

21-23 June 2005, at US Military Academy, West Point, NY

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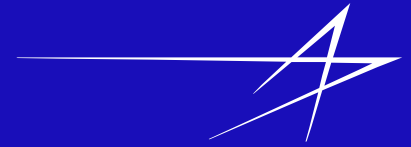
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Shipboard Organic UAV Operations

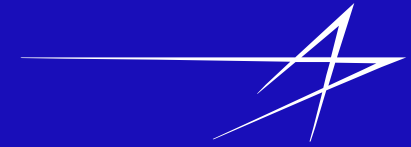
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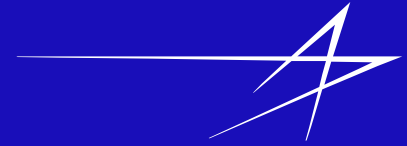
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Balancing Risk for an Uncertain Future



Topics

1 Background	• Littoral Initiatives in Fleet Battle Experiment Juliet • Industry Led Collaborative Execution
2 UAV Integration	• Evolution of Shipboard Organic UAV Concepts • Organic UAV Development Initiatives • Shipboard Implementation
3 UAV Ops Results	• Shipboard Operation • Conclusions / Recommendations



1. FBE-J Experiment Background

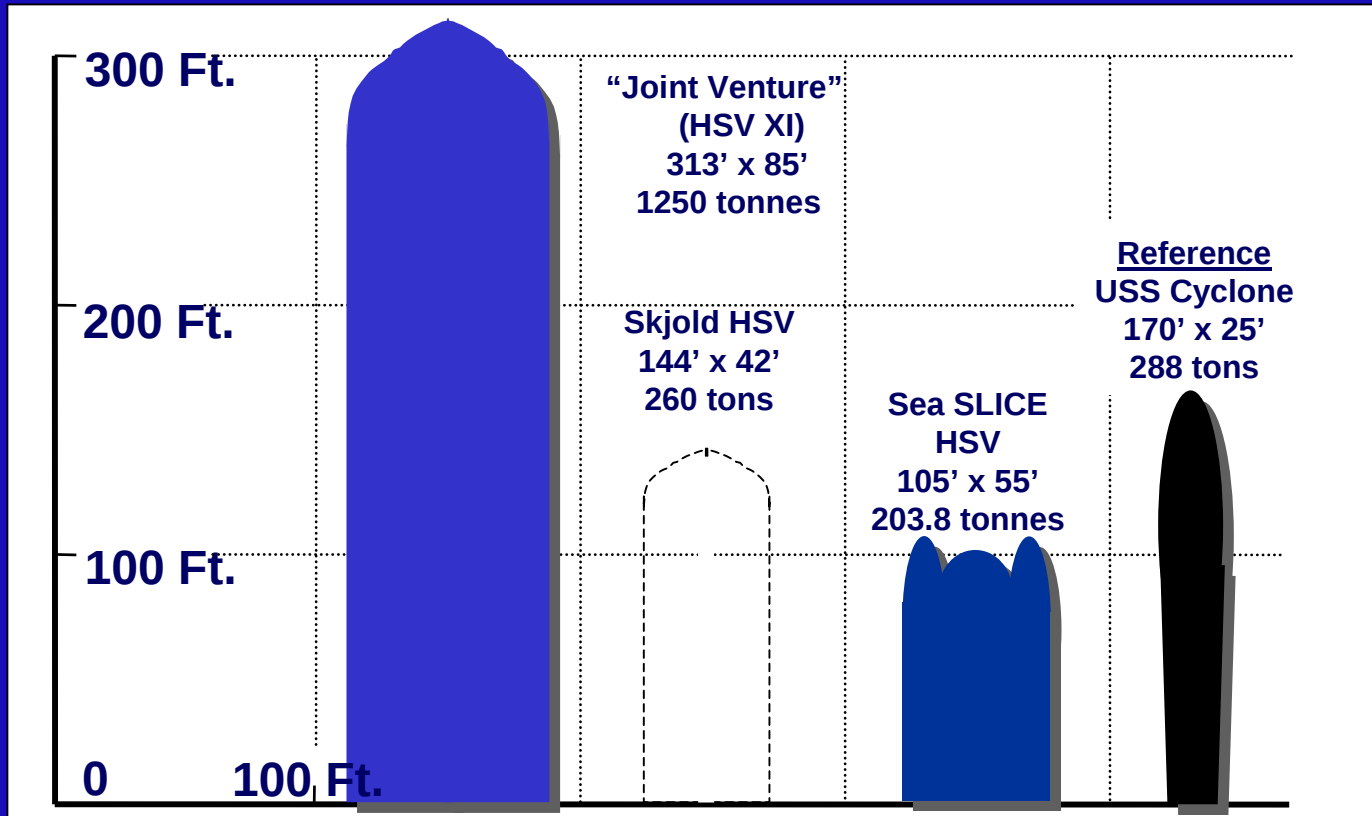
- **Navy Littoral Initiatives Assigned (July-Aug 2002)**
 - **Demonstrate Reconfigurable Littoral Platform**
 - **Demonstrate Netfires CONOPS in the Littoral**
- **Led Industry Collaborative Development**
 - **Organize as Sea Slice Team**
 - **Start Littoral Design with a Clean Sheet**
 - **“Be a Littoral Combatant” was Prime Requirement**
 - **Derive All Other Requirements**

Origin: Experimentation Platform Sea Slice



Unique, Fast, Stable Platform with Fortuitous Proportions

FBE-J HSV Size Comparisons

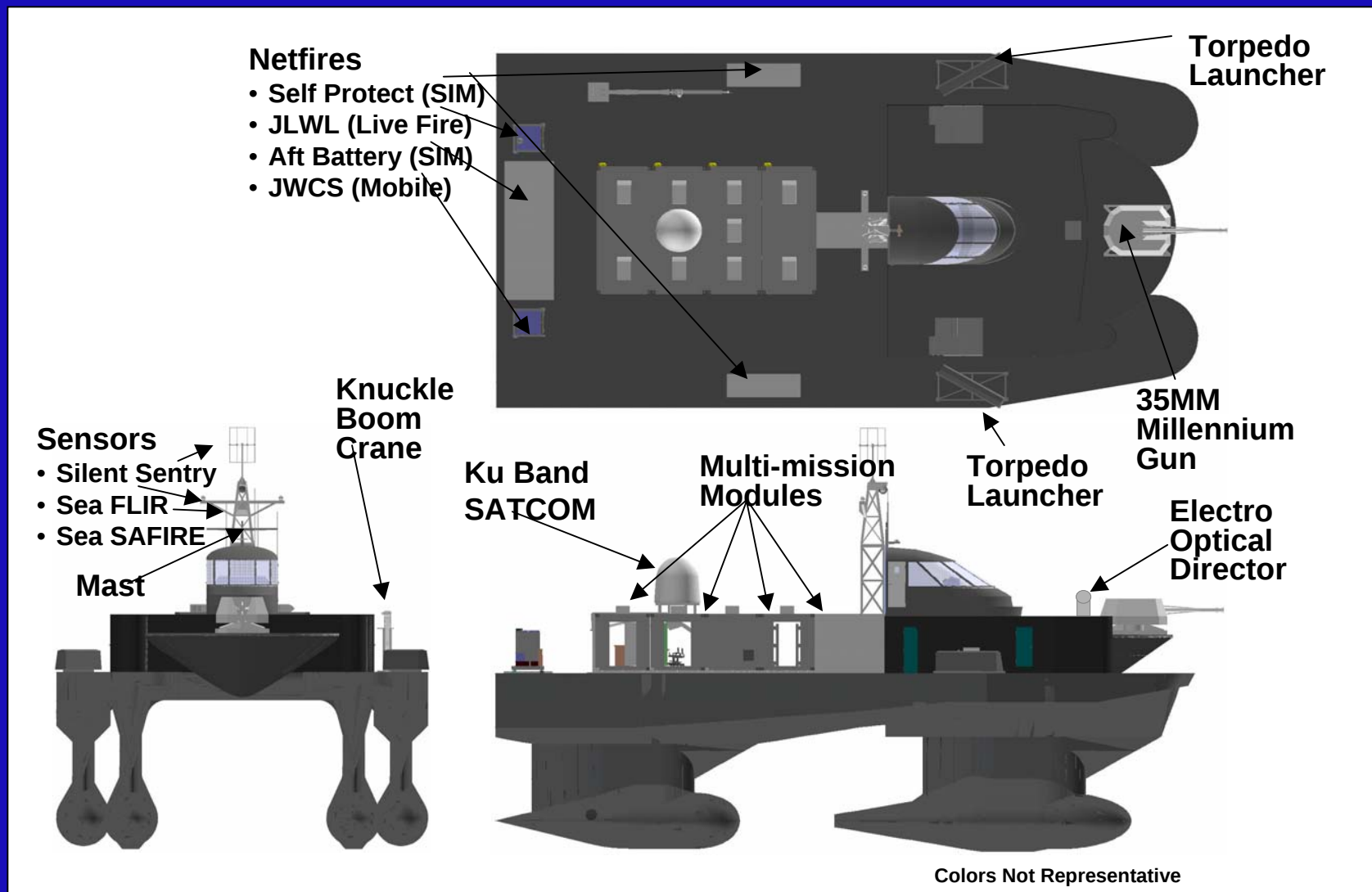


Sea SLICE Provides The Speed and Seakeeping Performance of a Ship 3-5x times its Size

Integrated Experimental Platform



Final FBE-J Sea SLICE Configuration

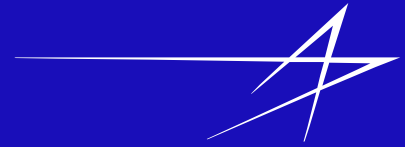


Driving Sea SLICE Concepts for FBE-J



- **Primary Experiment: Reconfigurability**
 - Modular Mission Capability Implementation
 - Swap Out Equipment Every Few Days
 - Reenter Fray With New Mission Configuration
- **Netfires Man-in-the-Loop Naval CONOPS**
- **Front Line “Node” Enabling Net-Centric Warfare**
- **Sea SLICE Multi-mission Modules**
 - Command & Control (Supports all other modules)
 - Netfires (390 Simulated Rounds + One Live Firing)
 - Torpedo Launchers (Simulated 4 Rounds)
 - 35 MM Gun Module (Simulated + Live Fire)
 - Passive Sensor Suite (3 FLIRs, Passive Radar)
 - Special Missions
 - Unmanned Underwater Vehicle
 - Towed Mapping Sonar
 - SOF Support (VBSS)

Modular Mission Payload



- **Tasking**
 - Equipment Mounting, Transport, and Positioning
 - Rapid Sea SLICE Reconfiguration
 - Support for Naval Fires and Mine Warfare
- **Accomplishments**
 - Performed Multiple Concurrent Tasks
 - Combined Self Protection Modules and Mission Modules
- **Lessons Learned**
 - Human Factors Investigation/Improvements Required
 - Strong Support for Side Scan Sonar Module
 - Gun Module Performed Well
 - Vert Rep Worked Well for STOM Support



Vision for Collaborative Execution



Collaboration of
Industry with Navy

Cost Effective
Operation

Industry Resources
and Support



Communications
Suite

Concept Development
and Validation

US Navy Venues
and Scenarios

Industry Sea Trial Initiative

Method for Collaborative Execution



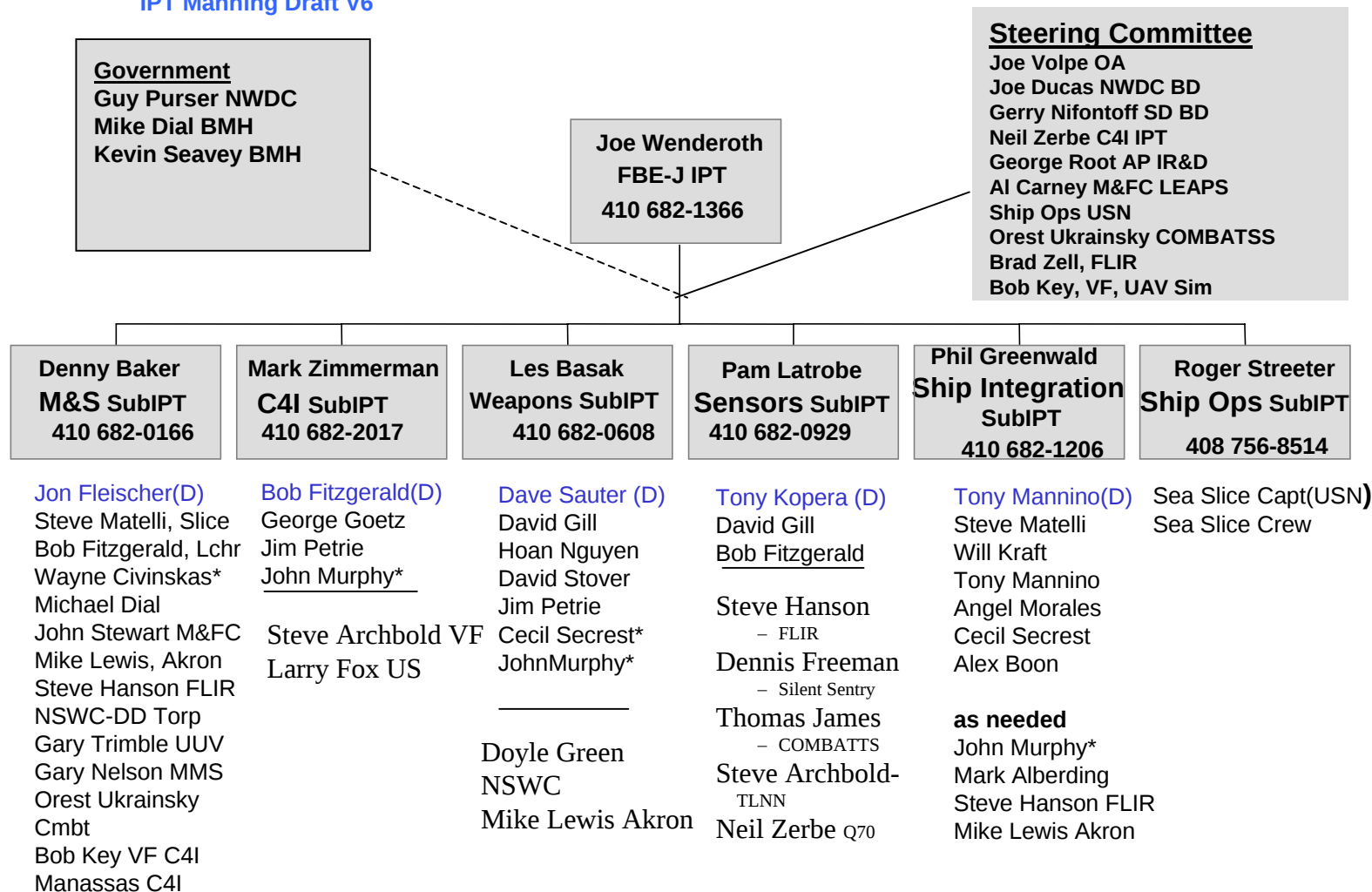
- **Form IPT and SubIPTs to Execute Integration & Test**
- **Manage Team at the Platform Level**
- **Invite Technology Collaborators and Vet Their Products**
- **Select Fielded Technologies (Intermediate Development Level)**
- **Form Advisory Group – Control Team Expectations**
- **Satisfy Navy Experiment Initiative Requirements, but...**
- **Start with Clean Sheet - “Be a Littoral Combatant”**
- **Allow for Overlapping Capabilities (Redundancy)**
- **Develop Agreements among Partners (Terms of Reference)**

Team Building is a Social Process

Sea Slice Team FBE-J IPT Partners

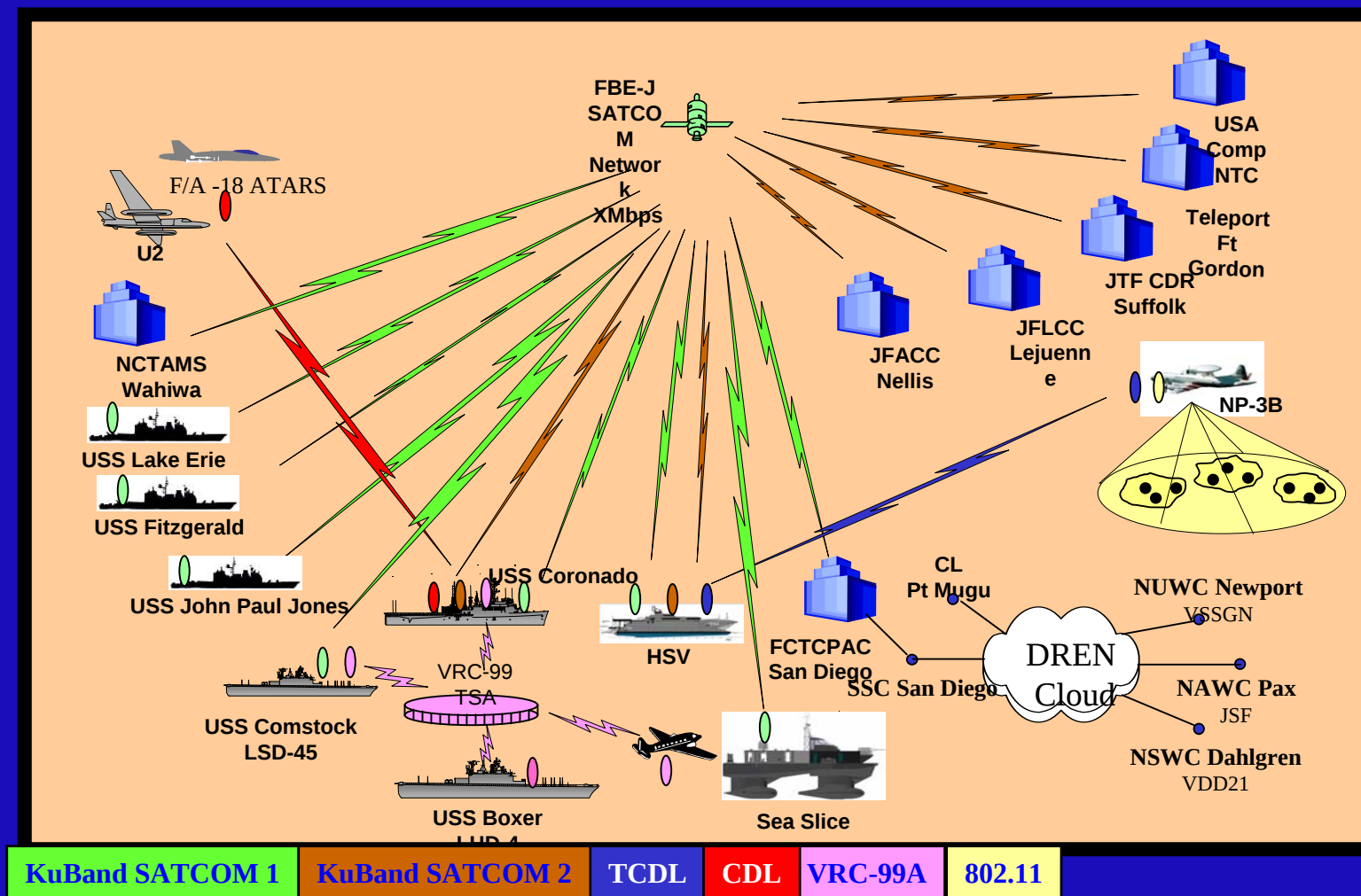


IPT Manning Draft V6



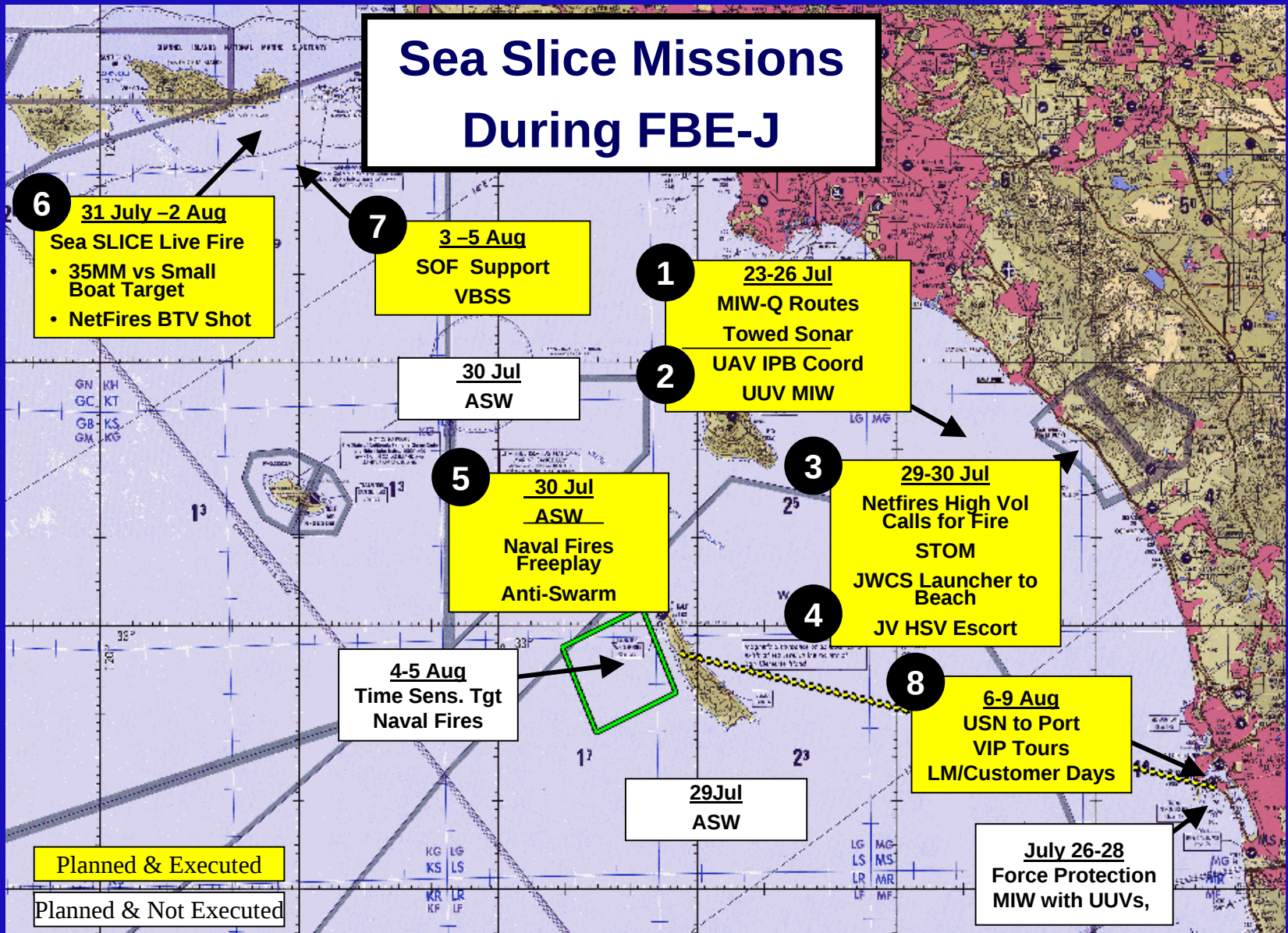
Lots of Players → Complex Communications

FBE-J Communications Architecture



NWDC Slide (with LM mods)

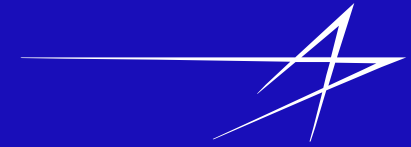
Sea Slice Missions During FBE-J



Challenging Schedule Provides Many Opportunities



“Our” FBE J Conclusions / Recommendations



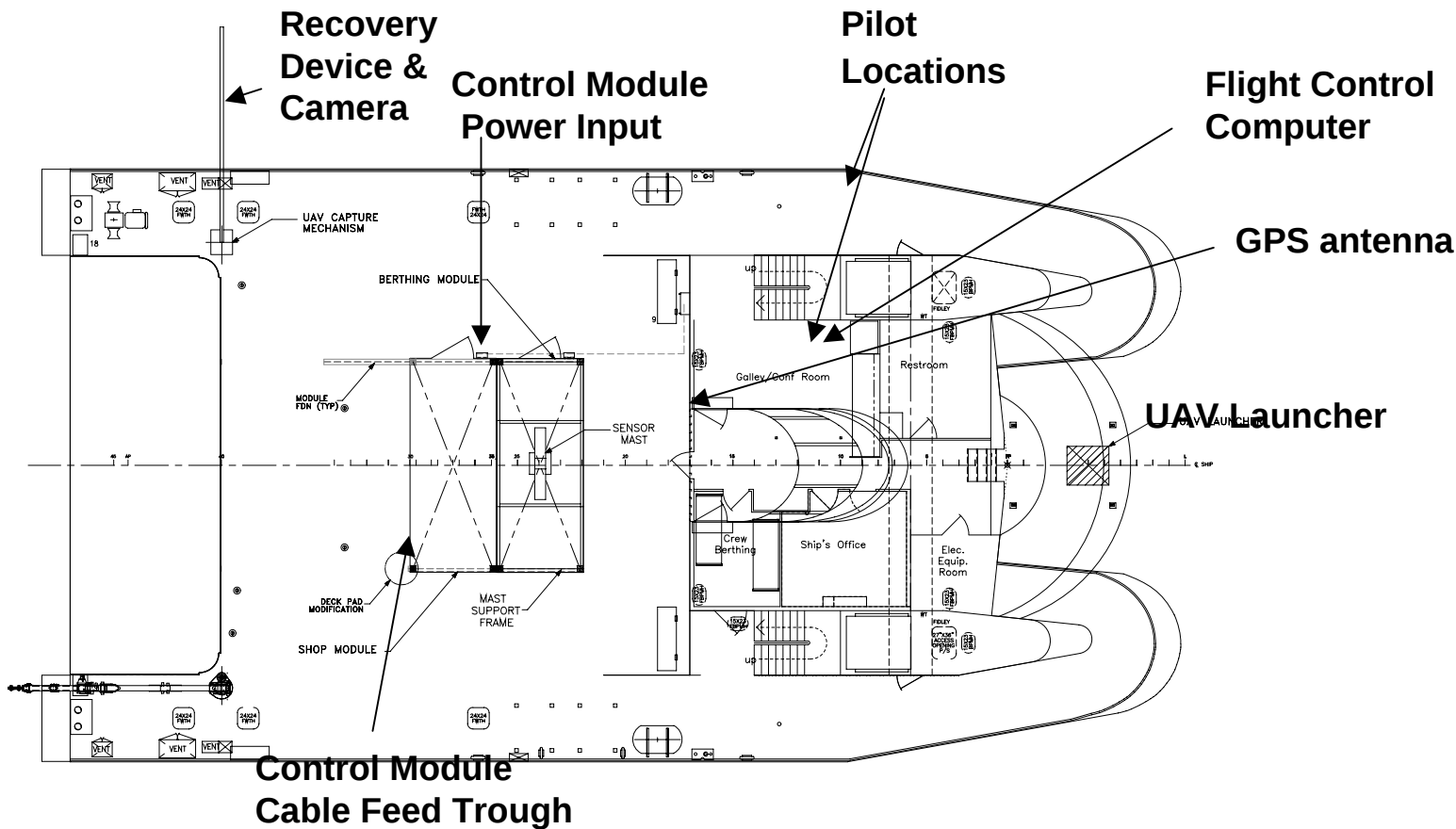
- **FBE J Proved Utility of Focused Mission Modules**
 - **Spawned Focused Mission Ship and LCS Solicitations**
 - **Rapid Reconfigurability Can Be Achieved**
- **Coordinated Small Boat Attacks are a Major Threat**
 - **Need a Surface-to-Surface Weapon with Standoff Range**
 - **Must Rapidly Find, Identify, and Attack Fast Attack Craft**
- **Anti-Small Boat System Requires:**
 - **Persistent Surveillance with Organic Off Board Platform**
 - **UAV Mission Module Integrated with Weapon System**
 - **Generic Components (Launch, Control, Capture)**

2. UAV Mission Module Integration

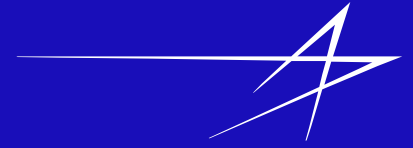


- **Evolution of Shipboard Organic UAV Concepts**
 - **Use Systems Orientation with Shipboard Demonstration**
 - **Enable Weapons Engagement with UAV Technology**
- **Organic UAV Development Initiatives**
 - **Design for Minimal Manning**
 - **Strive for Routine, Persistent UAV Operations**
- **Shipboard Implementation**
 - **ONR Demonstration Funding via Small Business (STTR)**
 - **Develop Generic Components (Launch, Control, Capture)**
 - **Define Mission Specialist Roles and Procedures**

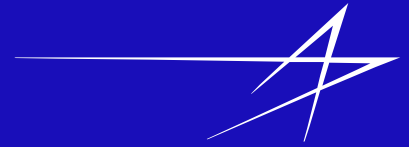
Sea Slice UAV Ops Demo Arrangements



Demo Shelters & Mission Mast



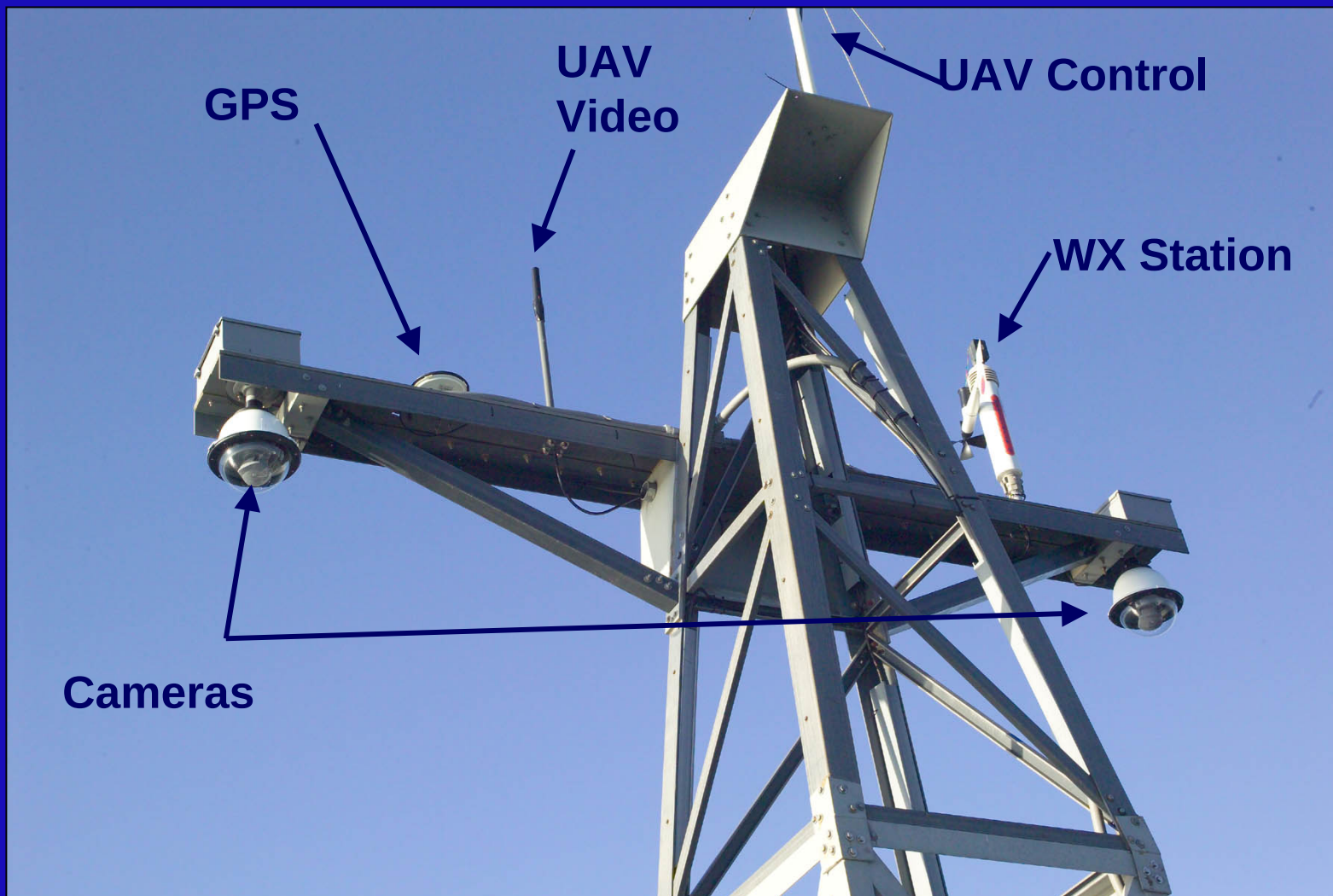
Shelter Loading On Sea Slice



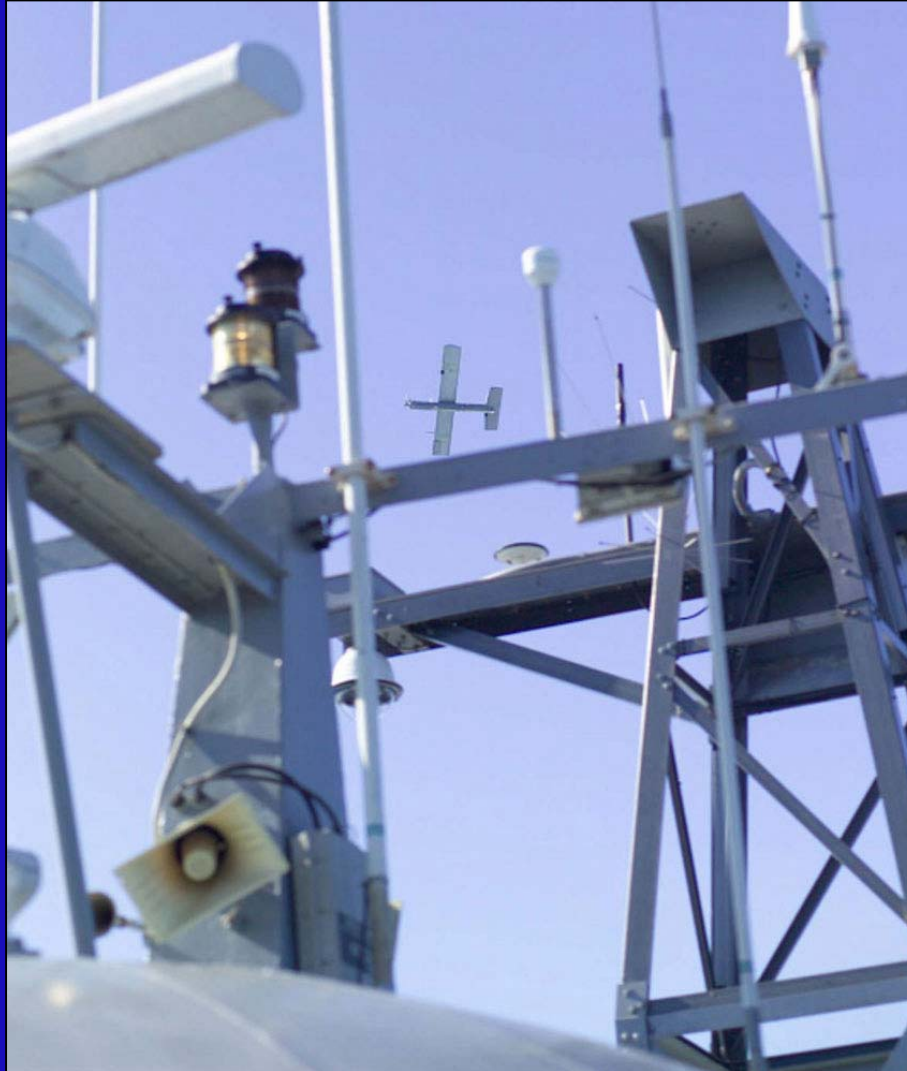
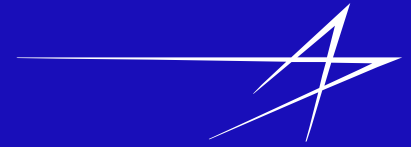
Shelter Universal ISO Mounts



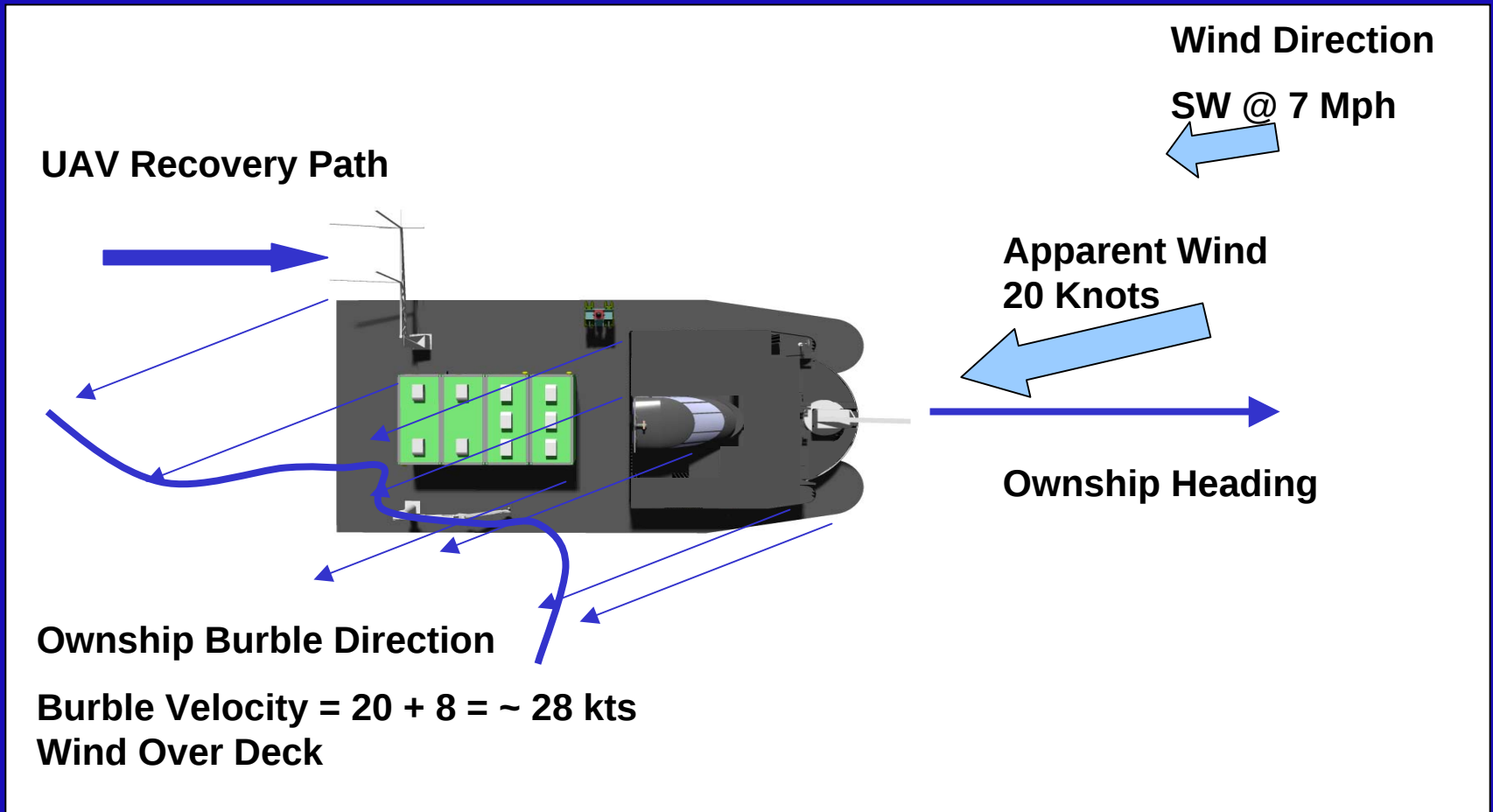
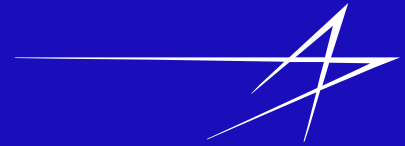
Mission Mast as Installed



Complex EMI/EMC Environment



Ownship Heading Plan for UAV Recovery

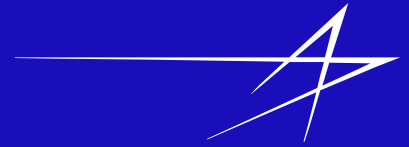


Consider Wind Over the Deck

ANLAS / GUSS / Valiant Control Station

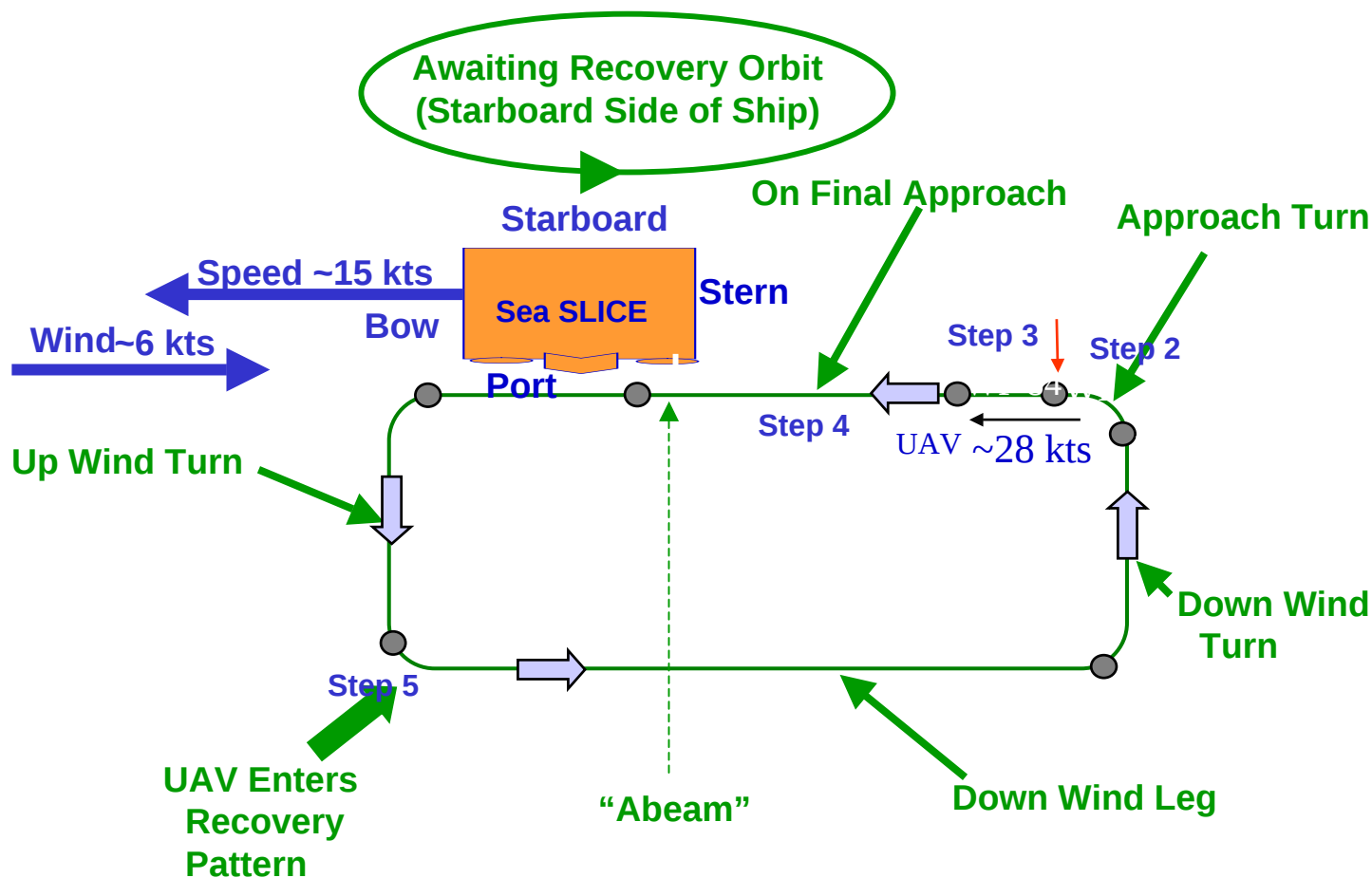


Pilot with Manual Control

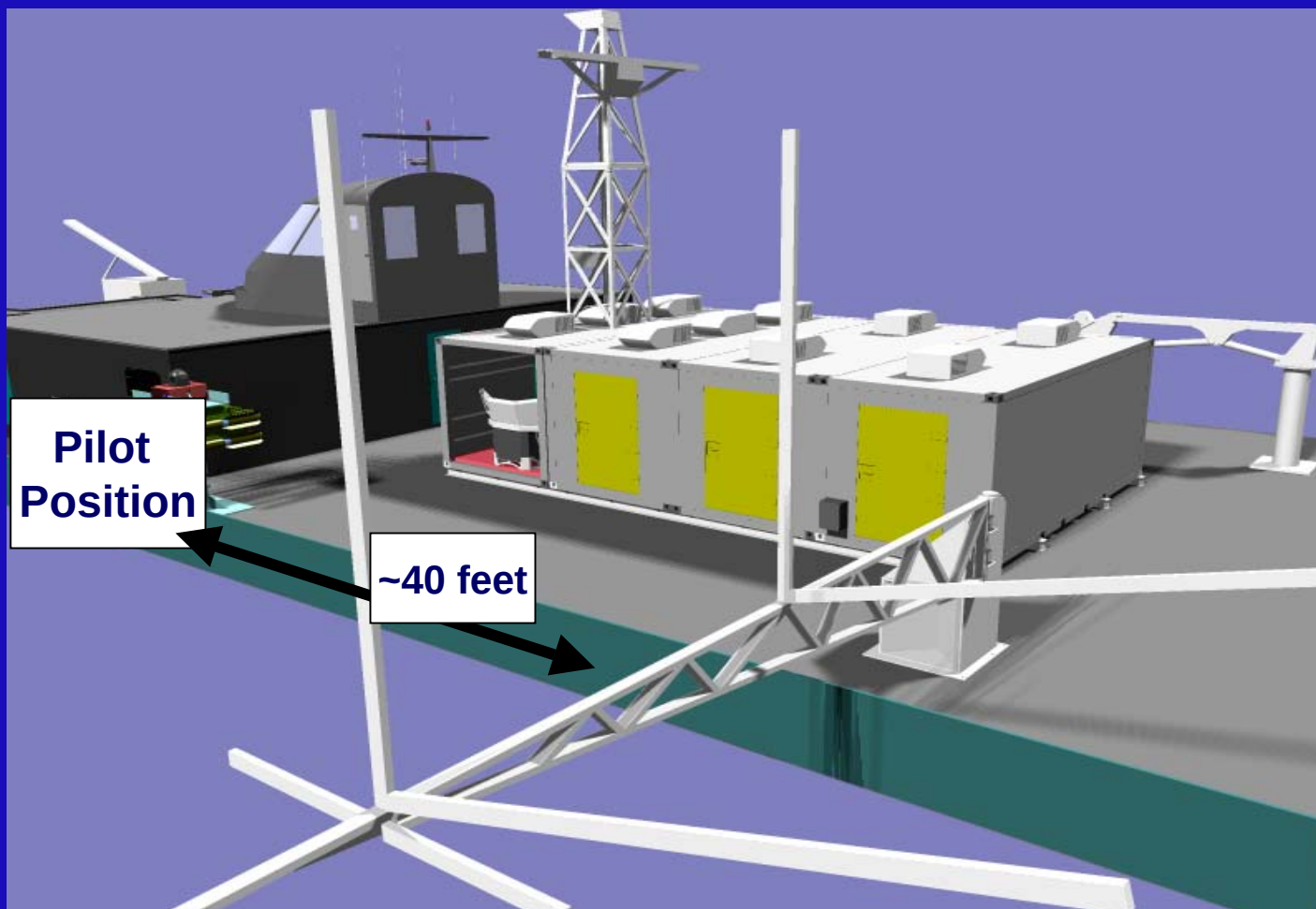


Demonstrate Automation Needs

UAV Recovery Operations At-Sea

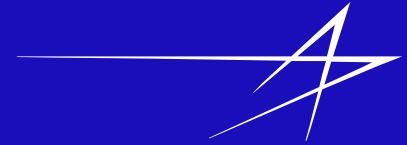


Pilot View Point: Net or Arresting Line Capture



Pre-Launch Checks





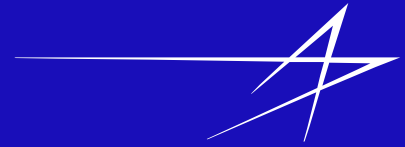
3. UAV Ops Results

- **Shipboard Operation**
 - **Launch Methods**
 - **Manual and Automated Control**
 - **Recovery Sequence**
- **Conclusions / Recommendations**
 - **Shipboard Impact**
 - **Mission Module Evaluation**
 - **UAV Operations**

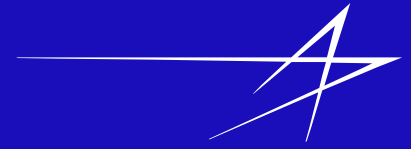
Silver Fox Launch from Sea Slice



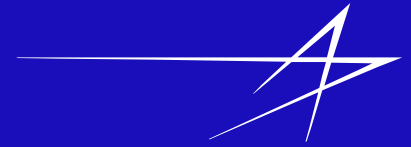
Recovery System Stowed



Deploying Recovery System

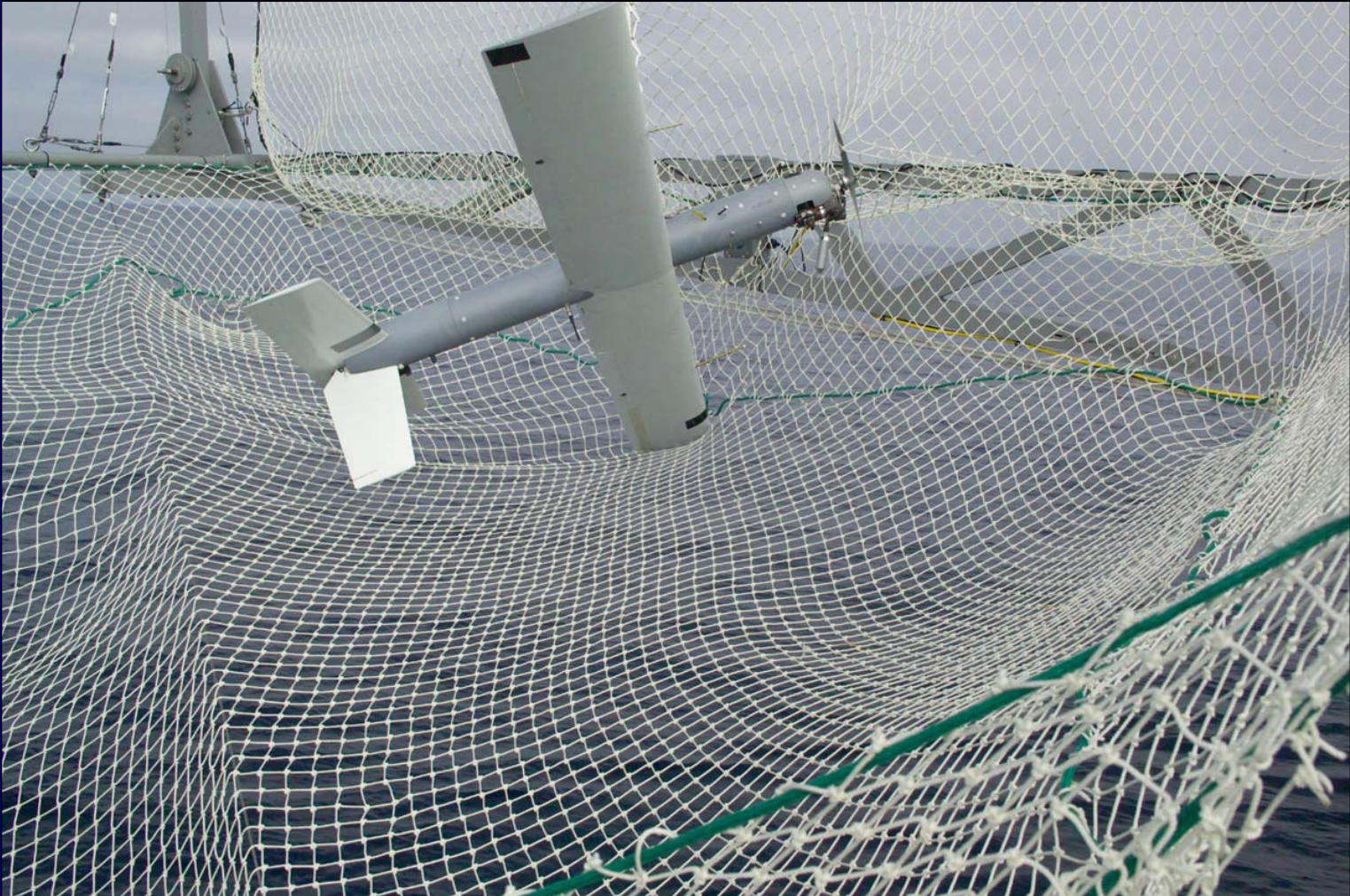
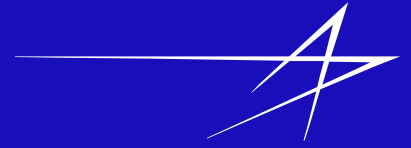


Net Recovery of Silver Fox

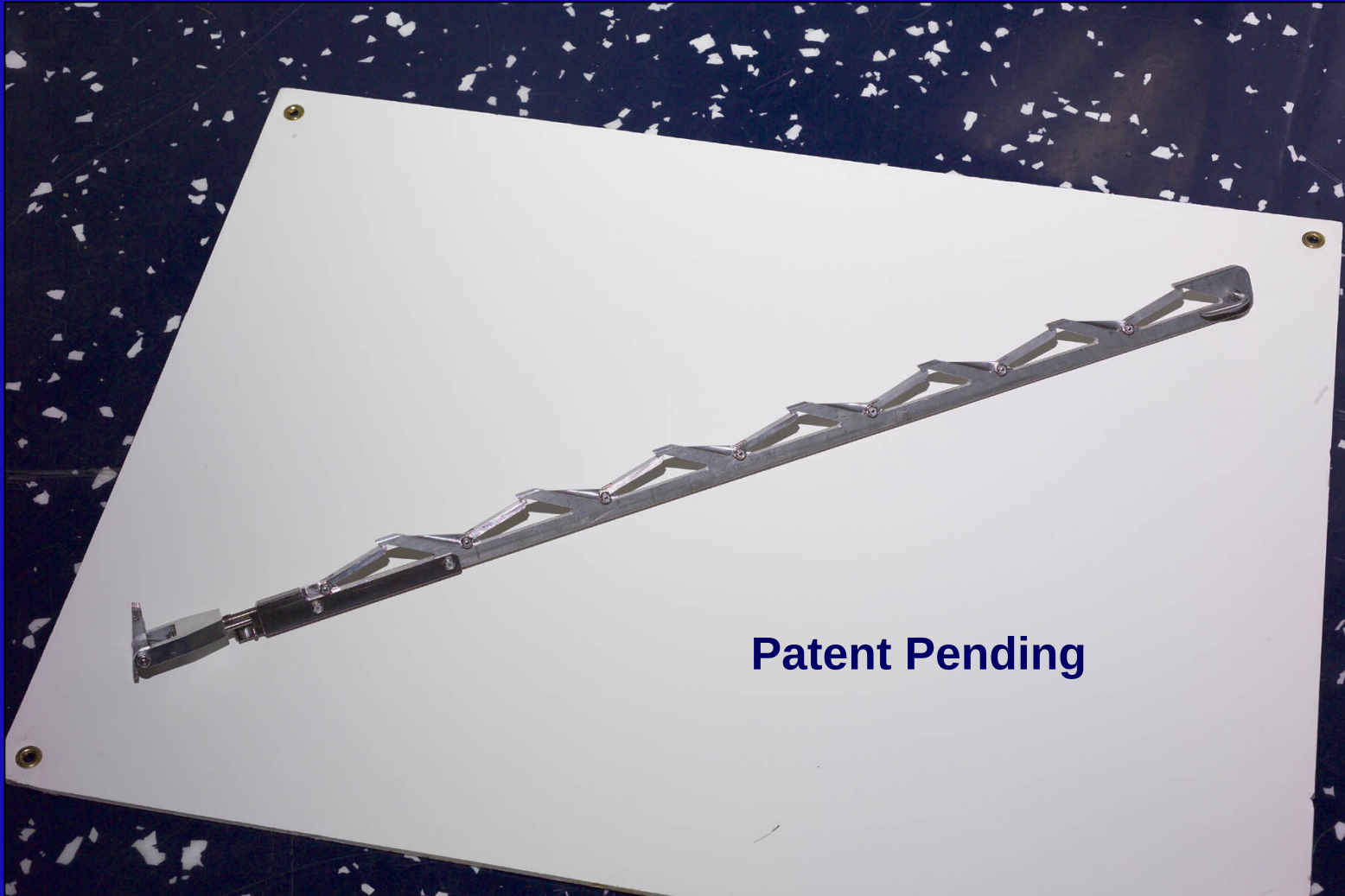


Patent Pending

Recovered Sliver Fox

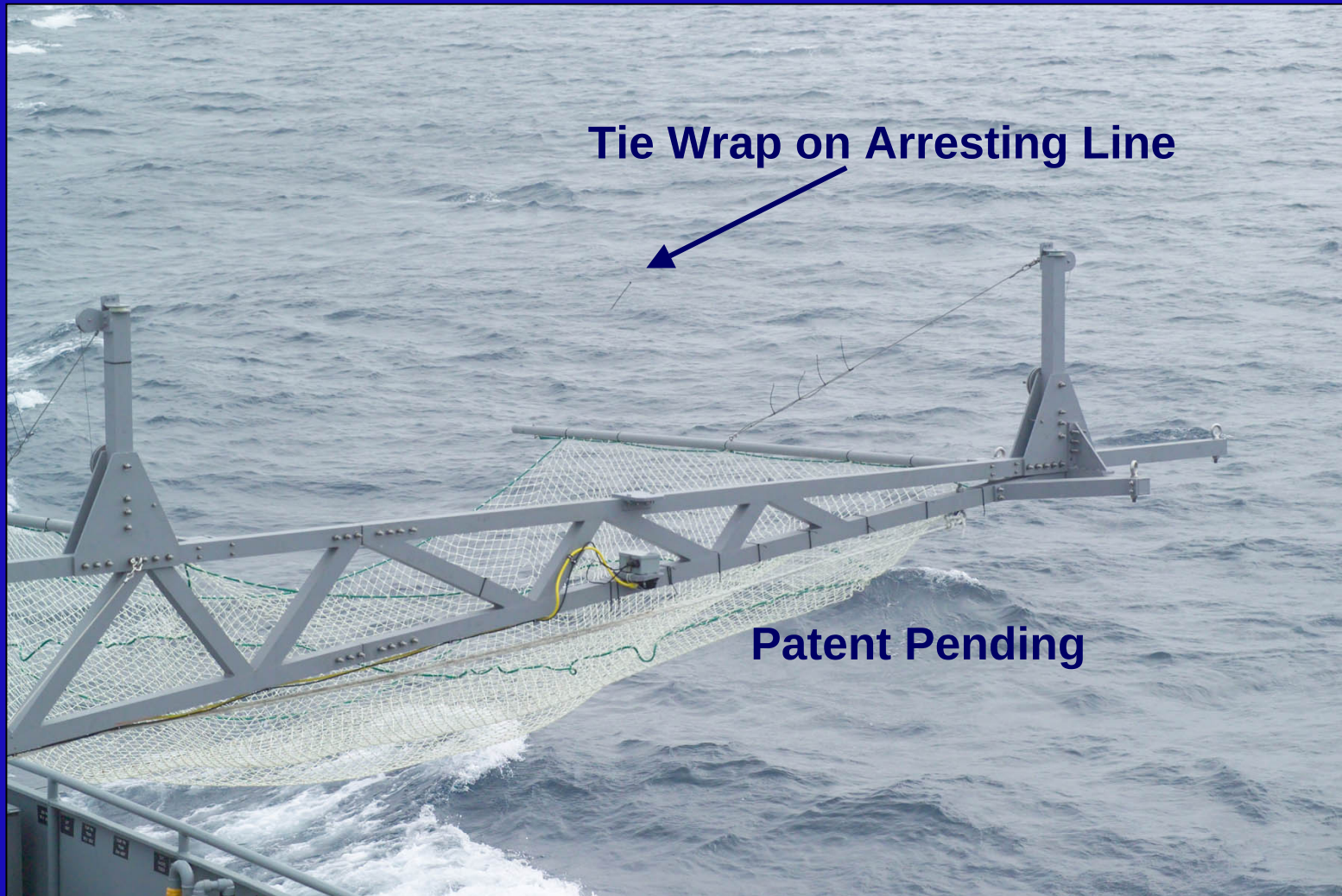


A-SULCRS Developed Tail Hook

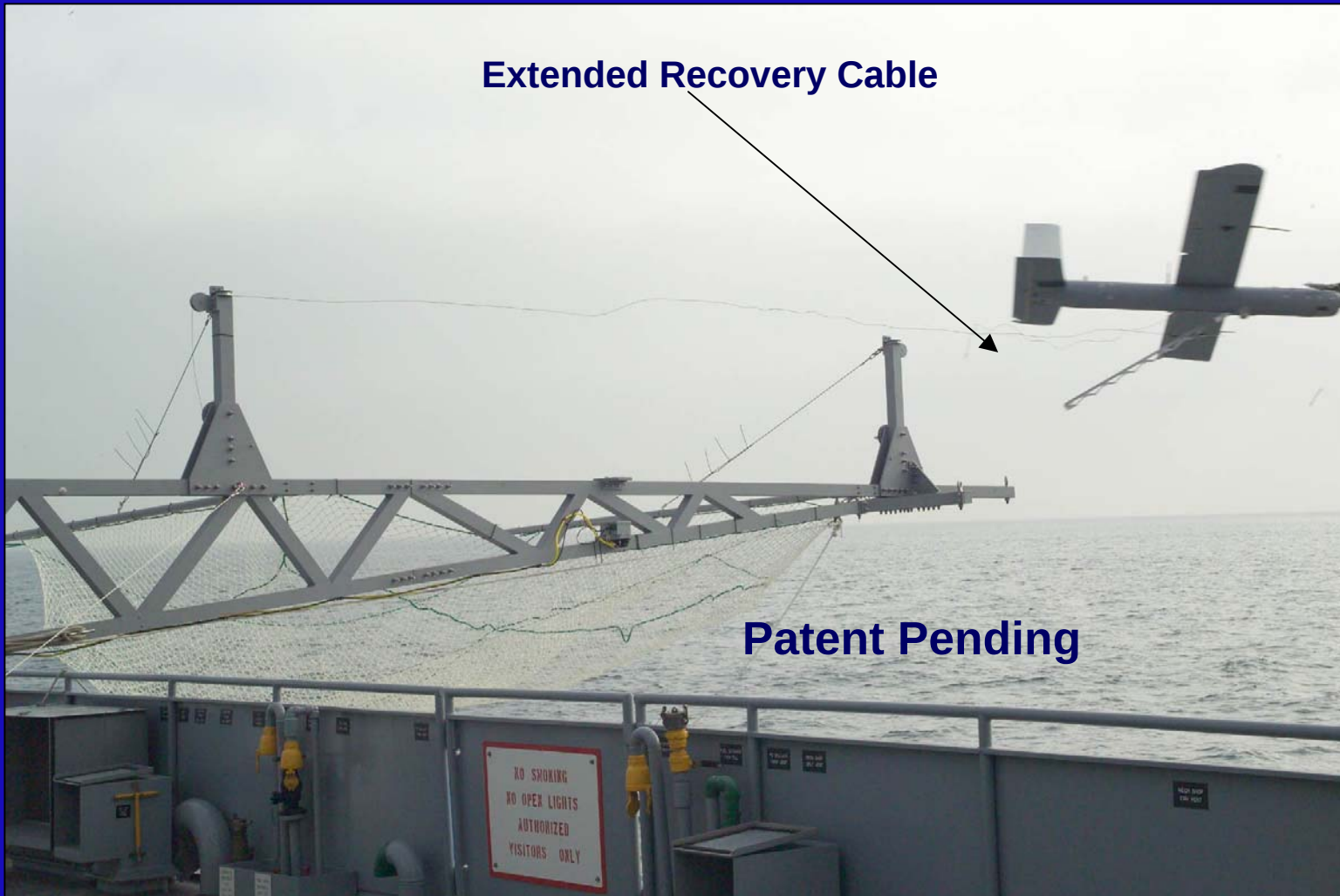


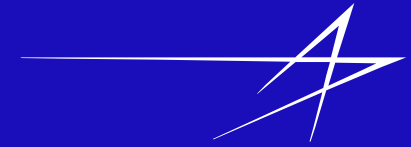
Patent Pending

Arresting Line Configuration



Initial Arresting Line Engagement





Demonstration Summary

- **Launch:**
 - 8 of 8 Successful UAV Pneumatic Launches with Tail Hook
 - Hand Launch and Bungee Launches are also Possible
- **Control**
 - Remote Operational Control (Mission Control)
 - Drop Hook Executed Reliably
 - Flight Plan Transmit Verified
 - Glide Slope Control
 - Generally Good for Positioning UAV for Recovery
 - Auto Recovery Control
 - Requires Improved UAV Flight Control Accuracy for Success
- **Recovery**
 - Net Recoveries
 - Promising, Especially with Tail Hook Net Capture
 - Comments: UAVs Design Tradeoff for Maritime Recovery Operation
 - Arresting Line Recoveries
 - Requires More Testing for Characterization
 - Comments: Tail Hook and Latch Design Looks Promising

Sea SLICE Underway

