ELECTRIC SHIP

EDUCATION

9 May 2006

OVERVIEW

- **Undergraduate Program (EECS)**

  - 6.061 Introduction to Electric Power Systems (20 yr – undergrad + 2N)
  - 6.131 Power Electronics Laboratory (newer – undergrad+ 2N)
  - 6.188 Special Power System Laboratory
  - Physics of energy
  - New classes to be introduced in:
    - Power Electronics IC design
    - Wireless communication

- **Graduate Program (EECS)**

  - 6.685 Electric Machines (advanced 2N)
  - 6.961 Seminar in Advanced Power Systems (newer, advanced 2N)

- **Course 2N for Navy and Coast Guard Officers (ME)**

- **Theses Supervised**

Naval Construction & Engineering at MIT

- **Program**
  - Fully funded Navy Graduate Education Program for Naval Officers
  - Sponsor – Naval Sea Systems Command (SEA05)
  - USN – 5 year (PhD), 3 year (NE/MS) and 2 year (MS)
- **History**
  - Course XIIIA Established 1901
  - 7 current Admirals are graduates – historically 50% of Engineering Duty Flag Officers
  - Several PhD theses by Navy officers
- **Navy Faculty**
  - 2 USN officers on faculty since 1910
    - Full MIT Faculty members, Professors of the Practice

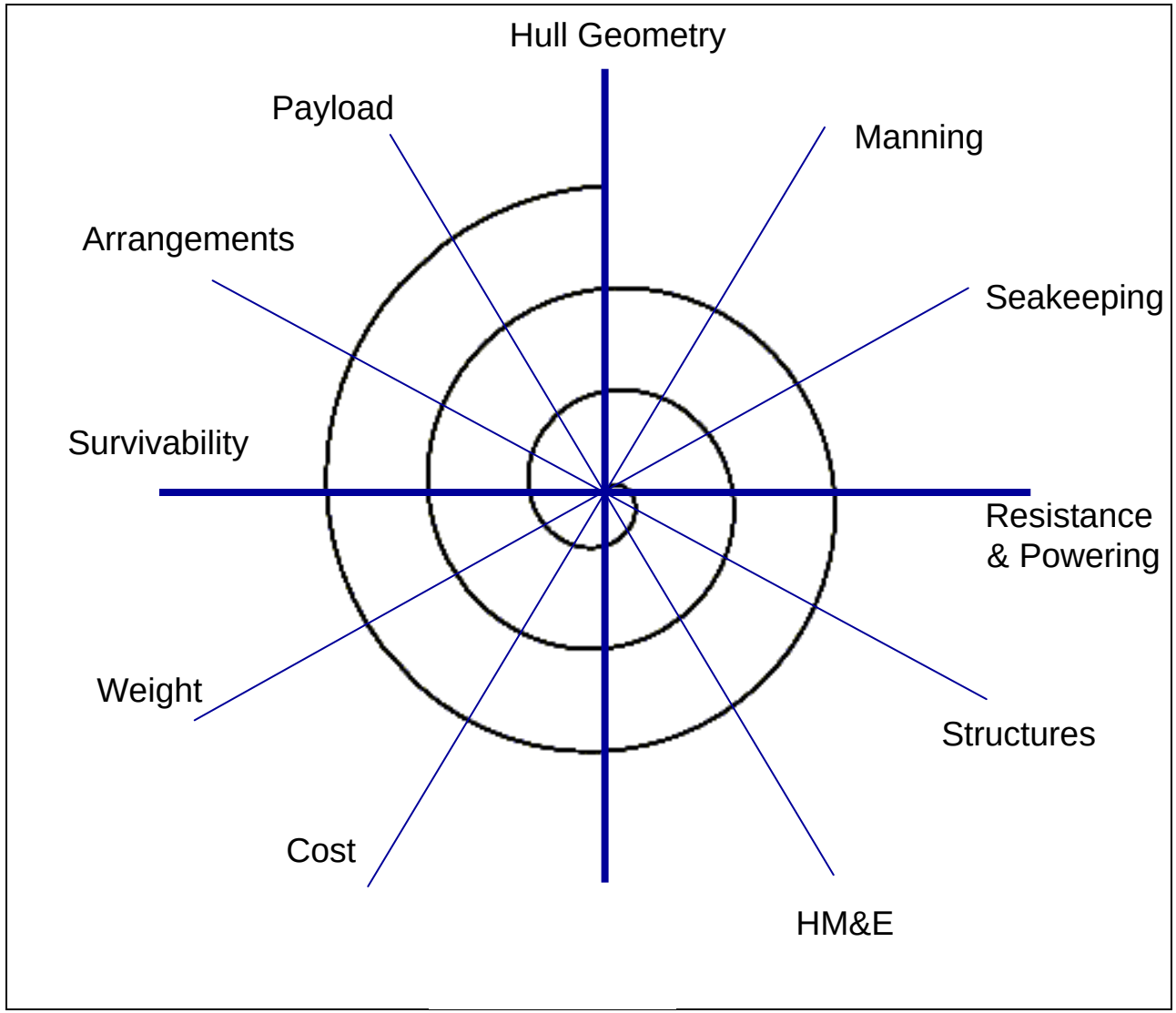
2N Students

- **Currently onboard – 40**
  - **31 U. S. Officer students**
    - 25 U.S. Navy NE/MS
      - Annual quota of nine 2N
    - 2 Ph.D. candidates (one 2N EDO and one PMP x-EDO)
    - 4 U.S. Coast Guard
  - **9 International students**
    - Greece (3), Taiwan (1), Turkey (1+2), Canada (1), Singapore (+1)

Naval Construction & Engineering at MIT

- **Objectives**
  - ***Broad graduate technical education*** for US Navy, US Coast Guard, and foreign naval officers (professional Naval Engineers)
  - ***Ship Design*** – A continuum of courses leading to year long total ship design project
  - ***Technical area concentration*** - A specific thesis area, e.g., hydrodynamics, structures, acoustics, power engineering, etc.
- **Graduates**
  - Prepared to direct large-scale ship system programs
  - Future leaders in ship concept formulation, design, acquisition, construction, modernization, maintenance, and industrial support

The Ship Design Spiral



Ship Design Sequence

2.701 Intro to Naval Architecture (1/F)

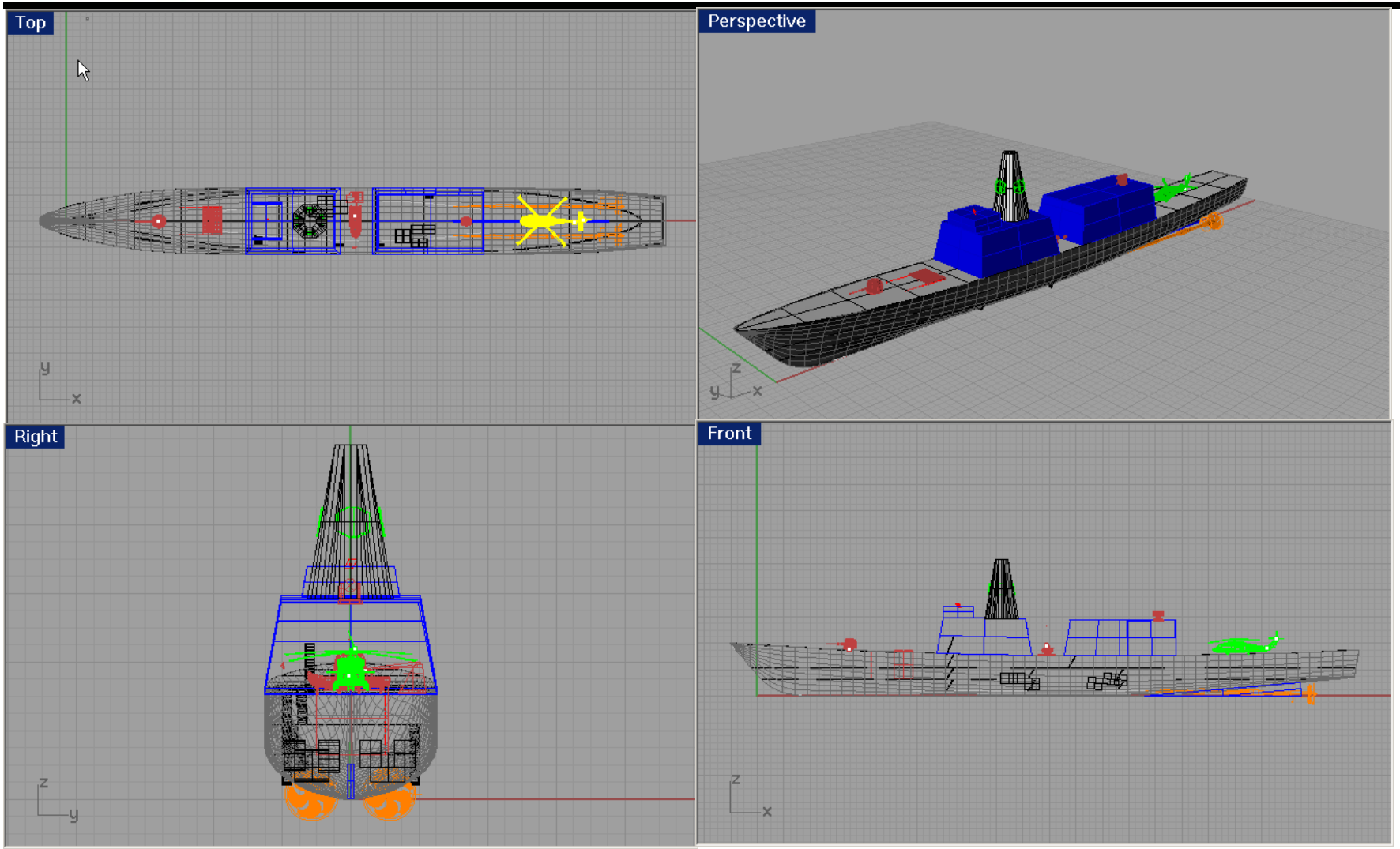
2.702 Computer Aided Ship Design Tools (2/Sum)

2.703 Principles of Naval Ship Design (2/F)

2.704 Projects in Naval Ship Conversion (2/IAP)

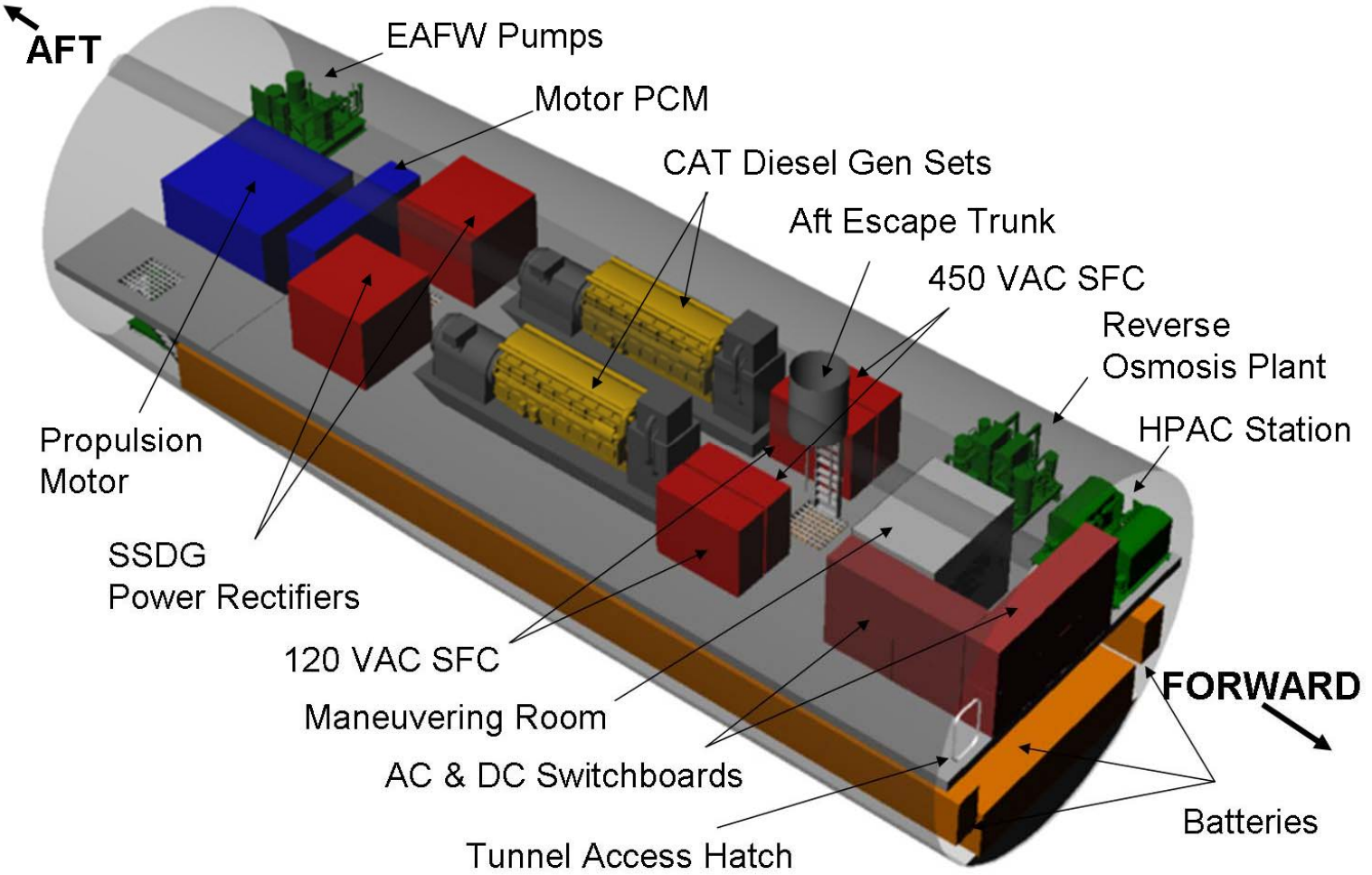
2.705 Projects in New Naval Ship Design (3/F&S)

2.702 Output: 3-D model



2.704: SSN 688I Diesel-Electric Conversion

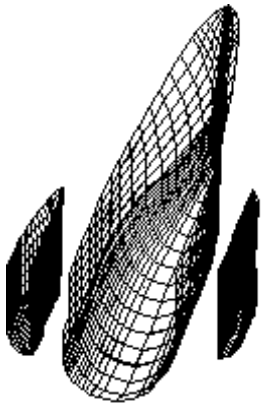
(Engine Room CAD Model)



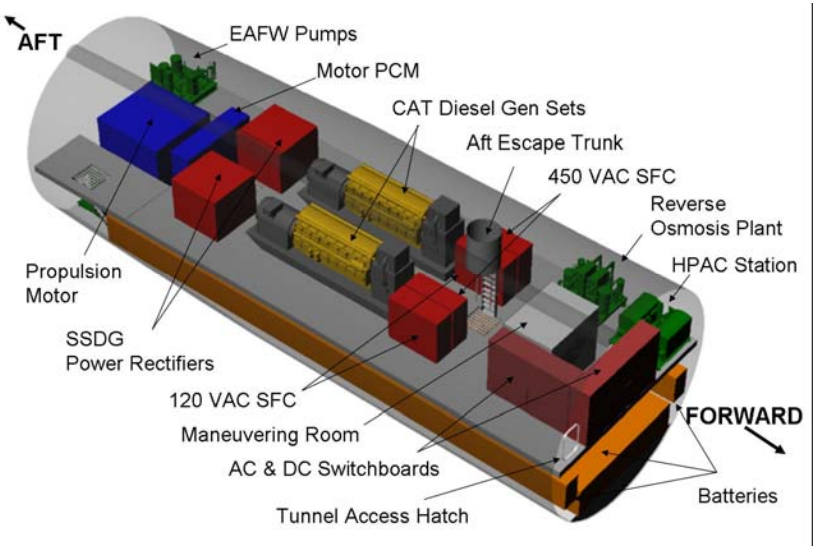
Design Projects

Recent Examples

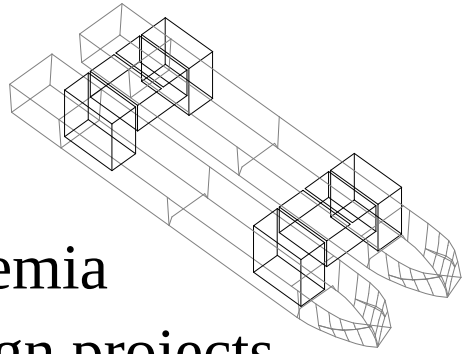
- **Conversion *(one month)***
  - Container Ship to Intermediate Transfer Ship – 2005
  - LHD-8 to Helicopter Operations Support Ship – 2005
  - LST-1179 to Riverine Combat Support Ship – 2006
  - Rail Gun on DDG51 – 2006
  - DDG51 to Protection of Shipping Vessel – 2006
  - Rim Electric Drive (Internal) Submarine – 2006



- **Blank sheet of paper *(year-long)***
  - Covert Collection & Employment Sub. – 2005
  - High Speed Connector – 2005
  - Intermediate Transfer Ship – 2005
  - Sea Based Maintenance Ship – 2005
  - Sea Base Assault Connector – 2005
  - Unmanned Vehicle Host Ship – 2006
  - Special Operations Forces Submarine – 2006
  - Unmanned Aerial Vehicle Carrier – 2006



Ship Design and Shipbuilding Technology Symposium



- Annual Event: DoD, Navy, industry & academia
- Showcase: OE research, 2N theses and design projects
- Discussion: Technology, ship design, ship production

2002 - *"Designing the Navy for a New Type of War"*
RDML Paul Sullivan, DepCom for Integrated Warfare Systems, SEA05

2003 - *"Sustainable Sensing and a New Type of Navy"*
RADM Jay Cohen, Chief of Naval Research

2004 - *"Autonomous Vehicles - Under the Waves of the Future."*
RADM Stephen E. Johnson, Director of Undersea Technology, (SEA073)

2005 - *"Sea Basing 2015 – Concept Design Solutions"*
RADM John M. Kelly, Commander, Navy Warfare Development Command

2006 - *"Littoral Warfare Platforms"*
RDML Charles Goddard, Vice Commander, Naval Sea Systems Command

You WILL present your thesis / design projects to Navy Experts

Recent Theses

- Non-intrusive Load Monitoring aboard USCG Cutter
- Swimmer Delivery Vehicle (SDV) Propeller redesign
- Analytical and numerical approaches to failure of ring-stiffened cylindrical shells
- High Speed Linear Induction Motor Efficiency Optimization
- Evaluation of Non-Intrusive Monitoring for Condition Based maintenance Applications on U.S. Navy Propulsion Plants
- Wave effects in Shallow Water on Autonomous Underwater Vehicles
- A Preliminary Design Tool for Resistance and powering Prediction of Catamaran Vessels
- Multi-Objective Collaboration Optimization of Naval Fleets
- Harmonic Distortion in an Integrated Power System for a Surface Combatant
- Optimal Control Theory Applied to Ship Maneuvering
- Autonomous Underwater Vehicle Recharging System

Professional Summer at MIT

Purpose

- Needs of 13A students, round out their professional knowledge
- Gives others an opportunity to study and discuss applicable Navy technical issues

Instructors - Experts in their fields

History - 34 years

Courses - **Classified** and Unclassified Courses, hosted at Draper Labs

Submarine Combat Systems
Submarine Concept Design
Surface Ship Combat Systems Design Integration
Weapons Effects and Ship/Submarine Survivability
Ship and Submarine Signatures
Modern Ship Production and Ship Repair

Power & Propulsion
Maneuvering & Control

- 2.611 Ship Power and Propulsion

  Agreed to re-structure the class with input on powering from ME-Energy area

- 2.154 Maneuvering and Control of Surface and Underwater Vehicles

  Has changed to include project in control of a model-scale ship