

# Bigger

isn't always better





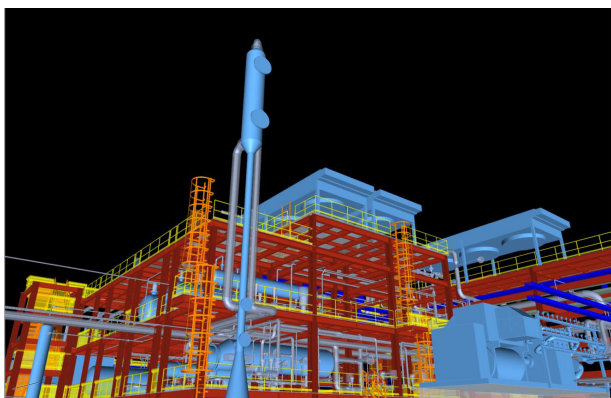


**John Burrow and Laura Musick, Black & Veatch,** outline how a resurgence in the popularity of small scale LNG facilities is meeting the needs of investors concerned about the industry's current state of over-supply.

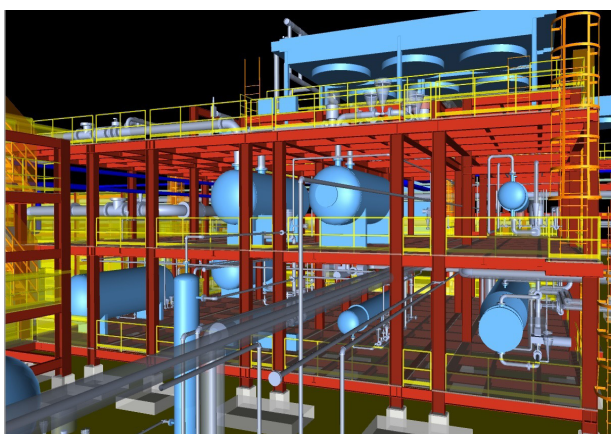
**T**he global LNG industry has matured dramatically since the first significant developments in the 1960s, and over that time there has been many trends come and go. The market has entertained a wide variety of different contract structures, plant capacities, and execution strategies to meet the latest needs of an ever-changing industry. With the current concerns of an over-supplied LNG market, a new trend of small scale LNG or micro LNG has emerged, bringing many new players along with it. For the purposes of this article, small scale LNG will consider facilities with a capacity of 0.3 million tpy or less.

The bar to enter the LNG market as a producer or developer has traditionally been quite high. Projects shifted to a mega train approach to take advantage of economies of scale, but that left small outfits like local utilities or transportation industries unable to compete. The complex liquefaction processes, multifaceted long-term contracts, and billion-dollar price tags left little room for small LNG consumers. Recently, there has been renewed interest in the value of small scale LNG facilities. The simplicity and reduced risk that these facilities bring can neutralise, if not





**Figure 1.** Black & Veatch standard SSLNG 3D model utilising truckable modules.



**Figure 2.** Truck transportable process modules are stacked and cross linked into a contiguous structure.

over-compensate, for the efficiency gains and economies of scale that large baseload LNG plants offer. A smaller capacity lends itself to several clear benefits, which align with investors' interests.

## Can small scale LNG compete?

Small scale LNG facilities provide a number of financial advantages. It is common practice in the LNG market to evaluate the cost of a liquefaction facility on a US\$/tpy basis. When strictly looking at this basis, small scale LNG facilities will almost always have a higher cost of production than a baseload plant; however, one of the major benefits that small scale LNG offers is the significantly lower CAPEX investment required for the plant to reach commercial operation. Many large baseload facilities have been developed over the last decade to produce upwards of 6 million tpy. These facilities carry price tags of tens of billions of US\$ and can include over 500 miles of pipeline. Conversely, a 0.1 million tpy liquefaction facility with limited storage and access to a pipeline could cost less than US\$100 million.

As the old saying goes, time is money. Investors and developers are drawn to projects with a quick return on investment. A second key advantage of small scale LNG facilities is the time to market. The simplicity of these plants allows for a 0.1 million tpy liquefaction facility to reach commercial operation less than two years after the final

investment decision (FID). Using baseload LNG facilities in Australia as an example, it is common for a baseload capacity LNG project to take four years or more to reach commercial operation after FID.

Finally, small scale LNG can offer unmatched flexibility. These units have a significantly smaller footprint than baseload facilities and are easily scalable. Pipeline costs can make or break a project, so the ability to locate a facility near existing infrastructure is critical. Small scale LNG facilities can also be used to replace natural gas pipelines entirely. In situations where terrain or land rights may be challenging, natural gas can be liquefied in a more convenient location and trucked as LNG to the end user. This method, often called a virtual pipeline, has been used successfully in remote areas of China for decades. As LNG use increases globally, this solution will likely become common in other regions as well.

## Standardisation

Standardisation and off-the-shelf designs are a hot topic in the oil and gas industry, and the concept offers many potential benefits. Standardisation can greatly reduce the time and money spent during development stages, as well as offer consistent results, which reduce the project risk. However, it does present its own challenges: how do you safely and effectively design a facility without knowing a feed gas composition, ambient conditions, applicable codes and standards?

While it is nearly impossible to apply a singularly comprehensive facility design to different regions of the world, where there are various feed gas compositions and differing regulatory requirements, a flexible base design can be tailored to meet the unique needs of a specific project. Using its PRICO® technology project experience, design philosophies, commercial experience, FEED and EPC experience, and lessons learned from the execution of more than 20 projects in this small scale range over the last 15 years, Black & Veatch has developed a standardised small scale LNG facility design and execution approach that can optimise project delivery within the small capacity space.

## A standard solution

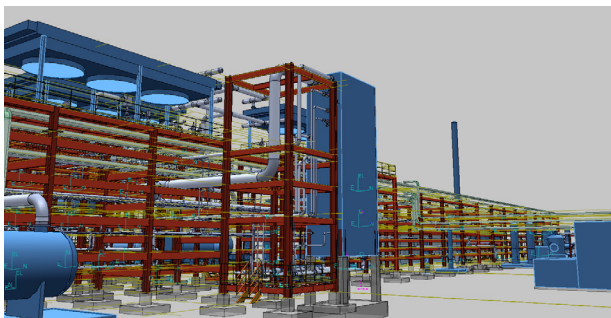
In order to support the rapid project development cycle that small scale LNG typically demands, Black & Veatch has taken the approach of standardising its 0.1 - 0.2 million tpy small scale LNG plant design. Preliminary and FEED-level design works for the standard small scale LNG plant have been conducted up-front to reduce the time to market for these plants. Such activities include process design, equipment specifications, P&ID development, 3D model development, structural and E&I design, and pricing for major equipment and fabrication subcontracts.

## Methods for standardisation

In developing the standardised small scale LNG plant, the following central themes were applied to guide the design work.

## Broad design conditions

Design conditions for Black & Veatch's standard plant, such as gas compositions, gas inlet conditions, and environmental data, have been conservatively selected to ensure the plant will operate over a broad range of conditions and over the small



**Figure 3.** Module design scope includes both process units, pipe racks, and skidded units.

scale LNG capacity range – with no modifications to the plant layout, piping design, or static equipment design. The PRICO SMR is well-suited to this, given its typical wide operating range with regards to gas compositions.

### Targeted upsizing

In the standardised concept, all but the most critical design elements have been fixed for operation over the entire production range of the small scale LNG concept. This requires the targeted and limited upsizing of piping and process equipment – increasing the cost very slightly at this size range in order to benefit from the gains in schedule and flexibility they provide. To move from the low to high end of the small scale LNG capacity range, only a handful of key process equipment pieces need be touched.

### Scope bolt-ons

The plant design was based around a base scope that provides safe and operable facilities for gas treatment, LNG liquefaction, and required utilities. The focus was on providing a lean design that optimises CAPEX, while providing a functional and efficient plant. That said, the plant was designed to accommodate various optional scope items that are standardised bolt-on features that can be added with little to no impact to the design. For example, LNG storage, LNG truck loading, power generation, unit weather-proofing buildings, additional admin buildings, and stair towers may be included or omitted to meet the needs of the project or desires of the client.

### International codes basis

Current design work was conducted using international codes to maximise geographic applicability. For some code jurisdictions, additional design customisation may be required, but given the starting point, this will be minimised.

### Modularisation

These plants are often sited relatively far from established marine transport infrastructure and readily available sources of skilled construction labour. As such, the Black & Veatch standard small scale LNG plant has been designed to maximise modularisation and prefabrication as far as is practical, while accommodating over-the-road transportation. The company's approach is to avoid the common pitfall of breaking a 'typical' stick-build plant design into small modules, which is likely to result in an overall increase in site piping connections, steel connections, and other hook-up works.

The design of Black & Veatch's standardised plant was undertaken with modularisation in mind and from the ground

up, as compact, truckable, stackable modules that minimise site connections and avoid duplicated structural steel. The end result is a simplified, efficient design that aims to streamline installation and move a significant amount of site construction labour away from the project site, to the more controlled environment of the module fabrication yard.

The standardised modules contain process equipment, piping, structural steel, instrumentation, and lighting wired to on-module terminals and trays for homeruns of power cable. In order to reduce site installation costs, modules are designed to be set and stacked using relatively low-capacity cranes. The stacked modules are interconnected with drop-in, prefabricated platforming, resulting in a structure that is operationally comparable to a monolithic structure. In addition to complete modules, skidded equipment, as well as prefabricated pipe and steel, will be utilised to streamline required site works.

### Schedule impact

The use of standardisation in the design of Black & Veatch's standard small scale LNG plant can allow a more rapid completion of the design phase of work. Equipment specifications will require little or no engineering work to be offered out for bid. Coarse HAZOP data is available for use based on currently operating facilities and would only need to be updated with vendor data and client operations inputs.

A 3D design model is already well along in development. Schedule savings of approximately 4 - 6 months may be realised versus a non-standardised design. Modularisation, while it may not directly shorten the project schedule, can serve to de-risk it. Significant amounts of site work move from the construction space to the manufacturing space where production is more predictable, productive, and safe.

### Project cost impact

Standardisation of the small scale LNG plant design provides opportunities for cost savings due to reduced need for engineering, resulting in faster time to market and associated return on investment. Equipment capital costs are generally unaffected by standardisation; however, a fixed and repeatable approach may create opportunities for economy of scale savings that can be passed along to the project. In addition, the lean design approach taken here emphasises equipment manufacturer's standard offerings; these are often a better fit for small scale LNG projects and can eliminate excess cost.

Extensive modularisation, skidding, and prefabrication, while adding some additional structural steel, can serve to de-risk the project costs as the potential for site work over-runs is limited. In addition, the potential exists for cost savings due to labour rate deltas between site and the module fabrication yard. This is, of course, location-specific but bears mentioning when the facility will be located in a high-cost/low-availability labour market.

### Conclusion

Small scale LNG will increasingly provide an opportunity for the development of smaller pockets of stranded gas. Standardisation of these smaller projects will enable the most efficient use of capital and support the faster development cycles that these projects usually demand. Modularisation, when applied from the ground up, can provide an efficient and cost-effective means to install these plants in areas with limited transport infrastructure. **LNG**