocarbons
- Expander refrigeration cycles
- Nitrogen refrigeration cycles
- Mixed Refrigerant Loop (MRL) cycles

Our proprietary MRL liquefaction technology has been used in more than 20 peak shaving plants throughout North America. Both reciprocating and centrifugal compressors have been used in plants designed by CB&I with primary driver options that include gas turbines, gas engines and electric motors. We have a variety of MRL heat exchanger configurations including single and split loop MRL. We have also built 12 facilities that use an expander type system. CB&I has three patents on proprietary MRL and expander type cycles.



Mixed Refrigerant Loop Cycle (Split MRL Cycle)



Engineering Solutions... Delivering Results

Concept to Completion

Founded in 1889, CB&I has become an EPC leader, providing single-point services for all aspects of engineering, procurement and construction for LNG peak shaving systems worldwide. We deliver solutions that encompass process and detailed design, feasibility studies, material supply, fabrication, construction, precommissioning, plant start-up and operator training. For more than 50 years, CB&I has consistently provided innovative EPC excellence to the LNG industry.

More than a century of project management experience and established work processes have given CB&I unparalleled expertise to self-perform the work required to take a project from the drawing board to final acceptance. CB&I continues to maintain and add to an established and unequaled reservoir of LNG design, construction and commissioning knowledge and experience.

In addition to LNG peak shaving facilities, CB&I can provide full EPC services for the entire LNG value chain. We are ready with the experience, people and skills to safely deliver your next LNG project. Visit us at www.CBI.com.



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