DEMACO

Erik Admiraal, Demaco Holland BV, the Netherlands, analyses the overall cost of setting up a LNG plant.

COUNTING THE CO$TS

LNG burns clean, there is plenty available and the technology to produce and use it is on hand. Therefore, building a LNG plant, terminal or bunker station is certainly a smart investment. But what are the considerations taken into account when the investment decision has to be made?

Management

Building a LNG plant is like building a house. First you define the specifications: how many rooms, the type of insulation, a garage or not, etc. Then you go to tender to source the preferred project developer at the preferred price. Naturally there will always be one who will do it cheaper than the others and the temptation is to opt for this at the outset. Although this choice involves considerable cost savings, problems may soon arise. After the first year, energy bills are a bit higher than expected. After the second, the paintwork in the house is less shiny. After the third year, the wood on the house starts to rot in several places. Opex (operational expenditure) on energy consumption and maintenance costs are already starting to kick-in. What seems like a less economical offer at the outset is usually more sustainable in the long-term.

Building a new LNG facility requires a large investment. As an investor, one is usually keen to keep the Capex (capital expenditure) as low as possible.

The shortcut is to choose the traditional technologies: simple tank set up, non-insulated loading arms, glass foam insulated pipelines, etc. However, this does not necessarily provide the lowest Opex for both the storage tank and the LNG transfer lines.

Minimising BOG

When locally transporting LNG through pipelines, ensuring minimum boil-off-gas (BOG) is crucial. During the economic lifetime of a plant, terminal or bunker, millions of gallons of LNG will be transferred. In situations where there is no use for gas, BOG is a substantial loss. Losses in LNG lead to bigger compressors, larger diameter lines and less profitability. And these losses will persist for the life of the facility.

As a cryogenic gas, LNG requires cryogenic technology. In the industrial gas world there is plenty of proven cryogenic technology available. Vacuum insulation has been the standard for over half a century for all kinds of liquefied gases, even with much lower temperatures than LNG. Pressurised cryogenic tanks for liquid nitrogen, oxygen and argon are vacuum insulated for good reason. It is estimated that a typical LNG terminal with 2 km transfer lines (up to 30 in. dia.) can save over €4 million every year on BOG.

Demaco's vacuum insulated piping (VIP) can help minimise the amount of BOG while optimising profits.

Savings on maintenance

Opex is highly influenced by the necessity of the regular maintenance of conventional insulation on pipeline systems.

Figure 1. On site at the Lysekil LNG terminal.

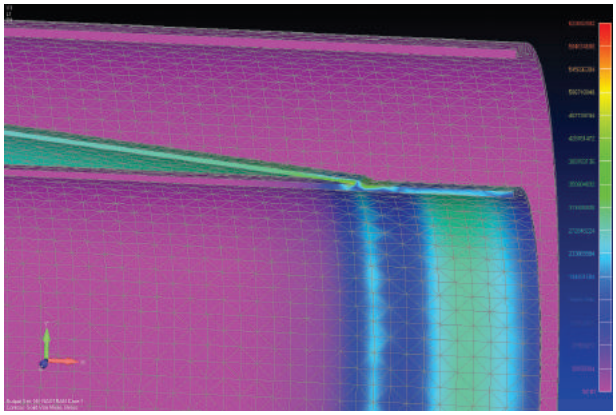

Figure 2. FEM analysis on VIP.

The stainless steel construction of the VIP requires almost no maintenance at all during the lifetime of the plant. Both operations and weather conditions will deteriorate conventional insulation, e.g. ice cracking up the foam.

Corrosion under insulation (CUI) may also occur, posing clear risks including a leakage of the line. A regular removal of the insulation to check the status of the LNG pipeline itself is necessary. VIP's pipe-in-pipe technology prevents CUI from occuring. The process pipe itself is situated in the cleanest environment possible, namely, the vacuum.

Vacuum insulated pipeline

With vacuum insulation there is no loss of the insulation value at all. Neither operations nor weather conditions will affect the stainless steel outer jacket.

There are three types of heat transfer that need to be blocked: conduction, convection and radiation. The VIP insulates against these by the following means:

- Conduction – an absolute minimum of heat-bridges/fixed points between the process pipeline and the jacket line.
- Convection – a static vacuum of around 1 x 10 - 5 mbar is created and maintained between the process pipeline and the jacket line.
- Heat radiaton – a highly reflective foil is wound with multiple layers of insulation (MLI) around the process pipeline.

These actions provide the highest insulation value technically achievable, thereby increasing efficiency in the transfer of LNG.

Safety and the environment

With LNG business booming as it is, more and more activities will take place in populated areas. For both safety and environmental reasons it is only a matter of time before a secondary containment will be mandatory.

In the event of a LNG leakage in the process line of a traditionally insulated pipeline (e.g. due to corrosion), the LNG will come out at an unpredictable location of the line. With the current design of the VIP line, the unlikely event of a malfunction of the process pipeline will result in LNG entering the vacuum jacket space. Due to the increase of pressure, the safety valve

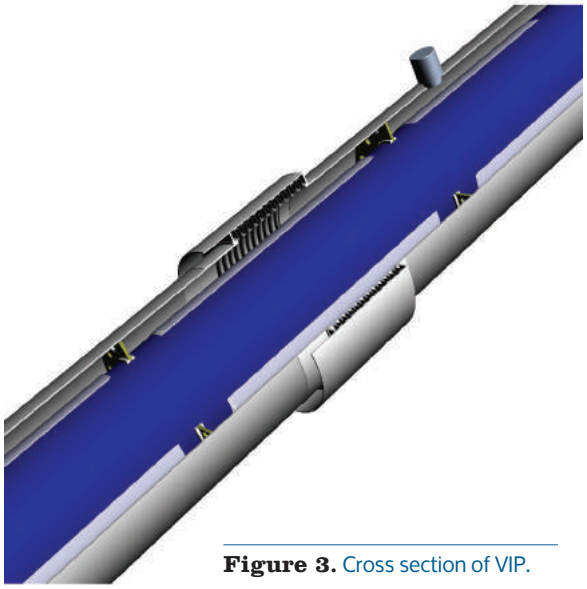

Figure 3. Cross section of VIP.

will blow. The location of the safety valve is clearly known, providing a controlled blow off point. There is even the possibility of having a collector line next to the LNG line to connect all safety valves. In case of a LNG leakage, the gaseous natural gas (GNG) will be blown via the safety valves through the collector line to, for example, a flare point. It is clear at which pipeline segment the leakage has occurred because of the visible 'snow' on the cooled skin of the vacuum jacket of the particular section. The temperature measurement per section will also clearly point out the faulty section in the control room.

If taken into account in the design, the outer jacket can also be used as a secondary containment, designed for the pressures occurring after the leakage of the process pipeline. In populated areas, having a secondary containment could prove to be crucial. It is almost unthinkable that ferry ships will be bunkered with LNG without all possible safety measures in place, while passengers are embarking.

Sustainability and future generations

As the operator of a LNG terminal, minimising environmental footprint is an important job. With conventional insulation systems, an enormous amount of non-biodegradable materials are being used during the lifetime of the plant and will be left over after insulation repairs and at the end of the LNG pipeline's life. However, there is little maintenance on the VIP and at the end of a plant's life the line can be recycled completely since it is made of stainless steel.

Lysekil LNG terminal

Demaco has received a VIP order for the largest LNG receiving terminal in Scandinavia, to be built by Cryo AB for Skangass. The receiving terminal is under construction next to Preem's refinery in Lysekil (100 km north of Gothenburg) on the west coast of Sweden. Besides delivery of LNG to Preem's refinery, a truck loading facility will be built in connection to the terminal. The terminal will also become an important hub for distribution of LNG as fuel for ships.
A shift to LNG as fuel is one of the most effective ways to reduce CO_2 emissions and meet stricter environmental requirements. The gas will come from the LNG plant at Risavika (another LNG project Demaco is working on with its VIP with Cryonorm Systems BV) near Stavanger. LNG will be delivered to Lysekil using Skangass' LNG carrier *Coral Energy*. The LNG terminal is scheduled to be in operation by the first half of 2014, with an estimated investment of €55 million.

Conclusion

In the past, investment decisions on LNG terminals were primarily taken on Capex issues. Increasingly, owners and users of LNG terminals are taking Opex into consideration. Together with the ever increasing demands for safety and environment protection, vacuum insulated pipelines will gain more prominence in the industry. **LNG**

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