



UNCLASSIFIED

NOTICE – The information in this document is what was presented at Industry Day in order to receive feedback on the material presented. Therefore the information in this document is subject to change and may be different from that contained in the final version of the BAA. The information in the final version of the BAA takes precedence over any information contained in this presentation.

Advanced Mooring System (AMS)

Industry Day

Washington DC – 27 April 2010

**ONR Program Officer
Ms. Katherine Mangum
(703) 588-2216
katherine.mangum@navy.mil**

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

1

UNCLASSIFIED



UNCLASSIFIED

Industry Day

Tuesday, April 27

8:00 – 8:10	Introductions/Comments
8:10 – 8:20	Seabasing Overview
8:20 – 8:45	Program Overview, History, Objectives
8:45 – 9:00	Introductory Video
9:00 – 9:30	Background
9:30 – 9:45	Break
9:45 – 10:30	Current Scenario
10:30 – 11:00	Performance Specs and Requirements
11:00 – 11:10	Break
11:10 – 11:50	Performance Specs and Requirements cont.
11:50 – 12:30	Focus Area Priorities
12:30 – 1:30	Lunch (not provided)
1:30 – 2:30	Potential Proposers (teaming) – Main room Government team convene – Breakout room
2:30 – 3:30	Q&A Session
3:30 – 3:45	Path Forward

UNCLASSIFIED



UNCLASSIFIED

Introductions / Comments

UNCLASSIFIED

Purpose / Procedures

- **Why are we here?**
 - **Promote industry awareness of AMS program**
 - **Present draft performance specifications and design requirements**
 - **Capture industry feedback – goal is a reasonable solicitation with clearly stated specifications and requirements**
- **Note taking is permitted**
- **Please write questions/comments on provided note cards – answers during Q&A Session**
- **All presentations/information cleared for public release to be posted after Industry Day**
- **Sign-up for FBO posting notification**

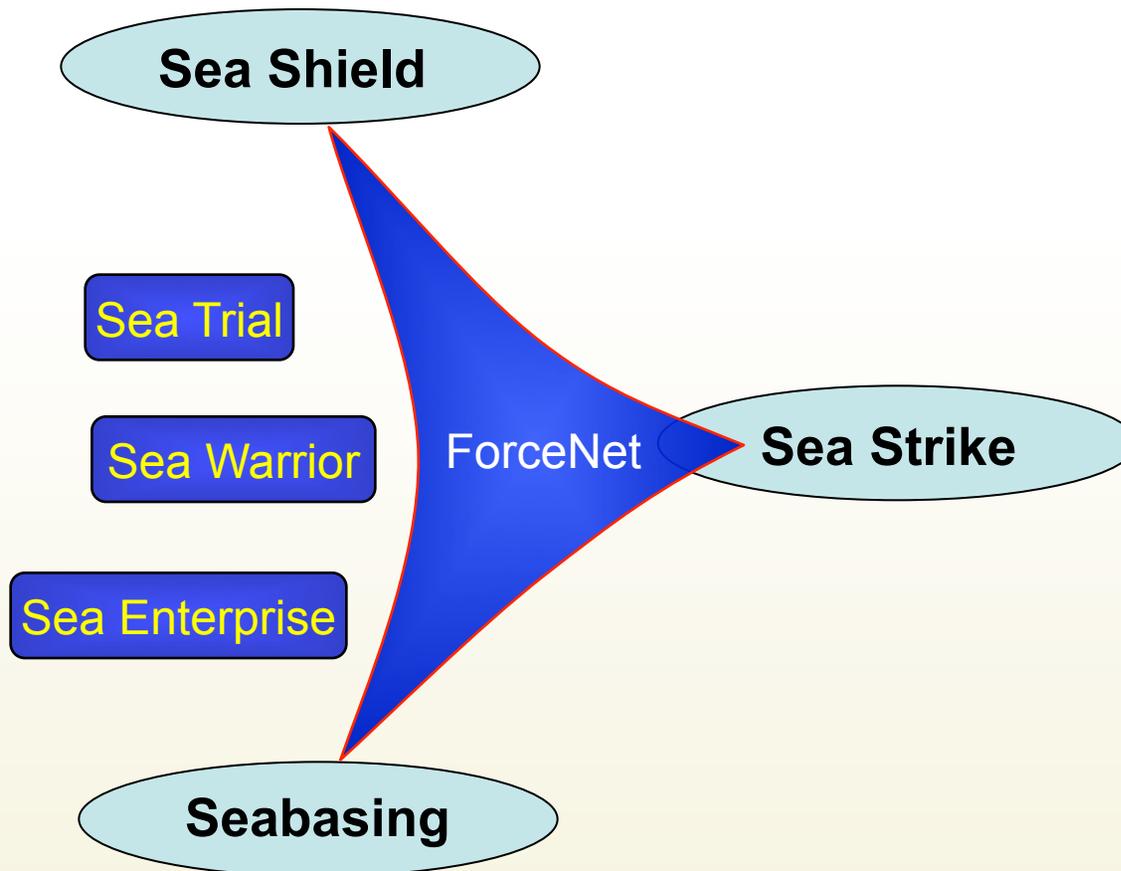


UNCLASSIFIED

Seabasing FNC Overview

UNCLASSIFIED

Sea Power 21



- Forward Presence & Pre-positioned Platforms
- Force Closure
- Defensive/Offensive
- Power Projection
- Focused Joint Logistics
- Coherent Joint C4ISR

Seabasing Concept: Deployment of warfighting capabilities sustained from the sea without reliance on shore facilities

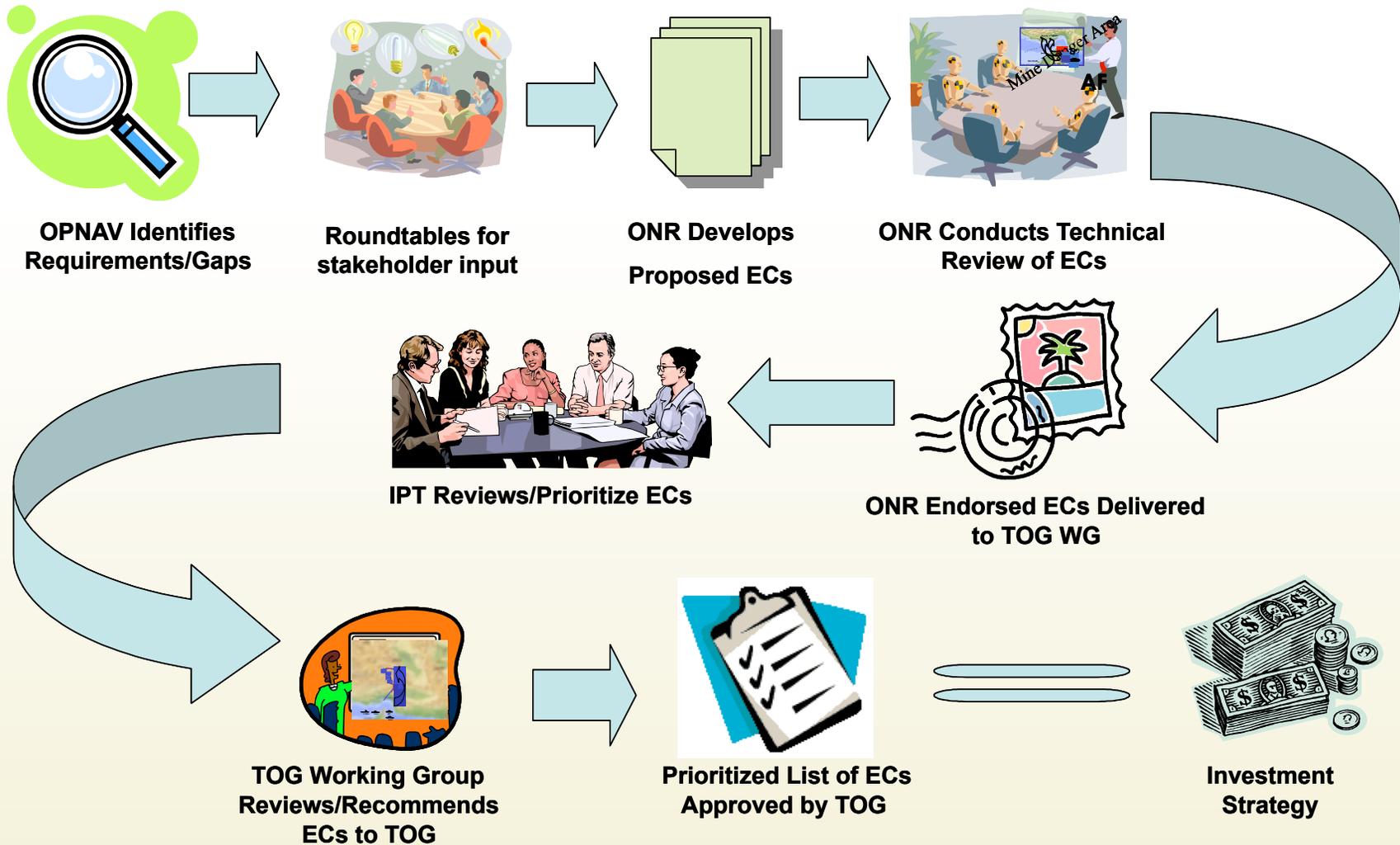


UNCLASSIFIED

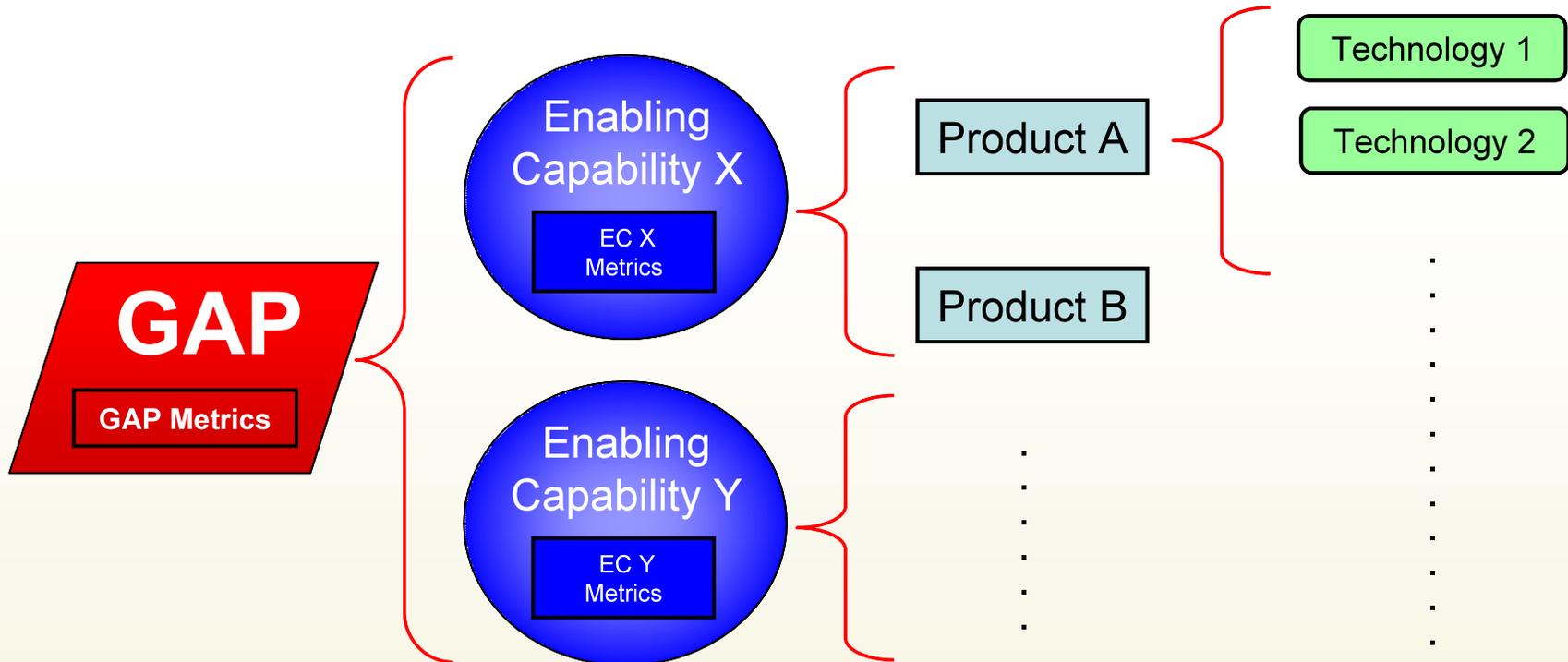
Seabasing FNC Goal

- **Develop and integrate technologies into products which can be demonstrated at TRL 6**
- **Transition to acquisition community to provide warfighter with required seabasing capabilities as envisioned under Sea Power 21**

EC Investment Strategy Process



Future Naval Capabilities



FUTURE NAVAL CAPABILITIES ARE FOCUSED ON FILLING WARFIGHTER GAPS



UNCLASSIFIED

Advanced Mooring System Program Overview

UNCLASSIFIED

Advanced Mooring System

Interest in fendering & mooring after recent events

- Interface Ramp Technology program refocused from Large, Medium-Speed, Roll-on/roll-off to Joint High Speed Vessel after CNO and Commandant of the Marine Corps expressed serious concerns about JHSV sea state 1 capability
- Joint West African Training Cruise 2008 - mooring lines snapping
- Flickertail State / container ship skin-to-skin test – cargo damaged



Mooring lines snapping

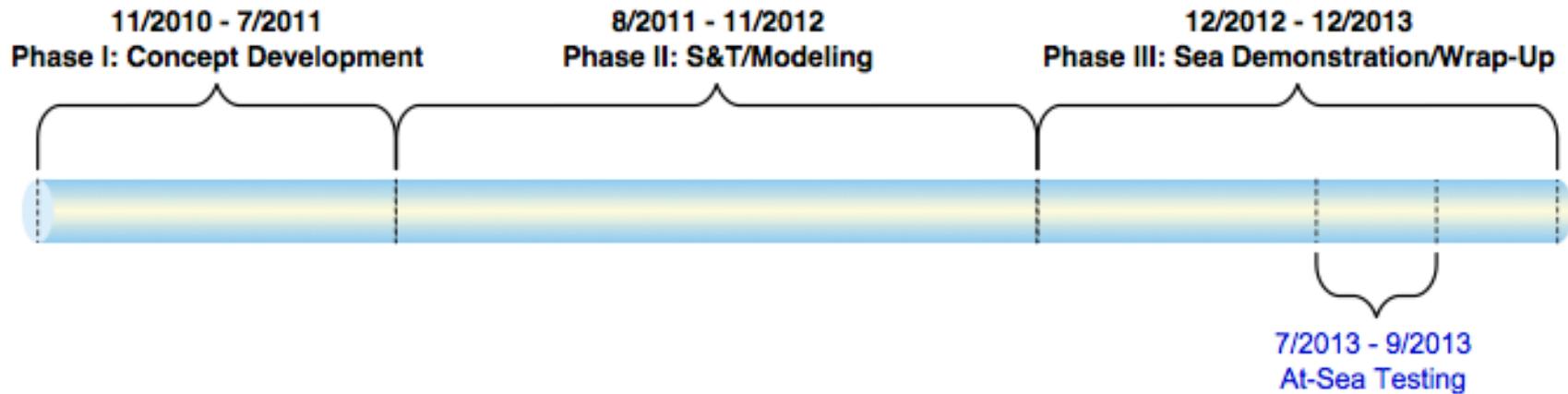


Flickertail State (Oct 2003)

Shortfalls in Current Capability

- **Sea-based loading and unloading of ships and connectors is slow, labor-intensive, and limited to lower sea states (1 or 2)**
- **Mooring and Fendering issues with Connectors**
 - Conventional mooring systems not designed for use with lightweight hull structures in the seaway
 - Conventional fenders exceed load limits of lightweight hull structures
- **Complicated by diversity of ships (large number of mooring permutations required)**
 - 10-12 mooring lines to a wide range of bitt and chock locations, numbers, and load ratings
 - Range of relative longitudinal locations to reach all container stacks with MLP crane
 - Fendering with large separations at waterline due to significant flare and waterline angles at ends of ships
 - Need to avoid fouling transfer systems to permit at-sea transfer

Project Schedule





Phase I Objectives: Concept Development

- **Concept of Operations for specific technology(ies)**
- **Concept design of full-scale technology demonstrator**
- **Estimated production acquisition cost**
- **Feasibility demonstration of concept through analysis, modeling and simulation**
- **Identification of ship impacts, risks and a risk mitigation plan**
- **Identification of applicable design standards, criteria, and procedures to provide equivalent margins of safety compared to traditional mooring equipment**
- **Proposed follow-on statement of work, test plan, demonstration plan, schedule and cost estimate.**



UNCLASSIFIED

Phase II Objectives: S&T/Modeling

- **Fabrication, testing, and evaluation of a sub-scale, proof-of-concept technology demonstrator**
- **Demonstration of sub-scale, proof-of-concept AMS technology demonstrator with moderate sea conditions acting on system**
- **Detailed design of a full-scale, proof-of-concept technology demonstrator**
- **Updated estimated production acquisition cost for a production AMS, with appropriately increased fidelity**

UNCLASSIFIED

Phase III Objectives: Sea Demo

- **Fabrication, testing, and evaluation of a full-scale, proof-of-concept AMS technology demonstrator**
 - Individual sub-systems
 - Full-system
- **Demonstration of full-scale, proof-of-concept AMS technology demonstrator in a relevant, dynamic motion environment (TRL 6)**



UNCLASSIFIED

Introductory Video

UNCLASSIFIED

Flickertail State / Containership Skin-to-Skin Test





UNCLASSIFIED

Background

UNCLASSIFIED

Background

- **Overview of types of skin-to-skin mooring anticipated to be required to support a sea base**
- **AMS would increase operating envelope to allow operations through Sea State 3 (threshold) to through Sea State 4 (objective)**



UNCLASSIFIED

Skin-to-Skin Mooring Cases

- **Large vessel to connector operations**
- **Navy Lighterage to connector operations**
- **Large vessel to large vessel operations**

UNCLASSIFIED



UNCLASSIFIED

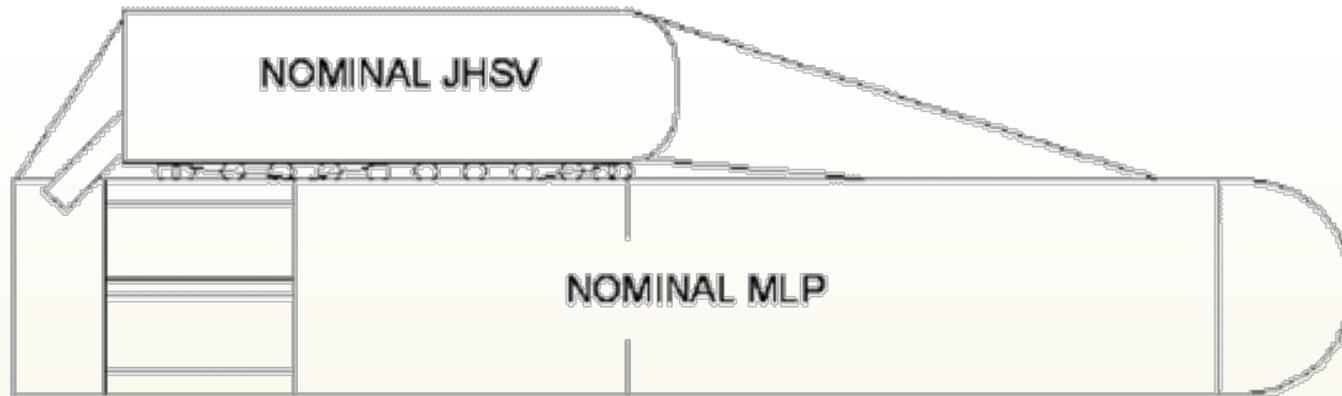
Primary Connectors/Lighterage

- **Connectors**
 - **JHSV**
 - **Landing Craft Utility (LCU) 1600**
 - **LCU 2000**
- **Lighterage**
 - **Improved Navy Lighterage System (INLS)**
 - **Roll-on/Roll-off Discharge Facility (RRDF)**

Primary Large Vessels

- **Large, Medium-Speed, Roll-on/Roll-off Ships (LMSR)**
- **Maritime Prepositioning Force (MPF) ships**
- **MLP variants**
- **Commercial container ships**
- **Secondary “large vessels” might include**
 - **Ready Reserve Force (RRF) crane ships**
 - **RRF Roll-on/Roll-off (RORO) ships**

Large Vessel to Connector Operations



TEN 3M DIA FENDER (FLOATING AT WATERLINE)

TWO 2.5M DIA FENDERS (SUSPENDED NEAR DECK EDGE)

TWO HEAD LINES (PROVIDED BY MLP)

THREE AMIDSHIPS SPRING LINES (PROVIDED BY MLP)

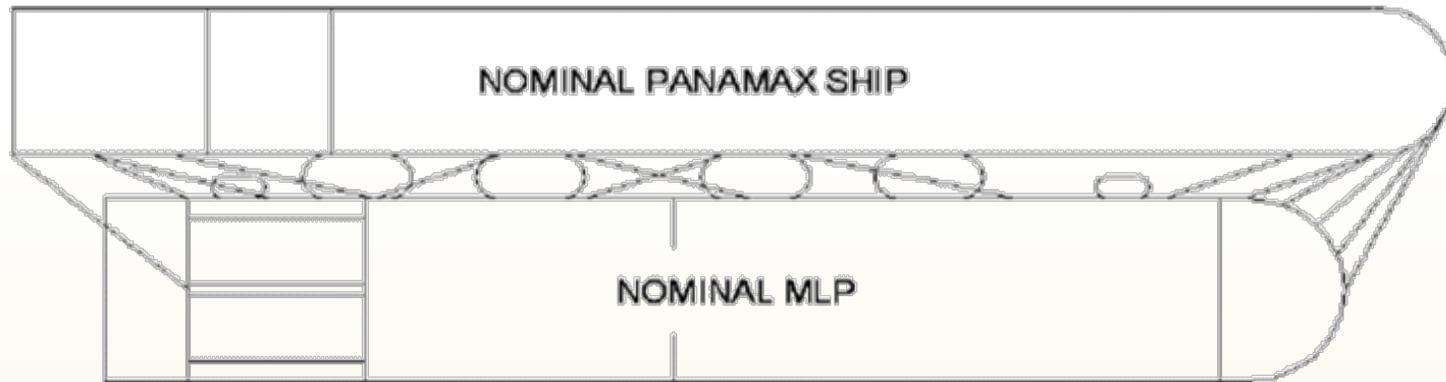
ONE STERN LINE (PROVIDED BY JHSV)

(NOT TO SCALE)

Lighterage to Connector Operations



Large Vessel to Large Vessel Operations



FOUR 4.5M DIA FENDER (FLOATING AT WATERLINE)

TWO 2.5M DIA FENDERS (SUSPENDED NEAR DECK EDGE)

SIX HEAD LINES (FOUR PROVIDED BY MLP)

FOUR AMIDSHIPS SPRING LINES (FOUR PROVIDED BY MLP)

FOUR STERN LINES (TWO PROVIDED BY MLP)

(NOT TO SCALE)

AMS Applicability

- Technology is needed for all ship classes which support sea-based logistics operations
 - *The large vessel to connector scenario will be what is demonstrated at TRL 6*
- A key challenge: potential for damage to the connector vessel during skin-to-skin mooring with the larger sea base vessel
- While the focus of the demonstration will be a large vessel to connector scenario, proposed technology solutions capable of facilitating all three scenarios will be viewed favorably



UNCLASSIFIED

Break

UNCLASSIFIED



UNCLASSIFIED

Current Scenario

UNCLASSIFIED

Current Scenario

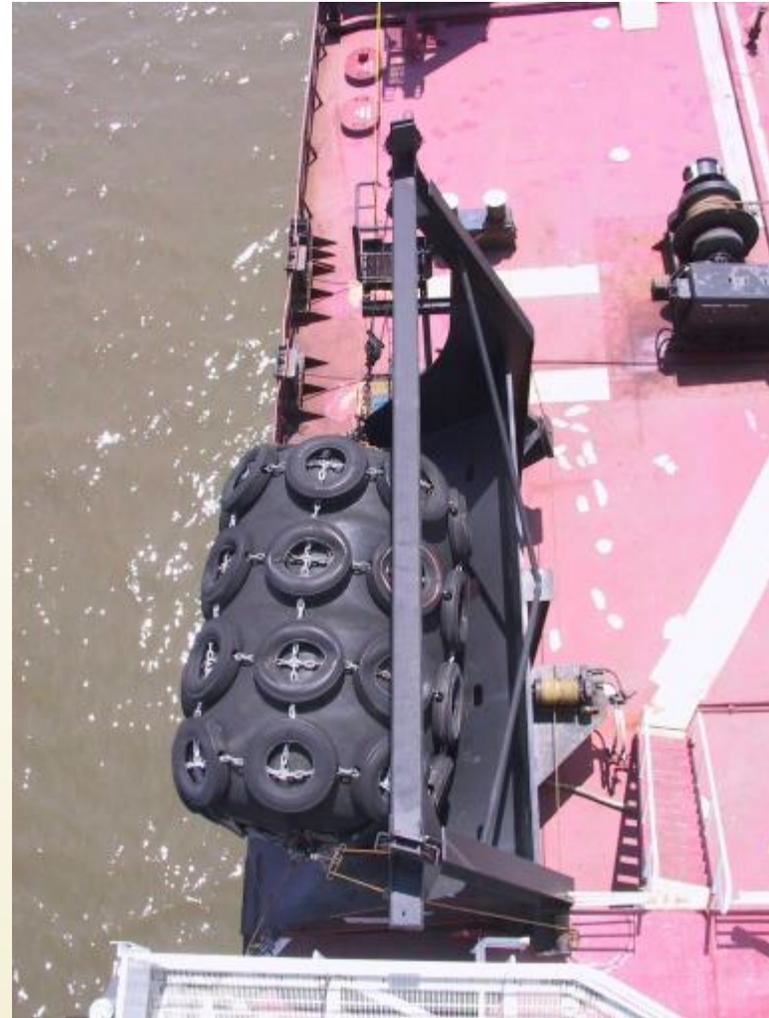
- **Skin-to-skin mooring for naval sea basing operations is not a current capability**
- **Closest commercial analogue is oil tanker lightering operations (non-rigid, moored connection between very large crude carrier and smaller oil tanker)**

Commercial Tanker Lightering Operations

- Detailed industry standard procedures and operational checklists for tanker lightering ops
 - See *Ship to Ship Transfer Guide: Petroleum* by Oil Companies International Marine Forum
- Mooring plan prepared by Mooring Master and approved by both vessels' Masters prior to arrival
- Mooring Master present during evolution, likely onboard approaching vessel

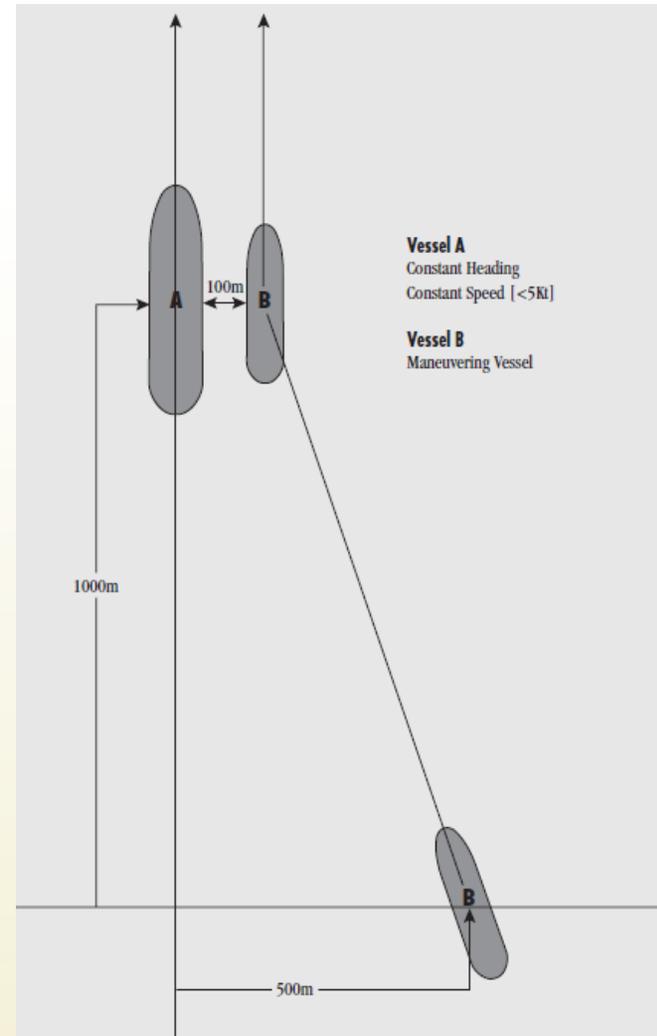
Commercial Tanker Lightering Operations (*cont.*)

Typically smaller lighter vessels are equipped with specialized fender systems specifically designed for skin-to-skin operations



Commercial Tanker Lightering Operations (*cont.*)

- Fenders are moved into position as vessels approach
- Figure shows typical approach maneuver to bring vessels parallel at which point the vessels will continue to close separation distance preparing for skin-to-skin mooring



Commercial Tanker Lightering Operations (*cont.*)

- Approaching vessel, with fenders already lowered, closes distance at approx 6 knots with larger tanker dead in water
- In heavier seas, larger tanker would steer a favorable course



Commercial Tanker Lightering Operations (*cont.*)

- Smaller lighter will typically approach larger tanker directly from starboard side at 3.5 knots, and within approx $\frac{1}{2}$ mile of tanker begin turning to starboard to begin approach on a parallel course
- Final approach occurs at approx 2 to 4 knots, closing at an angle of approx 5 degrees



Commercial Tanker Lightering Operations (*cont.*)

- First mooring line may be passed when vessels are approx 20 feet apart
- In calm seas, lines might not be passed until contact has been made
- Approaching vessel is using 50% left thruster and 10 degrees right rudder
- Forward lines are passed first, followed by stern lines



Commercial Tanker Lightering Operations (*cont.*)

- Once mooring lines are across and tensioned, cargo hoses are taken across
- In calm weather, both vessels will drift
- In heavier seas, lighter would typically shut down engines, with larger tanker steering a favorable course to reduce ship motions maintaining a slow forward speed



Commercial Tanker Lightering Operations (*cont.*)

- **Relative drafts of vessels shift and mooring system must be able to accommodate changes and vessel motions**



Commercial Tanker Lightering Operations (*cont.*)

- Mooring lines are removed at conclusion of skin-to-skin ops
- With lines cleared, larger vessel thruster is right 100% with rudder left 10 degrees to keep stern of smaller vessel clear
- Once sufficiently apart, rudder is eased and bow is allowed to swing out
- Once clear, fenders are recovered





UNCLASSIFIED

Performance Specifications and Design Requirements

UNCLASSIFIED



UNCLASSIFIED

Specifications and Requirements

- **Technical proposal shall address how proposed concept will satisfy performance specifications and design requirements established for final AMS**

General Specifications

- **System shall provide for open architecture, where appropriate (e.g. control systems) – threshold**
- **Operation and routine at-sea maintenance can be accomplished by ship's force personnel with minimal additional training – threshold**
- **Mitigate risks inherent in traditional mooring systems – threshold**
 - **Personnel safety (line handling)**
 - **Risk to vessels (approach, relative motions due to sea state and emergency break away)**

General Specifications

- **Scalable – threshold**
 - Accommodate range of ship motions
 - Scalable to alternative ship sizes and configurations
- **Modular and Deployable – objective**
 - Transferrable from one vessel to another
 - Technology is vessel independent
 - Minimal ship interface/impact

Environmental Specifications

- **Loads due to ship motion**
 - **Operational through sea state 3 – threshold**
 - **Operational through sea state 4 – objective**
 - **Survivable through sea state 8 in stowed configuration – threshold**
- **Equipment exposed to weather shall be capable of operating in air temperatures from -29°C (-20°F) and 49°C (120°F) with seawater temperatures from -2 C (28.4 F) to 35 C (95 F) – threshold**
- **Relative humidity 0 to 95% – threshold**
- **System must be designed to facilitate safe day and night operations – threshold**

Vessel Data

AMS will be required for a variety of vessels, with the following ranges of motions operating independently:

- **Roll: 1 to 12 degrees**
- **Pitch: 1 to 3 degrees**
- **Heave: 1 meter to 1.83 meters**
- **Surge: none to 1.2 meters**
- **Sway: none to 1 meter**
- **Yaw: none to 1 degree**

Vessel Data (cont.)

- **Accelerations** the system may be subject to include up to 0.15 g to 1.20 g vertical, 0.11 to 0.20 g transverse, and 0.10 to 0.20 g longitudinal
- **Mooring** may occur between vessels of lengths ranging from 100 meters to 276 meters
- **Vessel drafts** may range from 3.9 meters to 12 meters
- **Operating freeboards** may range from 3.5 meters to 6 meters with higher raised decks locally such as at bow and stern
- **Hullforms**. System should be designed to accommodate a variety of hullforms
- **Full load displacements** of 2,400 MT up to 105,000 MT should be considered

Operational Specifications

- **Employ skin-to-skin mooring; solutions relying on dynamic positioning will not be considered – threshold**
- **Operation at zero knots or minimum maneuverable forward speed up to 8 knots to maintain favorable heading – threshold**
 - Not at anchor
- **Support vehicle, personnel, and container transfer during skin-to-skin mooring – threshold**
- **Maintain safe separation distance – threshold**
 - 3 meter separation assumed for JHSV due to JHSV ramp
 - For large to large vessels such as MLP to containership, 4.5 meter fenders would be utilized absent AMS
 - Proposers may recommend alternative separation distances

Operational Specifications

- **Time required shall be**
 - **Less than 1 hour to moor – threshold**
 - **Less than 15 minutes to unmoor (planned) – threshold**
- **Accommodates**
 - **Freeboard differences between platforms – threshold**
 - **Draft changes during the evolution – threshold**
- **Proposed technology accommodates longitudinal changes in vessel alignment during the evolution – objective**
- **Facilitates emergency breakaways – threshold**
 - **Rapid, safe breakaway**
 - **Minimal time to recover AMS to an operational state**
- **Accommodates various hull forms and vessel characteristics – threshold**

Operational Specifications

- **Reliability, Maintainability and Availability – threshold**
 - **Operational availability of 98% ($A_0=.98$) or better**
 - **Actuators and other machinery components shall not require replacement of component parts during 5000 hours of operation ***
 - **Any control components shall not require replacement of component parts during a *Mean Time Between Failure* of 3750 hours ***
 - **Maximum *Mean Time to Repair* shall be eight hours for all sub-systems**
 - **System shall be designed to minimize scheduled preventive maintenance man-hours and not require use of proprietary tools or tools not normally carried aboard ship**

*** *Exceptions to part replacement requirements are planned replacement type components***



UNCLASSIFIED

Operational Specifications

- **Reliability, Maintainability and Availability (*cont.*)**
 - **System may be subjected to continuous periods of non-use up to three years. Following this period of non-use, system shall operate without degraded performance**
 - **System shall operate without degraded performance following lay-up and start-up maintenance after stowage**
 - **System may be subjected to idle periods of non-use up to 6 months in duration. Following this, system shall not require start-up maintenance prior to operation**
- **Amount of scheduled preventative maintenance shall be minimized – threshold**
- **Amount of special test equipment and tools required for maintenance shall be minimized – threshold**

UNCLASSIFIED



UNCLASSIFIED

Design Requirements

- **Area, Volume and Weight**
 - Ships are area, volume and weight critical – system area, volume, and weight shall be kept to a minimum
- **Workload**
 - Manning is a major lifecycle cost factor - workload requirements for system operation and maintenance shall be kept to a minimum
- **Safety**
 - Equipment design shall incorporate system safety practices to identify, classify, and manage mishap risk in accordance with MIL-STD-882

UNCLASSIFIED



UNCLASSIFIED

Design Requirements

■ Safety

• Failsafe Design

- Equipment shall be designed and constructed for failsafe operation
- Failure of a drive mechanism power source shall not result in damage to vessels or jeopardize safety of personnel;
- or result in uncontrolled movement of vessels or equipment

• Control System

- Failure or fault of a single control system component shall not result in uncontrolled movement of equipment;
- or result in equipment operations that jeopardize the safety of vessels, equipment or personnel

Design Requirements

- **System Controls**
 - **If technology contains a control system:**
 - **Control system shall perform self diagnostics upon start-up to ensure operational status**
 - **Control system shall continually monitor itself, halt operations if off-normal condition is detected, and notify operator**
- **System shall have safe range indications (procedural, mechanical, or electrical) for:**
 - **Operating limits, including range of motions**
 - **Wear**
 - **Failure of components**

Design Requirements

- **Ship impact (i.e. power, services, weight, and arrangements) shall be kept to a minimum**
 - Ship's service 125 PSIG LP Air is available
 - Wheels or rollers - contact pressure with ship's deck shall not exceed 250 lbs/sq.in.
 - Ship's service 440VAC, 60 Hz, 3-Phase, high resistance ground, Type I power system having steady state and transient characteristics in accordance with MIL-STD-1399-300
- **Any proposed ship modification must be made in accordance with classification society rules**



UNCLASSIFIED

Break

UNCLASSIFIED



UNCLASSIFIED

Focus Area Priorities

UNCLASSIFIED

Focus Area Priorities

- a. Technical Merit.** This focus area is divided into the following sub-areas which are listed in priority order
 - i. Performance.** This sub-area focuses on the extent to which the concept is expected to meet or exceed the performance specifications and design requirements in the areas of:
 - 1. Operating Envelope:** Concept improves the operating envelope for vehicle, personnel and container transfer during skin-to-skin operations
 - 2. Modular and Deployable:** Concept is scalable, modular and deployable
 - 3. Breadth of Applicability:** Concept facilitates all three scenarios
 - 4. Changes in Position:** Concept accommodates changes in draft and vessel alignment



UNCLASSIFIED

Focus Area Priorities (*cont.*)

a. Technical Merit (*cont.*)

ii. Ship Impact. Concept minimizes system area, volume, weight, and power

iii. Affordability. Degree to which acquisition and total ownership costs are minimized

iv. Risk Mitigation. Degree to which the concept reduces risks associated with skin-to-skin mooring

v. Technical Plan. Degree to which proposal describes a complete system concept and provide a detailed scope of work for development of core technology(ies)



UNCLASSIFIED

Focus Area Priorities (cont.)

- b. Scientific Merit.** This focus area assesses the degree of innovation involved and whether the proposed concept/technology presses the state of the art while still having credibility with regard to technical approach
- c. Technology Transition.** This focus area assesses a technology's potential Naval relevance and likelihood of implementation on Navy platforms
- d. Offeror's Capabilities.** This focus area assesses other related project experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives
- e. Team Strength.** Qualifications, capabilities, and experience of the proposed management team and technical personnel
- f. Cost Realism.** Realism of the proposed costs and availability of funds

UNCLASSIFIED



UNCLASSIFIED

Industry Day

Tuesday, April 27

8:00 – 8:10	Introductions/Comments
8:10 – 8:20	Seabasing Overview
8:20 – 8:45	Program Overview, History, Objectives
8:45 – 9:00	Introductory Video
9:00 – 9:30	Background
9:30 – 9:45	Break
9:45 – 10:30	Current Scenario
10:30 – 11:00	Performance Specs and Requirements
11:00 – 11:10	Break
11:10 – 11:50	Performance Specs and Requirements cont.
11:50 – 12:30	Focus Area Priorities
12:30 – 1:30	Lunch (not provided)
1:30 – 2:30	Potential Proposers (teaming) – Main room Government team convene – Breakout room
2:30 – 3:30	Q&A Session
3:30 – 3:45	Path Forward



UNCLASSIFIED

Lunch

UNCLASSIFIED



UNCLASSIFIED

Q&A Session

UNCLASSIFIED



UNCLASSIFIED

Path Forward

UNCLASSIFIED



UNCLASSIFIED

Adjourn

UNCLASSIFIED