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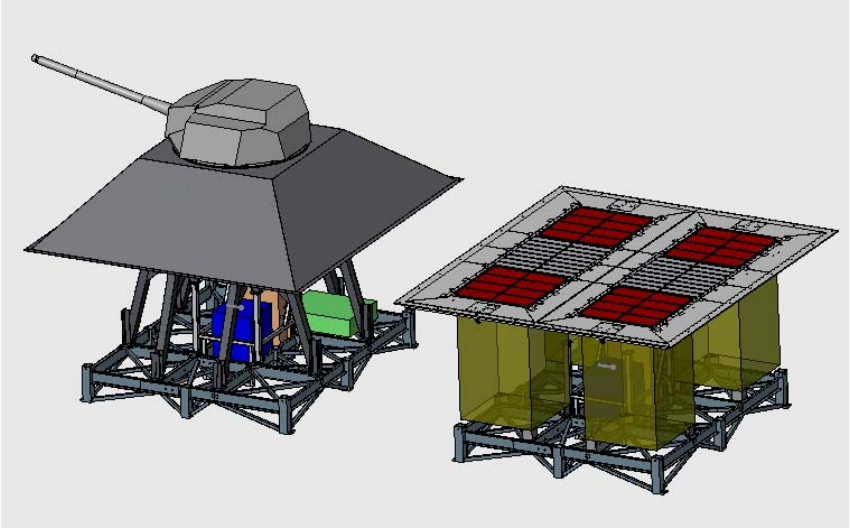
Implementation of Modular Weapon Systems Integration

LCS Surface Warfare (SUW) Weapon Modules



Mike Canaday

Littoral Combat Ship (SUW) Mission Modules

- Littoral Combat Ship is a Focused Mission Ship
- Littoral Combat Ship (LCS) will Use a Modular Approach to Integrate Mission Modules to the Seaframe
- Seaframe is the Core of the LCS
- Flight 0 Mission Module Capabilities will Include
  - Mine Warfare (MIW)
  - Anti-Submarine Warfare (ASW)
  - Anti-Surface Warfare (SUW)

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Introduction

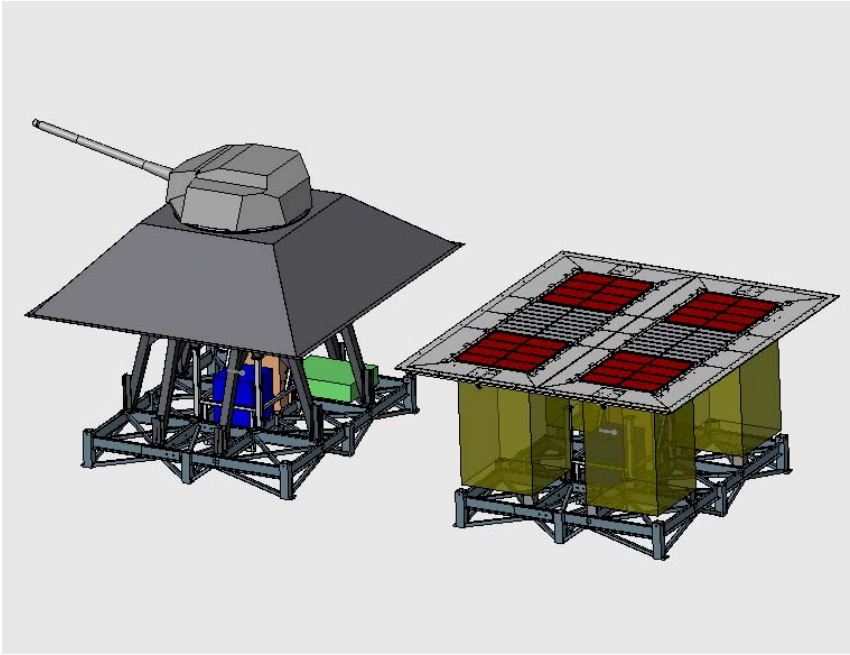
- A Mission Package (MP) Provides LCS with the Hardware Required to Support Specific Mission Areas
- A MP Consists of a Combination of Mission Modules (MMs)
- MMs are Installed in MM Stations or Mission Zones
- A Mission Zone Includes One or More MM Stations

Background

- The Concept for a Modular Approach to Weapons Systems Integration is Supported by Numerous Studies and Programs
  - SEAMOD in 1975
  - Ship Systems Engineering Standards (SSES) in 1980
  - NAVSEA's Affordability Through Commonality (AFC) Program in 1992
  - OSD's Open Systems Joint Task Force (OSJTF) in 1994
  - Carderock's Total Ship Open Systems Architecture (TOSA) in 1998
  - Dahlgren's Open Architecture Computing Environment (OACE) in 2003
  - 1980's foreign Navy Programs
    - Germany's MEKO Program
    - Denmark's STANFLEX Program

Background

- A Modular Approach To the Weapons Integration Offers Performance Benefits that Are Required for the LCS
- Adaptable Across Different Missions
- Rapid Forward Based Conversion Between a SUW, MIW And ASW Mission Package Versus Changes at a Ship Yard



Gun and Missile SUW
Weapon Station Modules

Background

- Advantages of a Modularized Approach to Weapons Systems Integration are not Limited to the War-fighter
- Logistics Support
- Standardized TEUs Shipping
- Rapid Upgrade to Newer Systems Improves Lifecycle Sustainment of Seaframe

Mission Module CONOPS

- The Mission Module Components, Packaged in ISO Containers, Arrive at a Friendly, Yet Undeveloped, Port
- The Components are Unpacked, Assembled, Checked Out, and Readied for Installation, Anticipating the LCS Arrival into Port
- When the Ship Arrives the Mission Package will be Installed and Checked Out in 1 Day (Objective) or No Greater than 4 Days (Threshold)

Interface Control

- Functionality Divided Between the Mission Modules and the Sea Frame
- Interfaces Between the Mission Module
  - Mission Module (i.e., The Weapon)
  - Mission Module Station (i.e., The Sea Frame)
- Allows for
  - Multiple Sea Frame Designs
  - Independent Mission Module
  - Future Growth

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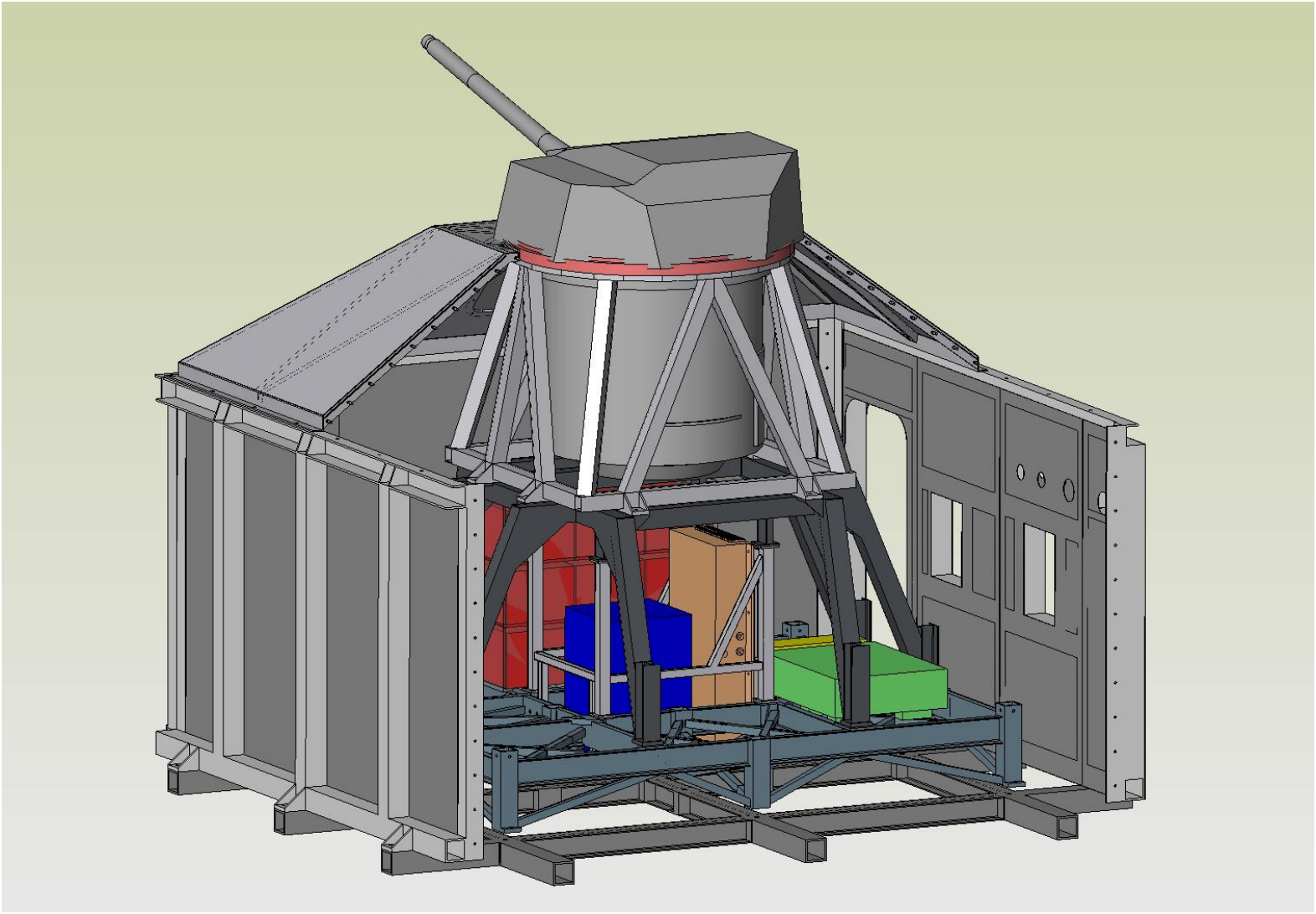
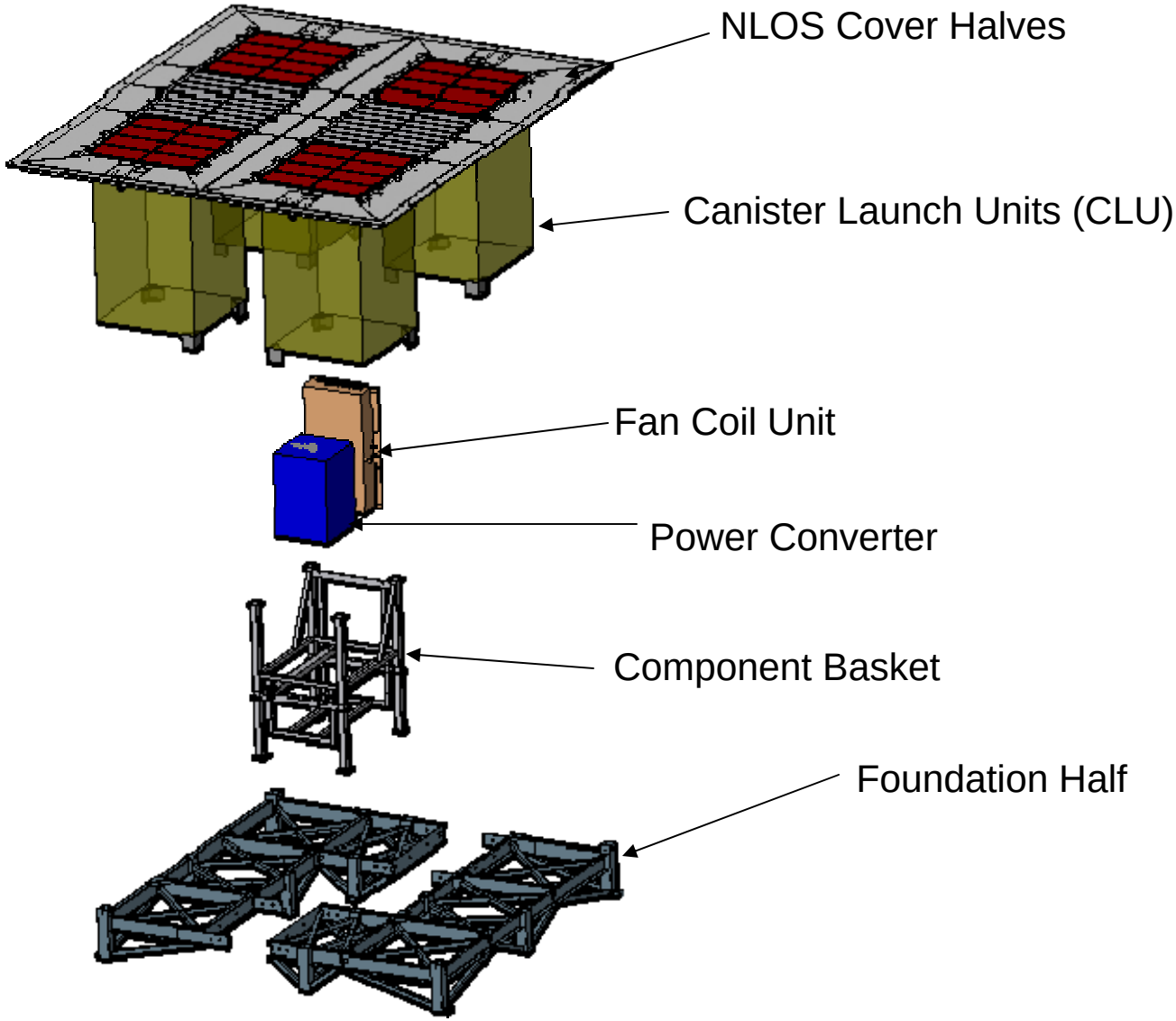
Interface Control



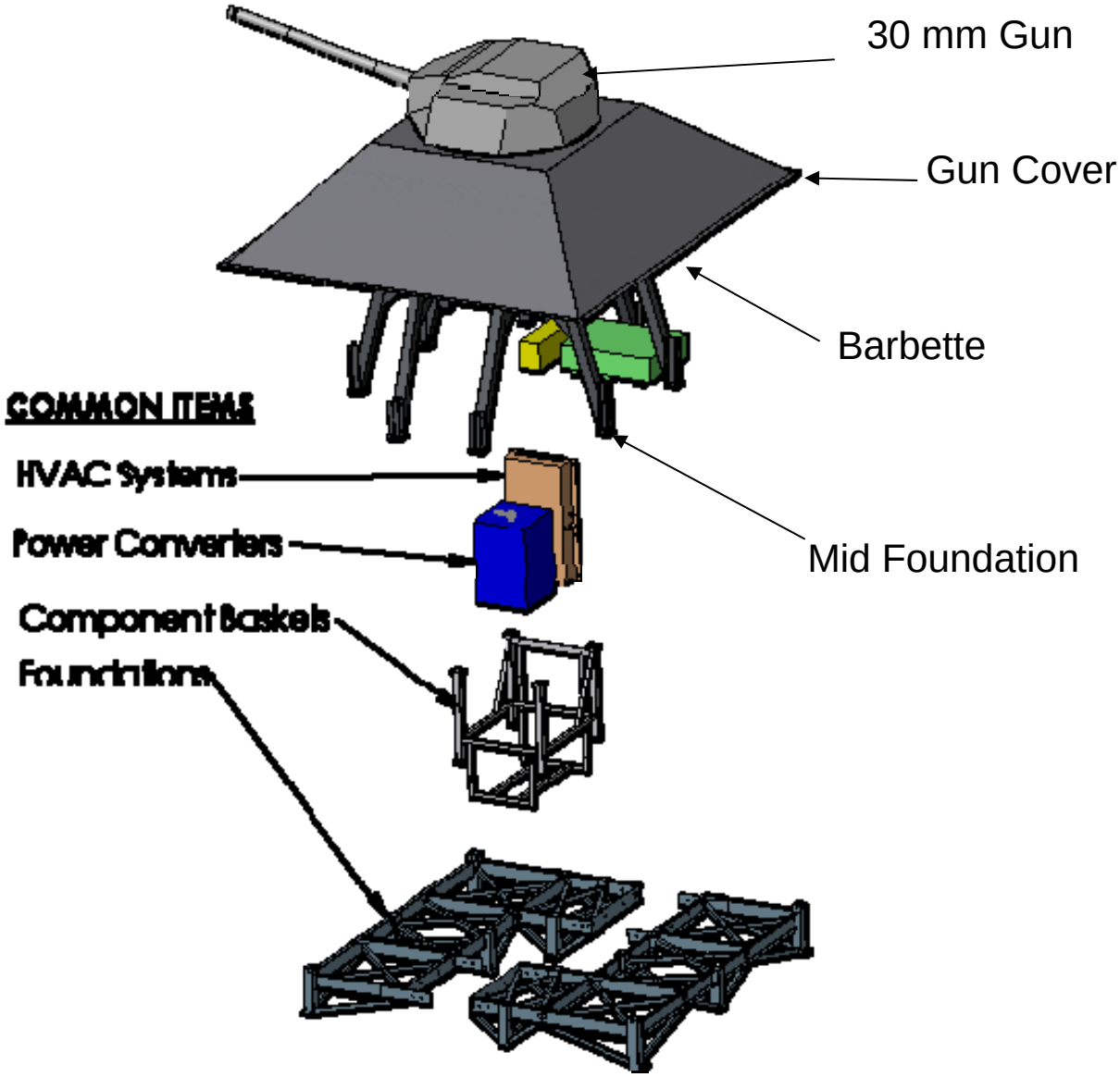
Analysis and Design

- The SUW Mission Module Mission Package Design has Progressed Significantly Due to Understanding Gained Through Analysis.
  - Weight Minimization
  - Suitability of the Sea Frame to Mission Package Connections
  - Prevention of Deck-to-deck Coupling
  - Gun Recoil and Green Water Load Suitability
  - Commonality and Standardization Between Modules
  - Manufacturability
  - Handling and Transportation Accommodations and Flexibility
  - Consideration of Human Systems Integration Factors
- Control of Environmental Issues
  - Thermal Loading and Required HVAC Systems and Ventilation
  - Corrosion of Electrical Connectors
- Safety Considerations
  - Integrated HVAC for Temperature Control
  - A Sprinkling System for Over-temperature Control
  - Control of Electromagnetic Interference by Proper EMI Seal Design

Missile Module Prototype

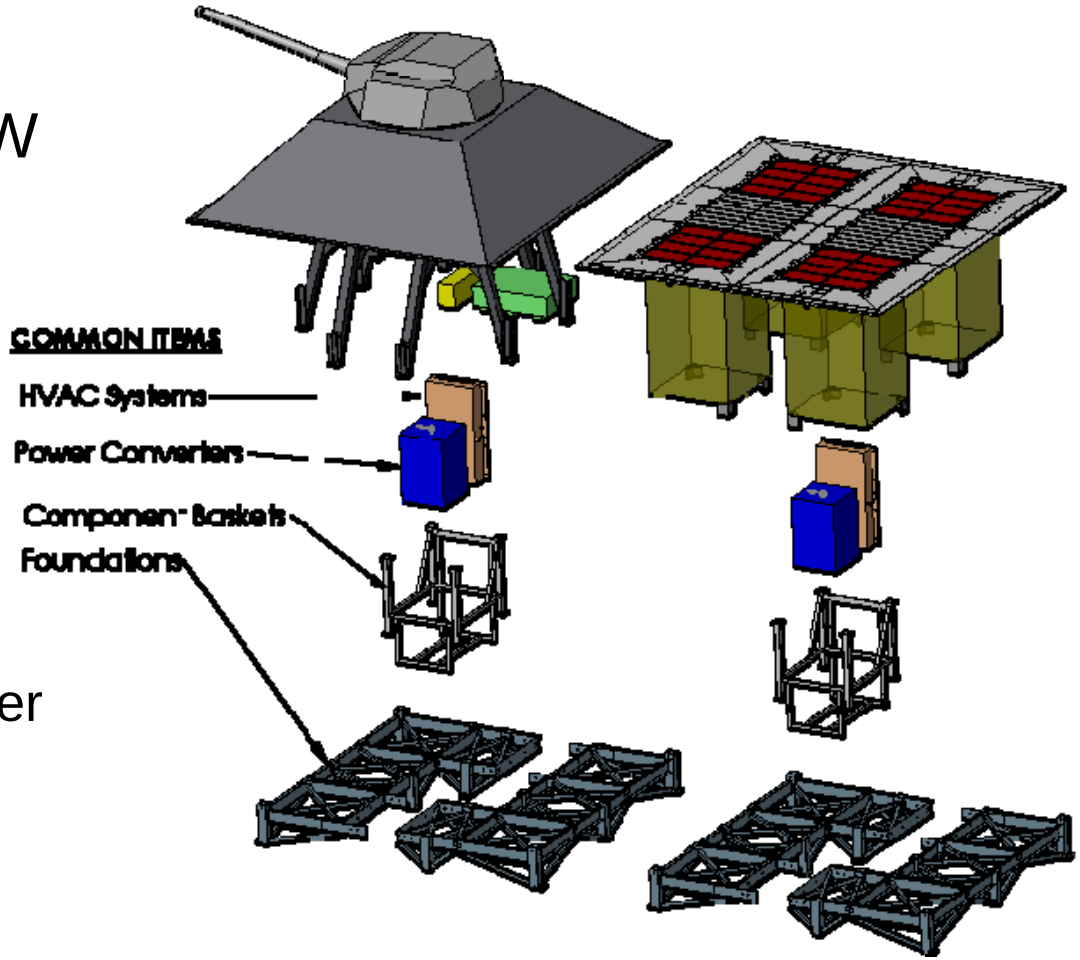


Gun Module Prototype



Component Level Modularity

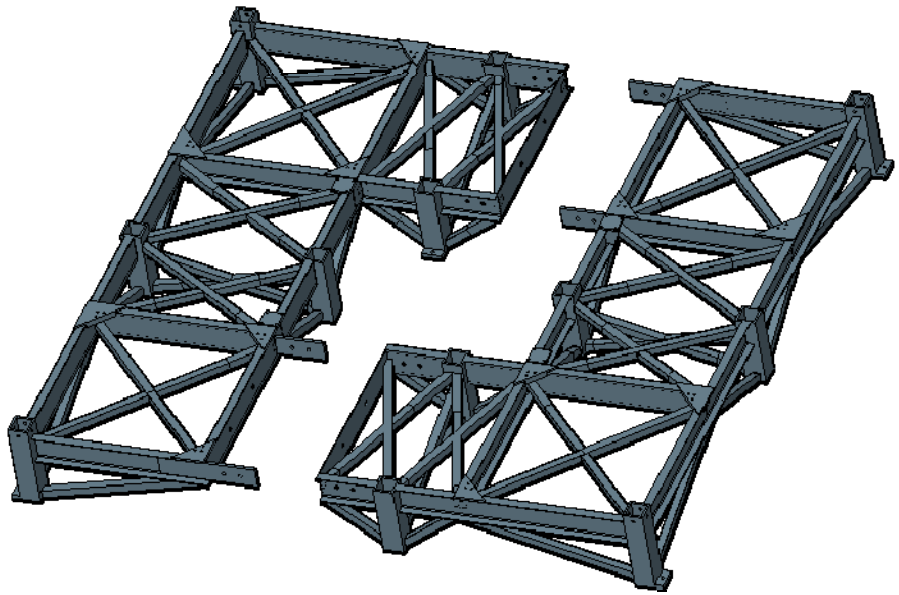
- Modularity of Components for the SUW Missile and the Gun Weapon Modules.
- Common Components:
  - Foundation
  - Heating/Cooling Unit
  - Power Converter
  - Mounting Basket for Heating/Cooling and Power Converter Unit



Mission Module Commonality between Launcher and Missile Variants.

Common Foundation

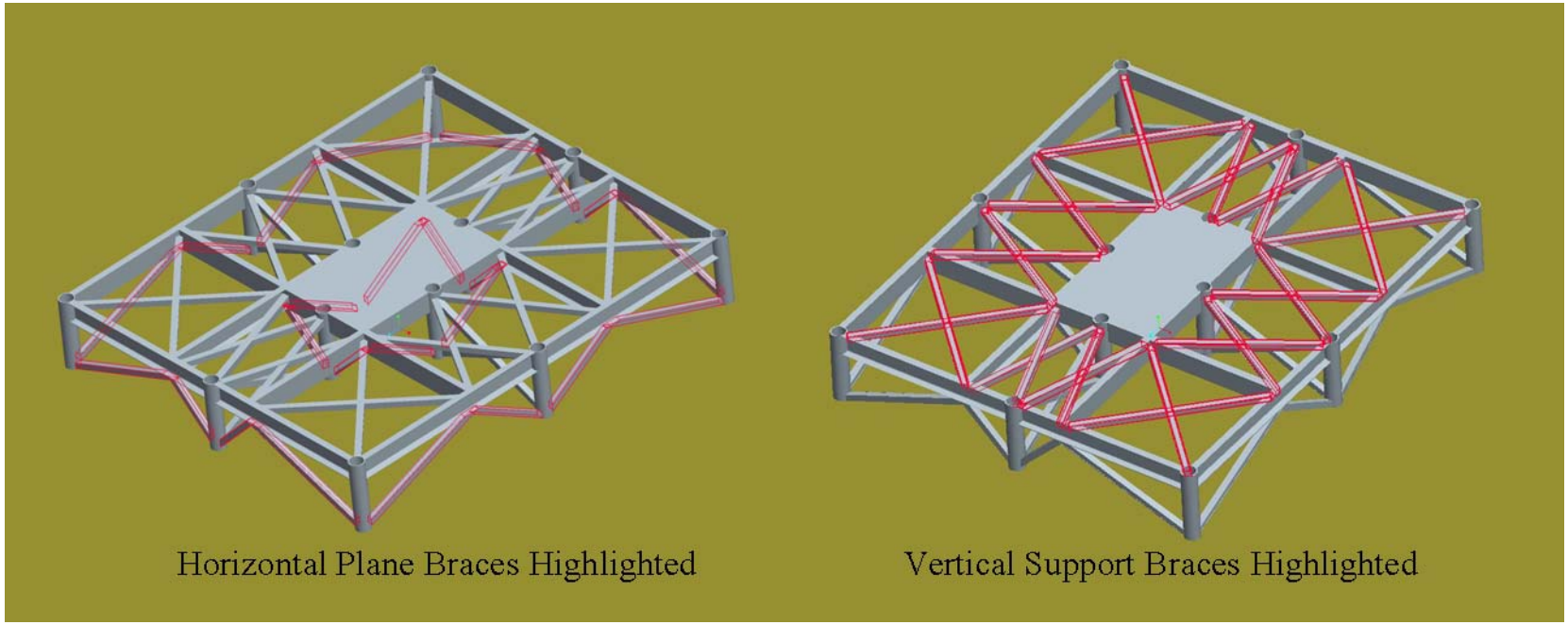
- A Major Mechanical Interface Element Between the Mission Module (the Weapon) and the Sea Frame (the Ship) is the Foundation.
- Common Between Missile and Gun Modules
- Transportability
  - 2 Pieces
- Near Miss Shock Loads
  - No Bolted Joint Friction
- Leveling



Two-piece SUW Mission Module Foundation.

Foundation Strength Design

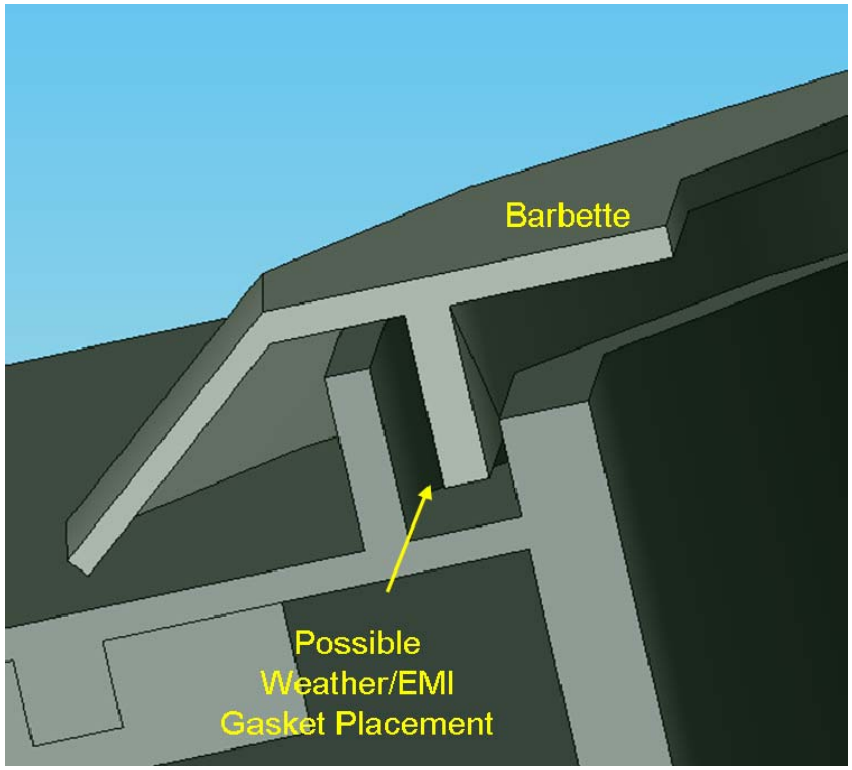
- Cross-bracing - For Reacting to Bending Moments



SUW Mission Module Foundation
Cross-bracing

EMI and Weather Sealing

- Challenges Protecting Against EMI and the Elements.
- Seals Must be
  - Durable
  - Maintain a Seal Under Varying Conditions
  - The Seals Must Not Permanently Deform.
  - Able to Accommodate Variations in Gap to be Sealed
- Modular EMI Seal
- Possibilities for EMI Sealing Other than Welding Include
  - Spring Core Gaskets
  - EMI Meshes
  - Conductive RTV
  - “Torturous Path” Designs



“Torturous Path” EMI Seal Design

Modular Weapon System Challenges

- Design is Optimized for Easy and Fast Change-out Mechanical Interface Standpoint,
- Installation of Gun and Missile Modules Must Meet Changeover Time Goals.
  - NLOS-LS Missile System has Inherent Adjustment Capabilities
  - 30 mm Gun System Must be Designed to Have Inherent Adjustment Capabilities as Well
- Need to Account for Uncertainty and Error in Seaframe to Module Interface.
  - Mechanical Adjustments
  - Electronic Calibrations at Installation
  - Control Compensation
- Future Modular Weapons Systems Will Also Need to Carefully Consider How to Achieve Total System Readiness in a Short Period of Time in Terms of Final Set-up and Alignment.

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Conclusion

- Modular Weapons Concept Offers a Flexible Method for Weapons Integration
- New Weapons Systems for the LCS can be Integrated by Using the Defined Sea Frame Interface
- Provides Easier Access to Developing Weapons Technologies
- Eases Testing of New Systems Prior to Integration
- Eases Weapon Integration on Other Platforms