

Massachusetts Institute of Technology
DEPARTMENT OF MECHANICAL ENGINEERING
Division of Ocean Engineering

2.611 SHIP POWER and PROPULSION

Frigate Plant Design Project, Fall 2006

General

The main purpose of the project is to provide students with experience in the selection and preliminary design of a propulsion power plant. The projects are to be conducted by teams of two students. The teams should develop their own design philosophy and selection criteria to be used in the process. The teams are required to compare several power plant and propulsor alternatives and to select the “best” overall plant configuration. The design should be developed in sufficient detail to demonstrate feasibility and practicality.

Design Data

The students should collect the design data for this project. Sources would include class notes, open literature, trade journals such as “Marine Log”, and SNAME publications. Students should take care to assess the confidence level and document that confidence in each written report of all design data used in the study.

Reports

Each team will be expected to submit three design reports. These are as follows:

1. Propulsor selection, due October 20, 2006, is discussed on the next page.
2. Power Plant selection, due November 17, 2006, should include the selection procedure and all the economic data.
3. Propulsion system engineering report, due December 12, 2006, should include realistic weight estimates, more accurate cost estimates, and engineering calculations.

Each report should contain:

- a. A summary of the designs investigated, including significant information and be located at the beginning of the report.
- b. A text section in which the procedure is described and the selected designs are critically evaluated.
- c. A number of appendices in which the design calculations are presented. This is particularly important if you have developed your designs using.

A high standard of report writing is expected for these reports.

Phase 1. Propulsor Selection

The study of the propulsor should include optimization of Wageningen (Troost) B 5 bladed propellers for diameter or rpm constraints, where appropriate. Cavitation considerations should be used to select the suitable expanded area ratios for the propellers. Assume that with modern design methods the propellers can operate successfully with 10% cavitation (predicted by the Burrill chart) at the operating (sustained) speed.

If you expect that a controllable reversible pitch propeller may be used in your final selection then you should place an upper limit of expanded area ratio of approximately 0.8, because a propeller with a higher EAR is not able to achieve reverse pitch. With electric drive and with diesels it is assumed that there is no upper limit on EAR (except the availability of propeller data) because these units can be reversed.

Your report should be written as technical proposal describing your approach and the results of your study. It is important to provide a summary near the beginning of your report that presents all the important technical details of your selected propulsor(s).

It may be prudent to provide your team with a choice of propulsors for the later phases of this project (e.g. CRP option and one fixed).

Frigate Study

Length	400 ft
Beam	45 ft
Draft	16 ft
Displacement	4100 LT
EHP at sustained speed of 28 kts	23,000 HP
EHP at endurance speed of 20 kts	6,350 HP
Maximum Propeller Diameter (twin screw)	14.5 ft
Propeller Centerline Depth	14.75 ft
Wake fraction, w	0.04
Thrust Deduction Fraction, t	0.095
Relative Rotative Efficiency, η_R	0.995