LNG INDUSTRY®

Standard and scalable

Published by Will Owen, Editorial Assistant
LNG Industry, Wednesday, 13 February 2019 11:00

David Franklin, AG&P Engineering, USA, looks at the use of standardised, scalable designs to improve efficiencies and increase options for users.

Standardisation has been the hallmark principal for cost reduction since the beginning of the industrial revolution. Engineering, developing and perfecting a standard product that fits a large market sector; finding responsible cost and schedule effective suppliers; and assembling and selling the same product over and over. Suppliers can minimise their costs and risks while reducing the cost to the assembler due to the efficiencies of volume orders, minimising tooling and labour charges, and spreading the engineering, design and procurement outlay over many units. Labour to assemble the final unit can be also be reduced over time as the most cost-effective and efficient ways to assemble supplies and test units are learned. With each successive unit, errors are reduced and quality is improved.

These principals are currently applied in the manufacturing of virtually all consumer products from food preparation, to electronics, to automobiles. Shipyards often use standard LNG carrier designs to minimise costs. LNG carriers are designed to international standards, such as the Oil Companies International Marine Forum (OCIMF) and the Society of International Gas Tanker and Terminal Operators (SIGTTO), among others, for draft, length, manifold sizes and positions, so the interfaces and conditions for loading and discharging LNG are common across the industry.

AG&P is applying these well-established principles to the maximum extent possible to the designs for its innovative LNG regasification facilities. While the site and equipment arrangement may vary, the basic building blocks remain the same. By standardising the regasification train size around the LNG liquid volumetric flow rate, the LNG pump impellers, vaporisers and the cryogenic liquid pipe and valve sizes can be standardised and easily customised. For example, increase the design pressure by changing the pipe class from Class 300 to Class 600. This minimises changes to the PFDs, piping and instrumentation diagrams (P&IDs), equipment data sheets and equipment sizes, and allows suppliers to have pre-approved equipment that can be ordered with minimal engineering input.

Standardisation also applies to instrumentation and control systems, logic, cause and effects, and installation details. This reduces the costs for spare parts inventory and maintenance as the same units are used across several projects. P&IDs, PFDs and module arrangements can be standardised and re-used with minor changes from project to project.

The best way to understand the benefits of standardisation is to review three theoretical projects that have different conditions and show how AG&P's standard regas modules and standardised equipment would be incorporated.

Standard regasification modules

The specifications of AG&P's standard regasification modules are as follows:

- Capacity: 125 million standard ft3/d* (MMSCFD) (250 m^3/hr LNG).
- Type (by heat source):
  - Glycol-water, multi-tube, hairpin shell and tube vaporiser (seawater).
  - Fan ambient vaporiser (ambient air).
  - Water bath vaporiser (natural gas fired).
- Boil-off gas (BOG) compressor: 10 tph at 6 bar (centrifugal).
- Send-out compressor: 10 tph (carbon steel reciprocating).

Project number one

- Land-based (stick-built).
- Required capacity: 350 million standard ft^3/d (750 m^3/hr LNG).
- Natural gas discharge pressure: 30 barg.
- Heat source: seawater.
- Design BOG capacity: 10 million standard ft^3/d (8 tph).
- Sparing: N+1.
- Vaporisers: 4 x 125 million standard ft^3/d (ANSI Class 300 model).
- Retractable low pressure LNG pumps: 4 x 250 m^3/hr discharging at 6 bar for recondenser (two impellers).
- Common vertical static mixer recondenser sized for full liquid flow (3 x 250 m^3/hr) but can receive varying volumes of BOG from the BOG compressor.
- Common high pressure LNG pump suction drum sized for required residence time with retractable high pressure pumps aligned with each LNG regas train. Also acts as phase separator to allow excess BOG to be sent to the send-out compressor.
- Retractable high pressure LNG send-out pumps: 4 x 250 m^3/hr differential head of 26 bar (seven impellers identical to low pressure pump impellers, common shaft diameter, but larger motor).
- Both pump services retractable with common foot valve assemblies, standard pump well diameter, Class 150 head plate for low pressure pump, Class 300 head plate for high pressure pump. Retractable pumps allow for the changing of the pumps, while simultaneously operating the other trains and minimising the number of installed pumps.
- Standard seawater/glycol-water regas modules 4 x 125 million standard ft^3/d each with:
  - Standard multi-tube hairpin shell and tube vaporiser with Class 300 flanges on the tube side.
  - Standard glycol-water pumps.
  - Standard seawater/glycol-water heat exchangers.
  - Standard glycol-water filters on the train.
  - Standard glycol-water expansion drum.
  - Standard control valve stations for the glycol-water and LNG.
  - Standard pipe sizes for seawater, glycol-water, LNG and natural gas.
- BOG compressors: 2 x 10 tph standard.
- Send-out compressor: 2 x 10 tph carbon steel pipeline compressor project specific designed for 6 bar suction and 32 bar discharge (not cryogenic).
- Standard model 4 AGP Z crossover metering skid.

Project number two

- Floating storage and regasification unit (FSRU) (modular).
- Required capacity: 225 million standard ft^3/d (450 m^3/hr LNG).
- Natural gas discharge pressure: 53 barg.
- Heat source: natural gas fuel fired.
- Design BOG capacity: 1 million standard ft^3/d (9 tph).
- Sparing: N+1.
- Vaporisers: 3 x 125 million standard ft3/d (ANSI Class 600 model).
- Retractable low pressure LNG pumps: 3 x 250 m^3/hr discharging at 6 bar for recondenser (two impellers).
- Common vertical static mixer recondenser sized for full liquid flow (2 x 250 m^3/hr), but can receive varying volumes of BOG from the BOG compressor.
- Common high pressure LNG pump suction drum sized for required residence time with retractable high pressure pumps aligned with each LNG regas train. Also acts as phase separator to allow excess BOG to be sent to the send-out compressor.
- Retractable high pressure LNG send-out pumps: 3 x 250 m^3/hr differential head of 26 bar (13 impellers identical to low pressure pump impellers, common shaft diameter, but larger motor).

- Both pump services retractable with common foot valve assemblies, standard pump well diameter, class 150 head plate for low pressure pump, Class 600 head plate for high pressure pump. Retractable pumps allow changing of the pumps while simultaneously operating the other trains and minimises the number of installed pumps.
- Standard water bath vaporisers 3 x 125 million standard ft^3/d with Class 600 on the regas tube bundles.
- BOG compressors: 2 x 10 tph standard.
- Send-out compressor: 2 x 10 tph carbon steel pipeline compressor project specific designed for 6 bar suction and 55 bar discharge (not cryogenic).
- Standard model 3 AGP Z crossover metering skid.

Project number three

- Jetty based (modular).
- Required capacity: 250 million standard ft^3/d (500 m^3/hr LNG).
- Natural gas discharge pressure: 70 barg.
- Heat source: seawater.
- Design BOG capacity: 10 million standard ft^3/d (8.5 tph).
- Sparing: N+1.
- Vaporisers: 3 x 125 million standard ft^3/d (ANSI Class 600 model).
- Retractable low pressure LNG pumps: 3 x 250 m^3/hr discharging at 6 bar for recondenser (two impellers).
- Common vertical static mixer recondenser sized for full liquid flow (3 x 250 m^3/hr) but can receive varying volumes of BOG from the BOG compressor.
- Common high pressure LNG pump suction drum sized for required residence time with retractable high pressure pumps aligned with each LNG regas train. Also acts as phase separator to allow excess BOG to be sent to the send-out compressor.
- Retractable high pressure LNG send-out pumps: 3 x 250 m^3/hr differential head of 66 bar (22 impellers identical to low pressure pump impellers, common shaft diameter, but larger motor).
- Both pump services retractable with common foot valve assemblies, standard pump well diameter, Class 150 head plate for the low pressure pump, Class 600 head plate for the high pressure pump. Retractable pumps allow for the changing of the pumps while simultaneously operating the other trains, and minimising the number of installed pumps.
- Standard seawater/glycol-water regas modules 3 x 125 million standard ft^3/d each with:
  - Standard multi-tube hairpin shell and tube vaporiser with Class 600 flanges on the tube side.
  - Standard glycol-water pumps.
  - Standard seawater/glycol-water heat exchangers.
  - Standard glycol-water filters on the train.
  - Standard glycol-water expansion drum.
  - Standard control valve stations for the glycol-water and LNG.
  - Standard pipe sizes for seawater, glycol-water, LNG and natural gas.
- BOG compressors: 2 x 10 tph standard.
- Send-out compressor: 2 x 10 tph carbon steel pipeline compressor project specific designed for 6 bar suction and 32 bar discharge (not cryogenic).
- Standard model 3 AGP Z crossover metering skid.

As can be seen from the above, the only customised equipment in project number one is the static mixer recondenser, LNG suction drum and the send-out compressors (standard pipeline type). The only customised equipment in project number two is the static mixer recondenser, LNG suction drum and send-out compressors (higher pressure). Project number three is the same as project number one except for the number of trains and changing the flanges on the high pressure piping to Class 600. All other equipment is standardised. Even some of the jetty and cargo transfer equipment can be standardised, such as LNG unloading arms, LNG ship-to-ship (STS) hoses and high pressure gas marine arms. Even though the process conditions may change, and site and jetty limitations may revise the plant layout, standardisation will always minimise process engineering, mechanical engineering, piping engineering and procurement, greatly reducing the schedule to complete an LNG regas facility.

Summary

When planning any LNG project, one of the toughest challenges is ensuring the terminal will be able to meet both current and future demand while phasing capital investment. AG&P's LNG import terminals are scalable and modular, allowing expansion in line with demand growth, while standardised designs and equipment ensure a significantly faster schedule and more cost-effective facility. This allows project owners to choose the initial infrastructure they need according to the site-specific requirements for each project for efficient capital deployment. This flexible approach means assets can be built quickly and cost-efficiently, so a project is operational faster, delivering quicker returns to investors.