The use of natural gas is becoming more and more prominent in everyday life. The current culture of environmentally friendly trends has led to various applications of natural gas and it is now viewed as an essential resource to be utilised in the battle to reduce pollution and protect the planet.

Natural gas has applications in various fields such as power stations, power plants, urban regasification, and as a transportation fuel – e.g. for buses, cars, trains, etc. This leads to huge quantities of natural gas being transferred from producers to the end-users. (To read more on this topic see articles published in LNG Industry’s October 2017 issue).

Nicolas Fariney, Fives Cryomec, Switzerland, discusses the current state of the cryogenic pump sector and how manufacturers are making the ‘pumps of the future’ a reality today.
In light of this, optimising the transportation of natural gas is becoming an important challenge that needs addressing. Most of the time, natural gas is transferred in its liquid form, as LNG, using trailers and ISO containers. This is because natural gas is far easier to transfer and to store in its liquid state than in its gaseous form; LNG takes up far less space than gas and is easier to handle. However, once the gas has been transferred or stored as LNG, it can be returned to its gaseous form via the regasification process. This is important for end-users as many work with natural gas but not with LNG.

The main aim of a transfer process is to ensure a safe and reliable transfer of LNG from tank, to trailer, to ISO container. Natural gas can become unstable if it is not handled properly and avoiding high-risk situations is a top priority.

**LNG trailers**

The temperature of a standard shipment of LNG is approximately -160°C. This is the reason why it can only be transferred using cryogenic centrifugal pumps. These pumps are specially designed to withstand very low temperatures of down to -200°C.

Historically, the pumps intended for cryogenic liquid transfer have always been designed with a mechanical seal.

**Figure 1.** Sectional drawing of a centrifugal cryogenic pump with mechanical seal.

This seal type is commonly used for the transfer of all kinds of cryogenic liquids – nitrogen, oxygen, argon, CO₂, etc. – in addition to LNG. These pumps are either installed at the back of the trailers or directly onto the ground (stationary installation).

The main challenges posed by the use of mechanical seals are the risk of leakages, and their relatively short life time (between 800 and 1200 hours depending on the manufacturer). Obviously, the leakage risk of a seal for a LIN trailer (transports Nitrogen) is not an important issue, but for a LNG trailer it can become a serious safety problem. As a result, the regulations and standard practices regarding such matters are evolving quickly to provide maximum safety and to minimise all risks. The aim of cryogenic pump manufacturers is to design the 'trailers of the future' today, in order to meet the new regulations.

**A new challenge**

Market research undertaken by Fives shows that there will be several new requirements that will become mandatory in the near future:

- 100% pump safety – 0% risk of leakage.
- Compact pumps – increased tank volume on trailers (high profitability on each delivery/very low space available at the back of a trailer and on containers).
- Revamping – new pumps should be able to replace a mechanical seal pump and avoid creating the need for major modifications to existing trailers in the process.

The most suitable solutions to these requirements seem to be capsulated pumps as they meet all the stated requirements. It is true that this pump range already exists, but the cryogenic pumps currently available on the market do not possess all the required features.

**Capsulated pumps**

Some examples of capsulated pumps include: The sealess pump and submerged pump ranges.

The sealless pump's range includes the VS7 from Cryostar, the Cryomec VSMP from Fives, and the AC-32 from ACD Cryo.

The submerged pump range includes the Substran from Cryostar, and the TC-34 from ACD for example. The main feature of those pumps is that they are all vertical. This means that they cannot be installed in the place of a mechanical seal pump.

It is complicated and more expensive for the user if their chosen solution is the submerged pump as these pumps need to be installed directly into a tank or inside a pit. This automatically makes extensive modifications of existing trailers a fundamental necessity, rather than a choice.

**The way to the future**

Fives has designed a new alternative pump by combining both sealless and submerged technologies. This new product is called the Cryomec HSMP which stands for Horizontal Sealless Motor Pump.

The general arrangement of the new Cryomec HSMP is quite similar to that of the mechanical seal pump in terms of size. However, it can be shown to be even more compact than a mechanical seal pump when equivalent units (same...
power and impeller size) of the two designs are compared (an example is shown in Figure 4).

The main issue for customers is being able to replace the pump without modifying their current trailer completely, or buying a new trailer specially designed for the new pump. As this new pump is the same size, it enables a trailer to be revamped with only minor modifications.

Submerged pumps might appear to be a suitable solution, however their installation is problematic and requires a much more complicated revamping process. Further to this, a sealless pumps is easier to operate, is low maintenance, and provides multiple technical advantages:

- The entire pump (motor casing, pump casing, impeller, inducer, etc) is primarily made of aluminium which guarantees low weight. Aluminium also means that the pump is certified for installation into the Exproof zone. As the pump tightness is IP67 (and the junction box is IP65), 0% leakage of the pumped fluid can be guaranteed.
- There is exactly the same pressure in the motor casing as in the suction line; e.g. if the suction pressure reaches 5 bar, the gas inside the motor will also be of 5 bar (MAWP at suction is 16 bar).
- The front bearing is lubricated with the pumped fluid and the back bearing is greased to last its life time.
- The motor winding is self-cooled thanks to the temperature of the liquid being pumped.
- The wiring connections are simplified as the junction box is directly sealed on the pump motor casing. It already includes all the required connections for power, PTC/PTO, and PT100s for temperature control.

The principle of the pump is to eliminate the Exproof area from the inside. This is achieved by the pump being completely purged prior to starting, leaving no oxygen at all inside. This total absence of oxygen guarantees an Exproof zone inside the pump.

**Low TCO**

There is no seal and no seal gas (or continuous purge gas) in this pump. The number of parts that will suffer wear is therefore very small.

This pump is optimised for long time overhaul intervals with low spare parts cost. Its OPEX (operating cost) is reduced to the minimum.

**Alternative applications with high potential**

The sealless pump does not only have a large potential for the LNG market but it also offers new perspectives for high purity liquids. High purity fluids are used in the food, biological, health, and electronics industries (e.g. CO², Pure LIN, Pure LAR). High purity gas prices are rapidly increasing and customers are looking for suppliers who can provide the highest quality gases. These customers are therefore very interested in pumps which can prevent any contamination and any leakage of the pumped liquids. Thanks to its new technology, the sealless pump offers just this, as well as high profitability and reliability.

**Conclusion**

The worldwide regulations concerning safety and environment protection are evolving and it is already known that the requirements will become stricter in the near future. The sealless pump seems to be the best solution to balance the needs of customers and the constraints of new, upcoming regulations. The yearly increasing demand for LNG leads pump manufacturers to anticipate the need for ‘pumps of the future’ in every field, and not just for trailers.