LNG SHIP BUNKERING – FROM IDEA TO OPERATIONS

Liquiline

CREATING ENERGY LINES

M/S Stavangerfjord, 10 - 12 April 2018

Knut Førland, Managing Director Liquiline LNG

Company Profile

- A Norwegian based gas technology company and provider of services and innovative solutions for transporting and storing liquefied gases:
  - ✓ Technical and commercial consultancy services
  - ✓ Terminal construction company
  - ✓ Specializing in the small-scale LNG market
  - ✓ Focusing on Ship Bunkering Terminals and LNG Buffer Storage Systems

Photo courtesy: Liquiline

Photo courtesy: Liquiline

Company Profile

- Privately held and member of the Network LNG Norway (www.networklngnorway.com)
- Partnership with the Greece company METKA (www.metka.com), a leading international EPC contractor and industrial manufacturing group
- Technical cooperation and office sharing with LMG Marin (www.lmgmarin.no), one of the European's leading ship design houses

Photo courtesy: Liquiline

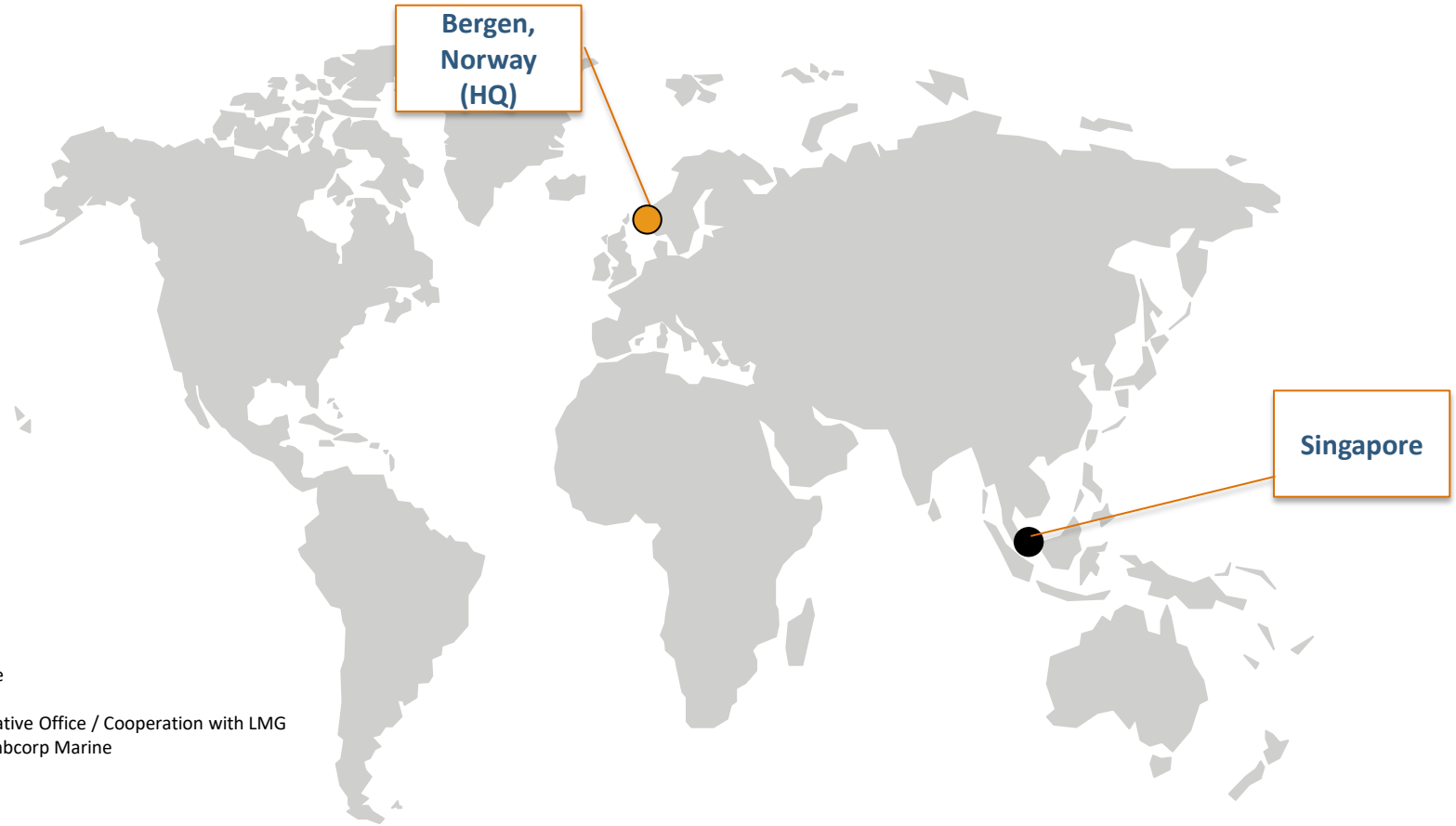
Photo courtesy: Liquiline

Ownership structure

- Established as a wholly owned subsidiary of Hirtshals LNG, part of the Fjord Line Group. Following a Management Buy Out in September 2015 and a private placement in June 2016, the shares in Liquiline LNG are currently owned by the following:

- Knut Førland – 60 %
- Tatomi Invest – 40 %

A Scandinavian based company with partner in Singapore



Head office

Representative Office / Cooperation with LMG Marin/Sembcorp Marine

An LNG Midstream partner

LNG Wholesale → LNG Sourcing → LNG Logistics → LNG Terminals → End user

Wholesaler X

Wholesaler Y

Wholesaler Z

Bunkering solutions

Shipping

Filling station solutions

Transport

Regasification and Storage Buffer solutions

Power production & industrial processes

Bunkering challenges…

- Lack of LNG infrastructure
- Unpredictable volumes
- High capex
- Lack of feeder vessels
- High distribution costs
- High LNG prices
- Lack of competence

But there are solutions…..

Photo courtesy: Liquiline

Direct loading

- Using tank containers or semitrailers to bunker ships
- Ships can be bunkered at place of preference instead of having to detour to bunker somewhere else
- No need for quayside construction
- A flexible bunkering solution
- Early-bird solution to get started
- Good alternative in a start up phase, or when ships have small fuel tanks

Photo courtesy: Liquiline

Photo courtesy: Liquiline

Multiple loading facility

Photo courtesy: Liquiline

Photo courtesy: Liquiline

- Bunkering solution where two or more containers/semitrailers can discharge simultaneously
- Reduces total bunkering time for the ship
- Minimal need for quayside construction
- Flexible and cost-effective
- This solutions enables a quicker start-up for distribution of LNG. Can build a bunkering terminal with a storage tank later on

Bunkering terminal

Photo courtesy: Liquline

Photo courtesy: Liquiline

- Onsite storage tank
- All process systems prepared for tank no 2
- Civil work prepared for tank no 2
- Prepared for downstream vaporisation and gas distribution
- EPC delivery
- Operations and service contract
- Applicable for supplying larger customers both in volume and number

Ship-to-Ship transfer

Photo courtesy: Liquiline

Photo courtesy: Gasnor

- Ferry rebuild to be LNG bunker barge supplying Viking Lines new cruise ship
- Ship-to ship transfer between to Gasnor LNG carriers

Construction of Danmarks first LNG Bunkering Terminal

Some key information:

Photo courtesy: Fjord Line

- **Customer: Fjord Line AS**
- Two LNG-fueled cruise ferries
- 1,500 passengers - 600 cars
- 4 x 5,600 kW gas engines
- Trading between Norway and Denmark on daily basis

What was the alternative for bunkering ?

1. Onshore terminal on the dock
2. Loading from trucks
3. Loading from LNG carrier (sea to sea)

Liquiline`s Feed study concluded that the best solutions for this customer was an onshore terminal on the dock.

The terminal was built in 2015:

- 500m^3 horisontal storage tank
- LiquiStation™ Bulk bunkering solution
- High speed bunkering (3500 l/min)
- Automatically operations
- Possibility for truck loading to ship
- Possibility for loading storage tank from truck and LNG carrier

Hirtshals a strategic port

Important milestones

- Started with a concept study in 2013 and a FEED study in 2013/2014
- Contract signed with Fjord Line in August 2014
- Ground work and civilian work started in October 2014.
- Building of the terminal started in February 2015.
- Delivered on schedule 30 June 2015 and also close to budget (as normal in Norway)

Photo courtesy: Liquiline

Liquiline to Construct Denmark's First LNG Bunker Terminal

By George Backwell

Tuesday, August 19, 2014

Liquiline says it has entered into a contract with Fjord Line to design, construct and commission an LNG ship bunkering terminal for Fjord Line AS at the Port of Hirtshals, Denmark.

Port of Hirtshals scene: Photo Liquilline

The terminal will be constructed at the Port of Hirtshals, where Fjord Line operates a daily service with one of its two LNG-fuelled cruise ferries *MS Stavangerfjord* and *MS Bergensfjord*. This will be the first LNG ship bunkering terminal in Denmark.

Important activities in the project

- **The process was divided in 5 activities:**
  - ✓ Engineering and design of LNG tank/ pump/equipment/ layout
  - ✓ Environmental survey
  - ✓ Detail design preparation study and procurement
  - ✓ Civil Work and installation at the pier of Hirtshals
  - ✓ Commissioning and approval of all accepts of the plant

Some pictures from the work on site

Photo courtesy: Liquiline

Photo courtesy: Liquiline

Photo courtesy: Liquiline

Photo courtesy: Liquiline

Photo courtesy: Cryovat

Photo courtesy: Liquiline

Fjord Line Opens First Danish LNG Bunkering Terminal

Port of Hirtshals became the first Danish port to offer LNG bunkering services following the opening of Fjord Line's LNG terminal on July 1.

Fjord Line invested in a 500 cubic meters LNG tank and terminal facilities at Hirtshals to optimize operation of its two LNG-powered cruise ferries – M/S Bergensfjord and M/S Stavangerfjord – that sail the routes between Bergen, Stavanger and Hirtshals, as well as between Langesund and Hirtshals.

With the addition of the LNG bunkering station in Hirtshals, the two ferries can reduce their fuel loads and not carry more fuel than is needed.

"According to the plans, this LNG terminal is the first step in the future development. We wish to expand the terminal so that, in addition to bunkering our own two cruise ferries, M/S Bergensfjord and M/S Stavangerfjord, we can also offer bunkering to other ships running on LNG. With this, we are expanding the commercial foundation for the development of LNG supply for ships on one of the world's most trafficked sailing routes," said **Morten Larsen, CEO at Fjord Line.**

LNG Transport by LiquiTainers®

Photo courtesy: Liquiline

LNG Logistics

LiquiTainers®

Photo courtesy: Liquiline

Photo courtesy: Liquiline

Photo courtesy: Liquiline

- By road
- By sea
- By rail

New solutions on its way…

Development with Rolls-Royce Marine and DNV GL

LNG Logistics
LiquiSys® (www.liquisys.com)

LiquiSys is a remote monitoring solution for the LNG industry and provide web access to terminals and containers

Monitoring process values and equipment status

- Remote control of equipment
- Alarms displayed on screen
- Alerts sent by SMS or e-mail
- Historical data displayed as trends and digits

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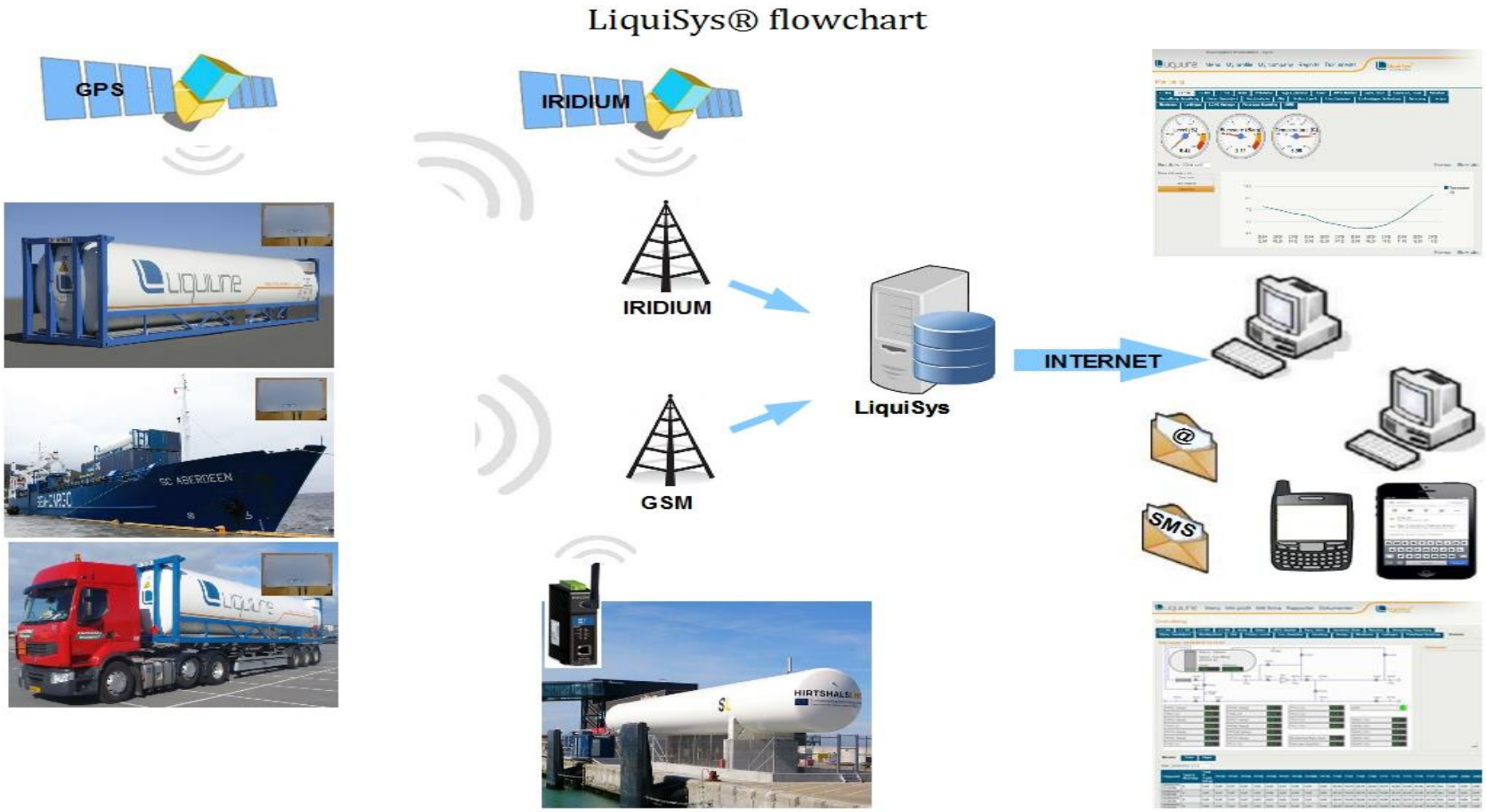
LiquiSys® - Flowchart



Summary

Photo courtesy: Liquiline

- Give the concept study and the FEED study high priority
- Close cooperation with local authorities essential for the success
- Play with open cards and be proactive
- Use your best project manager
- Use well qualified subcontractors and equipment with high quality
- Provide safety, LNG training and LNG exercises top priority from day one

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