First US LNG Bunker Barge

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Clean Jacksonville bunker barge
First LNG bunker barge to facilitate initial US supply

- LNG liquefaction plant and marine berth on 37 acres industrial water-front on the St. Johns River in Jacksonville, FL
- Newbuild bunker barge
- Serving TOTE Maritime Puerto Rico and other marine customers in US Southeast
- Actively targeting other markets including power, trucking, rail and space
Clean Jacksonville bunker barge

Bunkering TOTE's newest 3,100 TEU LNG-fuelled containerships
Main Features of the 2,200 m³ LNG Bunker Barge

- Based on conceptual design fully developed by GTT
- Designed to operate in inland waterways, bays, harbors and US coastal waters
- No propulsion machinery
- Conventional towing by hawser wire or pushed from the stern and/or maneuvered from the hip
- Jones Act: US flag vessel, built in US, owned by US citizens
- Lightweight of ~1,350 LT and achieves speed up to 8 knots
- Dimensions 70.7 m L x 14.9 m B x 4.9 m D x (2.5 m d)
Boil Off Gas Management

- No gas consumers onboard
- Tank pressure setting @ 700 mbarg
- Necessity to manage the Boil Off Gas
  - 6 Stirling StirLNG-4 cryocooler units
  - LNG at highest calorific content and easiest transfer operations
- Safe and robust system:
  - 3 generators: 2 main generators and 1 standby
  - Standby generator coupled with 3 cryocooler units in emergency case
  - In extreme case, tug supplies stripping pump power for spraying

More than 27 days of holding time in case of emergency …on a 1 mile transit!
Tank Design Features

- Mark III Flex containment system
- 1 combined dome (4.3m*4.3m) with instrumentation, liquid/gas penetrations, BOG relief valves
- Sump cavity for stripping pump
- Condensate return line on ceiling
- Barge equipped with the $REACH_4^{TM}$ Bunker Mast for safe, reliable LNG transfer (500m$^3$/h)
Preparation for Tank Construction

- 25 Feb 2015: Shipbuilding contract signature
- Apr 2015: Start of CCS engineering, procurement of main equipment, etc.
- Jul 2015: Steel Cutting
- Feb 2016: Barge Launching
Tank Construction

- Flat bar welding, marking, flatness measurement, stud welding (except bottom) performed before launching

- **Apr 2016**: Panel installation begins

- Pump tower/combined dome plug/dome cover already assembled at work shop and installed

- CCS tests:
  - Primary membrane test using Helium instead of NH3
  - SBTT test for secondary

- **Early Jan 2017**: tank completed

CONRAD implementation of membrane technology was a success!
Barge Commissioning

- Cold tests at Conrad Shipyard
- Gas trials at Harvey Gulf, Port Fourchon, LA (3 x 340 m³ small LNG ISO tanks)
- Design and safety at the terminal adjusted
- All future operational scenarios tested
  - 635 m³ of LNG loaded (record for the plant) in several parcels due to terminal commercial operations and trucks’ logistics
  - Pressure rise: in black-out mode, 16 mbarg/h to be compared to 18-23 mbarg/h by simulation
  - Sump performance: able to discharge to 1.7 m³ heel with stripping pump

CONRAD delivered the barge to TOTE on 20 August 2018
Ensure all personnel that will operate the barge are certified in accordance with USCG requirements.

Ensure appropriate personnel (barge, tug and shore based) have detailed understanding of the barge, its operation and equipment.

Ensure personnel are competent to undertake all operations that may be conducted with the barge, both now and in the future, with full regard to the safety of personnel and the surrounding environment.
Barge in Operation

- 27 Sep 2018: First commercial bunkering
  - Barge loaded with 1,500 m³
  - Perla Del Caribe: LNG fueled containership with type C tanks at 5 barg
  - Connection was achieved in ~20 minutes via the bunker mast
  - 1,000 m³ LNG transferred in under 4 hours
  - Barge tank pressure management with vapor recovery from the Perla Del Caribe
  - Additional vapor recovery and maximum flowrate thanks to the Cryocoolers
  - New pressure rise test performed with tank isolated – Prise = 22 mbarg/h
  - Spraying method has been tested to increase the holding time

- Many bunkering events to date = building more and operations experience
- Opening new opportunities for the barge to serve a growing market
Support provided by GTT

- Development of the conceptual design and Approval by Class
- Support for Design Basis Approval by USCG
- Detailed engineering for LNG Tank Basic Engineering for CHS
- Assistance for Procurement and Construction for LNG Tank
- JAX LNG Terminal Interface and Compatibility Study
- Bunker Mast design commissioning first operations
- Cold Test And Gas Trial Test Procedure documents
- Commissioning Tests
- Bunkering simulations and training
- Assistance during operation, maintenance
Main takeaways of the first LNG bunker barge in the US

- USCG rules were to be developed in parallel of the project

- The adaptation of Hazardous zones definition based on IGC code to USCG policy letter was very difficult and induced many changes

- Lack of small scale LNG equipment proved challenging

- Strong collaboration between all stakeholders, including regulators was critical

- The construction of the membrane tank was finished 20 months before delivery and was a SUCCESS (budget and schedule): “the most straightforward item”