Ship-to-Ship LNG Bunkering

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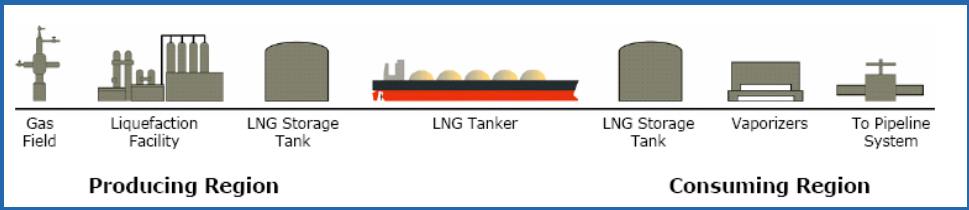
EXMAR company

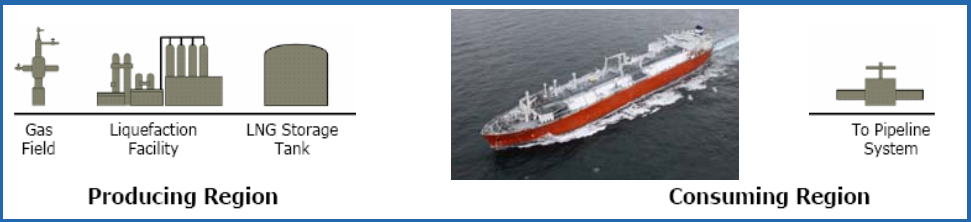
- Belgian Shipowner active in:
  - LNG
  - LPG
  - Offshore
- Sister companies with:
  - Dry Bulk Carriers
  - Crude Oil Tankers
  - Container ships
- In-house departments (a.o.):
  - Technical Projects (EXMAR & sister cies)
  - Ship Management and Operations

LNG Added Value Chain

Conventional LNG Shipping



The EXMAR Solution



➔ One-Stop Solution for LNG Shipping, Storage and Regasification

EXMAR pioneer in LNG - milestones

- 1978: largest LNG carrier built at BOELWERF affiliated shipyard
- 2000 to 2010: 10 LNG carriers ordered, built and put in operation
- 2005: first LNG carrier delivered with on board regasification (LNG RV)
- 2006: first transfer of LNG between 2 LNG carriers, at sea (Ship – to – ship , STS)

STS in operation

STS Key Components

- **Process:**
  - Composite hose
  - Handling/positioning devices
  - Connection/reduction spool piece
- **Safety:**
  - Emergency release coupler (ERC)
  - Hydraulic power pack for ERC'S
  - Hose fall-braking system
- **Software:**
  - Handling procedure
  - Operating manual
  - Training scheme

EXMAR STS compared to alternatives

	EXMAR	Alternatives
Hose diameter	200mm	400 .. 500mm
Liquid hose numbers	6 .. 8	1
Applicable standards	Shipping	Offshore
Environmental condition	calm	Storm ?
Developed by	Shipowner, in-house	Oil companies, large engineering offices, contractors, JIP's, …
Start development	2005	2000
First operation	2006	?
Cumulated operations	40	none
System investment cost (MM€)	0.5 … 2.0	>10.0

STS vs. bunkering/operations

		STS	Bunkering
Transfer capacity	***m3/h***	**4,000 … 6,000**	**300 … 1,500**
Number of hoses		**8 … 10**	**1 … 3**
Hose handling		**Existing ship manifold crane**	**Specially designed hose handling crane**
Hose connection		**Bolted flange**	**Special connector**
Relative motion of connection points	***Meters amplitude***	**1.0**	**1.5**
Modification to vessels		**None**	**Bunkering ship: purpose built Receiving ship: bunker station**
Technical standard		**EN1474 pt. 2 and 3**	**DnV, GL, IMO (bunker station only)**

STS vs. bunkering/operations

		STS	Bunkering
Vessels involved	Master	LNG RV	Bunkering ship (bunkering station)
	Slave	LNG C (possibly from 3rd party)	Standardized receiving ship
Transfer location		Open sea (calm), sheltered water, quayside,	Open sea (calm), sheltered water, quayside,
Most Relevant Authorities	Quayside	Harbour authorities	Harbour authorities
	Sheltered waters	Coast Guards, Territorial waters authority	Coast Guards, Territorial waters authority
	Offshore / territorial waters	Coast Guards, Territorial waters authority	Coast Guards, Territorial waters authority
	Offshore / international waters	IMO, SIGTTO	IMO

Design criteria for a successful system

- Simple:
  - Lay–out
  - Number of components
  - Component type selection/design
- Crew friendly:
  - Limit hose diameter
  - Develop system with crew
  - Crew to write the manuals
- In line with known procedure:
  - Start from existing procedures with oil bunkering
  - Identify the difference and adapt
- Safe:
  - Reduce number of flanges, swivels (leaks)
  - Extensive component testing and certification
  - Crew training and responsibility

Conclusions for Bunkering System

1. Key components are available from STS
2. Reference (STS) regulatory environment works
3. Industry acceptance will only be possible if the system is:
   a) Simple
   b) Safe
   c) Cost efficient
   d) Easy to learn and to use
   e) Adaptive to different locations
4. System development should be lead by the users, not by the suppliers of equipment and services

Questions?

Thank you.

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