GTT Expert in LNG

LNG Solutions for distribution in the Philippines

3rd LNG Supply, Transport and Storage Philippines

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GTT in brief

▶ An engineering company with more than 50 years of experience in the design of the Membrane Cargo Containment Systems

▶ GTT is a public company listed on the Euronext Stock Exchange (Paris)

▶ 111 projects (1) (LNGC, VLEC, FSRU, FLNG, barge and GST) currently on order

▶ Around 380 highly qualified people (1), present worldwide
GTT solutions over the LNG value chain

- From small scale to large scale
- Tanks for land based terminals
  - Regasification and liquefaction plants
  - In-ground
  - Above ground
- Floating storage solutions
  - Regasification and liquefaction plants
  - Open sea
  - Quay side
- Shipping
Pagbilao LNG hub

- One tank under construction of 130,000 m³
Land based solutions
A segmented offer to store LNG with Membrane technology

**Storage capacity (cbm)**

| 1K  | 5 K  | 10 K  | 30 K  | 300 K+ |

**SOT (Small Onshore Tanks)**
Metallic or concrete envelope, (Single or Full integrity)

**Cylindrical flat bottom**
Metallic or concrete envelope, (Single or Full integrity)

**GST®**
Concrete with polygonal inner face (mainly Full integrity)
GTT land storage technology

- GTT has optimized the design of the system since the first installation in 1972

- 33 membrane tanks using GTT technology have been constructed and are operational

- Based on the same principles as LNG Carriers, the recognized advantages cover:
  - Compactness of the design
  - Easy design for large size tanks
  - High prefabrication
  - High local content
  - Best earthquake behaviour
  - No limit in thermal cycles – easy (de-)commissioning
  - The cost savings

- Existing tanks built between 8,000 m³ and 200,000 m³
Small onshore tanks
A viable option compared to tank farm

- Reduced foot print, no risk of BLEVE, limited process piping…
GST Flex - Concept

Objective

- Propose a LNG tank made of precast concrete easy to assemble on site (capacity: 2,000 - 15,000 m³)
- The precast concrete elements are prefabricated in factory, shipped to site and connected on site

Advantages

- Modularity and flexibility of the design
- Construction period is reduced with a short time of presence on site
- Excellent solution for remote areas and mid size storage requirement
Gravity Based Structure

- **Target capacity**: from 2k to 30k

- **Steel or concrete caisson**
  - Mooring and berthing
  - LNG Storage
  - Process

- **Adapted for each situation**
  - In quayside with transfer arms
  - Near shore onto sea floor

- **Features**:
  - Strong resistance to external hazards
  - Construction in dry-docks or floating dock
  - Structure, containment system and process completed in construction site
  - Transportation by towing
  - No building impact in ports activities
Small scale LNG Ship concepts
Key features

- Better economics
  
  *by maximizing scale effects*

- Flexibility in operations
  
  *by allowing any LNG quantity to be delivered to multiple clients*

- Shallow water constraints
  
  *by proposing innovative low draft solutions*

- Safety and reliability requirements
  
  *by relying on proven systems*
Milk-run operations for small scale distribution

- Based on the distances between the terminals & associated LNG demand, milk-run operations can be the most efficient:
  - Larger shipping capacity
  - Reduced number of vessels
  - Reduced number of crews (the size of the crew is not proportional to the ship size!)
  - Lower maintenance
  - Lower number of port calls

- But need for:
  - Access to many harbours
  - River trade
  - High manoeuvrability
  - High cargo capacity
  - Compact dimensions
  - Ability for partial cargo delivery (all filling levels)
Shallow Draft LNG Carrier

- Modularity of membrane systems for flexible and optimized solutions

- Tank shape customized to fit a particular hull

- A design of a small scale LNG Carrier with a shallow draft is then possible, with a large cargo capacity

- A shallow draft carrier is fit for regional distribution:
  - Easy access to many harbours
  - Coastal and river access
  - Large LNG volume
Shallow Draft LNG Carrier – 16,500 m³

**Hull:**
- $L_{bp} = 126$ m
- $B = 28$ m
- $D = 11.7$ m
- $T_{des} = 4.8$ m

**Cargo Tanks:**
- Capacity = 16,500 m³
- Number of tanks = 2
- BOR (LNG) = 0.200% V.p.d.

**Propulsion:**
- DF-DE
- Speed = 12.5 kts
- Twin-screw / Fixed pitch

**Manoeuvring:**
- Twin propeller solution with high-lift rudders
- Forward thruster with high thrust for independent manoeuvring
- “Crabbing” possible if reduced tug support

**Forward wheelhouse for better visibility**

**Partial fillings possible**

**Design Approved by ABS and CCS**
Shallow Draft LNG Carrier – 6,000 m³

**Hull:**
- $L_{bp} = 92.55\text{m}$
- $B = 20.7\text{m}$
- $D = 12.20\text{m}$
- $T_{des} = 3.7\text{m}$

**Cargo Tanks:**
- Capacity = 6,200m³
- Number of tanks = 2
- BOR (LNG) = 0.250%V.p.d.

**Propulsion:**
- DF-DE
- Speed = 11kts
- Twin-screw / Fixed pitch

**Manoeuvring:**
- Twin propeller solution with high-lift rudders
- Forward thruster with high thrust for independent manoeuvring

**Forward wheelhouse for better visibility**

**Partial fillings possible**
Tug and Barge: combining shipping and storage

**Principle “Drop and Swap”:**
- Barge loaded at the conventional LNG plants
- Loaded unit shipped in with a tug and moored
- The barge provides storage
- As the barge is emptied, another full one could be shipped in

**Remarks:**
- Very shallow draft
- But limited sea-keeping ability and speed
- No need for onshore tank, but two barges
- Less cargo transfer operations (only at loading terminal)
- Crew of a tug boat, not the one of an LNG carrier
2,200 m³ LNG barge

Main parameters:
- LOA: 64.6 m
- B: 14.8 m
- Draft: 2.6 m
- Tonnage: 1,440 GT
- Speed: up to 8 knots

Cargo:
- 2,200 m³ (100%)
- 2,066 m³ deliverable volume
- 4.5 hour full transfer time

- Single Cargo Tank: GTT Mark III Flex CCS
- Equiped with GTT REACH4 LNG transfer arm
- AIP Received from ABS and DNV-GL

- Late February 2015, GTT received an order from Conrad Orange Shipyard for this 2,200 m³ LNG barge for the US market
Barge under construction

Pictures: courtesy of CONRAD SHIPYARD
Partnership with AG&P

- GTT signed of a Technical Assistance and License Agreement (TALA) with AG&P (Atlantic, Gulf and Pacific Company) in April 2016 as outfitting company

- Construction of membrane systems for onshore tanks, LNG bunkering infrastructure, LNG carriers and other LNG-related GTT

- AG&P personnel have been trained and qualified to install GTT membrane systems
Outfitting industrial scheme

- The following industrial scheme can be envisioned:
  - Shipyards able to propose GTT membrane tanks for the LNG projects
  - Shipyard responsible for the steel works, accommodations, HVAC, general integration…
  - Cargo tanks construction is subcontracted to an outfitting company

- FSRU, Small LNGC...
- Hull
- Accomodation
- HVAC
- Cryogenic tanks and piping
- Outfitter
Role of the outfitting company

“Outfitters” provide service for membrane erection to shipyards interested in proposing membrane solutions without any investment

The outfitting company is in charge of:
- Engineering works linked to the tanks and cryogenic equipments \(\text{from GTT}\)
- Procurement of cargo tank components
- Qualified workers for special tasks (flatness, welding…) of containment system
- Supervision of local workforce for insulation works
- Cryogenic piping outfitting (eventually)
- QA/QC
- …
- The interface between the yard and GTT
Conclusion

- Technologies are already available to offer several options to end-users for their LNG chain

- Onshore tanks have a long track record and there are options to cut costs and reduce construction schedule, without compromising safety

- First LNG terminal under construction in the Philippines with GTT onshore tank system

- LNG shipping is moving quickly. Long trade LNG shipping keeps improving and small scale solutions can be tailored to customer needs
Thank you for your attention

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