CHART®

LNG

FUEL SOLUTIONS FOR SHIPS

Innovation. Experience. Performance.®

About Chart

Our focus is cryogenics. Chart is a recognized global brand for the design and manufacture of highly engineered cryogenic equipment used from the beginning to the end in the liquid gas supply chain.

Our products are critical components in the separation of oxygen, nitrogen and noble gases from air and in the processing and liquefaction of natural gas. Our distribution and storage products and engineered systems are fundamental to the delivery and end-use of liquid gases across a multitude of applications in industry and for energy.
Chart has operations located in USA, the Czech Republic, China, Germany, Australia, and the United Kingdom.
We express our brand promise through our tagline: *Innovation. Experience. Performance.*®

Innovation – We are passionate about what we do and dedicated to continuous, innovative development.

Experience – Customers rely on our knowledge because we are experts in our field.

Performance – We fulfill expectations. We respect our customers and are committed to meeting their needs.

Chart Vacuum Technology®

Providing the best insulation system to protect your valuable gases from harsh ambient conditions results in lower pressure rise and lower losses, yielding better gas utilization. Chart Vacuum Technology® is at the core of why Chart is recognized around the world as the premier supplier of cryogenic equipment.

Chart's production plants are fully audited and compliant with Quality System ISO 9001:2008 and Environmental System ISO 14001:2005

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About you

You are a conscientious **shipowner** who values the reliable, efficient and low maintenance operation of your fleet. The lifetime cost of your vessels is what drives your decisions.

OR:

You are a professional **shipyard** that works with partners rather than suppliers. You value companies that perform according to what has been agreed, on time delivery, project management and engineering support.

OR:

You are a strong **LNG bunker fuel provider** that strives to serve their customers with flexible and safe means for ship-shore connections and appreciates the highest level of experience in building LNG bunkering stations.

LNG Ship Fuel Solution

Our systems are custom designed according to the specific needs of the ship's operation. We seamlessly integrate our fuel solution with the ship's engines, controls, safety systems and other connected equipment.

Benefits:

- Tanks with the highest quality vacuum insulation available in the industry
- Operational flexibility and zero maintenance over the lifetime of the vessel
- Concepts that minimize weight and optimize space
- Fast and worry-free on-board installation
- Simple operation

LNG Bunkering Solution

Our bunkering solutions range from on land LNG bunkering stations to LNG storage and transfer systems on-board bunker vessels. Also, flexible mobile solutions for LNG supply to ships are part of Chart's product portfolio. Many of the plants that Chart delivers combine marine bunkering with vaporization equipment (for gas supply to local industry) and/or LNG vehicle fueling and/or truck loading/offloading.

Benefits:

- Reliable - unprecedented experience in building LNG bunkering plants
- Highest quality vacuum insulation
- Total LNG solutions - from design to installation
- Customized and adapted to specific local needs and functions

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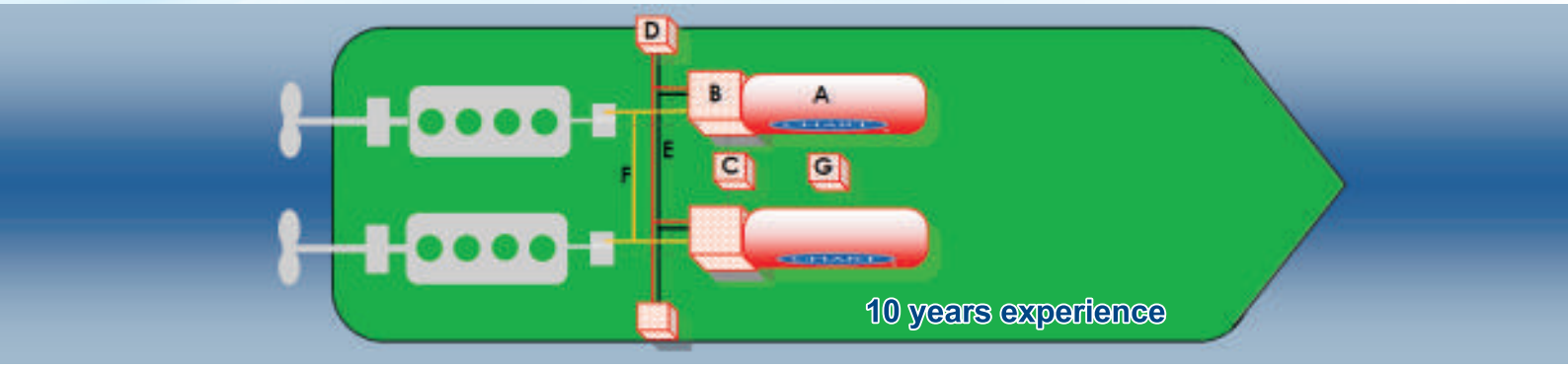
Typical LNG Ship Fuel Solution



A) **Vacuum insulated tanks**
Fully stainless steel tanks with perlite or multi-layer insulation, pressure up to 10 bar. Typically there are two tanks for single gas applications and a single tank in case of dual fuel engines.

B) **Coldboxes**
Stainless steel enclosure with A60 insulation, which acts as a containment for all valves of the tank and the heat exchanger (product and PBU vaporizer).
The coldbox is integrated with the storage tank. All pneumatic and electrical lines within the cold box are terminated in a junction box located outside the cold box.

C) **Water-Glycol systems**
The water-glycol heating fluid is heated by engine cooling water or other means (i.e. exhaust gases).

D) **Bunker stations**
For bunkering of the ship from starboard and/or portside.

E) **Piping for LNG bunkering**
The LNG filling lines are vacuum insulated, the vapor return lines are not vacuum-insulated but can be supplied double walled (below deck). All lines can be purged by nitrogen.

F) **Double walled gas supply lines**
The annular space of the gas supply lines are vented with nitrogen and gas-monitored.

G) **Gas Control System (GCS) and Gas Safety System (GSS)**
The safety and control system operates and controls the LNG fuel tank(s) and associated equipment – valves, detectors, heat exchanger(s), bunkering station, etc. All actuated valves operate pneumatically.
Safety detectors are typically: 2x flame, 2x gas and 1x leakage detector per cold box.

Further Chart performs all engineering work and takes care of the classification approvals. During installation we provide supervision and also execute the start-up and commissioning.

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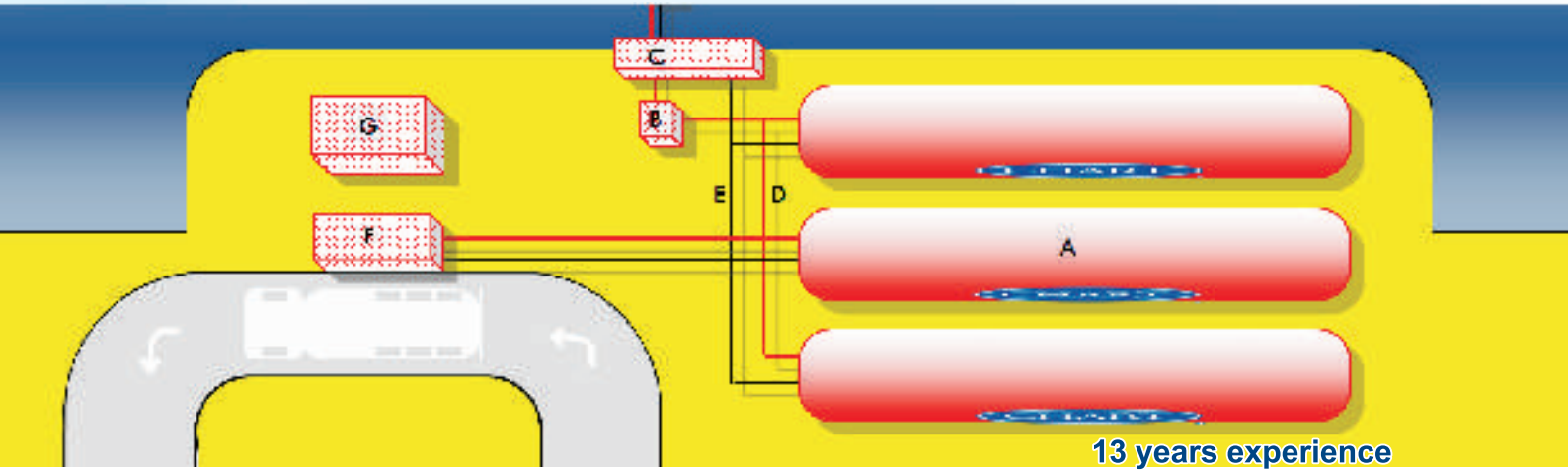
Typical LNG Ship Bunkering Station



A) **Vacuum insulated tanks**
Vacuum (typically perlite) insulated LNG storage tanks with volume up to 1225m^3.

B) **LNG transfer pump**
Cryogenic transfer pump with ability to adjust flow rates to the requirements/capabilities of the receiving vessel.

C) **Jetty filling module**
LNG supply and gas return connection with hoses and dry quick couplings. Also break away couplings and flow meters are part of this module. Hoses may be supported by crane for easy handling and height adjustment (height differences of ship's bunker stations and/or tidal height differences). For larger installations a loading arm can be applied.

D) **LNG piping**
Vacuum insulated or foam insulated LNG transfer lines.

E) **Gas return piping**
Stainless steel gas return piping.

F) **Truck loading/offloading module**
Hose connection for LNG delivery to (or withdrawal from) the storage tanks by truck or ISO container. This module is typically equipped with a pump and flow metering equipment.

G) **Control station & safety system**
This system consists of a main switchboard, PLC touch-panel and all safety instrumentation including gas detectors, flame detectors, LNG leak detectors and ESD pushbutton(s). Uninterrupted power supply is ensured by batteries. Remote data transmission is available as an option.

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Customization

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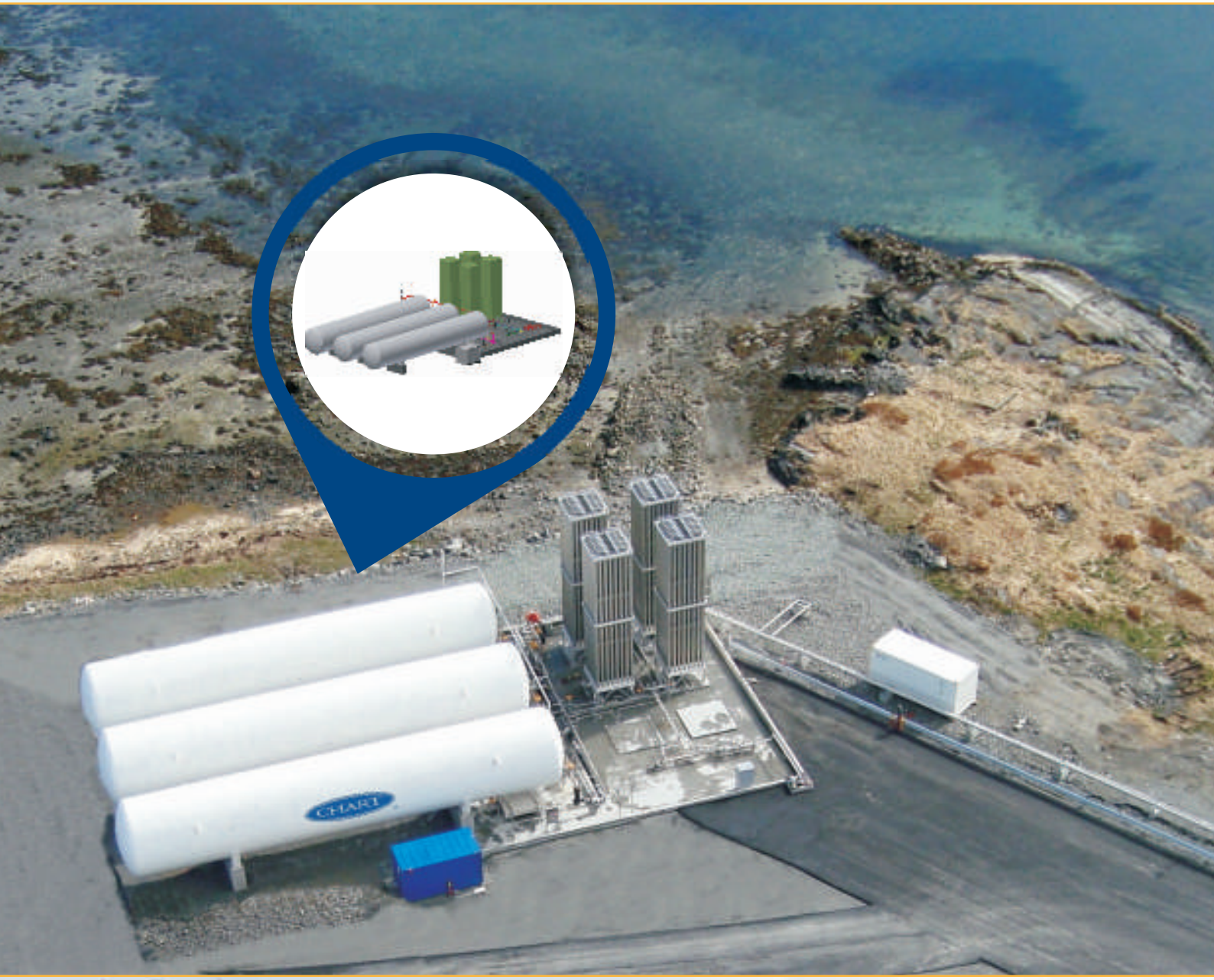
is our standard



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