“Supply, storage and handling of LNG as ship's fuel”
Björn Munko
LNG 17, Houston
• **Short Company Introduction**

• Small LNGC and LNG tanks

• Bunker supply chain

• LNG fuel gas systems

• Conclusions
‘TGE Marine is a long established market leader in the design and construction of cargo handling systems for ships and offshore units carrying liquefied cryogenic gases (LNG, LPG and petrochemical gases)’

- Personnel: approx. 60 engineers & specialists plus temporary staff
- Main Office: Mildred-Scheel-Str. 1, 53175 Bonn, Germany
- Branch Office in Shanghai, China
Business activities and expertise

**Cargo handling systems and cargo tanks for Gas Carriers**
- LPG carriers, CO\textsubscript{2} carriers
- Ethylene carriers
- LNG carriers

**Cargo handling systems for Offshore units**
- FSO/FPSO for LPG
- FSRU and FPSO for LNG
- CO\textsubscript{2} liquefaction, storage and offloading units
Business activities and expertise

Fuel Gas Systems for seagoing vessels

- Fuel gas supply systems
- Fuel gas tanks
- RoRo, Container, Ferries, ...
- Bunker Barges, Bunker Boats
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19-May-2010 „Coral Methane“ loading at Zeebrugge, First loading of a small carrier at a large import terminal.
• Up to 8,000 cbm per tank cylindrical tanks
• Up to 15,000 cbm bilobe tanks (patented supports)
• Ship sizes up to 50,000 cbm have been studied
• Tank pressure 2.7 to 4.0 barg
• BOG handling by pressure increase or fuel gas consumption
• combined carriers (LPG/Ethylene/LNG)
LNG tank systems

• Membrane tanks embedded in ship structure
• Independent types IMO A,B and C
• Type A (prismatic) and B (prismatic, spherical ...), typically low pressure
• Type C (cylindrical, bilobe), pressure vessel & crack propagation, proven system easy to build and operate
**Tank Insulation**

- Vacuum insulation for small cylindrical tanks (mainly fuel tanks)
- PS or PU preformed slabs covered by steel sheets, allow for conical and bilobe shapes
- PU foam covered by polymeric protection layer
- Special panels for increased insulation efficiency
- Choice depending on requirements (operation/consumption schedule, possible tank shape)
Why using type C tanks for small LNG carriers?

- Current designs from 1,000 to 40,000 m³
- IMO type C to allow for:
  - partial loading
  - no secondary barrier
  - High loading/discharge rates
  - Pressure build-up possible
  - Separate construction and easy installation
  - Multiple cargoes
  - wide range of volume per single tank
- Flexibility in BOG handling:
  - Dual fuel propulsion
  - pressure build-up
  - reliquefaction (?)
- Arrangement to fit small and large terminals
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Bunker supply infrastructure

- Feeder vessels (small LNGC/ATB)
- Hub terminals (on-/offshore)
- bunker vessels
- trucks
- bunker terminals
- mobile tanks

30,000 m³ LNG FSRU / floating bunker hub - Feed study
• Today’s bunkering: “truck and hose” solutions

• Requirements for future operations:
  • High loading rates due to tight time schedule
  • Large total amount of LNG for larger vessels
  • Safe but easy handling of heavy equipment
  • Dry-break emergency couplings
  • Bunkering during cargo operations

• This will only be possible with bunker vessels coming alongside or dedicated bunker terminal for some ship types (tankers)

• Regulations and standards for the bunker interface and related operations are currently being prepared by several international working groups
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Auxiliary systems:
- Water-glycol heating system
- Inert gas system
- Vent / ventilation
- Valve remote operation
- Safety systems
- Automation & control

LNG fuel gas systems – basic components
LNG fuel gas systems – basic aspects

- Focus on ECA/SECA areas like North Sea, Baltic & North America
- Tank space is a challenge for designers to reduce loss of cargo space
  - relatively easy for tanker/chemical or gas carrier on open deck, also retrofit
  - small container feeder: first bay in front of bridge loosing cargo space
  - medium size container vessel: open deck aft of accommodation or first bay
  - large container vessel (two island): below accommodation block
  - ferry/cruise liner: below deck following B/5 restriction
  - RoRo/RoPax: mobile tanks, esp. for retrofits
LNG fuel gas systems – vacuum tank with “cold box”

- Highly-efficient vacuum insulation
- Equipment inside “cold box”
- Bottom outlet to feed tank vaporizer
- Tank operation pressure 6 to 8 barg
- Tank design pressure 8 to 10 barg

Source: Cryo AB
LNG fuel gas systems – basic TGE system

- Type C single shell foam insulated tank
- Bilobe or conical shape possible
- Pump inside, all outlets on top
- Tank operation pressure 0 to 3 barg
- Tank design pressure about 4 barg
- Equipment in ventilated processing room in flexible arrangement
LNG fuel gas systems – two stroke engines

- 2 stroke DF engines (Diesel cycle) require high injection pressure (150 – 300 barg)
- HP pumps and HP heater
- Tank design pressure 4 barg
- Low pressure consumer available?
- Booster pump inside tank also for supply to aux. engines
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CONCLUSIONS

• LNG as fuel is an environmentally friendly and commercially attractive way of ship’s propulsion
• Technical solutions for LNG supply infrastructure and on-board storage and processing are available
• Small LNG carriers are part of an existing and quick developing market, driven by LNG supply to remote areas and LNG as ships fuel
• Excellent safety record of LNG business and proven safety systems are limiting risks
• Development of bunkering infrastructure and regulatory framework is the main challenge
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