HSC Francisco - the first dual fueled fast ferry using LM gas turbines.

Ivan Bach, Program Manager
March 2016
Our businesses deliver value

**POWER & WATER**
Revenue: $27.6B
Profit: $5.4B
Leading globally in power generation & water technologies

**OIL & GAS**
Revenue: $18.7B
Profit: $2.6B
Pushing the boundaries of technology in oil & gas to bring energy to the world

**ENERGY MANAGEMENT**
Revenue: $7.3B
Profit: $0.2B
Enabling utilities and industry to efficiently manage electricity from the point of generation to the point of consumption

**AVIATION**
Revenue: $24.0B
Profit: $5.0B
Providing our aviation customers with the most technologically advanced & productive engines, systems & services for their success

**HEALTHCARE**
Revenue: $18.3B
Profit: $3.0B
Developing transformational medical technologies & services that are shaping a new age of patient care

**TRANSPORTATION**
Revenue: $5.7B
Profit: $1.1B
Being a global technology leader & supplier to the railroad, mining, marine, stationary power & drilling industries

**APPLIANCES & LIGHTING**
Revenue: $8.4B
Profit: $0.4B
Answering real-life needs, defining trends & simplifying routines. Leading a global lighting revolution to deliver innovative solutions

**GE CAPITAL**
Investing financial, human & intellectual capital to help our customers build their businesses
Diverse Worldwide Marine Customers
Proven ... >14M operating hours

Navies
- 33 Navies globally
- 56 Military Programs
- 1300+ Engines delivered

Commercial marine
- 17 Cruise liners
- 19 Fast ferries
- 8 Fast cargo ships
- 5 Yachts
Gas turbine value in referenced fleet

**Fast Ferries**
- First LM2500 LNG-powered fast ferry in service!
- High power $\rightarrow$ high speed
- Low weight $\rightarrow$ reduced displacement, reduced draft, reduced drag
- Compact $\rightarrow$ fits catamaran and trimaran hull form

**Cruise Ships**
- Cruise Ships
- Queen Mary 2 & Princess installed GT in base of funnel
- Small volume $\rightarrow$ more revenue generating space
- Small volume & low weight $\rightarrow$ arrangement flexibility
- Additional revenue space enhances payback

Emissions ... no visible smoke, Low NO$_X$

Power density ... advantage vs. diesel engines
- High power $\rightarrow$ high speed
- Low weight $\rightarrow$ reduced displacement, reduced draft, reduced drag
- Compact $\rightarrow$ fits catamaran and trimaran hull form
- Small volume $\rightarrow$ more revenue generating space
- Small volume & low weight $\rightarrow$ arrangement flexibility
- Additional revenue space enhances payback

Proven ... >14M operating hours
LM2500 gas turbine is a GE CF6 aircraft engine at heart.

GE’s LM aeroderivative engines:
- Share the same proven jet engine technology
- Are built under the same quality system, in the same factory
- Can be serviced worldwide ... like a jet engine
GE Marine GT genealogy

LM aero derivative designed for marine applications

<table>
<thead>
<tr>
<th>Applications</th>
<th>LM2500+</th>
<th>LM2500+G4</th>
<th>LM500</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD-11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B747, 767</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A300/310/330</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power Output</th>
<th>Thermal Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHP/KW</td>
<td></td>
</tr>
<tr>
<td>59,900</td>
<td>54,700</td>
</tr>
<tr>
<td>44,700</td>
<td>42.7%</td>
</tr>
<tr>
<td>47,370</td>
<td>40%</td>
</tr>
<tr>
<td>35,320</td>
<td></td>
</tr>
<tr>
<td>40,500</td>
<td>39%</td>
</tr>
<tr>
<td>30,200</td>
<td></td>
</tr>
<tr>
<td>33,600</td>
<td>38%</td>
</tr>
<tr>
<td>25,060</td>
<td></td>
</tr>
<tr>
<td>6,000</td>
<td>32%</td>
</tr>
<tr>
<td>4,470</td>
<td></td>
</tr>
</tbody>
</table>

All Ratings are at ISO No losses
Integrating proven technology for LNG carrier power & propulsion

- **Dual Fuel & Gas Operation**
  - 69,700,000 operating hours on gas
  - 21,600,000 on dual fuel engines

- **Combined Cycle Operation**
  - 10,700,000 operating hours

- **Dry Low Emissions**
  - 12,200,000 operating hours

- **LNG Fueled**
  - 1st LNG fueled fast ferry
  - World’s Fastest ship
  - 2 x LM2500 make 58 kts

- **Land-based & Offshore**
  - 42 Offshore installations
  - 179 land-based installations
  - 578 industrial installations

- **Cruise Ships**
  - 17 cruise ships

(All figures are LM2500/+/+G4 only)
Fast Ferry Value
Through system solutions & technology

Emissions
Tier III IMO compliance today
... without exhaust after-treatment

Engine Availability
High standards inherited from Aviation flight engines
>99% engine reliability

Power Density
Lowest kg/kW ratio

Fuel Flexibility
- Gas or liquid fuel operation
- Change over in the "fly"
- No pilot fuel needed for gas operation
- Accepts variations in the gas composition

No Methane Slip
Dual fuel engine, able to handle wide gas variation

Support Network
World-wide service network
Gas Turbine “Swap out” in 24-48 hours

Dual fuel Engine
- LM2500
  - 23 MW
  - 20 tons
- Dual fuel Engine
  - 10 MW
  - 50 tons
  - 10 MW
  - +100 tons

Engine Availability
- Single fuel Engine
- Diesel today
### Francisco Principal Particulars

<table>
<thead>
<tr>
<th>Shipyard:</th>
<th>INCAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner:</td>
<td>Buquebus</td>
</tr>
<tr>
<td>Contract duration:</td>
<td>May 2010 – July 2013</td>
</tr>
<tr>
<td>Class:</td>
<td>DNV</td>
</tr>
<tr>
<td>Main engines:</td>
<td>General Electric LM2500 Gas Turbines, Dual Fuel 22 MW</td>
</tr>
<tr>
<td>Length:</td>
<td>99 m</td>
</tr>
<tr>
<td>Beam:</td>
<td>26.94 m</td>
</tr>
<tr>
<td>Draft:</td>
<td>2.98 m</td>
</tr>
<tr>
<td>Deadweight:</td>
<td>450 tonnes</td>
</tr>
<tr>
<td>Capacity:</td>
<td>1000 passengers, 150 cars</td>
</tr>
<tr>
<td>Speed:</td>
<td>+58 knots @ 100 % MCR Lightship</td>
</tr>
<tr>
<td></td>
<td>52,5 knots service speed</td>
</tr>
<tr>
<td>Gas system:</td>
<td>Chart Industries</td>
</tr>
<tr>
<td>Waterjets:</td>
<td>Wartsila LJX 1720SR</td>
</tr>
<tr>
<td>Gearbox:</td>
<td>Renk Bus 175</td>
</tr>
</tbody>
</table>
LM2500 Dual Fuel Fast Ferry Package

Key features

- Easy installation (Package, Aux. Skid, TCP and Air Filter)
- Low installation weight
- Dual Fuel Capabilities - Seamless change over “on the fly”
- Under Pressure Ventilation
- No pilot fuel needed
- Low NOₓ emissions
- NO methane slip
- Easy Maintenance
- DNV High Speed, Light Craft certified.
- L 10,3 m x W 2.6 m x H 4 m
- Package weight 16,3 tons
Front engine removal design
Fast Ferry – Engine Room
Francisco’s Route
Buenos Aires to Montevideo

Distance: 106 nautical miles
Duration: 2 hours 12 minutes
2 daily crossing

Competition: Buenos Aires to Montevideo by plane takes +3 hours

Key features: First Class, Business Class, Tourist class and 1100 m² of tax-free shopping
Shore Infrastructure – Buquebus LNG Plant

The LNG Plant will be operational from November 2013.
Designs with DF gas turbines

**INCAT**

- Various concepts based on INCAT’s wave piercing catamaran design.

**114 m catamaran**

- 2 x LM2500 dual fuel, 42.6 knots, 1300 tdw, 1200-1400 pax, 560 TLM and 260 cars

**Austal**

- Various concepts based Austal’s trimaran designs

**127 m trimaran**

- 2 x LM2500 dual fuel, 42 knots, 1000 tdw, 1300 pax, 450 TLM and 123 cars
By using Liquid Natural Gas (LNG) versus Marine Diesel Oil (MDO), ship builders and ferry operators can reduce fuel costs as LNG production increases around the world. LNG fuel is the most cost effective way to meet these regulations. The high power output and low weight and size of aeroderivative gas turbines make them ideal for the fast ferry application.
Questions?

Thank you