



Danish Patent No. PR 178151

The zero-emission LNG bunkering facility makes it possible to fuel a ferry for a whole day's operation in less than 30 minutes, all handling activities included. The bunkering facility is fully automatic and requires no permanent staff on shore. With its modular design, the LNG bunkering facility can be dismantled and moved to another location in less than a week.

Simple and safe operation

Approx. 15 minutes before the ferry arrives to the facility by the quay, a signal is sent from the ferry to the control system of the bunkering plant. This activates the system and the LNG road tanker controls to start the pre-cooling sequence of the transfer pump.

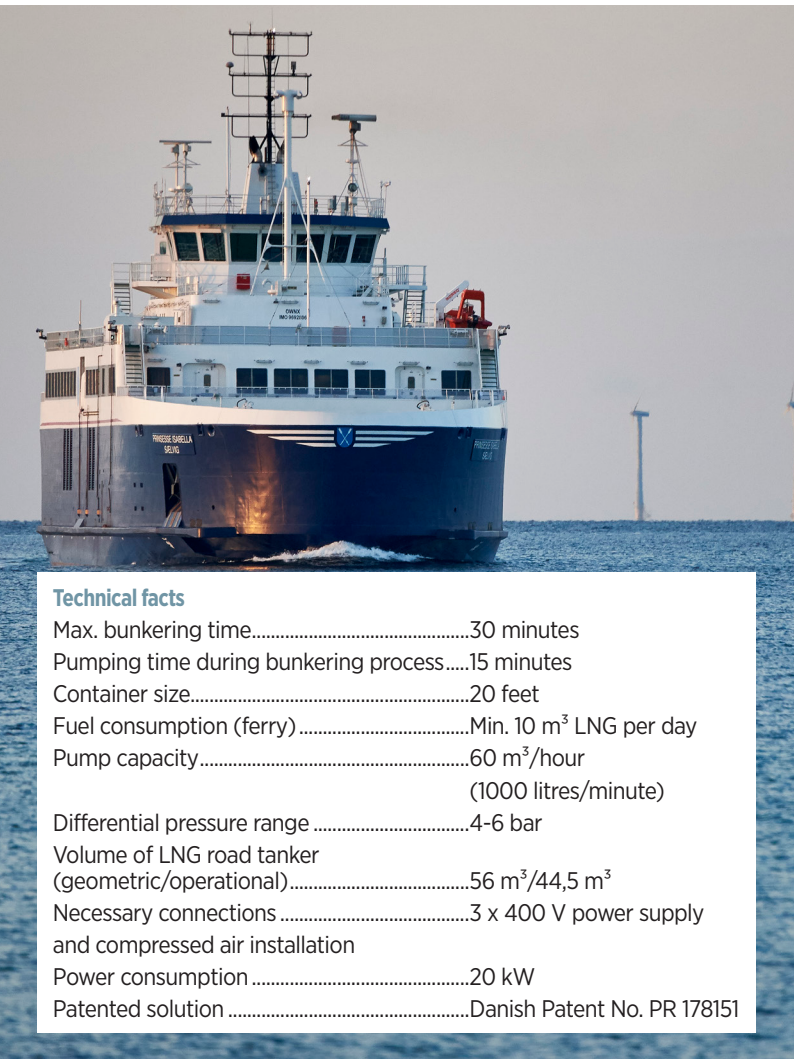
When the ferry has docked, a ferry crew member connects the EMS (emergency shut-down) cable, takes the loading hose from its parking position and connects it to the ferry bunkering coupling, and starts the bunkering

process on the HMI control panel. After the desired amount of LNG has been transferred, the process is stopped on the HMI control panel, thereby stopping the pump and closing the valve on the road tanker liquid outlet line. When 'bunkering valve close' is activated on the HMI control panel, the liquid is led back to the road tanker, thereby lowering the pressure in the bunkering line. When the pressure in the bunkering line has reached a preset value, the HMI will display 'disconnect bunker hose'. The loading hose is then disconnected and placed on the parking connection again.

As the ferry leaves, the remaining liquid in the lines will be vaporized and displaced to the road tanker through the vapour line due to thermal expansion and lower pressure in the road tanker. Finally, all valves are closed, putting the system 'to sleep' under vapour pressure. During 'sleep', the pressure in the system is kept on a constant level, thereby preventing any emission to the atmosphere.

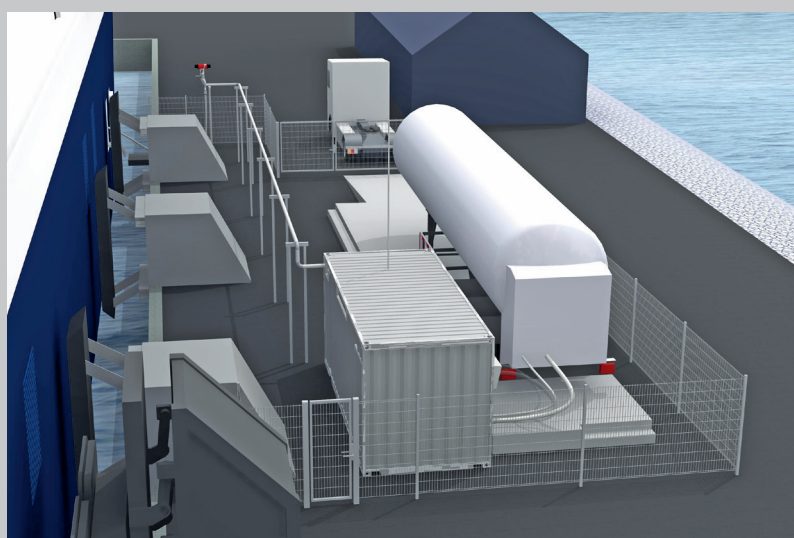
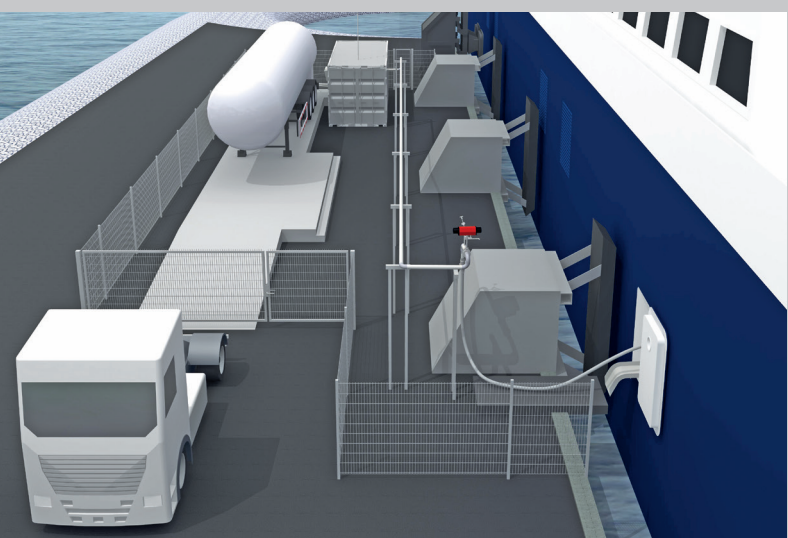
Kosan Crisplant's complete turnkey solution includes the following main items:

- Cryogenic transfer pump unit built into a 20 feet container
- Piping system incl. specially designed LNG dry couplings
- 2 specially designed LNG road tankers
- Parking ramp for road tanker
- Control system incl. safety system
- HMI control panels
- Power installation
- Theft-proof electrical panel placed outside Eex zone 1
- Compressed air installation placed outside Eex zone 1
- Fire and gas alarm system
- Fire fighting equipment
- Fencing, outdoor lighting and lighting in container
- All necessary approvals from the Danish Safety Technology Authority and the Danish Maritime Authority



Technical facts

Max. bunkering time.....	30 minutes
Pumping time during bunkering process.....	15 minutes
Container size.....	20 feet
Fuel consumption (ferry).....	Min. 10 m ³ LNG per day
Pump capacity.....	60 m ³ /hour (1000 litres/minute)
Differential pressure range	4-6 bar
Volume of LNG road tanker (geometric/operational).....	56 m ³ /44,5 m ³
Necessary connections	3 x 400 V power supply and compressed air installation
Power consumption	20 kW
Patented solution	Danish Patent No. PR 178151



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MAKEEN Cryo designs, manufactures, and delivers liquefaction, bunkering, refuelling, service, and engineering solutions for liquefied natural gas (LNG) and liquefied biogas (LBG) – clean and highly cost-efficient fuels. In every solution, we focus on implementing our 4 core principles: scalability, zero emissions, customisation, and mobility. MAKEEN Cryo is a division of MAKEEN Energy.