The New LNG Powered Ferry Generation

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CONCEPT NAVAL
Experts-conseils Génie maritime
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1. Introduction
Our Mission

As naval architects and marine engineers, we provide innovative custom solutions to shipowners and shipyards, offering them the best service possible.

Key Markets
- Ferries
- Passenger & Research vessels
- Turnkey solutions
- Workboats
- Specialized equipment integration
- Shipyard support
The Client – Société des traversiers du Québec

- Founded in 1971
- 13 ships
  -10 crossings operated by STQ (5,3M passengers)
  -3 crossings Operated in partnership
- 2 Maritime services operated in partnership
- More than 107,000 crossing per year
- More than 500 employees

STQ’s Mission Statement:
Société des traversiers du Québec seeks to contribute to the mobility of people and goods by providing high quality, safe, and reliable maritime transportation services that promote Québec’s social, economic, and tourism development.

Ref: http://www.traversiers.gouv.qc.ca/
2010-2011 annual management report
TBSC Ferries

Length (O.A.) 92.00m
Length (LWL) 86.87m
Breadth (O.A.) 26.40m
Depth 7.00m
Draught 4.50m

Capacity
Cars 115
Passengers 432
Crew 8

Speed 14 Kts
Propulsion 2 x Z-Drives, Electric
Generators 4 x LNG/Diesel
Power 5280 Kw
Autonomy 7 days

In partnership with stx Canada Marine
2. Program & Context
Quebec Cote-Nord: Economical context

- Pop: 100 000 (1.3 % of Qc)
- Forest product: 30%
- Fisheries: 20%
- Minerals export: 35%
- Exportation: 78% of regional production

Few economical facts (Confirmed)

- The Plan Nord (14B$ of 80B$ total)
- Romaine river dam (6.5B$)
- Consolidated Thompson, Lac Bloom Iron mine (410 M$)
- ArcelorMittal, Mt-Wright (2.1B$)

Ref:
www.crecotenord.qc.ca
www.plannord.gouv.qc.ca
The Cote-Nord: Quebec’s Engine of growth

Table 2
Employment Breakdown and Outlook by Industry
Côte-Nord Region

<table>
<thead>
<tr>
<th>Industry</th>
<th>Average 2008-2010</th>
<th></th>
<th>2011-2013</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level ('000)</td>
<td>Share of employment</td>
<td>Average Annual Growth</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Region</td>
<td>Region</td>
<td>Province</td>
<td>Region</td>
</tr>
<tr>
<td>All Industries</td>
<td>50.8</td>
<td>100.0%</td>
<td>100.0%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Primary</td>
<td>3.5</td>
<td>6.9%</td>
<td>2.3%</td>
<td>14.0%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>6.3</td>
<td>12.4%</td>
<td>13.5%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Construction</td>
<td>3.7</td>
<td>7.3%</td>
<td>5.6%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Services</td>
<td>35.6</td>
<td>70.1%</td>
<td>77.7%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Consumer services</td>
<td>14.3</td>
<td>28.1%</td>
<td>27.5%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Production services</td>
<td>10.2</td>
<td>20.1%</td>
<td>26.0%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Public and parapublic services</td>
<td>12.7</td>
<td>25.0%</td>
<td>25.1%</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

Source: Service Canada, Quebec Region
Historical estimates based on Statistics Canada’s Labour Force Survey
(see Notes on methodology)

http://www.servicecanada.gc.ca/eng/qc/sectoral_outlook/so_CoteNordPart2.shtml
**Area of Operation**

- 24/7 Operation, Departure every 20 min.
- Over 40,000 crossing per year.
- 1.2M vehicles and 1.5M passengers annually.
- Most used STQ ferry crossing for vehicles.

The ferry service saves up to 245Km of travel.

- 60% of forest and mining industry’s manpower commute regularly.
- Important link on 138 RD.
Region of operation  Saguenay-St. Lawrence Marine Park

Projet de ZPM
Estuaire du Saint-Laurent
Limites géographiques

Légende
Parc marin du Saguenay-St.-Lawrence
Limites proposées

CONCEPT NAVAL
EXPERTS-CONSEILS  GENIE MARITIME

The New LNG Powered Ferry Generation
Program & Context: Region of operation

**Saguenay-St. Lawrence Marine Park**

**Challenges:**

Environmental considerations
- Noise & Vibration
- Air pollution
- Water contamination

A dozen marine mammal species are found in the Estuary [...] **Nearly half of them are considered to be endangered species.**

Region of operation

Saguenay-St. Lawrence Marine Park

Challenges:

Manoeuvrability & Performance in Harsh environment
- Ice condition (up to 1 meter)
- Heavy Wind (30 to 60 kts)
- Strong current (7 kts)
## Current Vessels

<table>
<thead>
<tr>
<th>Construction</th>
<th>1980</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (O.A.)</td>
<td>81.97m</td>
</tr>
<tr>
<td>Beam (O.A.)</td>
<td>21.8m</td>
</tr>
<tr>
<td>Depth</td>
<td>5.67m</td>
</tr>
<tr>
<td>Draught</td>
<td>4.06m</td>
</tr>
<tr>
<td>Capacity</td>
<td></td>
</tr>
<tr>
<td>Cars</td>
<td>75</td>
</tr>
<tr>
<td>Passengers</td>
<td>399</td>
</tr>
<tr>
<td>Crew</td>
<td>7</td>
</tr>
<tr>
<td>Speed</td>
<td>12.5 Kts</td>
</tr>
<tr>
<td>Propulsion</td>
<td>Double-Ended (shafted)</td>
</tr>
<tr>
<td>Engines</td>
<td>2 x Diesel</td>
</tr>
<tr>
<td>Power</td>
<td>2386 Kw</td>
</tr>
</tbody>
</table>

During peak season, the service is supplemented by the 70 cars ferry M/V Felix-Antoine Savard.
3. Replacement Goals & Objectives
Replacement Goal & Objectives

Goals & Objectives
- Increase capacity and maintain cycle time;
- Reduce waiting time;
- Avoid the need for a third ferry during high season.

Main Concerns & Requirements
- Minimize environmental impact (Noise, sea & air pollution);
- Increase performance and manoeuvrability in all operating condition;
- Keep operation & maintenance costs as low as possible over a 25 years period;
- Demonstrate leadership by considering new technologies.
4. Developing a Concept

Propulsion Package Selection
Developing a Concept Propulsion Package selection

The New LNG Powered Ferry Generation

Comparative Analysis

-Clearly identify criteria and their importance
-List all options to consider
-Score every options against criteria to find optimal solution.

<table>
<thead>
<tr>
<th>Weight Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed power (kW)</td>
</tr>
<tr>
<td>Propulsion power at 14 knots</td>
</tr>
<tr>
<td>Maintainability</td>
</tr>
<tr>
<td>Reliability</td>
</tr>
<tr>
<td>Environment/Emissions</td>
</tr>
<tr>
<td>Radiated Noise</td>
</tr>
<tr>
<td>Fuel Consumption</td>
</tr>
<tr>
<td>Manoeuvrability</td>
</tr>
<tr>
<td>Ice Performance</td>
</tr>
<tr>
<td>Capital Costs</td>
</tr>
<tr>
<td>25 Year Operating Costs</td>
</tr>
<tr>
<td><strong>Total Score</strong></td>
</tr>
<tr>
<td><strong>Rank</strong></td>
</tr>
</tbody>
</table>
Developing a Concept Propulsion Package selection

The New LNG Powered Ferry Generation

Listing the possibilities

Electric
- Lowest noise

- Z-Drives
- Manoeuvrability

Mechanical Propulsion

High Speed
- 2 x Z-Drive
- 2 x VSP
- Shafted CPP

Medium Speed
- 2 x Z-Drive
- Shafted CPP

Diesel-Electric Propulsion

High Speed
- 4 x Z-Drive
- 2 x Z-Drive
- Shafted FPP

Medium Speed
- 4 x Z-Drive
- 2 x Z-Drive
- Shafted FPP

LNG
- Shafted FPP
- 2 x Z-Drive
Manoeuvrability & Ice Condition Performance

Propulsion system and hull design optimization.
4. Developing a Concept

The Choice of LNG
Emissions Reduction

Exceed 2015 SOx and Tier III NOx emissions standards for ECA
Impact of LNG propulsion on TBSC ferries design
Impact of LNG propulsion in TBSC ferries design

Preferred solutions
- Dual-Fuel “hybrid” engines;
- Double walls pipes and negative pressure ventilation with gas detection;
- Independent GVU room arrangement;
- Complete redundancy (LNG/MDO);
- Machinery spaces ventilation 100% redundant.

Design Challenge
- Subdivision Arrangement;
- Space requirement;
- More machinery, pipes and wires.
- Safety
The choice of LNG: What about the risks?

- LNG for ship propulsion is relatively new, TBSC vessels should be the first LNG powered ferries in North America.

- There is lots of talks, but experience and solid information to work with are hard to find.

- Several factors can affect the LNG benefits. A case by case analysis is a must.

- There will always be unknown...

  ... We can reduce risk by harnessing available knowledge and skills.
The Choice of LNG: A Manageable Risk

Available Knowledge

Unknown (Risk)

- Long term consumables and fuel price;
- Capital investment;
- Maintenance cost;
- Environmental requirements;
- Safety Requirements;
- Ship Program and context of operation;
- Evolution of Regulations;
- LNG availability;
- Crew training.

Global Analysis ➔ Decision
4. Developing a Concept

Other Environmental Initiatives
Black & Grey water treatment

Rush-hour management!
- More than 400 passengers, each 20 minutes.
- Ferries used as rest area.

100% Collection of Black AND Grey water

Solution:
- 17,000 l. Biological sewage treatment unit;
- High efficiency toilets & urinals (gravity system);
Noise & Vibration control

Objectives:
- Reduce underwater noise footprint (less than current vessels);
- Increase passenger comfort;
- Protect crew.

Solutions:
- “Diesel”-Electric propulsion;
- Flexible mounts for engines and machinery;
- Propeller optimization in order to avoid cavitation;
- Acoustic insulation in accommodation areas.

Required Performance Standards
- Lloyd’s Register, Passenger and Crew Accommodation Comfort
5. Conclusion
The New LNG Powered Ferry Generation

Conclusion

The challenges
- Implementing new technologies;
- Integrating space consuming equipments;
- Finding optimal solution considering stringent operational and financial constraints, as well as aggressive environmental goals.

The TBSC Project
- Increase Capacity;
- Demonstrate environmental awareness

The Solution
- 115 Cars capacity double-ended ferry
- Dual-Fuel (LNG/MDO)
- 2 x Electric Z-Drive
- Global noise reduction.
- 100% Grey and Black water treatment
The New LNG Powered Ferry Generation

We support innovation

Thanks!