FASTER INSULATION

Oliver Hills, Pittsburgh Corning, UK, explains how pre-insulation can cut down installation times onsite.

The application of effective cryogenic insulation is always challenging, particularly so during the restricted time frame of an LNG project. The insulation is expected to last for many years, even decades, after installation and to retain thermal efficiency by keeping out moisture and ensuring that joints and penetrations remain well sealed. Several years later (usually after the contractor's warranty period has expired), the time pressures of the short installation window are long forgotten and the results of the 'time: effectiveness' ratio of installation become evident. Therefore, it is essential to choose an insulation system that can both be rapidly installed as easily as possible and has the properties to resist the aggressively cold temperatures and cycles of an LNG facility.

Pre-insulation

Centrica's Isle of Grain site has been used for LNG storage since the early 1980s when liquefied gas was taken from the national transmission system. There were four 50 000 m^3, double-walled LNG storage tanks, two of which were commissioned in 1979 and the other two in 1981. After a quarter of a century of service, these tanks were emptied and revalidated. They were also adapted to cope with a fill rate over 300 times faster than the original design.

The tank bases were insulated with FOAMGLAS® HLB cellular glass insulation, which provided many years of problem free operation at cold temperatures of -161 °C (-260 °F). This meant that they did not need to be redesigned or renovated, thus extending their life for a further 25 years.

In 2004, extensive plant and pipework modifications were carried out and a three layer insulation system was installed: two layers of PIR and one layer of cellular-glass insulation. The PIR was installed in multiple layers to cope with the large amount of shrinkage of the PIR in cryogenic conditions, and the cellular glass was there to both insulate and to provide passive fire protection. This was a time-consuming installation process involving three layers of insulation, contraction joints, site-applied mastics and cladding, which made it very challenging for the contractor to install it properly and on time.

Figure 1. Pre-fabricated FOAMGLAS® insulation installed on the pipe.

Figure 2. Installation of pre-fabricated pipe insulation system.

There were two possible ways that installation time and quality could have been improved with some innovation.

One way could have been to pre-insulate offsite. Pre-insulation for LNG pipe service has been successfully achieved in other projects, such as Zeebrugge LNG where the FOAMGLAS insulation was applied 0.5 km offsite and the pre-insulated pipes lifted in. The strength of FOAMGLAS insulation makes this feasible, provided that project planning is well managed. Indeed, for this phase of the Isle of Grain project, a 40 m pipe pre-insulated with cellular glass was lifted into place where it was not possible to insulate in situ, but this opportunity was not exploited for the rest of this phase of the project. In many projects, pre-insulation cannot cope well with the changes and adaptations that need to be made as the project progresses.

The need for innovation

The need for new ideas to help the installers cope with shortening programmes, and to offset a loss of skills and manpower due to an ageing workforce, is driving the need for further innovation. For the second expansion of Grain LNG, a high level of pre-fabrication and pre-coating systems engineering was introduced. FOAMGLAS insulation was pre-fabricated into bends and T pieces as large as 42 in. in diameter and pre-coated with Terostat polymer as the vapour retarder coating. Straight sections were pre-formed into quarters, even for pipes as large as 42 in., which were again pre-coated with Terostat polymer. Prefabrication meant that the time consuming work of trimming many small pieces of insulation, and gluing them together into large fitting pieces was avoided. As such, installation of the fittings took minutes rather than hours. Installing four pieces rather than 15 can make a dramatic difference onsite and also reduces the quantity of site joints and jointing mastics used. There was no need for time consuming site application of vapour-retarder mastics since these were pre-applied, thus reducing total installation time significantly.

Other innovations also helped to improve the speed of installation. FOAMGLAS insulation contracts much less than organic insulations such as PIR, PU or FEF. The essential multi-layering techniques for these products (three or four layers, with insulation having to be applied as an over-sized diameter, making installation of these plastic foams more difficult) wastes installation time. FOAMGLAS insulation contracts at a rate very close to that of the steel pipe and does not suffer joints that open or crack due to the cooling. This means that cellular glass is more stable and has less stress in the joints and in the insulation material. It can also be applied at the same diameter as the pipe, meaning it is not necessary to allow spacing between the pipe and the insulation. This means greater system integrity and longevity, as well as quicker installation. An additional saving comes from being able to avoid having to install so many contraction joints. The difference between the rates of thermal contraction is so small that any differential can be taken up within the insulation joints rather than using inefficient and vulnerable wool-filled contraction joints.

The time benefits of the FOAMGLAS pre-fabricated insulation system were clearly seen by the contractor in the estimating phase. Traditional estimating programmes significantly over estimate the time it takes to install prefabricated FOAMGLAS insulation bends, T pieces and

Figure 3. A crane is used to hoist the pre-fabricated pipe to transport it for module construction.

straights. This was a prime example of how being open to new ideas and challenging traditional ways of working can make a significant difference to competitiveness.

It was at the site phase, however, that the real time savings became apparent, as the anticipated site programme was consistently beaten and material required earlier and earlier.

Following the success of the FOAMGLAS innovations on the phase 2 extension, the two layer all-FOAMGLAS terostat PCFR insulation system was chosen for the phase 3 extension, which was accomplished as module work by Fabricom in Newcastle, UK. The insulation was installed on large modules, which were then transported to the site by sea and lifted into place. Pre-fabrication was once again key to the programme and the work proceeded quickly, allowing the demanding programme requirements to be achieved.

Positive results

When the site work for phase 3 started, additional FOAMGLAS insulation innovations were introduced and staggered joints, where the outside layer is supplied longer than the inner layer and longitudinal joints are produced with a 90° stagger, became standard for FOAMGLAS pre-fabricated cellular glass bends and T pieces. This improves the integrity of the completed system without requiring additional site work. Complete dome ends were also supplied prefabricated to reduce site work and to improve installed quality. These were installed on both external domes and on domes within skirts, where the pre-shaped FOAMGLAS was prepared into large strips to fit in through the skirt walkways.

Prefabrication enabled time-critical phases of the Grain LNG project to be accomplished in good time and with fewer problems than more traditional ways of fabrication/installation. **LNG**