A sunset over the ocean with a boat's wake in the foreground. The sun is low on the horizon, casting a golden glow across the sky and reflecting on the water. The water is dark blue with white foam from the boat's wake.

A Case Study of an Evolving ESOH Program – One Company's Perspective

A Presentation By:

General Dynamics – Electric Boat Corporation

Rick Milnarik – System Safety Engineering

Mike Parulis – Environmental Engineering

October 27, 2010

Presentation Agenda

- Objective
- Background Information
- An Evolving ESOH Program
- What...How...Who
- Examples
- Achievements
- Summary



Presentation Objectives

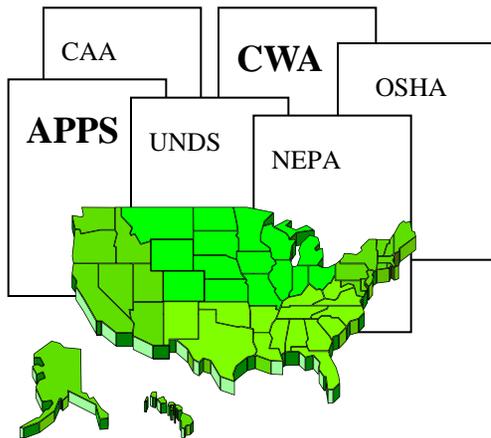
- Illustrate the evolution of the environment, safety & occupational health (ESOH) discipline and its place within Electric Boat.
- Emphasize that ESOH is part of an integrated systems approach, involving ESOH engineers, as well as shipyard, design and engineering organizations.
- Demonstrate, through a few examples, that ESOH is a natural fit in the Human System Integration (HSI) domain.



Background Information

Laws & Regulations Flowdown

Laws & Regulations



Department of Defense INSTRUCTION

NUMBER 5000.02
December 8, 2008

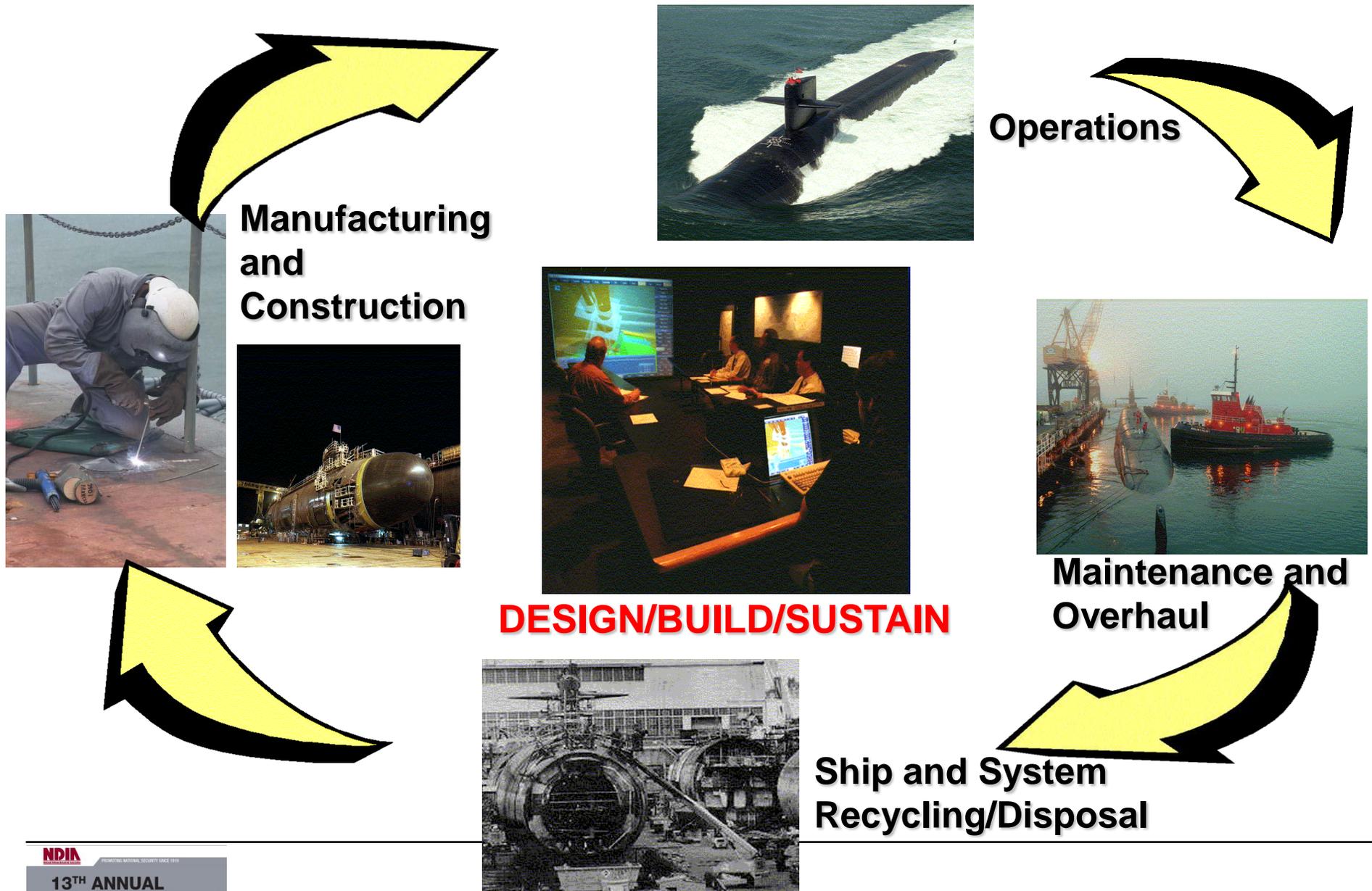
USD(AT&L)

SUBJECT: Operation of the Defense Acquisition System

- Ship Specifications
- Contract Requirements
- Program-specific HSI and ESOH Plans

Background Information

The Life Cycle Approach



Background Information - HSI Domains

Equips warfighters with the needed knowledge, skills & abilities

Training

Personnel Survivability

Provides that the warfighter will have all personal protection needed

Human Factors

Ensures that all aspects of the system are designed with full consideration of the inherent capabilities and limitations of the warfighter

Ensures that all aspects of the living and working spaces are designed with the warfighter in mind

Habitability



Addresses all aspects of defining requirements for personnel as well as obtaining and retaining those individuals

Personnel

Manpower

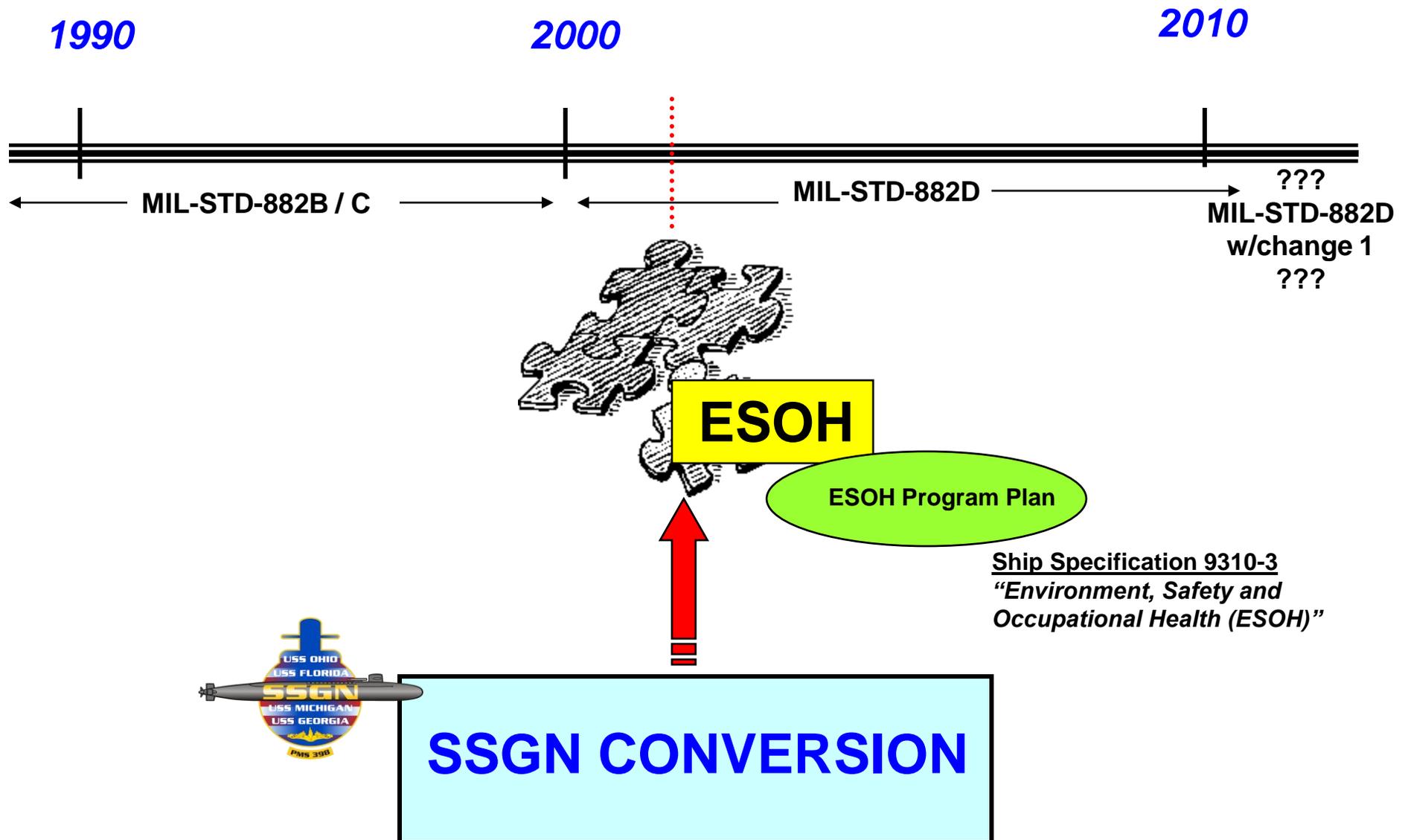
Environment

System Safety

Occupational Health

Design features that minimize the risks of illness, disability or death, and enhance job performance and productivity of the personnel that operate, maintain or support the system

An Evolving ESOH Program – Overall Program Level Focus

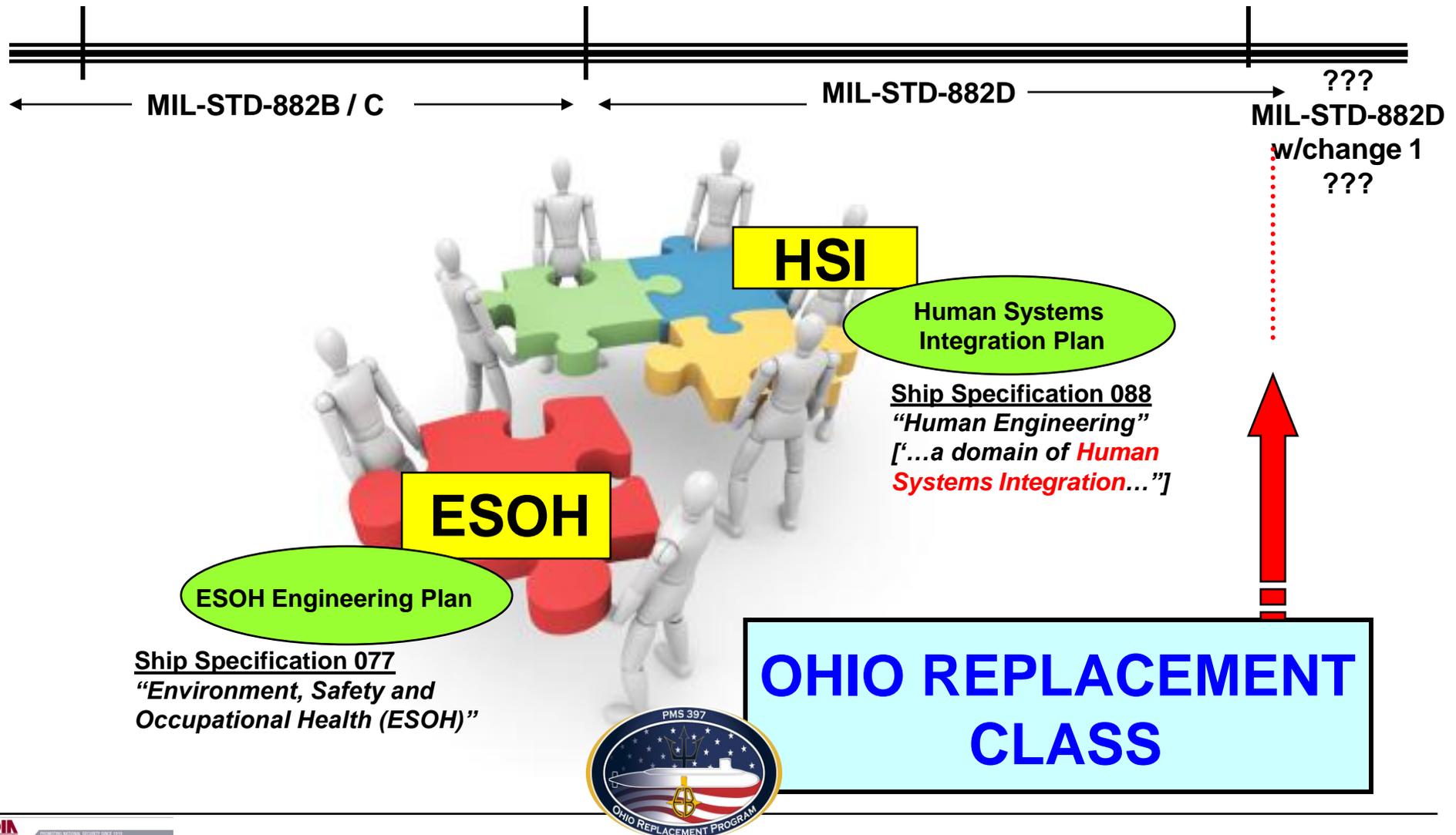


An Evolving ESOH Program – Overall Program Level Focus

1990

2000

2010



An Evolving ESOH Program – Organizational Structure

1990

VIRGINIA Class Block I & II

2000

SSGN Conversion

2010

VIRGINIA Class Block III

OHIO Replacement Class

System Safety Engineering

D495 – TRIDENT Planning

D428 – Electrical System Design

D411 – Life Cycle Engineering

Life Cycle Engineering

- > Human System Engineering Programs
- > RMA & ESOH



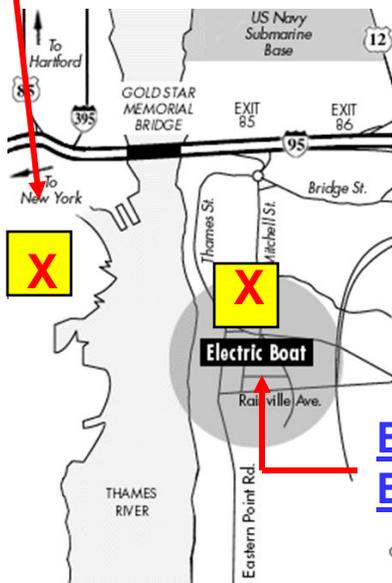
Human Factors Engineering

D427 – Power & Auxiliary System

D411 – Life Cycle Engineering

Environmental Engineering

D470 - Life Cycle Support



ESOH Engineering

ESOH Engineers are integrated into Design/Build/Sustain Teams to provide the ESOH perspective to help design out potential safety hazards and environmental impacts early in the design process.



Here's What ESOH Engineering Does...

Minimize / Eliminate Safety Hazards & Environmental Impacts:

- Carcinogens (lead, cadmium, beryllium, Cr⁺⁶)
- Mechanical/electrical/acoustic shock
- Ozone Depleting Substances -ODSs- (freon, 1,1,1-trichloroethane)
- Slips/trips/falls
- Volatile Organic Compounds -VOCs- (e.g., toluene, MEK, trichloroethylene)
- Ordnance detonation
- Toxic off-gassing products
- Unguarded rotating machinery



The Earlier in the Design that Hazards are Identified, the Easier it is to Implement Change in the Design

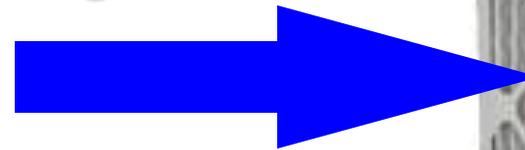
Here's How We Make It Happen...

Participate In Design Reviews and Product Development



Perform Hazard Analyses in Accordance With MIL-STD-882D

- Construction & Vendor Dwgs
- System Diagrams
- Test Procedures
- Standard Parts Library
- Tech Manuals & Ship System Manuals
- Planning Yard Alteration Work Packages

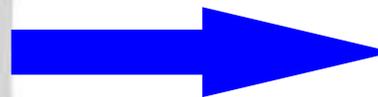


This Process Supports All Submarine Classes and Development Projects

Here's How We Make It Happen...

ESOH Filter Includes:

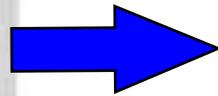
- Ship Spec Requirements
- NAVSEA Lists of Hazardous Materials
- Submarine Atmosphere Control Manual (ACM) Requirements
- Electric Boat SP 7-20 (Chemical Risk Reduction)
- Ammunition and Explosives Safety Regulations
- Human Engineering Design Standard Practice
- Weapon System Safety Guidelines Handbook



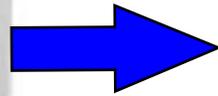
Identify ESOH Hazards and Mitigating Actions

- Environmental Impacts
- Safety Hazards

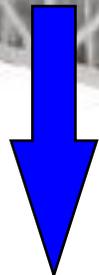
Here's How We Make It Happen...



Implement Mitigating Changes to Designs and Procedures

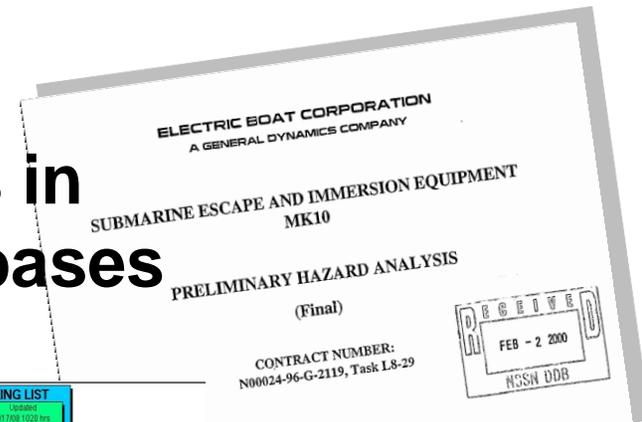


Document Results in Reports and Databases



Eliminate ESOH Hazards

- Unsafe Conditions
- Toxic Exposures
- HazMat Disposal



VIRGINIA CLASS SYSTEM SAFETY HAZARD TRACKING LIST
ELECTRIC BOAT CORPORATION

OPEN HAZARD REPORTS

- All OPEN Hazards
- Open Hazards Requiring Action Plan to HCF
- Open Hazards Requiring Training Support
- Open Hazards Requiring Testing
- HCF's at NAVSEA for Action

CLOSED HAZARD REPORTS

- All CLOSED Hazards
- Closed Hazards Requiring Drawing Review

SYSTEM REPORTS

- Weapon Systems
- Special Operations Forces
- Ship Control System
- Other Systems

INPUT FORMS

- Hazard Tracking
- Drawing Revis
- Test Requir
- Haza Closure

PROCEDURE ACTION ITEM LIST (PAIL)

- All Pails Sorted By Hazard No. (Detail Report)
- Open Pails Sorted By Hazard No. (Detail Report)
- Closed Pails Sorted By Hazard No. (Detail Report)
- All Potential Pails Sorted By Hazard No. (Detail Report)
- Document with Hazard Mitigation Schedule
- PAIL Document Schedule

PAIL Status "All" (Brief Report)

IMPORTANT! PLEASE TAKE NOTE:
Single click on the REPORT that you want to preview. INPUT FORMS and forms and changing data in reports. When using this database, please print what you may need and close out of the database as soon as possible. Keeping other potential users.

VIRGINIA Class Hazardous Material Map

Welcome to the VIRGINIA Class Hazardous Material Map

- PART SUMMARY DATA**
Click here if you know the VIRGINIA Class Single Parts Master (SPM) part number and want to see document, engineering, testing and QC information related to that part number.
- DRAWING NUMBER INQUIRY**
Click here if you know the VIRGINIA Class drawing number and want to see all parts and noun names. From here you will also be able to launch directly to PART SUMMARY and ENVIRONMENTAL application.
- PART NUMBER INQUIRY**
Click here if you know the VIRGINIA Class part number and want to see a brief summary about the part. From here you will also be able to view ENVIRONMENTAL and WHERE USED information.
- PART/CHEMICAL SEARCH**
Click here if you know a chemical constituent and want to see the VIRGINIA Class parts associated with that constituent. From here you will also be able to view ENVIRONMENTAL and WHERE USED information.
- ENVIRONMENTAL QUERY WIZARD**
Click here to create lists and reports from the Hazardous Material Map's numerous data fields. The ENVIRONMENTAL QUERY WIZARD contains the following categories: CONFIGURATION DATA, COMMENT SEARCH, MATERIAL SEARCH, NOUN NAME SEARCH, ENVIRONMENTAL QUERY WIZARD allows you to customize your search and output based on the information most important to you!

EXIT Exit VIRGINIA Class Hazardous Material Map

Example #1: Procedural Improvement

PROBLEM

Existing Tech Manual (TM) had
No **Beryllium** Warning

- VIRGINIA & SSGN hazmat
- DoD “Emerging Contaminant”
- Carcinogen

SOLUTION

During TM Revision, Added
“WARNING” Statements at Each
Step Involving Work on
Beryllium Piece Parts



Example #2: VIRGINIA Class Plastics Waste Stowage

The Act to Prevent Pollution from Ships (APPS) Prohibits Navy Submarines from Disposing Plastics at Sea After December 31, 2008.



Stowage of Plastics Waste Creates a Potential **Fire Safety Risk** Due to the Concentration of the Plastics Waste Becoming Fire Sustaining Fuel.

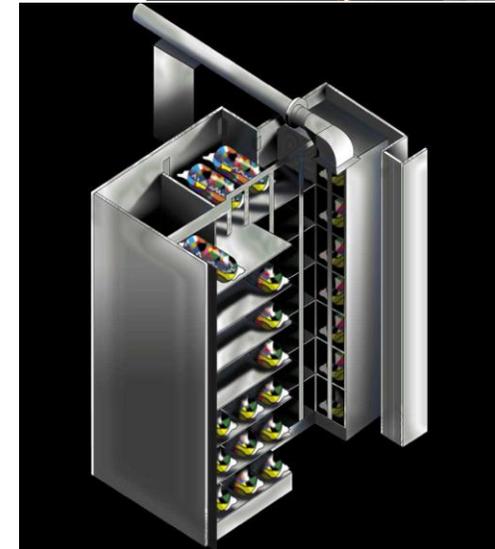


Example #2: VIRGINIA Class Plastics Waste Stowage (Cont'd)

**Testing was Performed to Assess
Fire Characteristics of Burning Bags
Filled With Plastics Waste**

**A Fire Risk Assessment per MIL-
STD-882 was Performed**

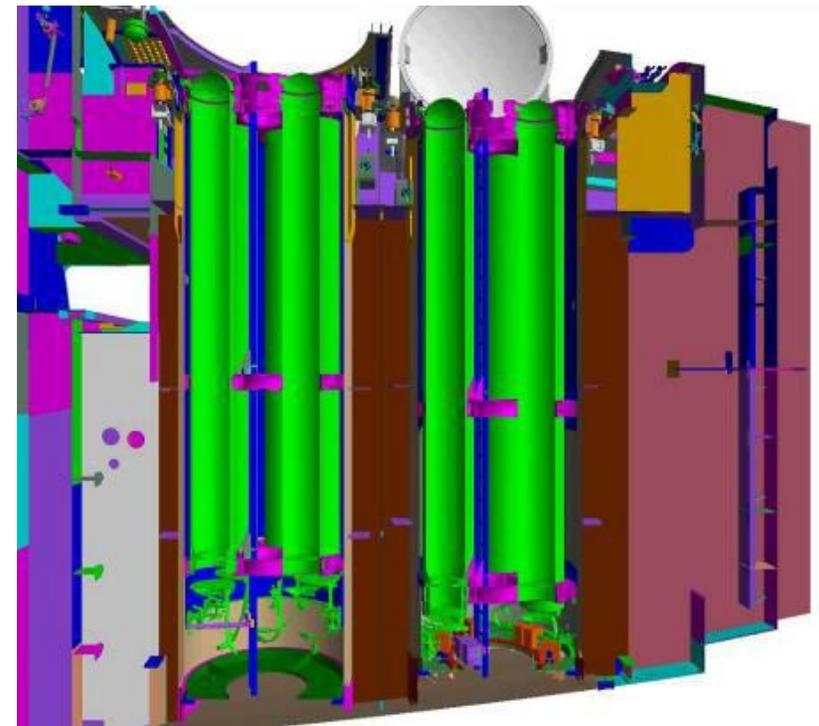
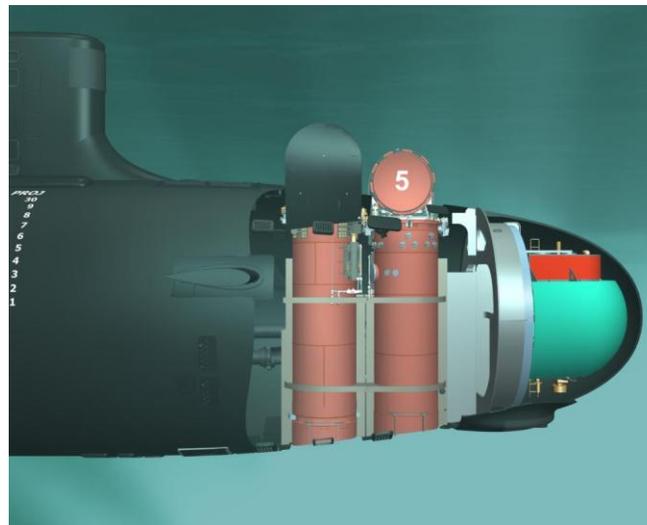
- No additional design changes were recommended in the stowage arrangement in the environmental space
- The risk was considered acceptable by the Fire Fighting System Design/Build Team and the NAVSEA Program Office.



Example #3: VIRGINIA Payload Tube (VPT) Multiple All-Up-Round Canister (MAC) Center Access Ladder

Confined Space Safety Issues (Limited Access to Equipment and No Outside Ventilation) Documented in the VPT Preliminary Hazard Analysis (PHA).

**No Access to
the Payload
Tubes From
Inside the
Ship Like
SSGN Class**

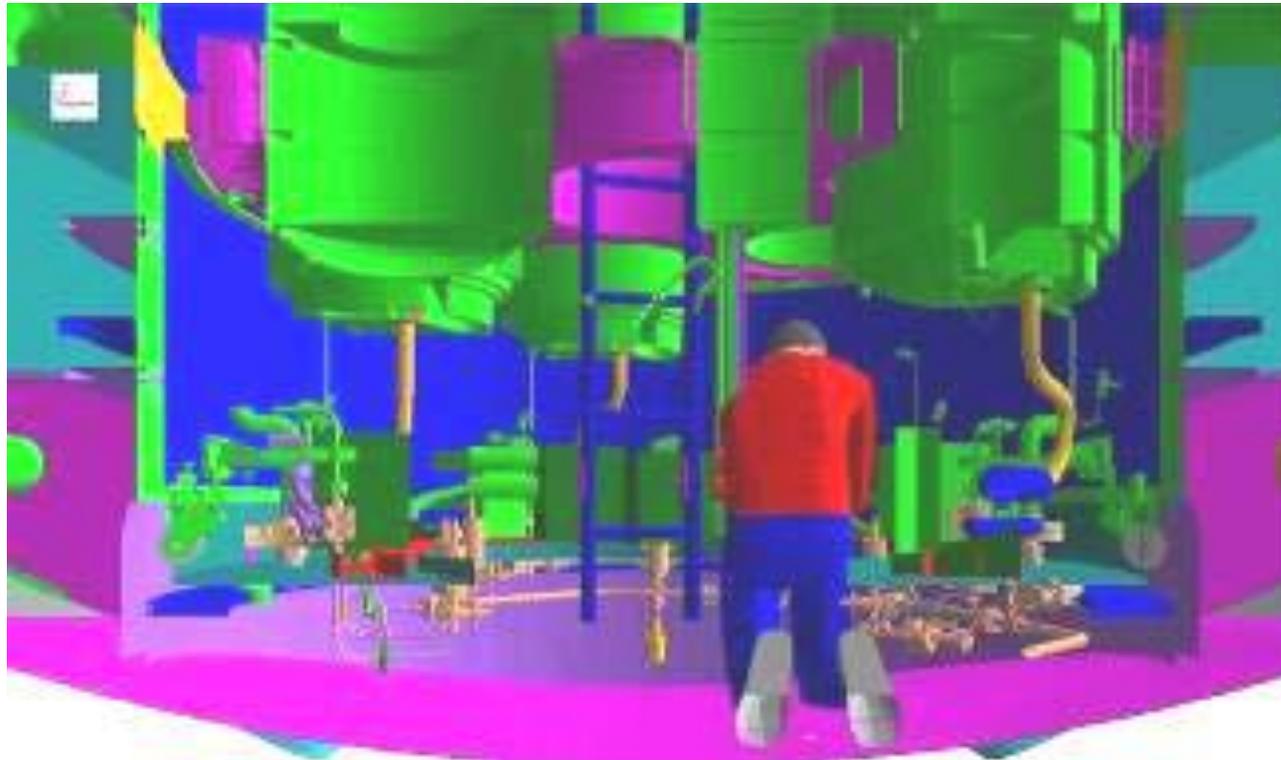


Example #3: VPT MAC Center Access Ladder (Cont'd)

Hazard Mitigation Includes:

Demonstrating Accessibility to Vital Equipment (Full Scale Wooden Mock-up)

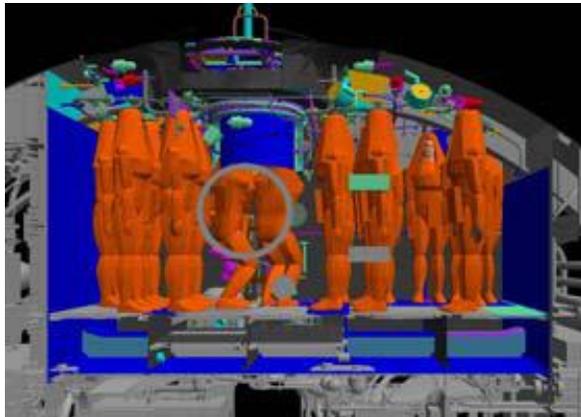
Providing Continuous Forced Air Ventilation to the VPT Through a Custom-built Center Cell Ladder



Example #4: Submarine Escape

Preliminary Hazard Analysis (PHA) on the Submarine Escape and Immersion Equipment (SEIE) MK 10 Made the Following Recommendation:

“Provide realistic MK10 S.E.I.E. pressurized ascent training for the submarine crews.”



Example #4: Submarine Escape (Cont'd)

That Recommendation Resulted in Construction of the New Submarine Escape Trainer at SUBASE New London.



ESOH Program Achievements

A Successful Team Approach has resulted in:

- **1995-1997 Environmental Security Awards - VIRGINIA Class Excellence in Pollution Prevention by a Weapon System Acquisition Program (NAVSEA/CNO/DoD/DON)**
- **1998 EPA Stratospheric Ozone Protection Award to VIRGINIA Class Program**
- **2006 Dept of Navy Special Recognition for Excellence - awarded to SSGN ESOH Integrated Product Team**
- **2007 International System Safety Conference Award for Best Paper – “Anatomy of an Award Winning Safety Program: A Case Study of the SSGN OHIO Class Conversion Safety Program”**



ESOH Success Recognized

Special Recognition by the Navy for Excellence in Safety in the Field of Acquisition

*“The program emphasizes the **integration of safety and environmental engineers** into the design/build teams to add the element of objectivity into hazard analyses. This team exemplifies the benefits of the **early integration of safety concerns** into the acquisition process.”*

Hon. Donald C. Winter, Secretary of the Navy

September 2006



Summary

- **Performed ESOH tasks in a variety of successful projects and programs**
- **Successfully integrated environmental considerations into the System Safety approach described in MIL-STD-882D (DoD Standard Practice for System Safety)**
- **Continue to interface with Shipyard Safety, Fire Dept., Industrial Hygiene, vendors, Environmental Resources Management, and Design/Build/Sustain teams in ESOH tasks**

ESOH is Part of the Integrated Systems Engineering Approach and Incorporates HSI Requirements

THIS CONCLUDES MY
PRESENTATION.
ARE THERE ANY
QUESTIONS?

