



PROJECT MEMORANDUM #5

Alaskan High Latitude Research Vessel

Concept Design/ Ice Operability

From: Dirk Kristensen
Date: 26 March 2001
File No.: 00100
To: Management Committee

Reference: 1. Joe Coburn email of 20 March 2001
2. Dirk Kristensen email of 20 March 2001

Hull lubrication

- There is only one type of hull lubrication system that has been shown to work on a consistent basis, that is the water deluge type system installed on the Canmar vessels *Kigoriak* and *Robert Lemeur* as well as the Swedish icebreaker *Oden* and, although less successfully, the *USCGC Healy*.
- When a sufficient amount of water is dumped from the deluge system onto the snow and ice just ahead of the vessel it can reduce ice resistance by 10% to 20%. The amazing thing is that the thicker the ice and snow, the bigger the improvement in resistance.
- The water deluge system also has the effect of reducing the extraction force from ridges by as much as 50%! This is very significant. Although it should be noted that the extraction percentage will not be quite as dramatic if you are starting with a hull that already has lower resistance due to either a stainless ice belt or Inerta hull coatings that are in good condition, although the ahead resistance should show the same improvement.
- The penalty that must be paid for this type of system is in the weight and space required. The systems are normally quite heavy as they employ large diameter piping, large double-chambered seachests, and large volumes of water somewhere in the range of 10,000 tonnes per hour. The power for such a system could be on the order of 400 kW. Arno Keinonen believes such a system would be highly beneficial in making the vessel more independent. We will have to assess the trade-off between weight and space versus operability in ice.

Azimuthing Thrusters

- Operability may be reduced by as much as 40% for a vessel without azimuthing thrusters, regardless of hull shape selected. This is due to the increased stern thrust that the azimuthing thrusters will provide as well as the less quantifiable aspect of significantly increased maneuverability/operability provided by the azimuthing thrusters. This is in part due the ability of the thrusters to readily clear ice from around the hull when correctly accounted for in the design.

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10% Reduction in Ice Resistance

- The 10% reduction in level ice resistance implies a much larger reduction in overall independent operability in ice. If you use a well rounded hull form, as you might for open water service, versus a hull with ice-breaking geometry you will significantly increase the extraction forces required for removal from ridges, perhaps by as much as 50%.
- The wedging action of the open water hull form will take place further aft, just forward of amidships but out of effective reach of the reversed thrusters.
- Arno Keinonen's experience, which is similar to our own, is that the rolling behavior of vessels with ice-going hull forms similar to the *Fennica*, *Nordica* or *Botnica* is far superior to conventional open water vessels. He states that one indicator of this is that these vessels are usually the last to leave the North Sea when storms arrive and that the more conventional offshore supply vessels do not fair as well.

Concluding remark from Arno Keinonen:

- If you start to think about the combined effects of all of the comments above, even though they are not strictly additive, you begin to see how significant the difference in performance can be. This is in line with the well known tasking of assessing what your operation requires, e.g. what operations are important and which are less important. I can assure you that the differences tend not to be minor and that the design choices made up front will influence the entire character of the vessel rather than be reflected in minor shifts in the performance numbers.