Public Interest Finding Request

For

[redacted]

Proprietary Equipment Specification

Date: 11 November, 2015

Project: *M/V Matanuska* Repower & Ship System Upgrades

References:

1. *M/V Matanuska Repower & Ship System Upgrades – Propulsion System Selection Report*
2. *M/V Matanuska Propulsion System Vendor Selection*

Project Intent: This is a FHWA funded project (No. 70212) to replace the existing main propulsion engines, main propulsion equipment and auxiliary systems on the M/V *Matanuska.*

Background: This purpose of this project is to repower the vessel due to the age and condition of the main propulsion engines and improving vessel maneuverability by replacing the vessel propulsion equipment. To accomplish these goals, new main propulsion engines with fast response time, new controllable pitch propellers, and a new steering gear system will be installed to replace existing equipment.

As part of the repower project Design Study Report, it was determined to include replacement of the vessel's propulsion system (See Reference 1) due to age of equipment and compatibility with new main propulsion engines. The results of this study recommended replacement of the controllable pitch propellers, the propulsion shafting, and reduction gears.

Rolls Royce, Berg/CAT Propulsion and Wartsila were considered for replacement equipment.

Justification: A Propulsion System Vendor Selection Report (Reference 2) was developed to determine what equipment should be used as a basis of design for the Contract documents and regulatory submittal.

We recommend Rolls Royce as the single source provider of the propulsion equipment for the following reasons:

1. The Rolls Royce equipment consists of an integrated CPP and reduction gear solution. This will simplify installation since there is no need for integration or for separate hydraulic power units and storage tanks.
2. Similar capital costs to the other vendors for similar scopes of supply.
3. AMHS Fleet Commonality – the new Alaska-Class Ferries and Tustumena Replacement vessel are utilizing similar Rolls Royce integrated CPP and reduction gear systems.
4. Serviceability – AMHS has an existing regional service contract with Rolls Royce for existing fleet equipment and maintenance.

5. The Rolls Royce solution is compatible with Environmentally Acceptable Lubricants (EALs) which are required for all oil-to-sea interfaces on vessels operating in US waterways as part of the 2013 EPA Vessel General Permit. The Berg solution is also compatible with EALs.

Purchase of this equipment is in the public interest due to the advantages listed above and as shown in Reference 2. The completed contract design and regulatory submittals are based on installation of Rolls Royce integrated propulsion equipment, therefore the contract guidance drawings will help simplify the construction process.

Estimated Costs: The estimated costs for this equipment is approximately $1,900,000

Finding of Public Interest

It is hereby found to be in the Public's best interest and ~~consider~~ consistent with the code of Federal Regulations Title 23, Section 635.411 and DOT&PF's Policy and Procedure 10.02.013 to specify the identified proprietary items in this federally funded project.

Submitted by:

11-18-15

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Date

Recommended By:

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Approved:

11-19-15

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Date

References

1. *Project 70212 – M/V Matanuska Repower & Ship Systems Upgrade, Design Study Report*, Glosten, Document No. 14104-08, Rev. –, 3 March 2015.
2. *Project 70212 – M/V Matanuska Repower & Ship Systems Upgrades, Vessel Maneuvering Report*, Document No. 14104-12, Glosten, Rev. –, 3 March 2015.
3. *Project 70212 – M/V Matanuska Repower & Ship Systems Upgrades, Propulsion Engine Selection Report*, Document No. 14104-09, Glosten, Rev. –, 3 March 2015.
4. *Berg Propulsion Manual, Technical Description*, J.W. Berg AB.
5. *M/V MATANUSKA Port and Starboard Shaft Power Measurements*, DEC Report No. 0357.101, Diehl Engineering Co., 20 October 2003.
6. *M/V MATANUSKA Port and Starboard Engine Power Measurements*, DEC Report No. 0424.101, Diehl Engineering Co., 13 June 2004.
7. *M/V MATANUSKA Port and Starboard Engine Power Measurements*, DEC Report No. 0528.201, Diehl Engineering Co., 20 May 2005.
8. *Inquiry of M/V Matanuska Allision with Ocean Beauty Seafood Dock, Petersburg, Alaska on May 7, 2012*, State of Alaska DOT & PF, 6 July 2012.
9. *Project 70212 – M/V Matanuska Repower & Ship Systems Upgrade, Pre-modifications Sea Trial Analysis Report*, Document No. 14104-03, Glosten, 20 October 2014, Rev. -.
10. *AMHS Matanuska Load Control Setting with Berg System – Preliminary Service Report*, TransMarine Propulsion Systems, Inc., 5 July 2011.
11. *Vessel General Permit for Discharges Incidental to the Normal Operation of Vessels (VGP)*, US Environmental Protection Agency (EPA), 2013.

Introduction

This report will discuss the current propulsion system and potential replacement options for the M/V *Matanuska*. This report is primarily concerned with the propellers, shafting, and reduction gear. The engine selection and discussion is the scope of a separate report (Reference 3).

Existing Propulsion System

The existing propulsion system on the *Matanuska* consists of a Berg controllable pitch propeller (CPP) system driven by an MaK diesel engine through a reduction gear. This CPP system was installed along with the new propulsion engines and reduction gears during the repower of the *Matanuska* in 1985. Various modifications have been made to the system since that time including the addition of the Stellar ESP 1000 propulsion control system and a new Berg propulsion control interface in 2013.

As described in the DSR (Reference 1), the CPP control system limits the power output of the engines to below their rated power, adversely impacting thrust and vessel response. Attempts in 2011 to put the propulsion system on a combinator curve were unsuccessful.

Repower Considerations

There are two options regarding the shafting and propellers for the repower project. The first option is to re-use this propulsion equipment; the second option is to replace it. This section will discuss the merits of each option for several areas of consideration.

Equipment Condition

At the time of the repower, the age of the CPP system on the *Matanuska* will be approximately 30 years. Indications from the vessel crew are that the mechanical condition of the CPP system is adequate and that there are no major deficiencies. If the equipment is retained, as a part of the repower, the equipment should be disassembled, inspected, renewed, and re-commissioned. It should be expected that as the equipment continues to age, maintenance requirements will increase, along with the risk of equipment failure.

Design Requirements

There is very little engineering documentation for the existing Berg CPP system. A request to Karl Senner / Berg Propulsion for all technical information regarding the CPP system resulted only in bollard pull thrust values, which are not helpful in evaluating the performance of the CPP system.

With no engineering documentation for the CPP system, there is no way to check for potential performance improvement or limitations of the existing CPP system with a new prime mover. If the existing propellers are to be kept, their thrust and torque characteristics are required for matching new engines to the existing propellers.

Arrangements

Reusing the existing shafting and CPP system would have no effect on arrangements.

A new CPP system can be designed to fit largely within the same envelope of the existing system. Without extensive model testing or CFD, there can be no definitive recommendations for alternate arrangements of shaftlines or propeller locations to provide improvements to the vessel propulsion or maneuvering. Additionally, major modifications to the arrangements of the CPP system would add considerable cost to the repower project.

It is recommended that a new CPP system, if installed, utilize similar shaftlines, bearing locations, shaft seal locations, propeller locations, and sterntube locations.

Power

Existing Berg documentation (Reference 4) indicates that the existing shaftline and propellers are designed for an engine output of 2,700 kW (3,620 HP) at a propeller speed of 180 rpm. Currently the propulsion system operates at 194 rpms at the propeller. The reason for the discrepancy in propeller speed is unknown. The measurements by DEC (Reference 7) indicate that the engines are limited by cooling capacity and a restriction was placed on the CPP system so as to keep the engines from overheating.

With a new diesel engine and engine auxiliary systems, it can be assumed that there will be no restrictions placed on the engine MCR.

Whether using a new CPP system or re-using the existing system, the pitch, rpm, and engine load will need to be evaluated to provide a maximum efficiency combinator curve for general transit scenarios. During maneuvering operations, it is assumed that the propulsion will be operated in a constant-speed mode at the rated engine speed for fastest response time. To create this combinator curve, the power/rpm/pitch characteristics are needed for the CPP system. Currently this information is not available from existing documentation or the manufacturer. Without these values, implementing a combinator curve will be very difficult.

Pitch Response

One of the items highlighted in the inquiry report for the allision in Petersburg, AK (Reference 8) was a slow pitch response of the CPP when ordered full-astern. The report indicated that the pitch was ordered full-astern during the crash-stop maneuver and at the time of the allision, about 46 seconds later, the indicated pitch was only about 75% astern. When the throttle was ordered full astern, the vessel was travelling approximately 8.8 knots over the ground.

A ship-stopping test was conducted during the pre-modification sea trials on 1 October 2014 (Reference 9). The vessel was brought to a stop from an initial forward speed of 8 knots. During this test, the propeller pitch control system limited the ramp rate of the pitch response. Full astern pitch was achieved after about 50 seconds.

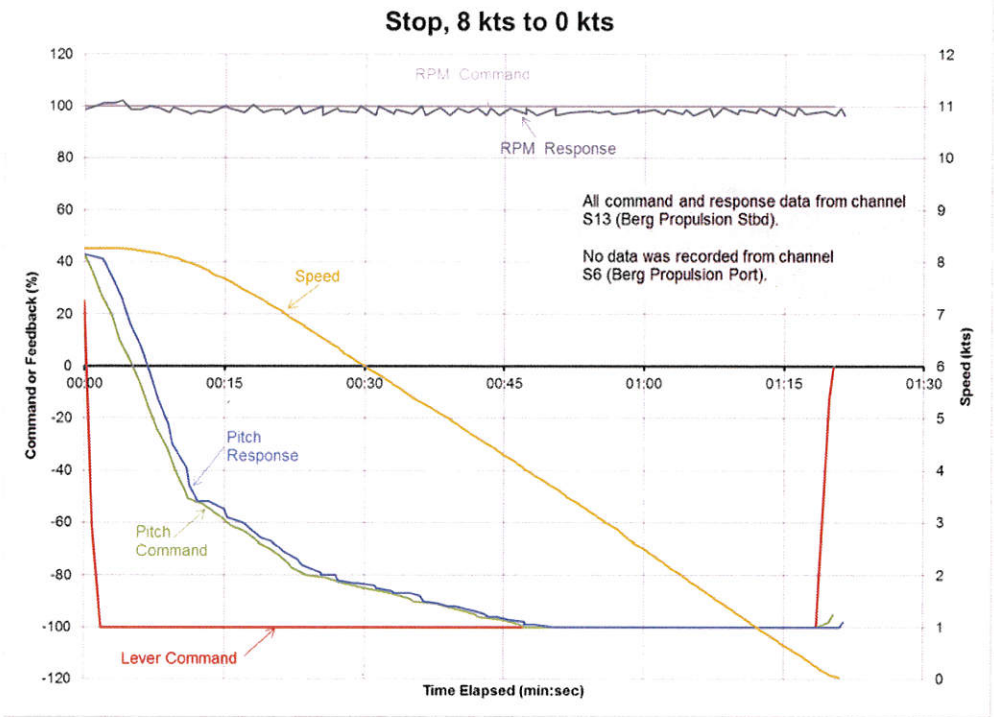

Figure 1 Pitch response recorded during October 2014 sea trial, from Reference 9

We were not able to find any definitive documentation onboard the vessel or from vendors or other state consultants to indicate the limiting factor on these pitch ramp rates. Usually these ramp rates are determined by the response rate of the prime movers or to limit cavitation and vibration. It is possible that the load response of the existing MAK engines is insufficient to allow large load changes.

To permit better maneuvering performance, a replacement engine with better load response characteristics should be considered. The CPP ramp rates can then be tuned more aggressively to allow better maneuvering and emergency response characteristics.

Controllability/Calibration

The DEC reports indicate that the *Matanuska* and the *Taku* both suffer from poor calibration of the pitch control system (References 5 and 6). When control levers are set to the same position on the port and starboard propellers, the indicated pitch at the oil distribution box would often be different between the two sides creating uneven loading of the engines. It was suggested in a later report (Reference 7) that the CPP system was tuned to correct this deficiency.

New CPP systems will be provided with new actuators and sensors that should allow tighter control of propeller pitch than the existing system.

Lubrication/Environmental/Seals

It is not known whether the existing Berg CPP system utilizes environmentally acceptable lubricants (EALs). The Vessel General Permit (VGP), Reference 11, requires that vessels use EALs in all equipment with oil to sea interfaces, including CPP systems. If the CPP system is replaced, EALs should be used. EALs do not have large impact to the operation of the CPP system. The major difference between a system using EALs and a system using conventional

oil is the addition of an oil/water separator as the EALs tend to be more prone to problems when water gets into the oil.

Servicability

The existing Berg CPP system is currently serviced by Berg Propulsion and Karl Senner, LLC. Recently Berg Propulsion was acquired by Caterpillar. It is not known at this time what effect the acquisition will have on the service and support arrangements of the existing CPP system on the *Matanuska*. Ralph Senner indicated in discussions that a similar arrangement of US service and distribution through Karl Senner, LLC is likely given his company's history and experience with Berg products.

The existing components of the CPP system are mostly original, installed in 1985 during the last repower of the vessel. In general, as products mature and move out of production, spare parts and services become more challenging to obtain. There have been no indications from the vessel that parts and service are currently difficult to obtain, but this should be expected to occur during the extended life of the ship if the CPP system is retained.

Efficiency

A new CPP system can be expected to be more efficient than the existing system. If the new CPP system is integrated with a new efficient rudder design, additional efficiencies can be gained. Rudder options are discussed further in Reference 1.

Potential Replacement Candidates

Below is a short description of some of the options available for replacement of the CPP system.

Berg/CAT Propulsion

Berg Propulsion was recently acquired by Caterpillar. The current sales and service provider for the United States remains Karl Senner, LLC.

Karl Senner has proposed a preliminary supply of two Reintjes LAF 3455H reduction gears and two CAT Propulsion type BCP 850f CPP systems.

Karl Senner has provided a budgetary cost estimate of $1,999,006 for the new reduction gears and new CPP shafting and propellers.

Rolls Royce

Rolls Royce is providing a CPP system and rudders for the new Alaska Class ferries currently under construction at Vigor Alaska.

Rolls Royce has proposed a preliminary supply of two Rolls Royce type 650 reduction gears and two Kamewa 79A1/4D-B CPP systems.

Rolls Royce has provided a budgetary cost estimate of $2,798,000 for the new reduction gears and CPP shafting and propellers.

Wärtsilä

Wärtsilä manufactures and services engines and propulsion solutions. The M/V *Kennicott* has a LIPS controllable pitch propeller system that is now serviced by Wärtsilä since Wärtsilä purchased LIPS in 2002.

Wartsila has proposed a preliminary supply of two Wartsila SCV 68 reduction gears and two Wartsila 4D845 CPP systems.

Wärtsilä has provided a budgetary cost estimate of $1,896,200 for new reduction gears and new CPP shafting and propellers.

Recommendations

Due to the performance and control deficiencies identified above, in combination with the age of the propulsion system, it is recommended that the propulsion system be replaced during the vessel repower.

Design Considerations During Repower

Some additional considerations for the vessel repower are listed below. These will be utilized if appropriate during the next stages of this project.

Analysis

Regardless whether the propulsion system is replaced or retained, shaftline analysis will be performed during the PS&E phase of the project.

Mounts

Use of adjustable mounts (Vibracon-type) allow easy alignment of drivetrain components. These will be considered during the PS&E phase if applicable.

Alignment

Diehl Engineering recommended performing alignment measurements on the existing propulsion system before removal. Performing this decommissioning alignment will reduce the time required to install and align the new equipment. This will be considered during the PS&E phase if applicable.

Propulsion Control System

The Berg BRC800 control system is the latest model available from Berg. If a new Berg system is selected, there may be salvage value in the operator panels and junction boxes. However, replacement of these components would be a small percentage of the overall cost of a repower project. The decision to re-use the Berg equipment should not heavily influence the choice of propulsion system.

Glosten

PROJECT MEMORANDUM

M/V Matanuska Propulsion System Vendor Selection		*10 April 2015*
TO:	Tom Atwood (AMHS)	
FROM:	James Wolfe, PE (Glosten)	
JOB/FILE NO.	14104.02	
DOC. NO.	14104-17, Rev. -	

References

1. *M/V Matanuska Repower and Ship Systems Upgrades, Design Study Report,* Glosten, Rev. –, 3 March 2015.

Introduction

This memo is intended to be a record for the reasoning behind the selection of Rolls Royce as the preferred vendor for the replacement of the propulsion system onboard the M/V *Matanuska*. The propulsion system will be replaced as a part of the repowering project, the scope of the project is defined further in Reference 1.

Budgetary quotations and preliminary arrangements for replacement propulsion systems were solicited from the following vendors:

- Wartsila
- Berg/CAT Propulsion
- Rolls Royce

The request for new shafting and propeller required that they be similar in form to the existing equipment to minimize structural modifications.

Selection

The scope of supply from each vendor considered included:

1. Controllable pitch propellers, Cu-Ni-Al material, 3.2m diameter, 4 bladed
2. CPP hydraulic systems
3. Shafting, shaft steel with watertight coating
4. Couplings
5. Shaft liners in way of bearings
6. Sterntube seal
7. Line shaft bearings
8. Shaft earthing
9. Sterntube and strut bearings
10. Bulkhead seal
11. Propulsion control for local, EOS, bridge, and wings

12. Reduction gear
13. ABS Classification
14. Technical drawings and documents
15. On-site installation support

AMHS has existing CPP systems from Rolls Royce, Wartsila, and Berg in the fleet. No preference was given for vendor commonality as AMHS already has technical and service support from each vendor.

The existing vessel propulsion control system was recently upgraded to a new Berg control interface. Berg indicated that they did not recommend attempting to re-use the existing propulsion control interfaces. This removed a potential benefit for choosing Berg as the propulsion system vendor.

Rolls Royce was selected for the following reasons:

1. Similar capital costs to the other vendors for similar scopes of supply.
2. Integrated CPP and reduction gear solution. This will simplify installation since there is no need for a separate hydraulic unit and tank.
3. Completeness of preliminary proposal. Rolls Royce initial proposal included all requested items, including seals and bearings.
4. Vendor response to questions: Rolls Royce was continually the most responsive vendor to technical questions. Given the tight timeline for this project, prompt responses are crucial to meeting the schedule.
5. The Rolls Royce solution is compatible with Environmentally Acceptable Lubricants (EALs) which are required for all oil-to-sea interfaces on vessels operating in US waterways as part of the 2013 EPA Vessel General Permit. The Berg solution is also compatible with EALs. As of this writing, Wartsila believes that they have an EAL compatible solution, but it has not yet been confirmed.