



EQUIPMENT SOLUTIONS
FOR LNG AND LBG

★ **DISTRIBUTION**
CRYOSTAR

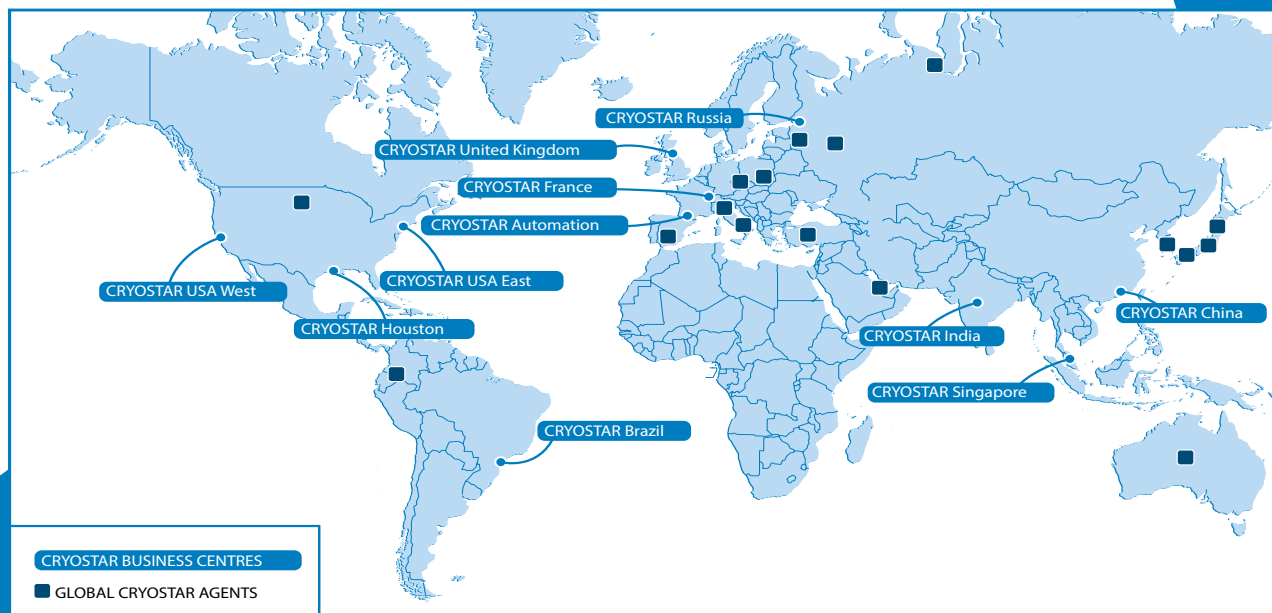


THE CRYOSTAR GROUP

CRYOSTAR is a cryogenic equipment manufacturer with more than 600 employees including 150 engineers. With its headquarters located in France, the company operates five production sites and is present worldwide through eight business centers and 16 business partners.

Founded in 1966 the company has over 40 years experience with LNG and has become the world leader for boil off gas compressors and on-board liquefaction units for LNG carriers. The company has delivered thousands of cryogenic pumps for liquid hydrocarbon applications (including methane, ethylene, ethane, etc.)

CRYOSTAR's engineers continuously innovate with patented solutions for various applications throughout the LNG supply chain such as small scale liquefaction, LNG transportation, LNG/LCNG vehicle refueling stations and LNG bunkering.



SAFETY AND STANDARDS

Safety is an integral part of CRYOSTAR's management and manufacturing commitments. For each new development or project, the company performs a risk analysis using approved techniques such as HAZOP (Hazard Operability) and FMEA (Failure Mode and Effects Analysis).

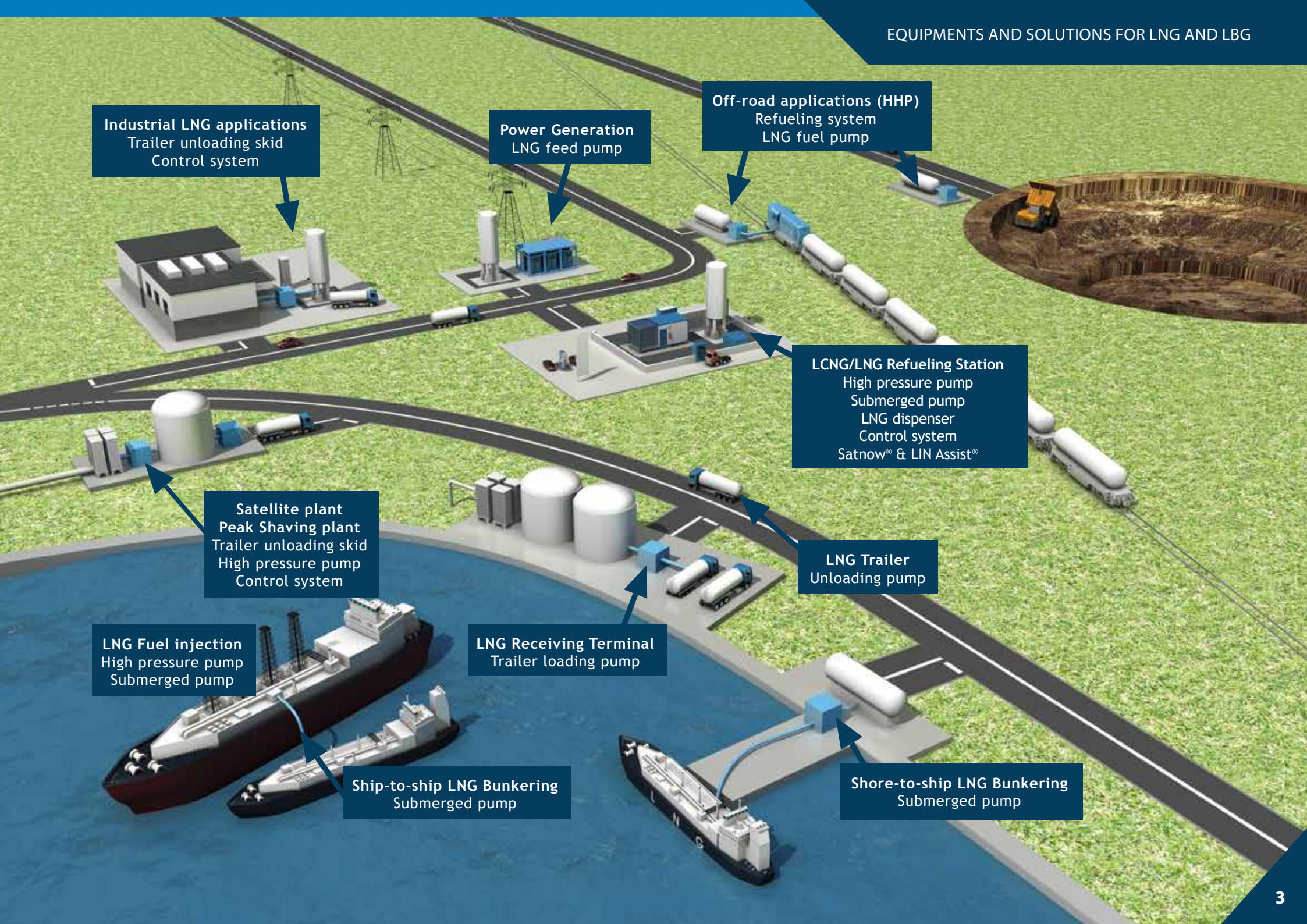
CRYOSTAR's equipments and solutions comply with most stringent machine and safety regulations such as the Pressure Equipment Directive 97/23/CE (Module H and H1) and ATEX.

FACTORY AND ON-SITE ACCEPTANCE TESTS

CRYOSTAR's headquarters host the world's largest and most sophisticated liquid nitrogen test facility for cryogenic pumps as well as a testing facility dedicated to turbines. CRYOSTAR engineers submit each pump and turbine to a performance test prior to shipment, offering customers guaranteed performance. CRYOSTAR provides commissioning, start-up and support for onsite performance test for liquefaction plants and refueling stations.

QUALITY AND ENVIRONMENT

CRYOSTAR is ISO 9001-2008 certified. To structure its environmental approach, CRYOSTAR has used the ISO 14001 standard to set up all the organizational and operational processes necessary for an aspiring Environmentally Responsible company. In parallel, CRYOSTAR has applied this approach to Health and Safety through the OHSAS 18001 standard. ISO 9001-2008/ ISO 14001-2004 / OHSAS 18001-2007 quality assurance system





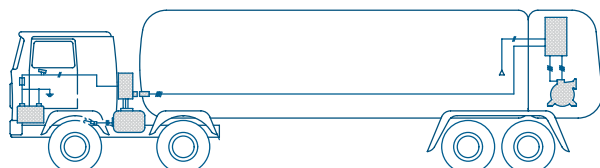
MOBILE TANKER UNLOADING PUMPS

Most of LNG trailers including pumps are equipped with CRYOSTAR centrifugal pumps, which are recognized for their high performance, reliability and safety.

Pumps are equipped with high efficiency closed impellers and helical inducers for low NPSH requirement. Rotating parts are balanced individually. The complete pump assembly is ATEX certified and includes all safety devices for safe operation.

Plug'in and Mixtran

Electric-driven pump with electric control panel powered through on-site electrical network or alternator driven by truck power take off (PTO)



Electric-driven pump with gearbox (type GBS/CBS) with shaft seal

Flow:	up to 30m ³ /h
Differential head:	200m



Electric-driven submerged motor pump (type VS) no shaft seal

Flow:	up to 75m ³ /h
Differential head:	140m

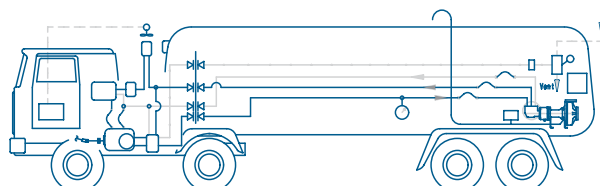


Electric-driven submerged pump (type SUBTRAN) no shaft seal

Flow:	up to 55m ³ /h
Differential head:	160m

Hytran

Hydraulic-driven pump with control panel and hydraulic system powered through truck power take off (PTO)



Hydraulic-driven pump with gearbox (type CBSH) with shaft seal

Flow:	up to 50m ³ /h
Differential head:	450m



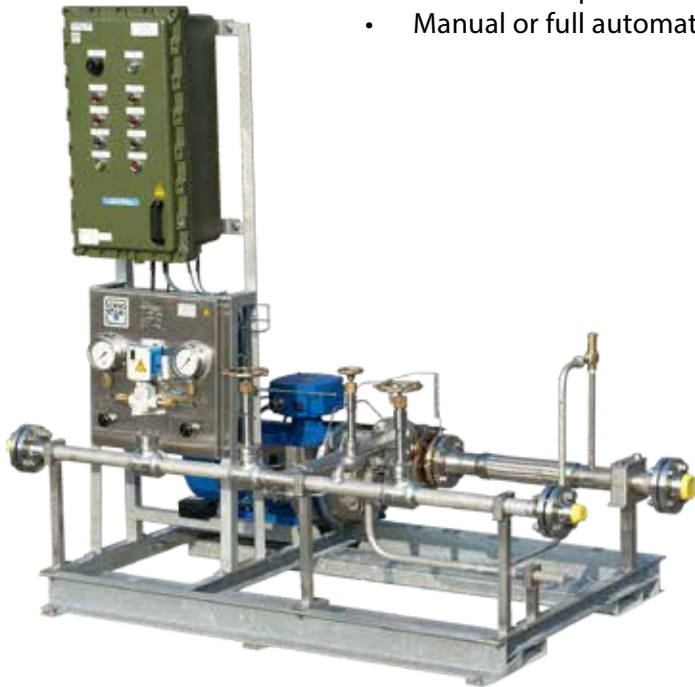
Hydraulic-driven pump (type CSH) with shaft seal

Flow:	up to 60m ³ /h
Differential head:	450m

STATIONARY TRANSFER PUMP SKIDS

Skidded unit

- CRYOSTAR centrifugal pump with external or submerged motor
- ATEX skid with piping, valves, instrumentation and safety devices
- ATEX control panel
- Manual or full automatic execution



Interface panel

- Control box with start/stop buttons, lights, pressure and level indicators
- Automatic management of trailer offload process which ensures a higher safety
- Accessibility to the trailer flexible hose outside of the equipment area
- Possibility to have a wired connection

Metering skid

- Coriolis technology based flow management
- Weights and Measures approval option available
- Measurement of loading and gas return flows



LNG TRANSFER PUMPS

A wide range of centrifugal pumps suitable for any kind of installation and duty. These pumps are available in different constructions and executions.



Pump type	CS/CBSD		GBS/CBS	MCP	VS	SUBTRAN
Installation	External					External or in tank
Duty	Intermittent		Intermittent or continuous			
Suitable for cold standby	No		Yes			
Construction	Direct coupled with shaft seal	Gearbox coupled with shaft seal	Direct coupled with shaft seal	Direct coupled Submerged motor	Direct coupled Submerged pump	
Max. flow rate	130m ³ /h	60m ³ /h	600m ³ /h	90m ³ /h	150m ³ /h	
Max. differential head	240m	285m	220m	220m	410m	

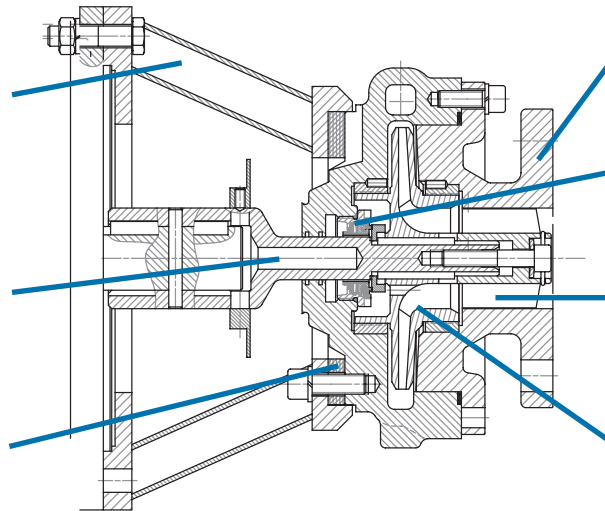
EXTERNAL PUMP with SHAFT SEAL

Type CS, CBSD, CSH, GBS, CBS, CBSH, MCP

Volute separated from electrical motor by an open intermediate piece with four hollow arms. This intermediate piece only presents four contacts points for low thermal conductivity

Hollow shaft to reduce thermal conductivity to minimum and slinger ring for improved safety

Thick insulation plate provides low thermal conductivity



Front opening of housing offers easier maintenance

Cryostar shaft seal

Helical inducer allowing low required NPSH

High hydraulic efficiency closed impeller



Cryostar shaft seal with composite ring

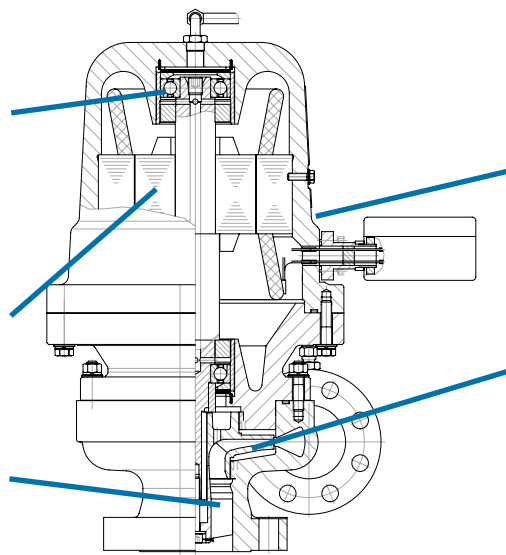
EXTERNAL PUMP with SUBMERGED MOTOR

Type VS

Motor bearings lubricated by the process fluid resulting in a "zero-maintenance" design

Special submerged electric motor cooled by the pumped fluid

Helical inducer allowing low required NPSH



Hermetically encapsulated pump eliminating the need for a shaft seal

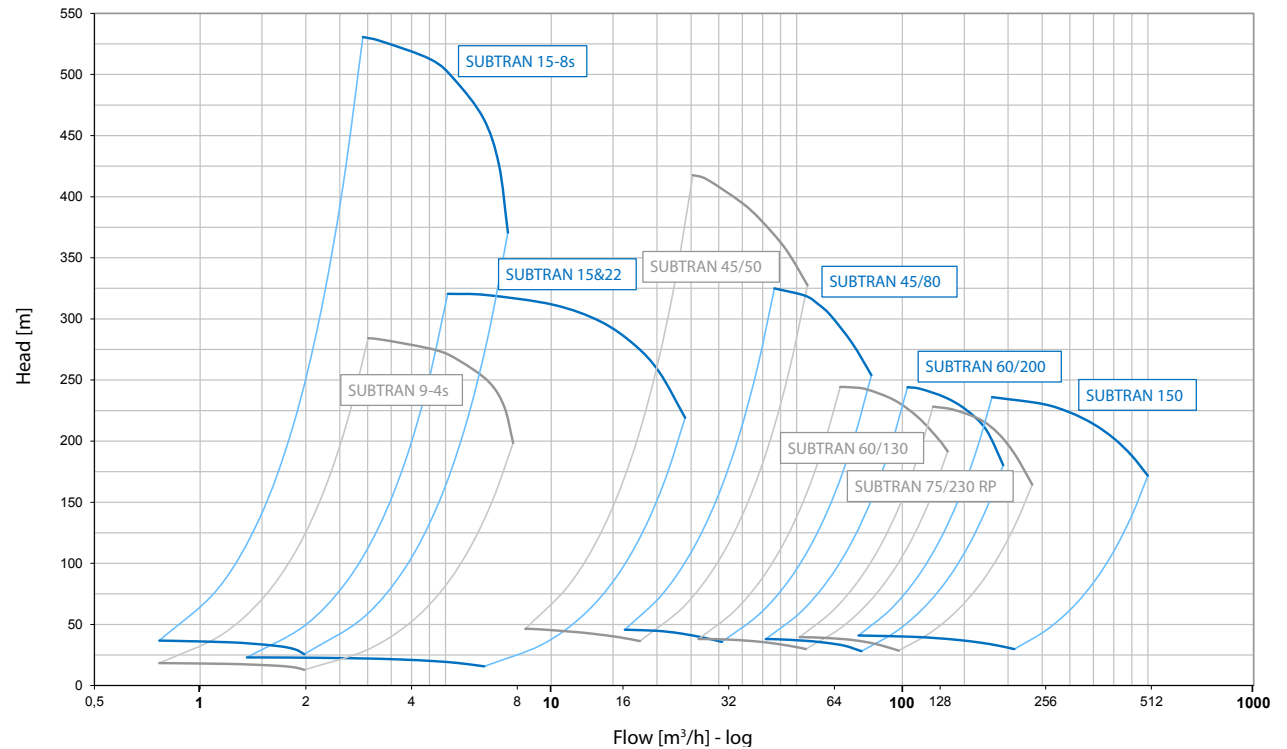
High hydraulic efficiency closed impeller





SUBMERGED PUMPS

CRYOSTAR SUBTRAN pumps are used throughout the LNG supply chain from liquefaction plant, through LNG tankers and carrier equipment, to LNG bunkering and vehicle refueling stations. The seal-less design offers higher safety with no risk of leakage and reduces maintenance costs to a minimum.

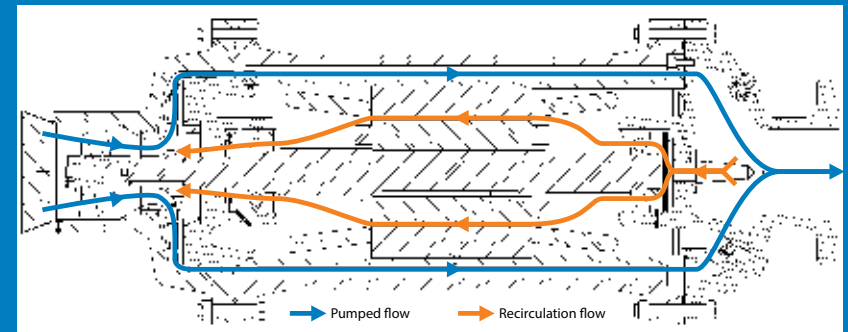


Internal flow recirculation

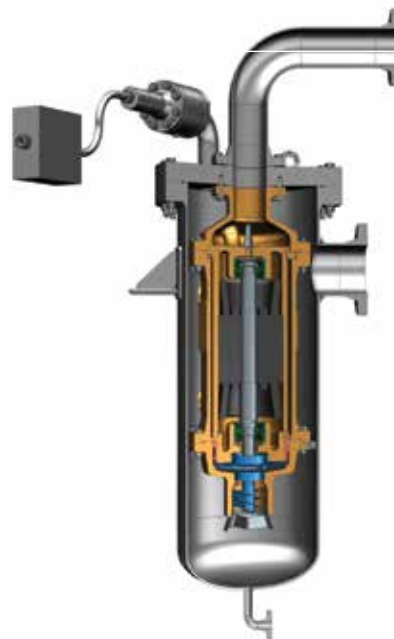
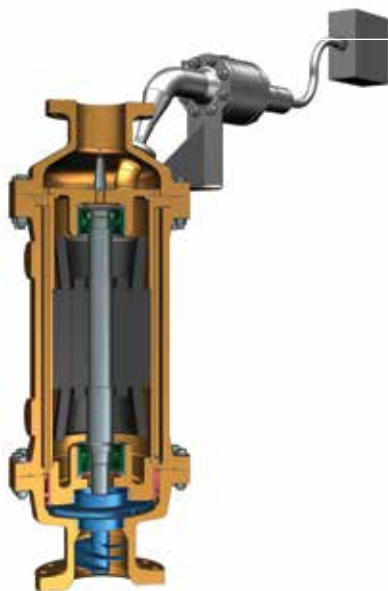
Two functions/benefits:

- Lubrication of the bearings
- Motor and bearing heat dissipation

Recirculation flow is calculated to evacuate maximal heat produced without evaporation of LNG



VARIOUS EXECUTIONS



	FV	LB	RP
DESIGNATION	Flanged V ersion	Low pressure B arrel (sump)	Removable P ump
INSTALLATION	In line Vertical or horizontal	In sump Vertical	In-tank Vertical or horizontal
ACCESSORIES	Flanges on suction and discharge	Sump, top plate and cable lead trough with junction box	Foot valve, cable system, top plate, vibration probes, etc
APPLICATION	Trailer loading/unloading Bunkering	Trailer loading/unloading Bunkering Peak shaving	Send out pump LNG terminal, Peak shaving
MAIN USE	External installation Cooling down time allowed	External installation Instant start	Atmospheric flat bottom tank



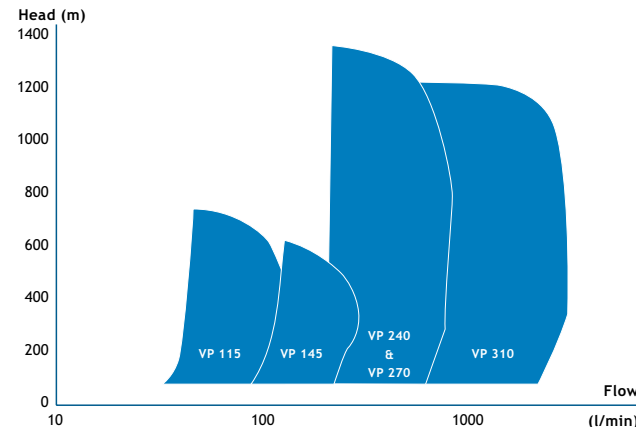
HIGH PRESSURE PUMPS

Used for LNG processing, LNG peak shaving/satellite plants and LNG fuel injection, CRYOSTAR high pressure pumps are recognized for their reliability and can run 24 hours a day without any maintenance for up to two years depending on site conditions.

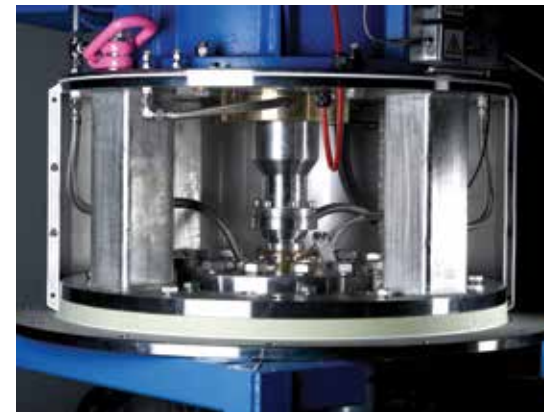
Multistage Vertical Pumps (VP)

The Vertical Pump (VP) is an external multistage cryogenic pump designed for cold standby and continuous operations. VP pumps are the best alternative to multistage submerged motor pump when LNG is stored in pressurized storage tanks.

VP are available in several sizes and multiple stages of the same design to meet the most demanding requirements in discharge high pressures up to 60 bar.



"Warm Box"



Highlights

Continuous duty:

More than 600 references on the five continents running continuously.

Legendary reliability:

Preferred high duty, high performance process pumps by all major industrial gas companies.

Temperature insulation and stability:

The VP is mounted on its "COLD BOX FLANGE" with a unique isolating flange in a "Composite" material for rigid mounting of the complete machine on the cold box and an efficient temperature break.

Continuous cold stand-by:

Closed and purged distance piece; this is the "Warm Box" execution avoiding any humidity penetration and ice building. Permanent standby in cold conditions with the bearing heating system. The pump is kept ready for an immediate restart any time.

Reciprocating pumps

Complete range of cryogenic reciprocating pumps available in simplex, duplex or triplex execution.

These pumps can remain in cold standby and can operate in intermittent or continuous duty for various applications such as LCNG refueling stations, peak shaving or high pressure injection for natural gas engines.

- ATEX certified skidded pump for increased safety
- High efficiency design with vacuum insulated cold end for minimum product losses
- Extended lifetime thanks to self-adjusting low pressure seals on cold end and new generation oil lubricated crank drives



MRP/LDPD - Belt driven

Capacity

Pressure : up to 500 bar

Flow : up to 337l/min (~ 12,000 Nm³/h)



HPP - Belt driven

Capacity

Pressure : up to 300 bar

Flow : up to 520l/min (18,500 Nm³/h)



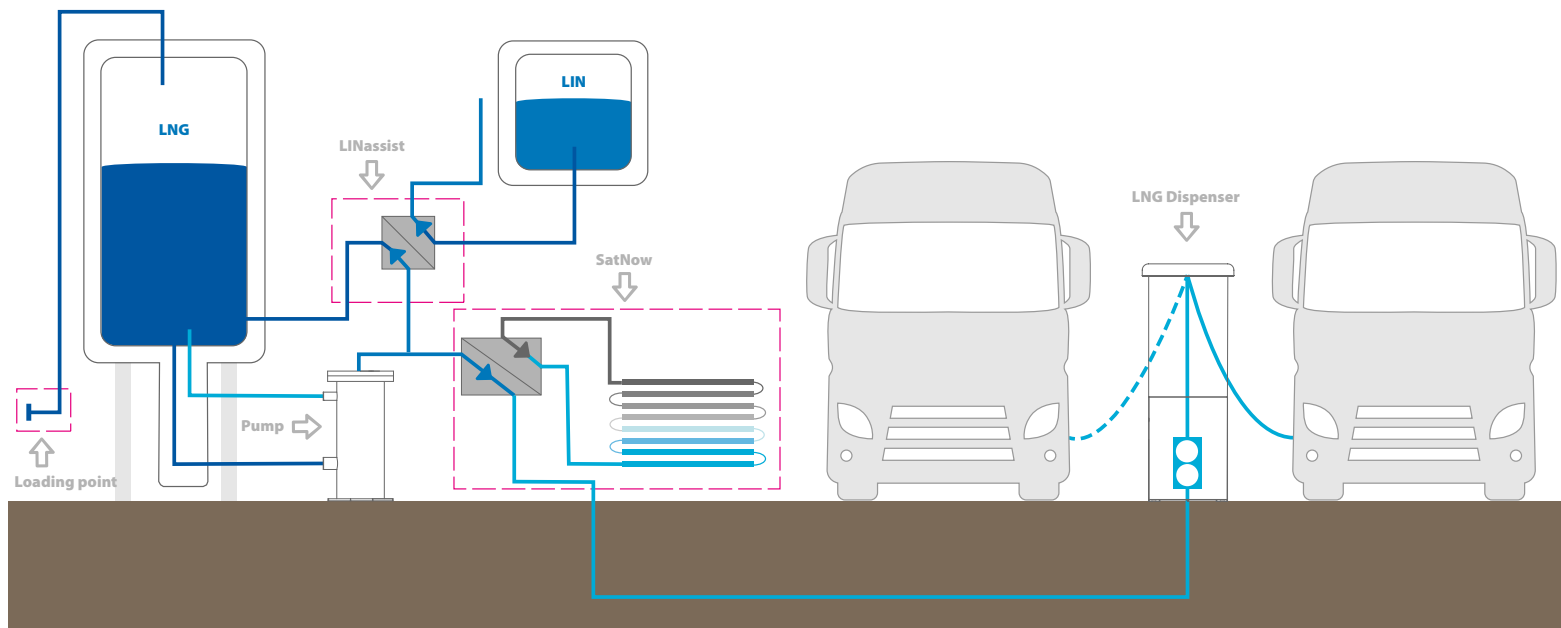
HPP - Gearbox driven

Capacity

Pressure : up to 600 bar

Flow : up to 520l/min (18,500 Nm³/h)

LNG REFUELING STATION



SUBTRAN™ pump skid

The SUBTRAN™ is a multistage submersed pump transferring LNG from the storage tank to the LNG dispensers. The SUBTRAN™ skid is a complete package mounted on rigid base frame with vacuum insulated sump, insulated piping and ATEX instrumentation and junction box.

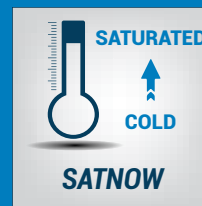
MAX FLOW RATE: 360l/min
(1x pump for 2x dispensers)

MAX DIFF. HEAD: 320m



SatNow™ saturation system

The SatNow™ is a patented system converting cold LNG at -162°C (3bar) to saturated LNG at -125°C (8bar) during the fueling (onthe fly). Thanks to SatNow™ a station with cold LNG inside the storage tank can fuel both type of vehicles. Besides there is no need to warm up the LNG in the storage tank => no down time.



Registered design

LinAssist™ boil-off minimizer

The LinAssist™ is a patented system using liquid nitrogen to maintain the LNG storage tank at a constant temperature and therefore at constant pressure. This system eliminates any possible gas releases of the storage tank.

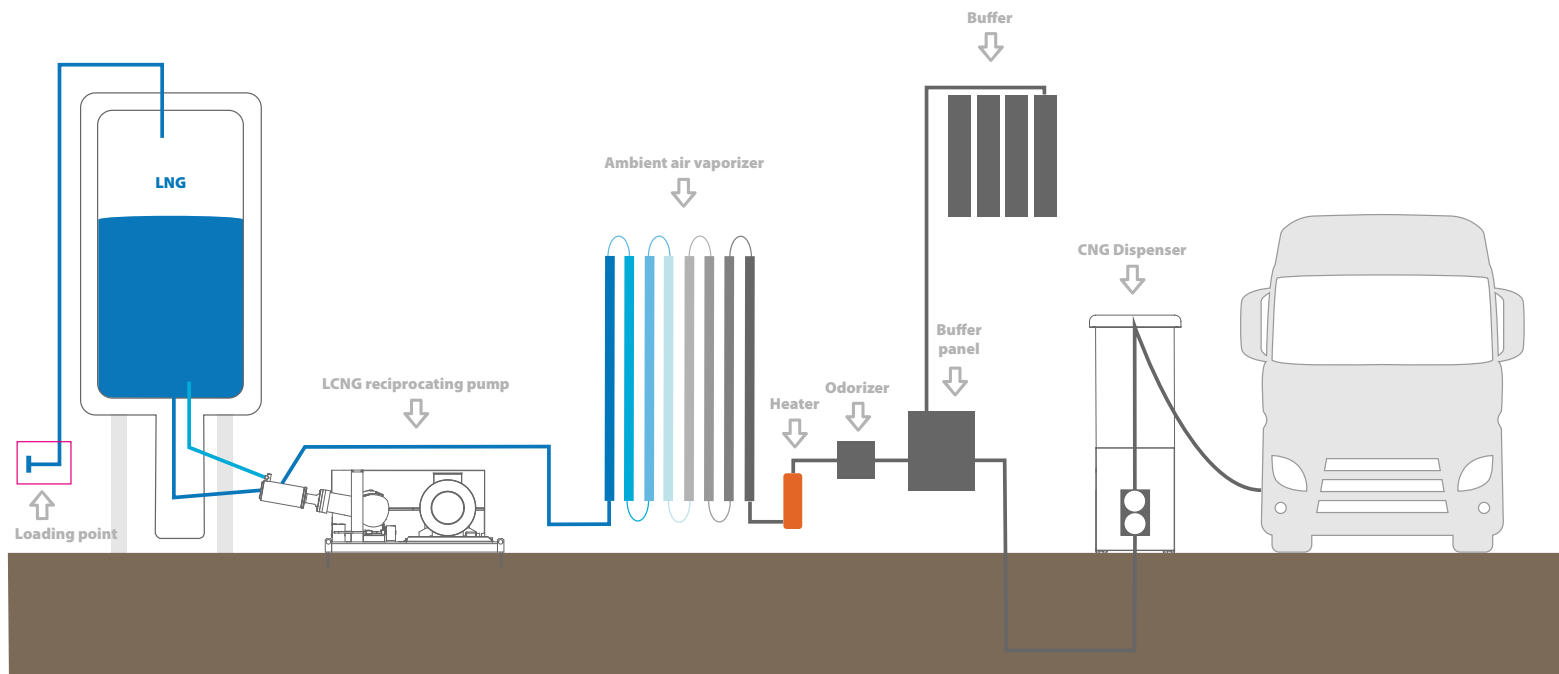


LNG Dispenser

The LNG Dispenser refuels vehicles with cold or saturated LNG. Its registered design ensures high safety and ergonomics to the operator. Its proprietary electronic card CRYO-FUELTRONICS™ allows a standalone use and IFSF communication with payment system. The flow meter and electronics are approved according to MID directive.

FLOW AT NOZZLE: 160l/min
(3 minutes for 450 liters tank)

LCNG REFUELING STATION



LCNG reciprocating pump

CRYOSTAR MRP™ pump series available in simplex/duplex/triplex with all necessary ATEX accessories for the safest and most efficient use

- High efficiency design with minimum product losses
- Long lifetime wear parts for reduced downtime
- Robust design based on Finite Element Analysis (FEA)

FLOW RATE: 800 to 2'700Nm³/h

PRESSURE: up to 360 bar



Buffer panel / Heater / Odorizer

The buffer panel controls both line and buffer pressure to deliver the right pressure to the CNG dispensers. It also controls the buffer capacity in order to open or close automatically the gas valve to the buffer storage.

The heater ensures that cold gas is not entering the buffer storage and the odorizer allows to readily detect any accidental leak in the process.

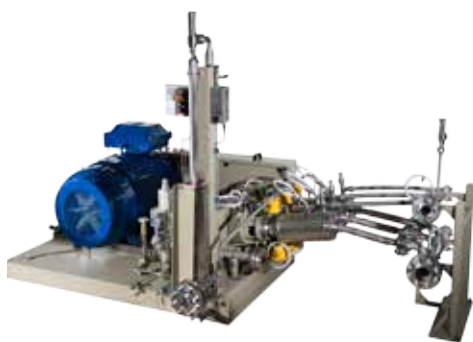


Ambient air vaporizer

Efficient ambient air vaporizer with aluminium fins fitted around high strength stainless steel inner tubes. The heat exchange is done by natural convection. For 24 hours a day operation 2 vaporizers are installed in parallel with an automatic switch every 4 hours.

OPERATION TIME: up to 8h

PRESSURE: up to 420 bar



User interface / Station control

Full automatic execution for smart and reliable operation.

Able to interface with industrial system / CRYOSTAR process control software with integrated modules for easy equipment upgrades / Data & defaults recording with automatic report and warning message sending / Remote station monitoring through internet connected devices (smartphones, touchpads...).

Electronics are approved according to MID directive.



BRAZIL

CHINA

FRANCE

INDIA

RUSSIA

SINGAPORE

UK

USA

For contact and address of the Cryostar
locations worldwide, please go to
www.cryostar.com/locations

★ www.cryostar.com ★