

**JOINT TRANSPORTATION COMMITTEE
EVALUATING THE USE OF LIQUEFIED NATURAL GAS
DECEMBER 7, 2011**



**CONSULTANT TEAM:
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2011 legislature directed the Joint Transportation Committee to:

- Investigate the use of liquefied natural gas (LNG) on existing Washington State Ferry (WSF) vessels as well as the new 144-car class vessels and report to the legislature by December 31, 2011 (Transportation Budget)

The study is to:

- Assess WSF's work and studies
- Identify the full range of issues
- Analyze the cost, risk, timeline, and related implications of
 - Changing the design of the new 144-car vessel to LNG
 - Retrofitting Issaquah class vessels

Why consider move from diesel fuel to LNG?

- Potential to significantly reduce WSF fuel cost
- Environmental benefits

LNG transition is a major change in strategic direction for WSF

Security

What, if any, impact will the conversion to LNG fueled vessels have on the WSF Alternative Security Plan?

Vessel Acquisition & Deployment Plan

What are the implications of LNG for the vessel acquisition & deployment plan in WSF's Long-Range Plan?

Vessel Design & Construction

What design and construction constraints should be considered in making LNG decisions?

Vessel Operation

How will LNG fueled vessels affect bunkering (i.e. fueling) & other WSF operations?

Business Case

What is the most cost-effective scenario to introduce LNG fueled vessels to the WSF fleet considering both operation cost savings & capital project costs?

LNG

- Natural gas cooled to -259 degrees Fahrenheit
- Must be kept at that temperature or returns to gas

CNG

- Not used for large vessels – volume too great
- Local developments may make it possible for WSF – but would require fueling every day

LNG Fueled Ferries - Norway

- First LNG ferry built in 2000 –now approximately 12
- Consultants interviewed 2 ferry operators in Norway & a LNG supplier

NORWAY FINDINGS

Capital Costs	15% to 20% higher Subsidized by government
Operation Costs	Avoid carbon tax on diesel Maintenance costs same as diesel now Crew size – same as diesel Training – 2 days to 1 week course
LNG Cost & Supply	Same fuel cost as diesel Recommend test actual fuel to be used during construction Shoreside fueling facilities make sense if there is sufficient demand Truck fueling– as planned for WSF used in Oslo & elsewhere Long term 7 to 10 year contracts
Security & Outreach	Minimal – 4 hour security meeting for Oslo LNG
Vessel Design	LNG storage tanks below deck Designed to emergency shutdown standard engine room

CONSULTANTS' CONCLUSION

Security and operation planning with associated public outreach should be the next step in the consideration of LNG for WSF vessels

- Legislature cannot make an informed decision until this planning is sufficiently complete to:
 - Assess the impact on the Alternative Security Plan and on WSF and Washington State Patrol staffing
 - Gauge public response
- Schedule & cost of security planning using modified Coast Guard process – 18 months and \$1 million

Recommendation 1. Provide funding for security & operation planning and public outreach in the FY 2013 budget

CONSULTANTS' CONCLUSION

Decision whether to build the 2nd new 144-car vessel as a LNG fueled vessel should not be made until the security planning is complete

- Security planning complete if funded – January 2014

Legislative policy decision – whether to build now as diesel to have delivery sooner (depending on funding – 2015)

- Which is most important: service improvements from 2nd new 144 or long-term potential fuel savings?
- Likely 2017 delivery if LNG (if funded and security plan complete)

CONSULTANTS' CONCLUSION

If delivered in 2017 or later most economical to consider as part of a series of 6 such vessels

- Long-Range Plan – 2025-2031 five new 144-car vessels
- Economies of scale are gained with purchasing more than one vessel at a time
- Purposeful design for LNG – rather than modify a diesel design is a benefit

Recommendation 2. New 144-car Vessel

- **Build as a diesel fueled vessel if the service improvements are more important than the potential fuel savings**
- **If want to consider LNG, await results of security plan and then build in the context of a 6 LNG vessel procurement**

CONSULTANTS' CONCLUSIONS

Retrofitting the 6 Issaquah class vessels will take at least 6 years & require the *Evergreen State* to stay in service unless/or until a 2nd new 144-car vessel is delivered

- *Evergreen State* planned to retire with 1st new 144 in 2014
- *Hyak* renovation must be complete before start Issaquah class retrofit - fall 2014
- Issaquah class retrofit most aggressive schedule 2015-2020
- 2014 and beyond – no preservation funding for Evergreen State in FY 2011-13 biennium 16-year plan
 - Preservation funding needed - \$0.4 million through 2018- then \$5.7 million for new propulsion system

Recommendation 3. Issaquah Class Retrofit

Decide after security planning complete. If elect to proceed recognize need for preservation funding for the *Evergreen State*. Amount of preservation funding depends on decision on new 144-car vessel.

**1st new 144 delivered 2014 - Retire
Evergreen State**
If decision - 2nd new 144 - Diesel

**Hyak (144-car) out September 2013 to July
2014**
2015 Potential delivery 2nd new diesel 144

Service Improvements
**2014 - extend Evergreen State (87 cars) to
allow Issaquah class retrofit**
**2015 - retire Evergreen State & continue
Issaquah class retrofit**

**1st new 144 delivered 2014 - Retire
Evergreen State**

If decision - 2nd new 144 - LNG

**Hyak (144-car) out September 2013 to July
2014**

**? Potential delivery LNG 144 (2017 or
beyond)**

Service improvements delayed

Six vessel LNG decision – how phase

**2014 – 2020 (or until LNG 144) - extend
Evergreen State (87 cars) to allow Issaquah
class retrofit**

CONSULTANTS' CONCLUSIONS

Safety is of paramount importance

- No U.S. experience designing & building passenger LNG vessels
- Other nations – particularly Norway – more experienced
- Classification society expertise can help overcome lack of experience

Pre-design process will allow the legislature to review design options before making a final decision

- These projects are large enough to require pre-design report

Major conversion decision should be sought from U.S. Coast Guard before construction of Issaquah class vessels

- If the Issaquah class retrofit is considered a major conversion the costs may be prohibitive as it may require bringing vessels up to current ADA and other standards

Recommendation 4. If the legislature funds LNG-fueled vessel design it should require WSF to:

- LNG vessels should be designed to a classification society rules
- Contract with outside firms with LNG expertise
 - Washington State firms would likely sub-contract
 - WSF should not design LNG vessels in-house

Recommendation 5. If the legislature funds LNG-fueled vessel construction it should consider amending the bid process to require bidders to include a LNG expert

- Allow qualitative assessment of the expert in the bid process

Recommendation 6. Get major conversion regulatory decision before more work done on Issaquah class retrofit

- WSF should request a ruling from the Coast Guard before detailed design and construction

Recommendation 7. Have the LNG fuel supply contract in place before the shipyard construction contract is let

- Test motors

CONSULTANTS' CONCLUSIONS

Bunkering will be more complex than diesel fuel but should not be a problem for WSF other than potential security plan requirements

- Norway observation
 - Supervision
 - Safety clothing
 - More sophisticated equipment

Maintenance and staffing costs should be the same as for the diesel-fueled vessels

- Norway maintenance costs— now the same, initially 10 to 15% higher
- Coast Guard could require more staffing as part of Certificate of Inspection

Cost of on-going classification service worthwhile investment

- Norway – do on-going classification for LNG vessels not diesel
- \$15,000 per year per vessel

Recommendation 8. WSF should maintain classification services for the operation of LNG vessels for at least the first 10 years of operation

Two forecasts for WSF LNG

- Delivery from outside Pacific Northwest (California or Wyoming)
- Delivery from within Pacific Northwest (FortisBC or other)
 - Market development causing suppliers to consider entering market
- Starting price \$1.25 per gallon to \$0.87 per gallon in 2015

Savings projected

- Issaquah class - \$140 to \$196 million over remaining life of vessels
- New 144-car vessel- \$86 to \$120 million over 60-year life

Jumbo Mark II

- 3 vessels – use 27% of fuel, built in late 1990s
- If convert to LNG \$355 to \$405 million in fuel savings over vessel life

Cost Estimate Process

- Detailed independent cost estimator
- Reviewed with shipyard in Norway
 - Experience with building LNG vessels
 - Currently retrofitting a diesel vessel to LNG of a similar size to Issaquah class vessel
 - Confirmed consultant cost estimate

Costs Projected

- Issaquah class – Six vessels
 - Year of expenditure dollars - \$140.7 million
 - 34% higher than WSF
- New 144-car vessel
 - Year of expenditure dollars (FY 13-15) - \$19.5 million
 - 25% higher than WSF
- Consultant estimate higher – include classification service, outside architect, shipyard expert, believe more complex project than WSF

CONSULTANTS' CONCLUSIONS

Security planning and outreach costs are substantial and the more vessels the costs cover the more cost effective the investment

- Costs in both new 144 and Issaquah class vessel estimate

Issaquah class retrofit is not a sound economic investment as the project is now structured

- Net present value negative except in the scenario with lowest fuel cost and lowest (WSF) capital investment
- Costs include only 2 years of operation of *Evergreen State* & no *Evergreen State* preservation costs
- Depending on new 144-car vessel decision, it could be more cost effective to wait for retrofits until 2nd new 144 in service
 - Depends on remaining life of Issaquah class vessels at that point

CONSULTANTS' CONCLUSIONS

New 144-car vessel investment is cost-effective

Worthwhile to invest in an exploration of Jumbo Mark II retrofit

Development of CNG supply should be tracked to see if it becomes a viable marine fuel for WSF

Recommendation 9. The legislature should provide funding for WSF to develop a more refined LNG business case and pre-design report including potential retrofit of Jumbo Mark IIs and update CNG information

- Work could be concurrent with security planning and public outreach