GENERAL DYNAMICS

NASSCO – Shipbuilding & LNG Propulsion

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NASSCO Lines of Business

Current Government New Construction
- MLP
- MLP/AFSB
- T- AO(X)

Future

Current Commercial New Construction
- Dry Cargo
- ECO Tankers
- ConRos & Containerships
- APT & SEACOR MR Tankers
- Additional Tankers

Navy Repair
- San Diego
- Norfolk
- Portsmouth
- Mayport

Puget Sound
NASSCO Facility Overview

Build Positions

Inclined Build Ways
Utilized for tankers and containerships

Graving Dock
Ideal for Tankers – tandem build capability (as shown)

Three Build Positions Capable of New Vessel Construction
NASSCO Commercial Partnership
Daewoo Shipbuilding & Marine Engineering (DSME)

- Proven parent design business model with Daewoo Shipbuilding and Marine Engineering Company (DSME)
- NASSCO selected DSME for its:
  - **Strategic fit**: a focused subsidiary, Daewoo Ship Engineering Company (DSEC), in place to execute international collaborations
  - **Procurement cooperation**: significant purchasing leverage to minimize equipment and material costs
  - **Technical compatibility**: same design software (TRIBON)
  - **Design portfolio**: a wide range of proven and efficient designs. Direct access to LNG carrier and bunkering vessel designs
  - **LNG Experience**: Specialized production line for the construction of LNG carriers

- World’s 2nd Largest Shipbuilder
- Revenue: $12 Billion (USD) in 2012
- Ship Production: 70 to 80 commercial vessels / year, plus specialty vessels and offshore modules
- Employees: 30,000 (including 3,300 Engineers)
NASSCO and DSEC Partnership

Key Discriminators

● 7 years of continuous cooperation
  ➢ 4 different programs including support for Government work
  ➢ Proven processes in place
    ▪ Seamless transfer of Design Data
    ▪ Procurement and logistics
      - Nearly all outfit material comes from Korea
      - Dedicated Logistics Center immediately adjacent to Busan New Port

● Strong interface with Class Societies and USCG

● World Class Design Capability
  ➢ Standard designs with world’s best fuel efficiency e.g. ECO MR Tanker
  ➢ Custom designs to meet owner’s exact requirements e.g. Jones Act containerships and LR Tanker

● Technology Transfer to improve production efficiencies

NASSCO & DSEC have a reliable record of Designing and Delivering High Quality vessels ahead of Schedule
Key Regulatory Milestones
Milestones Impacting Commercial Owners

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Construction Milestones

A 50 mt subassembly must be constructed before January 1, 2016 for Tier II Compliance

Regulatory Milestones

• EEDI – Energy Efficient Design Index
• EGR – Exhaust Gas Recirculation
• SEEMP – Ship’s Energy Efficiency Management Plan
• SOC – Start of Construction

Future Regulatory Requirements
Current Regulatory Requirements

NASSCO’s has the Capability to Build Two Additional Tankers Under the Current Tier II Emissions Regime

• ECA – Emissions Control Area
• 0.1% ECA Sulfur Limit

• Tier III Engine Regulations (Keel)
• Need Exhaust After Treatment

• EEDI Phase 1 (Contract)
• 10% reduction from 2013
Key Emission Drivers

Emission Control Area (ECA):
- Mandates low sulfur fuel or an alternative means of reducing sulfur oxide (SOx) within 200nm of the coast
- North American ECA enforcement – Aug 2012
- International ECAs currently exist in the Baltic Sea and North Sea
- ECAs planned for Alaska, Mexico, Great Lakes, Singapore, Hong Kong, Korea, Australia, etc.

Tier III NOx Emissions Criteria:
- New engine NOx emission restrictions come into effect in January 2016
- Restrictions require use of exhaust treatment systems (SCR/EGR)
- New limits represent a 75% reduction from current Tier II limits
- Vessels built in advance of Jan 2016 (keel) are not impacted

SCR – Selective Catalytic Reduction
EGR – Exhaust Gas Recirculation

NOTE: Silver equipment denotes additional NOx-reduction equipment
EGR Equipment
Significant Impact to Plant Laydown

Existing ECO design does not have enough Engine Room space to accommodate Tier III equipage
Key Drivers for LNG-Powered Ships
Emissions & Economics

- **Emission Regulations**
  - Emission Control Areas (ECAs) are in place and will expand in the future
  - NOx, SOx, and particulate matter (PM) regulations will continue to tighten
  - LNG as a ship’s fuel meets all current and future emission regulations

- **Fuel & Gas Prices**
  - Domestic natural gas is trading significantly cheaper than fuel oil
  - Owners are expected to lock-in LNG bunker pricing differentials to fuel oil

- **Fuel Efficiency of LNG**
  - LNG provides a 20-25% better calorific value than liquid fuel leading to significantly lower fuel consumption rates
  - Owners have stated that fuel costs represent 60-70% of OPEX

Despite a lack of a bunkering infrastructure, the emission and operational cost benefits are expected to drive operators toward LNG-propulsion
Key LNG Propulsion Design Facts/Figures

Summary

● LNG vs HFO Energy/Volume*
  - LNG has approximately 20-25% greater gross calorific value than HFO
  - However, HFO is more than 2x as dense, so LNG requires 1.6x more space to store the same energy value
  - And…LNG Fuel Gas System (FGS) takes up space
  - In summary, Real World Volume for LNG + LNG tanks + FGS is approximately 4x greater than HFO for equivalent energy

* Source: ABS Academy – LNG Fuelled Vessels

● Duel Fuel Engine Considerations
  - All slow-speed diesel, 2-stroke dual fuel main engines will require some diesel fuel be used as a pilot fuel
  - Engine conversion to Duel Fuel LNG can result in de-rating of approx 15-20% (depends on type of engine and actual conversion process)

● LNG Ready Concept
  - ECO MR uses a notional (not included) LNG propulsion capability to ensure design is feasible for conversion to LNG at a later date