LNG FUEL

What’s current & What’s Next

Tony Teo, Business Development Director
January 2012
Agenda

Background
Existing Short Sea Shipping
Future Ships
Background - Environment

Are ships built today prepared for stricter air pollution regulations?

Geiranger Fjord
1st Gas fuelled Ferry, January 2000 Prototype

Passenger/car ferry “GLUTRA”

- Capacity: 300 pax and 96 cars
  - Engines: 4 Mitsubishi Engs. @ 2 bars
  - Speed: 12 knots

International Gas Fuel Code:
- 2000 DNV Rules
- 2006 Initiated in IMO
- 2009 IMO Interim Guidelines (w/similar DNV Tech contents)
- 2010 Other Class issue Rules
- 2014 IGF Guidelines
“GLUTRA”

Refuel: 6 Days

Min 760mm

Lesser of B/15 or 2m.

Lesser of B/5 or 11.5m.

Min 760mm

2 x 1000 ft3
12 more Ferries ordered from 2007

MF Bergensfjord

- Capacity: 587 pax / 212 cars
- Speed: 21 knots with 2x16 cyl, 3530kW + 2x12cyl, 2650kW
- Engine: Rolls Royce, Bergen
Passenger Ferries, 2009

Capacity: 600 passengers
Engines: 2 x 6 cyl., 380 kw Mitsubishi
Max Speed: 12 knots
Tank Size: 1000 cu ft
Refueling: 7 days
Refueling time: 1 hour

“Tide King”
“Tide Queen”
“Tide Princess”
Tank Room Arrangement

- **VACUUM INSULATED TANK**
- **COLD BOX, Gas:** +15 °C
- **DUCT PIPE - GAS LINE,**
  - **VENTILATED,**
  - **GAS DETECTORS**
- **Block / Bleed valve**
- **MAINTAINS TANK PRESSURE**
- **WATER VAPORIZER IN/OUT**
- **TANK SADDLE**
- **VACUUM, GAS DETECTION, BILGE WELL ALARM**
Bunkering Arrangement & Piping

Requirements:

- Means for draining fuel at completion
- Lines arranged for inerting and gas freeing
- Gas line color coded
- Electrically bonded to hull

- Operational procedures
- Emergency procedures
OSVs with Wartsila DF Engines, 2003

- Reduction in NOx emission = 20,000 cars
High Speed Light Crafts

- **Builder:** Myklebust yard, Norway
- **Power Generation:** DF (Gas + Diesel)
- **Max Speed:** 20 knots, Range: 7 days

**Owner:** Buquebus, Montevideo

- **3 Norwegian CG patrol crafts**
- **1000 pax ferry, Argentina/Uruguay**
- **GE LM 2500 Gas Turbine**
- **50 knots**
4 RoRo ship on Order, 2008 & Coaster 2011

Type: RoRo/Containers
Main Engine: RR Bergen 35:40, V12, 5250 kw, 15 knots
Capacity: 94 TEU, Tanks: 430 m3

Fish Farm Product Vessel
Engine: RR Bergen.
Dwt: 2000 tonnes
Tank: 90 m3
Ferry Terminal and LNG Storage & Refueling Area (Bergen)

Ferries’ LNG BunkerStation

Luxury Waterfront Cottages
### Ships in operation

<table>
<thead>
<tr>
<th>Year</th>
<th>Type of vessel</th>
<th>Owner</th>
<th>Class</th>
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<tbody>
<tr>
<td>2000</td>
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<td>Fjord1</td>
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### Confirmed orderbook

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### Planned conversion

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New requirements to Energy Efficiency from 2013

- Apply to **new ships above 400 GT**:
  - **Building contract** on or after 1 January 2011 or
  - **Keel laid** on or after 1 July 2013 or
  - **Delivery** on or after 1 July 2015

- The index is defined as:
  grams CO$_2$ / capacity * nautical mile

\[
\text{Attained design } CO_2 \text{ index} = \frac{\text{Environmental cost}}{\text{Benefit for society}}
\]
DNV extraordinary innovation projects

QUANTUM, Container Ship Concept

ECORE, Ore Carrier

Lloyd’s List Global Award, 2011.

TRIALITY, VLCC Concept

OSHIMA ECO 2020
Objectives

Concept: Reduced fuel consumption and efficient operations.
Hull Features

- 14.5 knots => Wide hull form w/twin skeg
- 20% less Ballast
- Flipper fins

Oshima’s Seaworthy Bow

Integrated Rudder & Propeller

Air lubrication
LNG fuelled

SO\textsubscript{x} and PM reduction => 100%
CO\textsubscript{2} reductions => 50%
Clean working environment
No oil pollution risk

Tank Location:
Gas tanks have large energy content
Protection from:
- Ship side / bottom
- External fire
- Mechanical impact

C-type vacuum insulated tanks,
total capacity 2,700 m\textsuperscript{3} => 17,000 Nm
Machinery Arrangement

4-stroke M/E, 4000 kW each

Hybrid Shaft generators, 1500kW

Frequency converters

Aux engine, 1400kW
Operational flexibility

All electric deck machinery

Large capacity electric jib cranes, 4 x 75t
- High cargo handling efficiency
- Reduced energy consumption (15 -20%)
- Less noise
- No pollution

Composite Hatch covers
- 50% weight reduction
- Easy handling by deck crane
- Less maintenance
Financial Analysis

Compared to conventional OHBC, an additional investment of 23 MUSD
Pay back within 9.5 years

Improves NPV by 37.7 MUSD over 25 years
Summary

High re-Sale value
Cost effective

Environmental efficiency

100% SOx
100% PM
90% NOx
50% CO2

High Capex
Low Opex

$38M
Savings

Energy efficient

Flexible operation

Oshima ECO-Ship 2020
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Safeguarding life, property and the environment

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