Refrigeration technology for the oil and gas industry

In touch – efficient solutions for the oil and gas sector
Every day we are surrounded by products from the oil and gas industry, whether when driving a car, heating our homes, or washing our dishes and clothes. Mobility, living, and working would be inconceivable without products made of oil and gas. The efficient supply, refining, and transportation of these valuable raw materials possible partly thanks to products of GEA Refrigeration Technologies that ensure the required pressure or perfect temperature at the right time and place.

**In touch with oil and gas in all process phases**

**Cooling and compressing**

Since the end of the nineteenth century, GEA Refrigeration Technologies has been a leader in cooling processes and products, controlling the temperature of sensitive cargo, and compressing media. Today we service the oil and gas industry with a growing number of products and services.

It takes several million years before fossil fuels come into being. Since this process is similar for crude oil and natural gas, the two kinds of raw materials usually appear together. They are made from large quantities of dead organisms that have sunk to
the sea bottom, such as microorganisms, algae, or zooplankton. When sand and rock settle on top of this layer of organic material, the mass becomes air-tight and cannot decay completely, creating a so-called “digested sludge”.

The water-insoluble, long-chain hydrocarbons contained in this biomass are broken down into short-chain, gaseous and liquid hydrocarbon chains. Pressure and high temperatures decompose the finely distributed hydrocarbons, which can migrate within the pores of the rock. The converted hydrocarbons then collect in so-called reservoir rocks in the form of crude oil and natural gas. If the natural oil is trapped under impermeable layers of stone, preventing any further migration to the earth’s surface, and movement sidewise is also blocked, then it becomes more concentrated and forms a natural gas deposit. The gaseous hydrocarbons generally gather together as natural gas above the liquid crude oil in a so-called gas cap.

Oil and gas companies are subject to enormous cost pressure and must also finance extensive exploratory, access, and development work. The engineers of GEA Refrigeration Technologies assist you in keeping your costs down and saving primary energy. Our innovative technologies help you to manage and minimize emissions to meet the continually increasing demands of environmental-related regulatory requirements. We provide robust products and systems made from premium materials that ensure problem-free work processes for all areas of extraction, refinement, and distribution – onshore and offshore.

Condensation, recondensation, splitting, storage, separation, purification, intermediate pump functions, service, and measurements … for every link in the supply chain of natural gas and crude oil, the engineers of GEA Refrigeration Technologies provide the fitting solution.
A network of gas and oil transmission pipelines spans the globe. Thanks to technological advancements, these pipelines survive for decades. GEA Refrigeration Technologies’ cooling and compressor technology is employed for storage and shipping of these critical energy sources, and at crude oil pumping stations.

**In touch with natural gas and crude oil from the pipeline**

**GEA compressor with forward thrust**

Whether for heating your home or cooking your food, natural gas is instantly available, even though it has traversed great distances, usually in pipelines. The construction of piping systems is costly, but when completed, they reliably and safely perform their job independent of storms, blockage, or other tribulations. At least in this way, they are superior to trucks and tankers.

When extracted from the earth, natural gas is usually under high pressure and escapes practically by itself. If it is transported with piping systems, the pressure reduces during the long route to the consumer. Therefore, at intervals along the pipeline, compressor stations ensure that the pressure is maintained. Refrigeration technologies are employed at the compressor stations as well because natural gas warms up when compressed and must be re-cooled. Gas that is too hot has a lower density, and therefore, a higher pressure loss; however, high temperatures can damage the piping system and its insulation. In addition, water must be removed from the gas so that it does not collect in the pipes and cause corrosion. This process is also carried out, like gas cleaning, with the assistance of GEA Refrigeration Technologies’ products. GEA screw compressors ensure the required gas pressure at the gas turbine burner, so that this in turn can increase the pipeline pressure.

Transporting oil cannot take place without pressure and temperature regulation. Although oil will flow on its own due to its natural flow velocity, the flow of this this viscous liquid must be accelerated by pumping stations located at regular intervals along its pipeline journey. This is especially important in low-outside-temperature conditions, which have a negative impact on the flow velocity.

Cooling is especially critical when the oil line must be laid underground in permafrost soils. Oil flows at about 50 °C/122 °F through the pipeline, and additional pipe cooling keeps the concrete-hard soils from thawing and thus prevents the pipe from sagging.
The plant consists of two compressor lines with two water circuits each. The liquefied natural gas (LNG) plant utilized eight GEA XF series refrigerating compressors, each equipped with a 2,000 kW motor. The system is designed according to API guidelines. The steel compressors are suited for use in combustible environments and furnished with oil separators as well as lubricating oil coolers and pumps. Propane R290 is employed as the refrigerant.

The project also included the following GEA components:
- Eight GEA shell-and-tube heat exchangers and eight heat exchangers on the inlet side to ensure the correct temperature of the intake gas;
- Eight water-cooled oil coolers;
- Four high-pressure collection pipes;
- Two XF series compressors;
- Two evaporators to ensure sufficient cooling of the three generators.

As an example of GEA Refrigeration Technologies products in practice, we provided screw compressor units for water cooling at two liquefaction gas plants. The plants ensure condensation by cooling to -162 °C/259.6 °F of mine gas (coal gas) obtained from wellheads about 700 km away and transported via pipelines to a harbor for further transport by ship.

**In touch – water cooling for gas turbine compressors**

Refrigerating compressors for gas liquefaction
Sometimes cooling very simply ensures that something big becomes small – an important factor in economical shipping. While liquefied petroleum gas (LPG) liquefies under little pressure at normal temperatures and reduces to 1/260th of its original volume, liquefied natural gas (LNG) is shipped at below -160 °C/256 °F in thermally-insulated pressure tanks.

**Refrigeration technology for gas en route**

**Space is money: safe and economical travel**

Importing LNG by ship is increasing. This is due to the fact that production wells are nearing depletion in some countries and because some countries would like to emancipate themselves from individual gas exporters. In response to this trend, the necessary infrastructure is growing accordingly. In turn, GEA Refrigeration Technologies is responding to the increased demand for cooling technology.

If natural gas is cooled to -163 °C/261 °F, it liquefies and shrinks to 1/600th of its volume in the uncompressed state. This energy-rich liquid is shipped in special insulated pressure tanks in special LNG tankers. Frequently, membrane tanks are preferred over sphere tanks, due to their ability to adapt to the ship’s structure and optimally fill out the shipping space. They are made of Invar®, an iron-nickel alloy, which is especially tolerant of temperature fluctuations. The membrane tanks do not deform even under prevailing minus temperatures inside and tropical temperatures outside.

Despite the sophisticated insulation, nothing can be done to prevent the tank contents slowly warming up and a partially evaporating. The vaporized gas must be discharged to ensure that the pressure in the tank does not exceed a certain limit. As a rule, this gas is used for the ship’s propulsion. For this reason, many LNG tankers are designed as turbine ships and are also suited for operation with natural gas.

Ships with gas recondensation plants may displace turbine ships in the future, should natural gas prices rise above those for alternative fuel. A few of the modern LNG tankers are already designed for the installation of recondensation plants, so that they can be upgraded at relatively low cost.

Whether for liquefaction on land, cryogenic engineering and recondensation on board, or regasification, products from GEA Refrigeration Technologies are utilized in the complete liquefied gas process, both onshore and offshore.
Upstream
- Adsorption Dehydration with Glycol
- Solid Bed Dehydration (Absorption)
- Dew Point Gas By Joule Thomson
- Dew Point Gas By Expander
- Dew Point Gas By Refrigeration Plant

Downstream
- Natural Gas Dew Point Control
- Light Hand Separation
- Gasoline Fractionation
- Condensate Recovery

Regasification terminal with zero off gas
- Reliquefaction Plant

Refinery and Petrochemical
- Condensations
- Cooling of Chemical Reaction
- Refrigeration Facilities
- Nitrogen/Instrument
- Air Compression, Drying
- Off Gas Compression
- Flare Gas Recovery

Offshore Transport
- Liquefied Gas Plant
- Load/Unload Facilities
- Liquefied Natural Gas (LNG)

Service and Spare parts
- Spare parts supply
- Pre shut-down activities
- Maintenance visit and plant performance analysis
- Units inspection
- Scheduled spare parts supply
- Emergency supply
- Expert team at site for turnaround and pre-turnaround
- Plant and equipment enrolment in maintenance services and support

Storage
- Boil Off
- Loading/Unloading
- Facilities
- Cooling Down
In touch with your requirements

Solutions for the oil and gas sector

On the mainland or on the high seas: with products from GEA Refrigeration Technologies you can efficiently and safely extract, transport, and refine raw materials. In many applications, we assure that you maintain the required pressures and precise temperatures.
Fertilizer plants
GEA Refrigeration Technologies designs and delivers chillers for industrial processes and for plant-water utilities, as well as key components for ammonia boil-off systems.

Environmental systems
GEA compressors and process chillers are used for flare gas recovery by liquefaction, as well as for separation into the various light ends. Such units can also be applied in propylene and ethylene boil-off systems.

Petrochemical plants
GEA Refrigeration Technologies offers systems for process refrigeration and for plant-water refrigeration facilities. These units are typically used for overhead condensers in the separation train. Typical applications are for TDI, LDPE, and HDPE – as well as for hydrocarbon and ammonia boil-off.

Air separation
For air separation, GEA customers benefit from our know-how and long experience with CO₂ applications.

Gas separation
GEA Refrigeration Technologies provides refrigeration plants for gas liquefaction (LPG, GLT, and LNG) and for separation of the constituents into light-end fractions: e.g. butane, and light gasoline. In addition, GEA equipment is widely used in related plants and storage systems; e.g., for recovery of hydrocarbon boil-off.

LNG plants
GEA Refrigeration Technologies provides refrigeration plants for gas liquefaction as well as for gas separation in LNG facilities.

Steel mills
Customers benefit from GEA solutions for SO₂ emission abatement and from our long experience with these applications.

Offshore applications (FPSO)
GEA Refrigeration Technologies provides solutions for chilling with utilities facilities and for gas liquefaction. GEA compressor skids for use in these applications are designed and manufactured not only according to the customer's needs, but also conform to strict API standards and relevant design codes. In addition, GEA offshore equipment is optimized in size and weight.

Power plants
Our solutions for power generation include compressors for fuel gas boosting, gas turbine inlet cooling systems, gas treatment, and carbon capture storage.

Refinery
GEA Refrigeration Technologies designs and supplies gas boosting systems for refineries.
Our products provide solutions to the problems you face. As your expert partner, GEA provides you with a wide range of standard or customized solutions. GEA collaborates with you to define the optimum configuration for your application that minimizes project schedule, installation expense, and operating costs, while maximizing functionality.

**GEA Refrigeration Technologies for the oil and gas industry**

**Our products for your products**

**Compressor package**
The system we are delivering is based on GEA Grasso screw compressors. It includes pre-assembled compressor skids and lube-oil circuit skids, which are designed and manufactured according to API standards and additional major relevant design codes. Centrifugal compressors or other alternative compressors may also be used, depending on customer requirements and process conditions.

**Boil-off package**
Refrigerants based on ammonia or hydrocarbons – as well as liquid propane, propylene, and ethylene – are stored in special vessels at low temperature. Ambient warmth raises this temperature. The resulting vapors must be vented to avoid pressure build-up. They are changed to liquid form and returned to the storage vessel. GEA Refrigeration Technologies designs and delivers complete boil-off packages.

**Chillers**
Water chillers, brine chillers, and process chillers: GEA Refrigeration Technologies designs and manufactures liquid chillers based on vapor compression technology for all applications and temperature ranges encountered in the oil and gas industry.

**Screw compressors**
With their six model sizes, the GEA screw compressors in the X-Large range cover volumetric displacement requirements from 3,250 to 8,560 m³/h. The components have been designed to cope with the extreme demands typically encountered in this application sector. This includes life cycle, availability, and preventive and remedial maintenance. In addition, these compressors can be built to satisfy the standards API 619 or ISO 10440.
We also provide service expertise. This means that we will support you in the planning phase, implementation, start-up, and maintenance of your equipment.

In touch with our customers
With a view to your success

Planning and consulting
Finding the optimal solution for your project requirements is a challenge that we gladly welcome. From our comprehensive product portfolio, we assemble the most suitable solution for your specific needs. We also provide measurement and control technology. Our team also supports the installation of your components and aids in their initial start-up. When everything flawlessly functions from the very beginning, you can rest assured knowing that your GEA equipment will perform reliably and efficiently for years to come.

Service
GEA's international service network is always there for you – online or on site. We also provide predictive, preventive, and remedial service to ensure the long-term life and operation of your equipment.

Parts
GEA has support points around the entire world that stock normal wear, spare, and exchange parts. This means that minor repairs or maintenance won't be a major problem. To simplify logistics, reduce the proliferation of part types, and enhance our service to you, we place keen focus – as early as the machine-design phase – on using the same wear parts in as many different modules as possible. This approach maximizes parts availability and enhances fast assignment of our service team.

Training
GEA Refrigeration Technologies also provides full training to customer operators and supervisors for plant commissioning, plant start-up, plant service scheduling, maintenance issues, as well as plant-operation and plant-performance analysis.

Visit GEA Refrigeration Technologies at www.gea.com to learn more about us and our solutions.
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Excellence • Passion • Integrity • Responsibility • GEA-versity

GEA Group is a global engineering company with multi-billion euro sales and operations in more than 50 countries. Founded in 1881, the company is one of the largest providers of innovative equipment and process technology. GEA Group is listed in the STOXX® Europe 600 Index.