Introducing new bunker fuels in ports: The port perspective

Captain Johan Gahnström

SSPA Sweden AB

The 9th International Harbour Masters Congress

May 2014
Bruges
Agenda.

• Presentation by SSPA, Captain Johan Gahnström
  – Compliance strategies for meeting MARPOL 2015
  – Pilot projects and case studies
  – Port Policies for LNG bunkering

• Questions
SSPA Sweden AB

- Providing maritime consultancy services on a worldwide basis

- Independent Consulting Company, fully owned by the Foundation Chalmers University of Technology

- Main clients: Maritime operators and ship yard industry, energy companies, industry, ports, authorities, EU, OECD, IMO, EMSA

SSPA: The bridge between theory and practice....
Compliance Strategies for meeting MARPOL 2015
Introduction – IMO MARPOL Annex VI

<table>
<thead>
<tr>
<th>Current and confirmed Emission Control Areas (ECAs)</th>
<th>Entry into force</th>
<th>Effective from</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baltic Sea SECA (SO₃)</td>
<td>19 May 2005</td>
<td>19 May 2006</td>
</tr>
<tr>
<td>North Sea SECA (SO₃)</td>
<td>22 November 2006</td>
<td>22 November 2007</td>
</tr>
<tr>
<td>North America ECA, up to 200 nautical miles (SO₃, NOₓ and PM)</td>
<td>1 August 2011</td>
<td>1 August 2012</td>
</tr>
<tr>
<td>US Caribbean Sea ECA, Puerto Rico/US Virgin islands (SO₃, NOₓ and PM)</td>
<td>1 January 2013</td>
<td>1 January 2014</td>
</tr>
</tbody>
</table>
ECA - Emission Control Areas

- Baltic Sea, North Sea & English Channel
- North America
- Others to come...
Ship owner’s choice in SECA...

- **Low sulphur fuel**
  - Easy and low CAPEX
  - Very high OPEX

- **Scrubber installations**
  - Medium CAPEX but uncertain, complicated and medium OPEX

- **LNG propulsion**
  - High CAPEX
  - But (potentially) lowest OPEX

- And Methanol…

Seagas at Stadsgårdskaigen, Photo Johannes Hüffmeier
The LNG price and introduction of small scale LNG

**Market Price**

**Sourcing cost**

**Supply cost**

- LNG Source
- LNG Feeder vessel
- Intermediate LNG terminal
- Truck / Bunker vessel / Pipeline
- Receiving vessels

**LNG compared to fuel- and gasoil (NWE)**

USD/MMBtu

- 1% fuel oil NW
- Gasoil
- LNG

Natural gas prices

History 2010 Projections

- Shale gas
- Tight gas
- Associated with oil
- Non-associated offshore
- Non-associated onshore
- Coalbed methane

SSPA: Your Maritime Solution Partner
Pilot projects and case studies
Examining experiences of risk analysis for LNG bunkering

Example case: Viking Grace

- The "Viking Grace" bunker LNG in downtown Stockholm, in operation 2013.
- SSPA supported AGA with all risk analysis for safe and efficient bunkering operations
- SSPA was a discussion partner with the client during the whole process
- Done in two phases
• GT 57 000
• 2800 passengers
• 880 passenger cabins
• 200 crew
• 1275 lane meters for trailers, partly with hoistable car platforms
• 500 lane meters for cars

DF-electric powerplant 4x W8L50DF
Flag: Finland

200 crew
1275 lane meters for trailers, partly with hoistable car platforms
500 lane meters for cars
Permission process

Terminal/Shore-side

Maritime

Port/STA
LNG vessel
Port/STA
bunkering
Bunkering permit

• "Uncharted waters" - no existing or stipulated process for permit approval
• AGA had to solve issues and answer questions along the process.
• Learning process
• Educating authorities
  – What is LNG?
  – Risks?
  – Fire dept was used to judging quantative data – not enough knowledge base of LNG incidents

• SSPA acted as partner to assist AGA in the risk assessment and answering the stakeholders/authorities questions during the whole process.
First idea was to place road trailers on existing road ferry

Refined proposal to place fixed tanks on rebuilt road ferry

- SEAGAS
- Road truck supplied LNG at separate terminal
- 70 ton LNG/call
- 1 hours alongside
First task

SIGTTO’s large scale LNG recommendations that was discussed in risk assessment as advised by STA:

- VTS
- Patrol boats
- Escort tugs
- Tugs
- Speed reduction
- Turning circle for LNG
- Pilotage
- “Passage planning”
- Establish safe mooring sites
- Weather restrictions
- Human factors
Second task

- SSPA did a Full Formal Safety Assessment
- Assisted AGA in answering questions in the permit process.
Accidents while bunkering

- Statistics from the Mediterranean 1977 to 2010 includes 12 accidents in connection with bunkering.
- Most common cause was overfilling of tanks.
- Hose rupture occur in two cases.
- SSPA analyzed data from the English accident database (MAIB, 2011):
  - Safety - 63.6%
  - Human Factor - 45.5%
  - Technical factor - 30.9%
  - Procedures - 45.5%
  - Practice - 40.0%
  - Environment - 18.2%
  - Equipment - 7.3%.

Most accidents occurs on deck,
Safety zone outline

• Safety zone size
• EX zone size
• Zone geometry
• Ignition sources
• Public information
• Safety zone enforcement
• Dispersion contours
• Fire radiation contours
Final questions from STA

Following AGA’s first application for a bunker permit the Swedish Transport Agency (STA) requested a more thorough risk analysis especially regarding STS bunkering. Following that some further questions were raised:

- The effects of swell from passing traffic at the bunker terminal (Loudden) and at the bunker quay (Stadsgårdskajen)?
- What happens if advised actions to reduce risk were not implemented?
- **Collision** between bunker barge and the *Cinderella* (high speed pax) or *Bildösund* (old steamship)

- The final report from SSPA could demystify these last questions
Current status

• AGA received permit for STS bunkering operations during normal cargo operations in downtown Stockholm

• Window for bunkering 50 min during morning rush hour.

• The bunker barge was delayed, rebuilt to fit amended class rules (Full IGC tanker!)

• So far > 300 bunker operations has been carried out without release of LNG
Viking Grace:

Film by AGA/LINDE
Outside ECAs? Example Busan Port

• If 15% of all vessels calling Busan port would chose LNG as a marine fuel, then:
  • The required amount of LNG would be 53,700 M³/day
  • That is approximately one Q-flex every fourth day.....

• Calculations by KAIST (Korea Advanced Institute of Science and Technology) and JIP with SSPA 2011

Is your port ready for new fuels?
Port Policies for LNG bunkering
New fuels in the port - the way forward

- Make a feasibility study combined with a market study.
  - This will look at all aspects on a high level, Make sure the study have a dialog with large customers in the port, what are their plans?
  - Competitive advantage towards other ports?
- Who will enter the market as seller and/or distributor of the new fuel?
  - Will the port actively look for someone to enter the market or will you chose a wait and see who enters the market.
  - A new bunker barge is expensive, who will pay?

- Mapping of
  - flow patterns
  - vessel types
  - bunkering needs
- Enabling
  - Market analysis
  - Trend analysis
  - Risk assessment
  - Etc…
Permit process LNG Bunkering

- Specific safety assessment for each bunker vessel, LNG flow rate and bunkering location in order to:
  - Identify credible accident scenarios; leakage, hose crack...
  - Estimation of possible consequences; heat radiation fire scenarios
  - Risk Control Options…
Port policy

- There is a need to update port bye laws and develop port procedures for new fuels
- SSPA assisted Ports of Stockholm with their safety manual and procedures for LNG in the port.
Conclusion
Enablers for LNG as ship fuel

• Make sure you have collected all facts before you start your journey.
• Minimise operability impact
  – Ensure that bunkering and embarking/disembarking of passengers can be conducted simultaneously.
  – Optimise bunkering time
• Identify risk based safety zones
  – depending on quantities handled, bunker flow and pressure
• Public consultation and awareness
  – Provide adequate information and demystify LNG by showing good pilot examples
The SSPA office...

- **Dimensions:** 88x38m
- **Length:** 260 m long
- **Height:** 12m high
Our capabilities

Environment

Ship design

Risk and safety

Intermodal transport systems

Marine operations and simulations

Port and coastal planning
Maritime Operations

- Port and Fairways
- Transport system and logistics
- Maritime infrastructure
- Ice management
- Risk assessment
  - Operation
  - Environment
  - Risk and safety
  - VTS, Harbour Management systems
  - ISPS
Ship Design

More than 7000 hull forms have been tested/designed at SSPA
Port development?

- Localization
- Fairway/Fairway Layout
- Turning basins
- Port layout
- Erosion, impact, fenders
- Risk and Safety
- Logistics and multimodal solutions
- VTS & VTMIS
- EIA
Simulation activities at SSPA

- Vessel performance
  - Maneuvering
  - New vessel concepts
  - New port layout
  - Sea keeping (with stabilizing devices)
  - Track-keeping and dynamic positioning (DP)
  - Lightering operations
  - Mooring analysis
  - Fender forces

- Investigations of environmental conditions
  - Weather windows – a specific ship in a specific environment
  - Tug types and number
  - Harbor layouts
  - Efficiency and safety

- Accidental investigations
SSPA Simulator
Ship dynamics

- The foundation for any serious nautical simulation is calculations on how the ship will react under influence of the control forces and the ships environment.
- SSPA uses its decades of experience in this area to make sure that the accuracy of the simulation is up to our client’s standards.
- Ongoing participation in several research programs makes sure that our knowledge on ship dynamics stays at the forefront of the industry.
Advanced mooring simulations (where standard systems lack capability!)

- Limit for northerly winds 12 m/s (mean)
- Bollards more sensitive than the lines
- Fenders limiting southerly winds

<table>
<thead>
<tr>
<th>Line</th>
<th>Number of lines</th>
<th>Connected to bollard nr</th>
<th>Breaking strength of one line [kN]</th>
<th>Bollard strength [ton]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>248</td>
<td>740</td>
<td>2x50</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>245</td>
<td>740</td>
<td>2x75</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>244</td>
<td>740</td>
<td>2x75</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>236</td>
<td>740</td>
<td>2x75</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>216</td>
<td>740</td>
<td>2x75</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>209</td>
<td>740</td>
<td>2x75</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>204</td>
<td>740</td>
<td>2x75</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>200</td>
<td>740</td>
<td>1x120</td>
</tr>
</tbody>
</table>
SSPA - LNG

- Ship design
- Market analysis
- Bunker infrastructure
- Terminal layout and operation
- Risk assessment
- Marine simulations
- Training

iii a) Immediate ignition and pool fire

Hazard radius 500 m
(12 kW/m², 2nd degree burns)
Hazard radius 660 m
(5 kW/m², 1st degree burns)

iii ) Intentional release of LNG

Total release of 14,000 tonnes LNG
Breach size 5 m²
Thank you.

Capt. Johan Gahnström.
 jog@sspa.se
 +46 31 772 9004.

More information?
SSPAs webpage; www.sspa.se
SSPA on YouTube; www.youtube.com/SSPAsweden
SSPA on LinkedIn; www.linkedin.com/company/sspa-sweden-ab