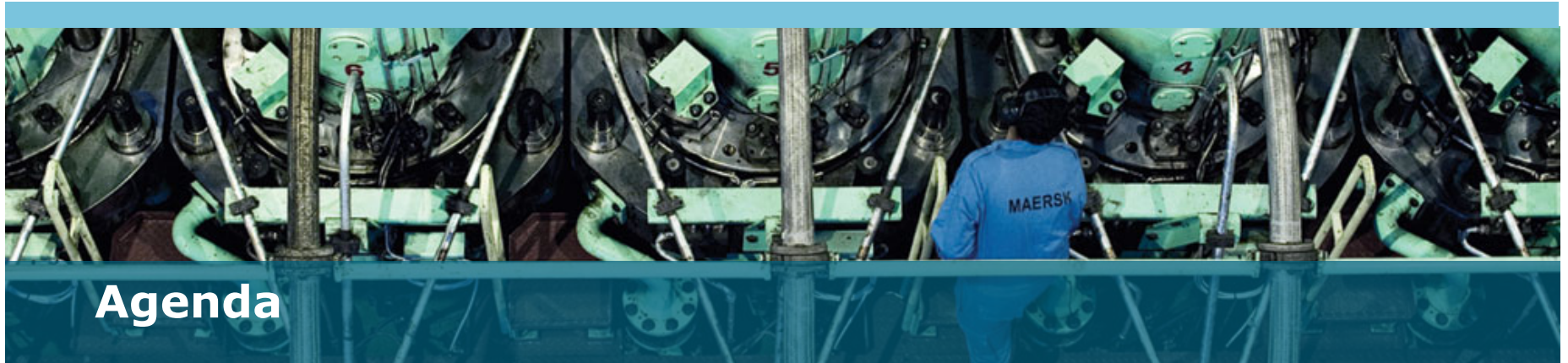


# Marine Small Scale LNG Distribution

September 22, 2011

VCC NGV Forum





## Agenda

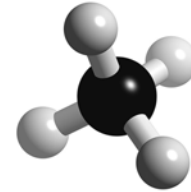
1. Maersk Line, Limited
2. “The Case” for CNG / LNG
3. AT/B Design Concept
4. Applications
5. Distribution Concepts
6. Conclusions



We provide world-class transportation and maritime services

- Maersk Line, Limited (MLL), **an American company, was established in 1983** to support the conversion and operation of five Maritime Prepositioning Ships
- We continue to be a leading operator, maintainer and charterer of ships for the U.S. Navy's **Military Sealift Command**
- Leveraging our unparalleled **global network**, we offer flexible and reliable end-to-end distribution
- Drawing from our experience as a ship owner and operator, **we provide innovative technical solutions** to reduce total ownership costs and increase operational reliability
- Our significant and sustained investment in the U.S. Merchant Marine and our fleet has made **MLL the largest U.S. flag carrier** in international trades

# The Case for Natural Gas & LNG



- **Abundant Supply NG**

- Domestic Shale Gas
  - U.S. – LNG Imports way down
  - Marcellus Shale – Globally in Top 5 Gas Fields
- Advances in Drilling and Stimulation – Horizontal Dir Drilling & Hydrofracking

- **Availability of LNG**

- Regional Liquefaction production - sources possible from pipeline gas
- LNG Import Terminals



- **Environmental Driver**

- Significant Reduction of CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub> and Particulates (PM)
- Marine Environment: International / US East Coast ECA & SO<sub>x</sub> ECA – Higher Fuel Costs (ultra low sulphur) & Equip Mods (scrubbers)

- **Economic Driver – The Price (July Clean Cities Alt Fuel Price Report)**

- Gasoline (regular) \$3.68 / Diesel \$3.95 / CNG \$2.07 per GGE

# The Case for Natural Gas and LNG

- **LNG / CNG as Fuel**

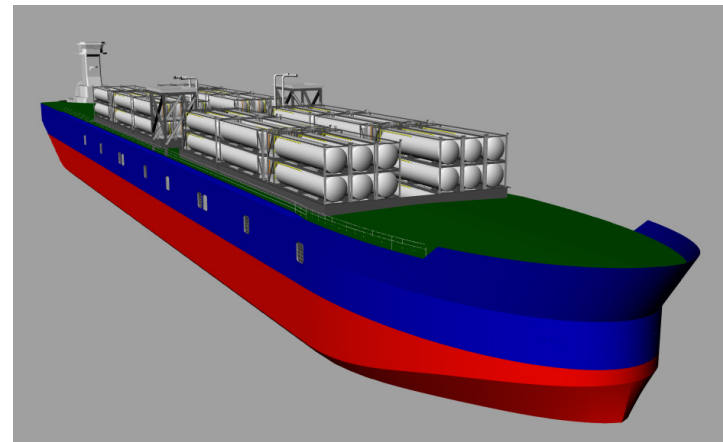
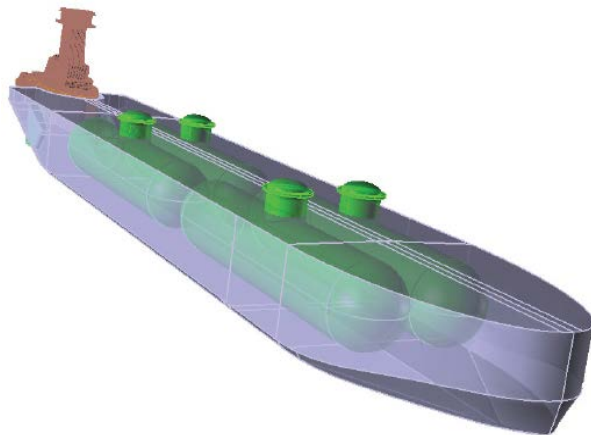
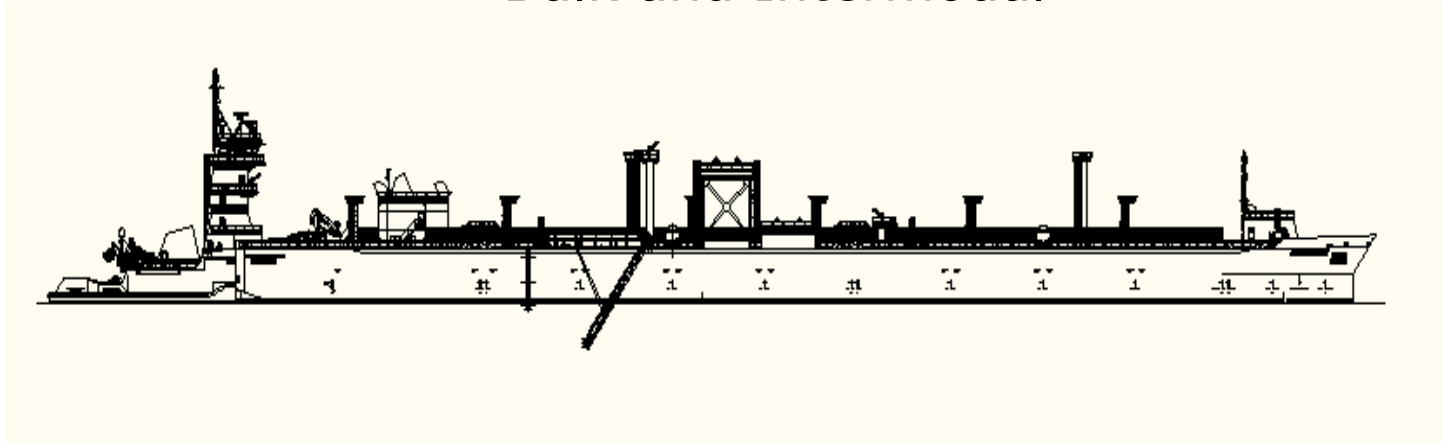
- Reduced emissions
- Reduced fuel cost
- Transportation fuel
  - Road Vehicles (heavy duty trucks, buses)
  - Marine Fuel – Growth Need (inport auxillary generators, propulsion)
- CNG from LNG (cars, fleet vehicles)

- **LNG as Marine Fuel – The Driver**

- Shipping: Phased in emission requirements set by International Maritime Organization (IMO)
- IMO North American ECA in force 2015; Sulphur content < 0.10%
- IMO NA ECA in force 2016: NOx reduction
- Ship Owner Choices
  - Install stack gas scrubbers
  - Burn fuel < 0.10% sulphur (very expensive / ?? Availability ?? / + additives)
  - **USE LNG**

# AT/B Design Concept

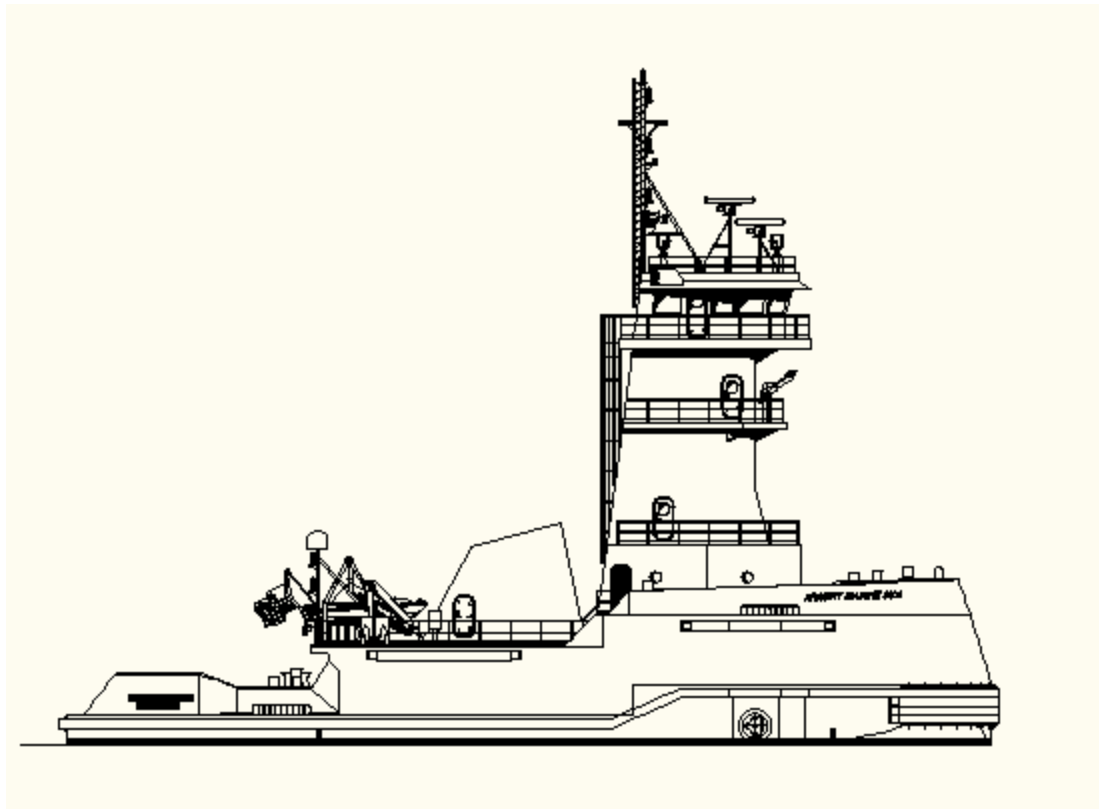
AT/B LNG/C :  
Bulk and Intermodal



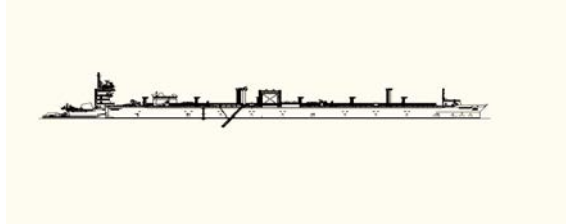
# Design Concepts

## Tug/Propulsion Unit

LOA: 121'. (36.9 m)  
Beam: 42' (12.8 m)  
Draft: 19'-6" (5.9 m)  
Connection: Articouple  
Propulsion: Diesel Electric  
Fuel: 100% Gas or Marine diesel  
Propulsion: 2 x 4,000 Hp  
(2 x 2983 kW)  
Safety: SOLAS / FIFI I



# Articulated Tug / Barge (AT/B): Design Concepts

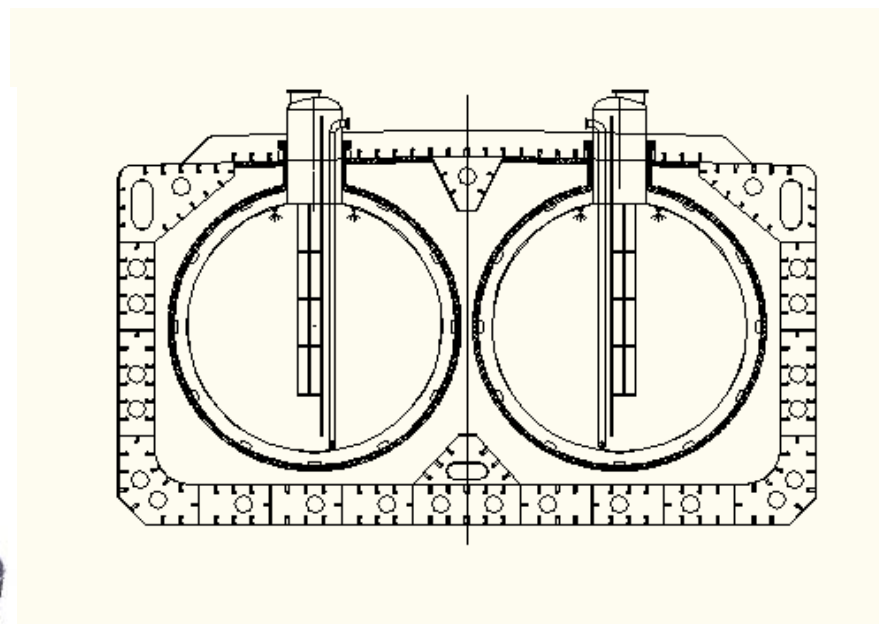
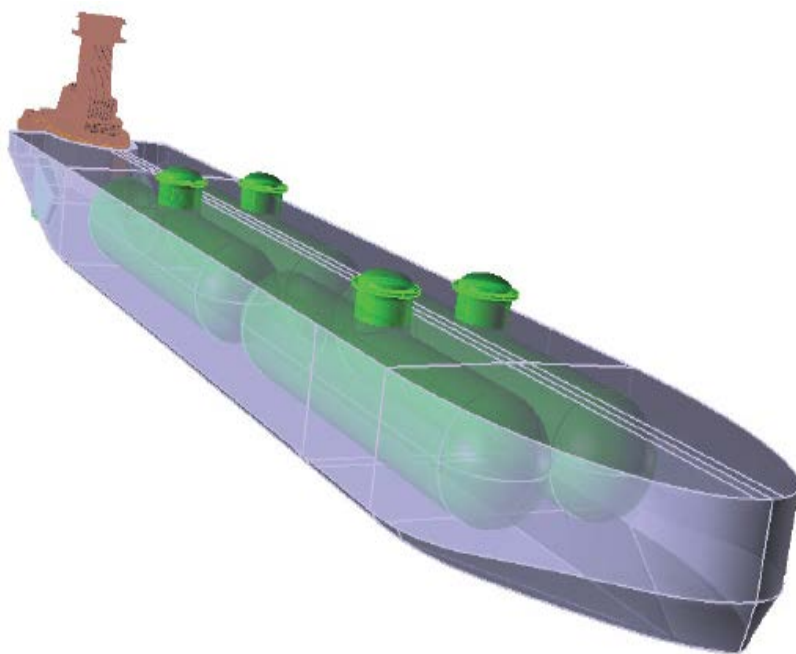


- **Serves Customers not near a pipeline and eliminates need for pipeline extension**
- **Bulk AT/B Transportation:**
  - < 20,000 m<sup>3</sup>: Bulk Type C Tanks (approx 1/10<sup>th</sup> capacity of LNGC)
  - Utilizes Existing LNG Terminals
  - Minimal Shore-side Resources
  - Flexible Delivery Options – “Swap and Drop”
  - Simplifies Distribution Start-Up (to access locations w/o pipelines)
- **Intermodal AT/B Transportation:**
  - < 10,000 m<sup>3</sup>: ISO LNG Containers (Tanktainers)
  - Utilizes Established & Proven Intermodal Network
  - Enhances Safety, Flexibility & Distribution Economics
  - Simplifies Distribution Start-Up

# AT/B Design Concept

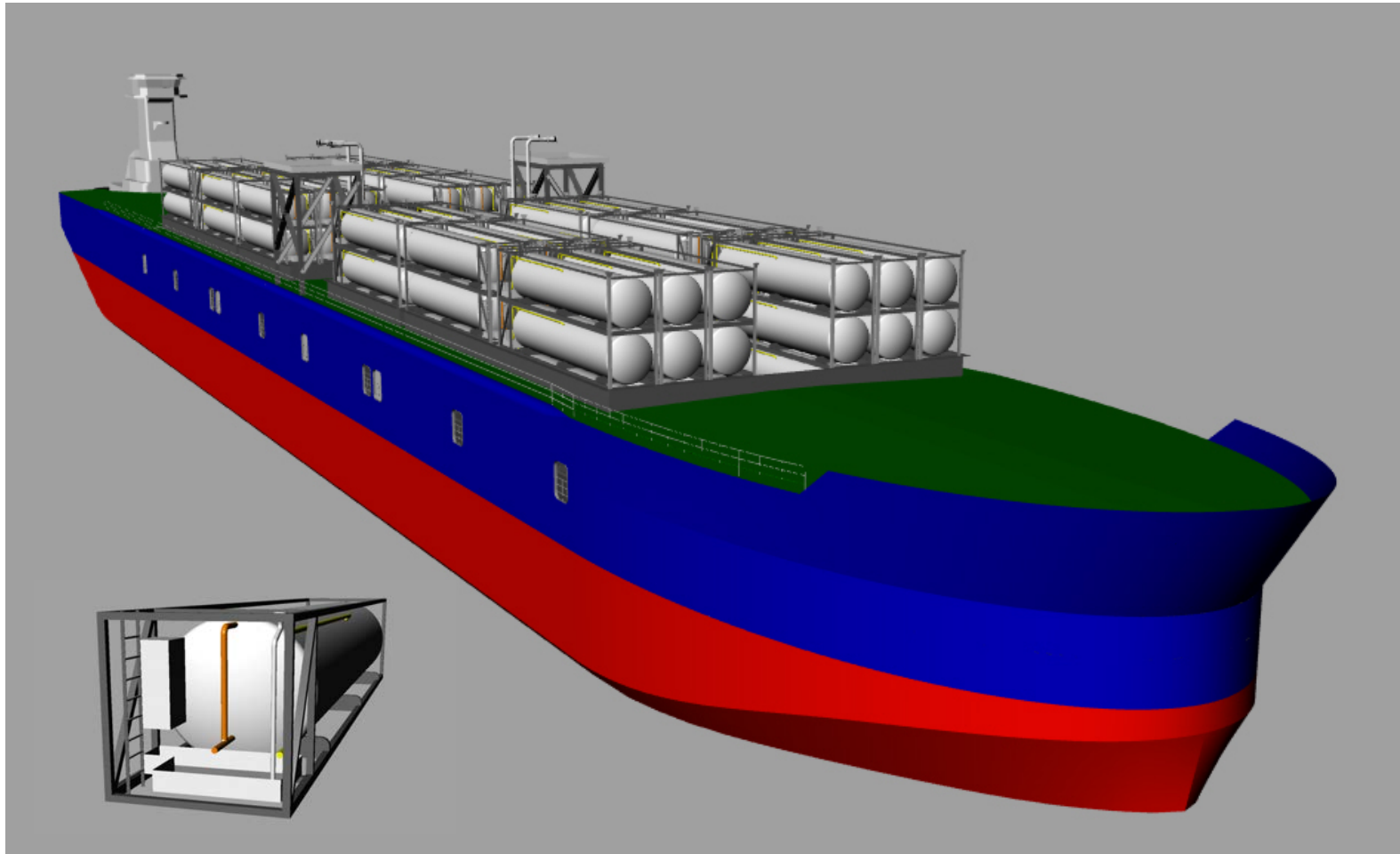
## Bulk AT/B LNG/C :

Built to: - International Gas Carrier Code (IGC)  
- Classification Society Construction Rules  
- U.S. Coast Guard



## AT/B Design Concepts

### Intermodal LNG AT/B



# LNG Fuel Intermodal Distribution System

- **Containerized LNG**

- ISO / US DOT Certified Intermodal LNG Tanks (Tanktainers)
- Replaces bulk liquid transfers
- No land-based storage tanks

- **Simplifies Distribution Start-up**

- **LNG Terminal to End User:**

- Vessel
- Truck
- Rail
- Filling Stations

- **Enables Mid-Large Scale Production vs. Local Production**

- More Efficient / Less Expensive



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## Design Concepts – The AT/B Distribution Demo

- <http://argentmarine.com/videos.html>

# LNG Fuel Distribution

- **Similar Distribution Model as Distillate Distribution**
- **Shoreside:**
  - Distribution Systems
    - Independent of Pipeline
      - Supplement to pipeline
      - Alternative to pipeline
    - Road Transportation
  - Applications:
    - From Import Terminal or Liquefaction Terminal to End User
      - Vessel / Fleet Yards / Refueling Stations
      - Port Support Equipment
- **Marine:**
  - Applications:
    - Base Load / LNG Peak Shaving Facilities
  - Hub & Spoke Distribution System
    - Vessel Bunkering – in the future
    - LNG Lightering – in the future

## Advantages of AT/B LNG Fuel Distribution

- Affords Maximum Operating Flexibility
- Hub & Spoke Distribution from Any Terminal
- Bulk Barge:
  - “Drop and Swap” Deliveries (two Barges / one tug)
  - AT/B Cargo Units Can Be Re-Located as Needed
  - AT/B Cargo Unit (barge) as storage tank (vice land storage tank)
- Intermodal Barge:
  - Deliveries Sized to Volume / Demand
  - Multiple Deliveries per Voyage with Intermodal
  - Use Existing Port Infrastructure – container terminals

## LNG – Safety Record

- **The Safety Record / Marine Transportation**

- LNG Tankers have been operating for 50 years; 350 ships globally
- LNG used as a marine propulsion fuel since 2001
- 20 ships (ferries) sailing in Norwegian waters
- Gas fuelled engines available from major manufacturers (Wartsila, Rolls-Royce, MAN Diesel)
- Major Classification Societies have issued classification rules for LNG-fuelled ships
- Regulations: IMO IGC Code, IMO Interim Guidelines for Gas-Fuelled vessels

- **LNG Facts:**

- In over 50 yrs of commercial transport, no major accidents have occurred
- No collision, fires, explosions or hull failures resulting in a loss of LNG containment in 50 yrs
- LNG is not stored under pressure, and when vaporized it is not explosive in an uncontained environment
- FERC Chair has stated, “The Sandia report provides a scientifically supported validation of the view that the risks of LNG are low and manageable.” (2004)

# Conclusions

- **LNG / CNG Positives:**

- LNG / CNG is a solution to compliance with stricter environmental emissions requirements (Vehicles and Marine Fuel)
- LNG's marine transportation safety record is excellent
- LNG marine transportation technology is proven over for 50 years experience

- **AT/B Design Concept Positives:**

- Small Scale / Small Quantities / Lower Risk and Consequence
- Small Footprint / Limited Visibility
- Uses Existing Facilities
- Development of Small Scale LNG distribution network promotes use of LNG / CNG for marine and vehicle use as fuel
- Port of Virginia is excellent location / positioned to be regional hub

- **Challenges:**

- Challenges exist in implementing an efficient, scalable, affordable distribution infrastructure
- Challenges exist in developing / aggregating regional demand
- Challenges exist in public perception of LNG

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## Thank You

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