1.0 Purpose

B. NautiCAN was contracted to review HRP azimuth thruster's performance, interpret HRP information, and evaluate sea trial data, results of CFD calculations and model test results and propose three levels of recommendations:

a. Recommend for optimizing existing HRP thrusters

b. Recommend for upgrading HRP thrusters.

c. Recommendation for attaining 12 knots.

2.0 **Conclusions and Recommendations**

A. The HRP trials data results are taken from the HRP repair and measurements report (appendix A) dated December 1997. The HRP original thrust predictions for single thruster are taken directly from the September 1994 data fax provided by HRP.

Calculations that HRP provided agree with the open water data for the propeller in nozzle 19a, for the design condition. Since there is no RPM shown, I could not reproduce same numbers for the of design condition. In my calculations, I am assuming constant power allowing RPM to change to approximate the electric motor performance.

From the sea and dock trials it is clear that power shown in the HRP report is measured electric power (V x A). To find what are electrical and mechanical transmission losses and to determine power that actually reaches propellers, I have compared dock trials results with the calculated power that propeller should absorb at bollard for the given RPM. Unfortunately, there are no results for the higher RPM and results had to be extrapolated. Results are shown appendix A.

I have used this calculated delivered power (to the propeller) to determine wake factors for the forward and aft thrusters. From the results of speed trials and calculated power absorbed by the propeller and than averaging results to correct for the effect of tide or wind, resulting wake calculation agree well with the results of CFD calculation for the original hull. Those results are shown in the appendix B.

All sea trials have to be taken with some reservation, since accuracy of measurements, sea and weather conditions are not known.

a. Recommendation for optimizing existing HRP units.

Existing azimuth units are operating at near optimum efficiency for the propellers in nozzle 19a. Skewed type nozzle propeller would help reducing vibrations. Replacing existing 19a nozzles with the

b. Minor upgrade recommendations for % increase in thrust
c. Best use of existing thruster recommendation
d. Major upgrade recommendation for best performance
3.0 Assumptions
a. Assumptions used from HRP data

b. Assumptions used for recommended upgrades
4.0 References

c. Appendices
A. Interpreted input data
B. Resulting Data of Existing Vessel Data Review
C. Resulting Data of Proposed Upgrade Review

Further improvement could be made by lowering propeller RPM and increasing propeller size. I will examine this in more detail when I get results of the CFD analysis and model tests.