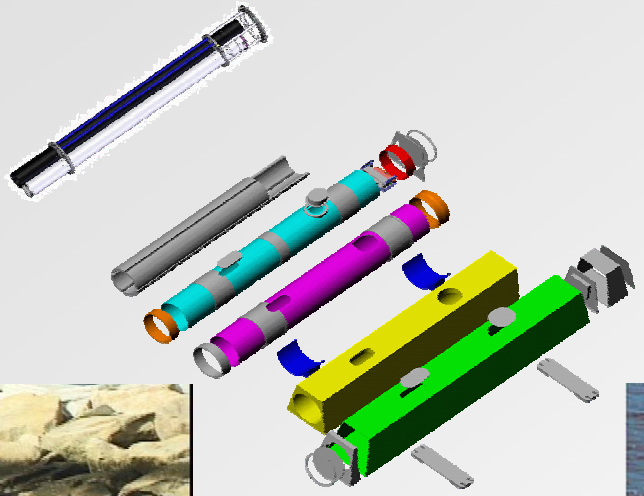
Advanced Surface Launcher (ASL)



Prepared by:
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Prepared for: NDIA UMV Conference
June 15, 2005

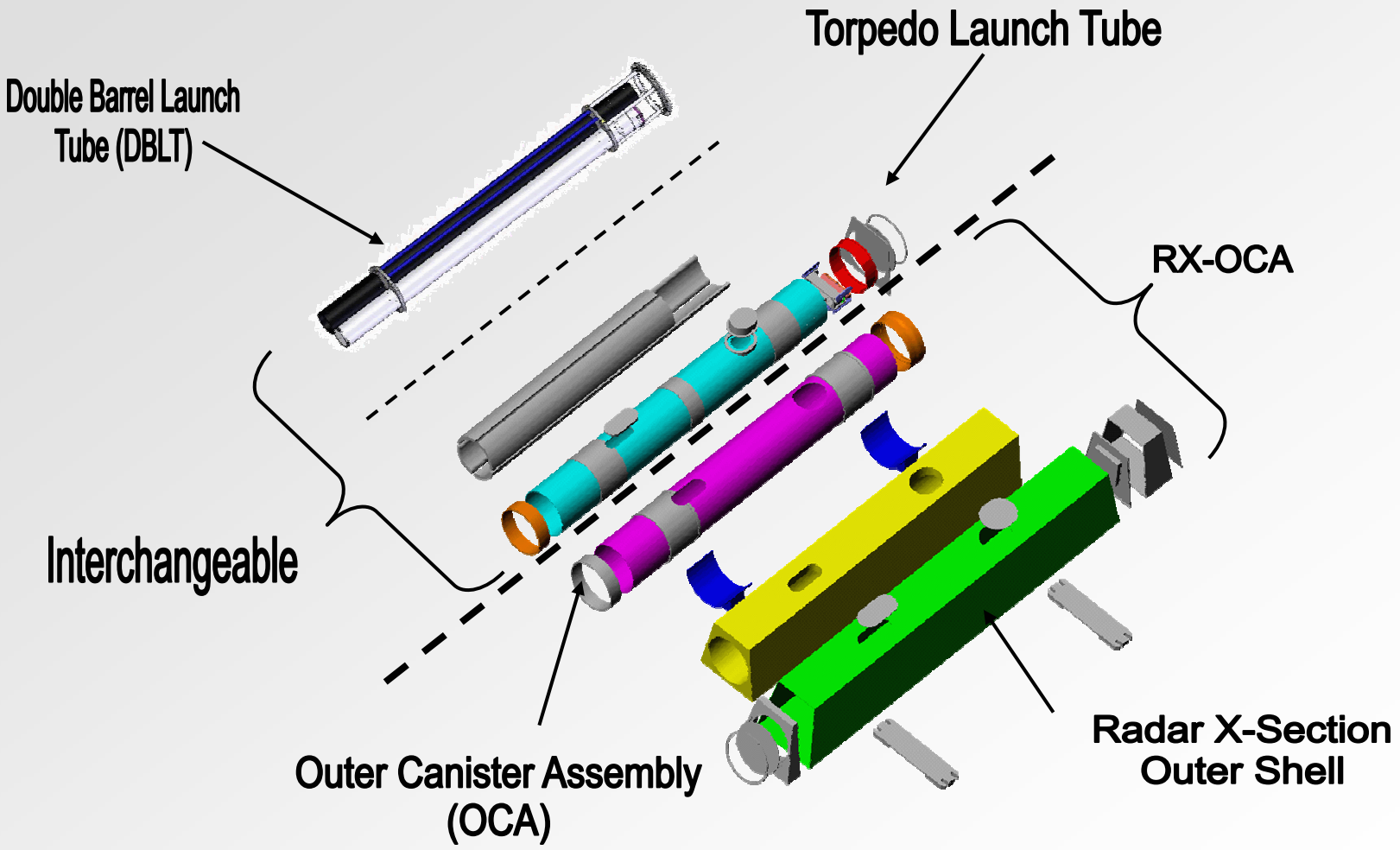
Agenda

- ASL Overview
- Summary of Testing Conducted
  - *Millennium* High Speed Ferry Testing
  - 11M USV Testing
- ASL Road Ahead Summary
- UMV Applications

Why ASL?

- **Proven**
  - **Mechanically at Technology Readiness Level 7**
- **Supports All-Up-Round (AUR) Concept**
- **Modular**
  - **Can be configured for a variety of platforms and payloads**
- **Commonality across different Navy Platforms**
- **Reliable**
- **Cost Effective**
- **Maintenance friendly (no high pressure air)**
- **Simple to configure/operate**
  - **Well suited for autonomous operations**

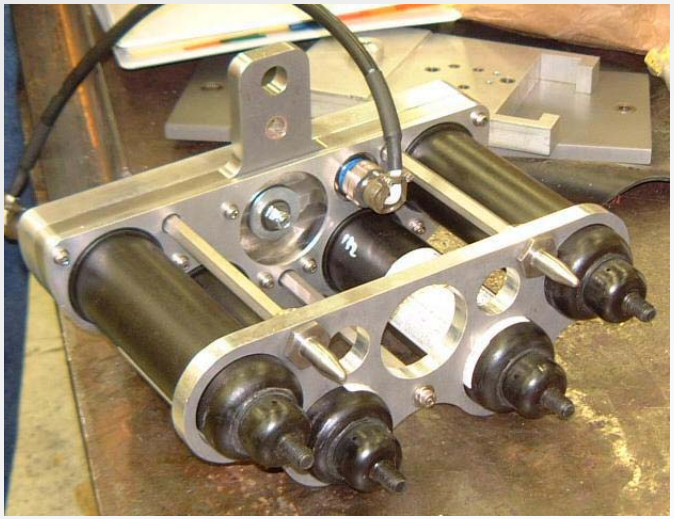
ASL Components Overview



Advanced Surface Launcher Concepts

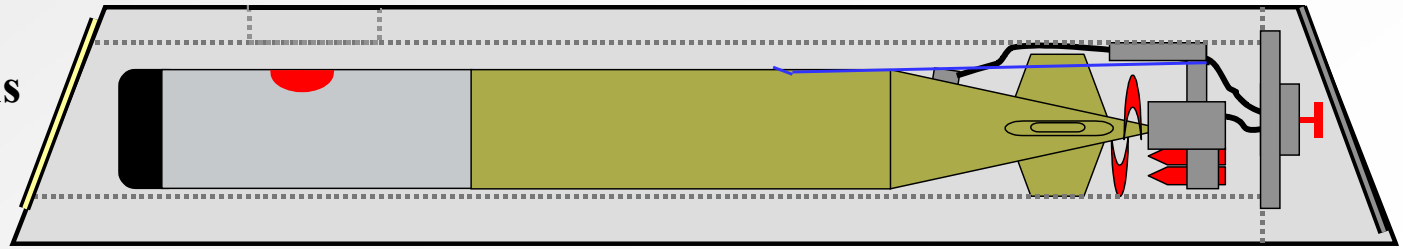
COTS AUTOMOTIVE AIRBAG INFLATORS

- Environmentally Benign
- Maintenance Free w/ Extended Service Life
- Inherently Safe & High Reliability
- Controllable & Predictable
- Simple Electrical Interface
- DoD Hazard Classification Completed (2.2)



"SMART" ALL-UP-ROUND LAUNCH CANISTERS

- Self-Contained Launch Functionality
- Seamless Interface to Fire Control
- Low Maintenance
- Unmanned Stations



Torpedo Launch Tube Assembly (Built and Tested)

Compatible With Torpedoes MK 46, 50 and 54
(Shown with Torpedo MK 50 Installed)

Summary of Testing Conducted

May 2004
Millennium
High Speed Ferry

January 2005
11M RHIB
Manned USV

May 2004 Test Platform
Millennium - High Speed Ferry

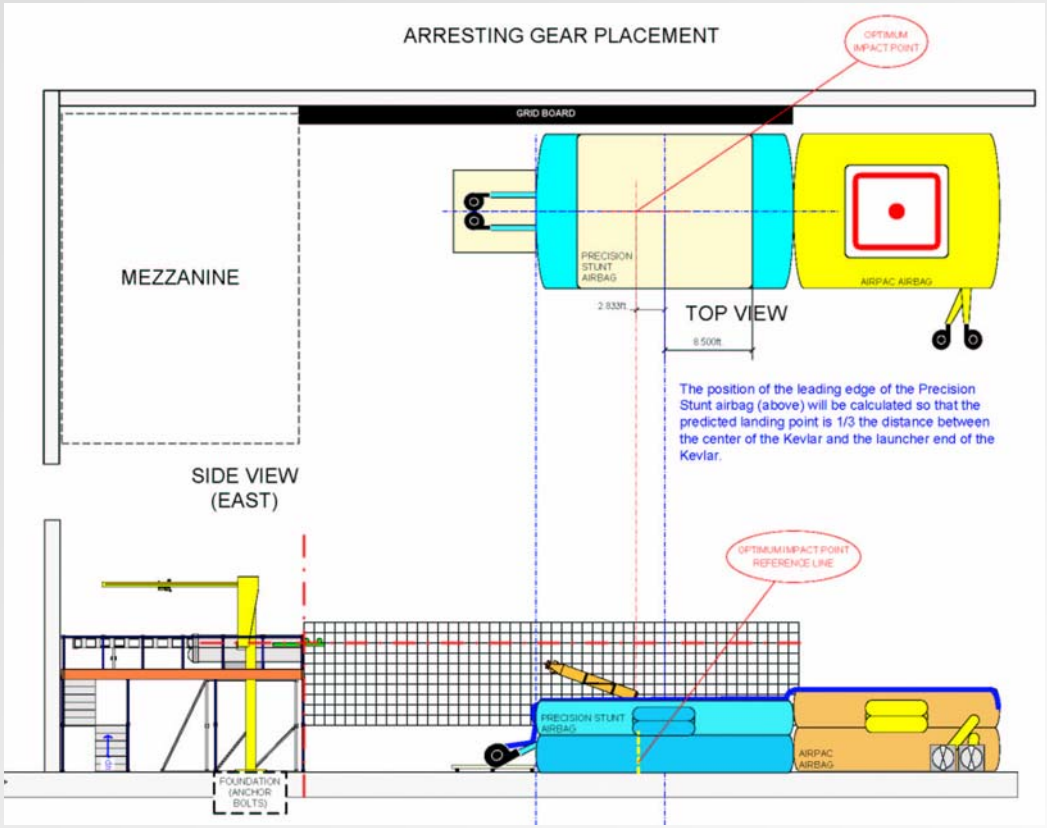
LOA: 122 ft Beam: 33 ft Power ~ 5200 HP Speed: > 35 kts
Launcher Height: 28 ft (waterline to barrel center)

Land Based Prerequisite Testing Summary

LAUNCH #	DATE OF LAUNCH	SHAPE	WEIGHT	TLS ELEV	# OF INFL	ACTUAL ACCEL (g)	ACTUAL PRESSURE (PSI)	ACTUAL EXIT VEL (FPS)	COMMENT
T-0	23-Apr	AIR-SLUG	N/A	HORIZ	4	N/A	N/A	N/A	AIR-SLUG TO TEST LICS TO ASL SUBSYSTEM INTERFACES.
T-1	26-Apr	54R	359	HORIZ	3	N/A	25.0	43.6	INITIAL MK 54 LAUNCH
T-2	26-Apr	54R-I	361	HORIZ	4	10.9	26.5	60.6	SECOND LAUNCH INTRODUCES INSTRUMENTATION TO REXTORP
T-3	26-Apr	50R	440	HORIZ	4	N/A	31.7	*54.8*	INITIAL MK 50 LAUNCH
T-4	27-Apr	50R	440	HORIZ	4	N/A	31.7	52.6	SECOND LAUNCH FOR REPEATABILITY
T-5	27-Apr	50R	361	HORIZ	3	N/A	31.2	*34.5*	START PROGRESSIVE INFLATOR FAILURE TESTS 4-3-2-1.
T-6	27-Apr	50R	361	HORIZ	2	N/A	32.0	18.5	CONT PROGRESSIVE INFLATOR FAILURE TESTS 4-3-2-1.
T-8	28-Apr	54R-I	361	HORIZ	3	No Data	26.9	*37.0*	R&D AND/OR DEMO LAUNCHES.
T-9A	30-Apr	54R-I	361	HORIZ	4	10.0	26.2	*57.1*	

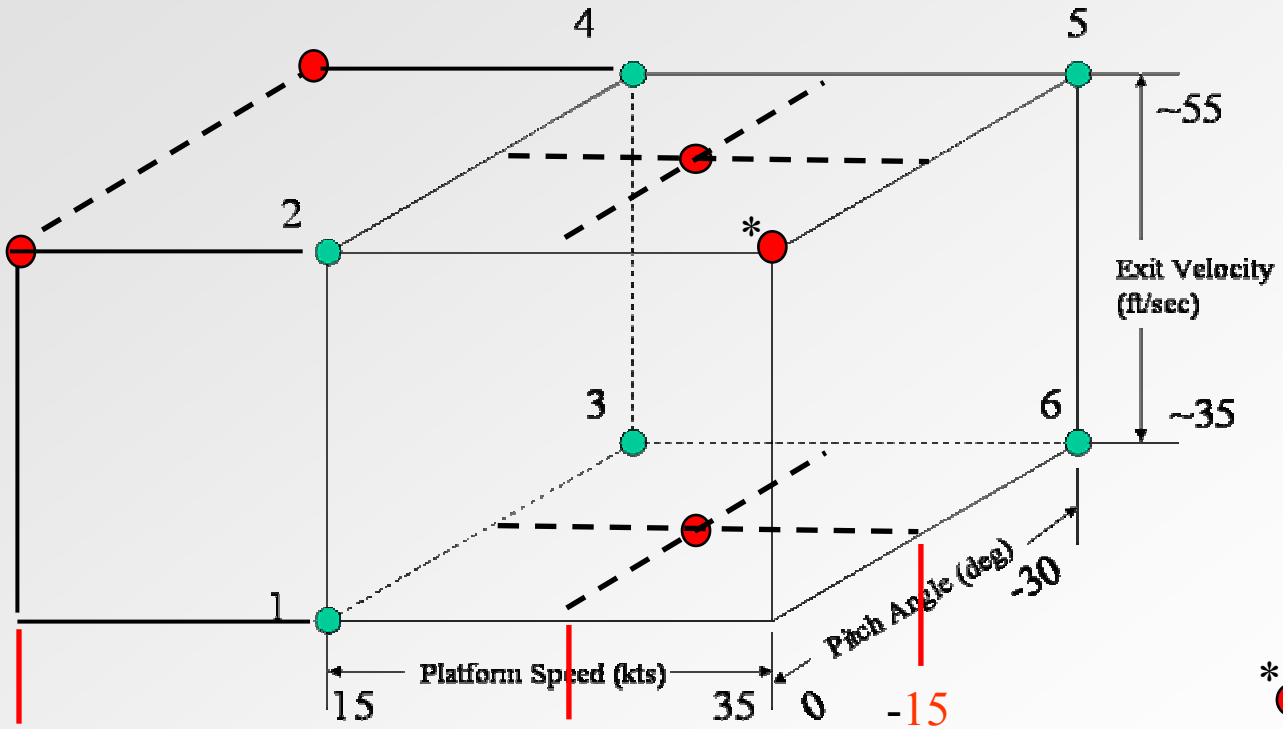
Land Based Prerequisite Testing Facility

SEA CORP Dynamic Test Facility (DTF)



Actual Launch window
MK 54R-I Torpedo

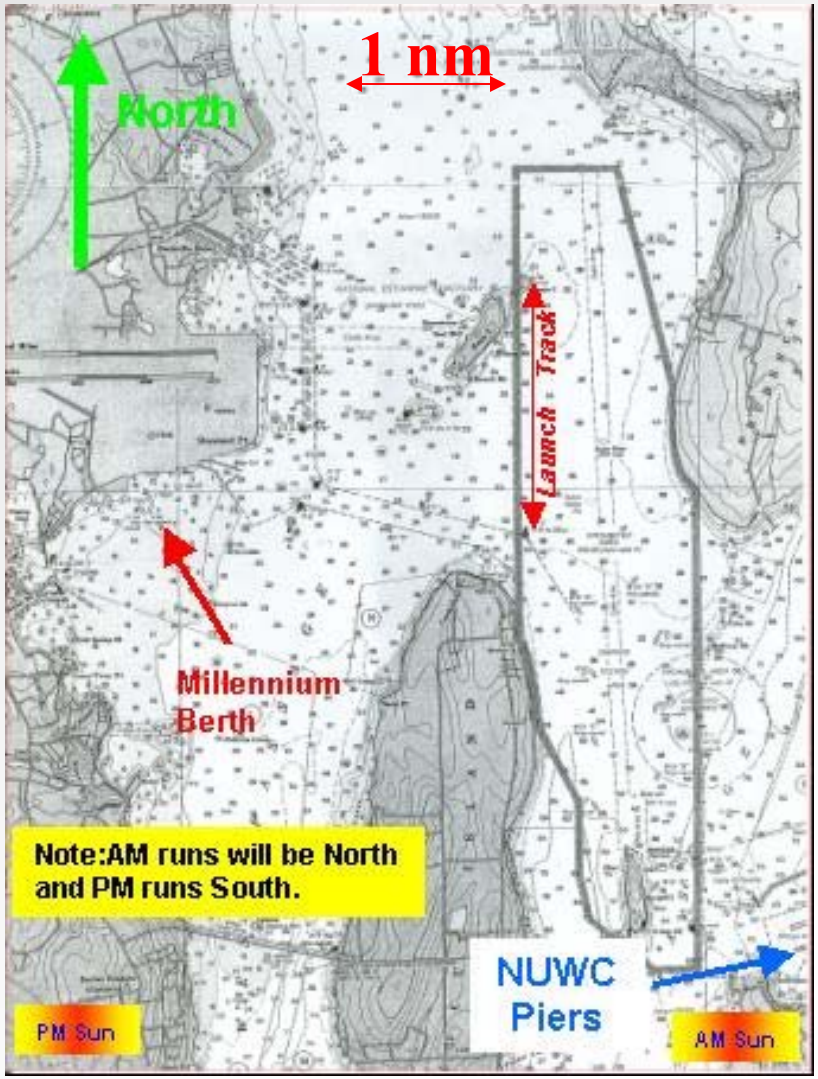
12 Launches Conducted
All Instrumented



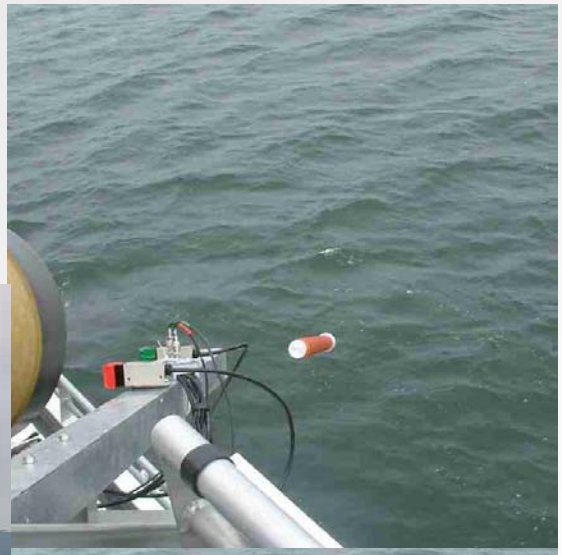
- Planned Test
- Additional Test Conducted
- * Two Launches conducted

Test Location

- **NUWCDIVNPT shallow water test range in Narragansett Bay**

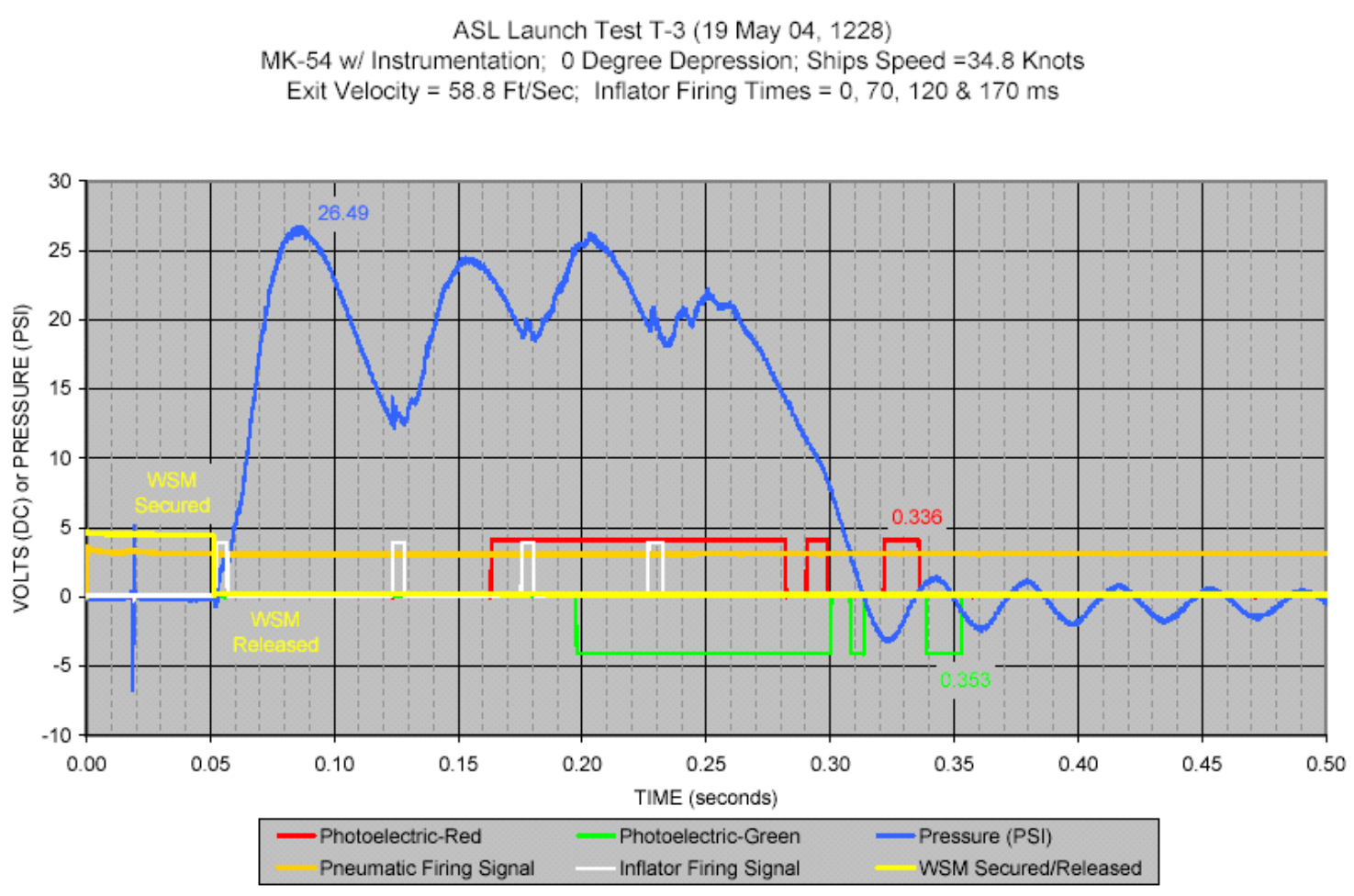


Test Images
(Countermeasure Launch)

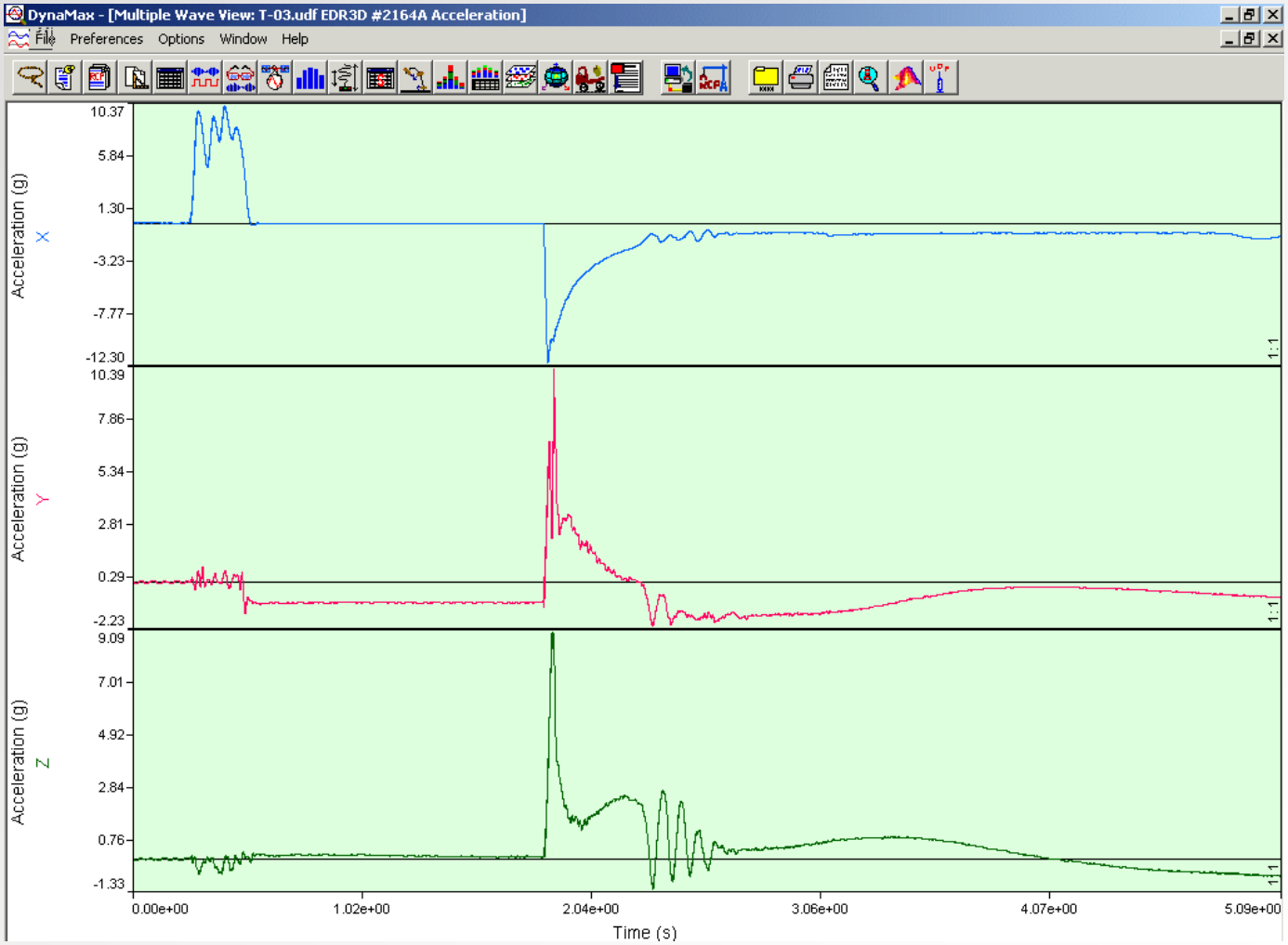


Test Images
(MK 54 REXTORP Launch)

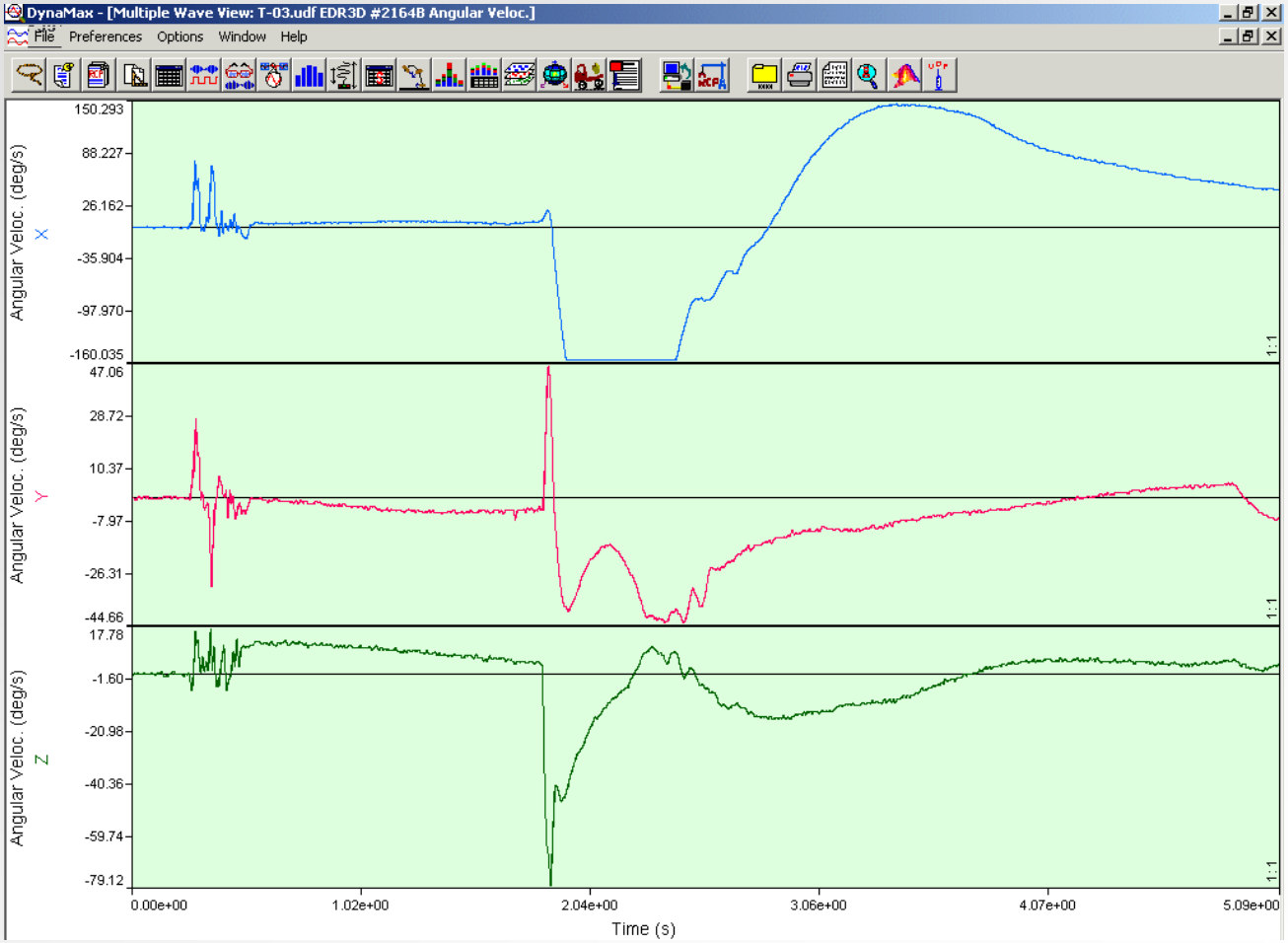
Sample of Launcher Instrumentation Data



Sample of Motion Master Acceleration Data

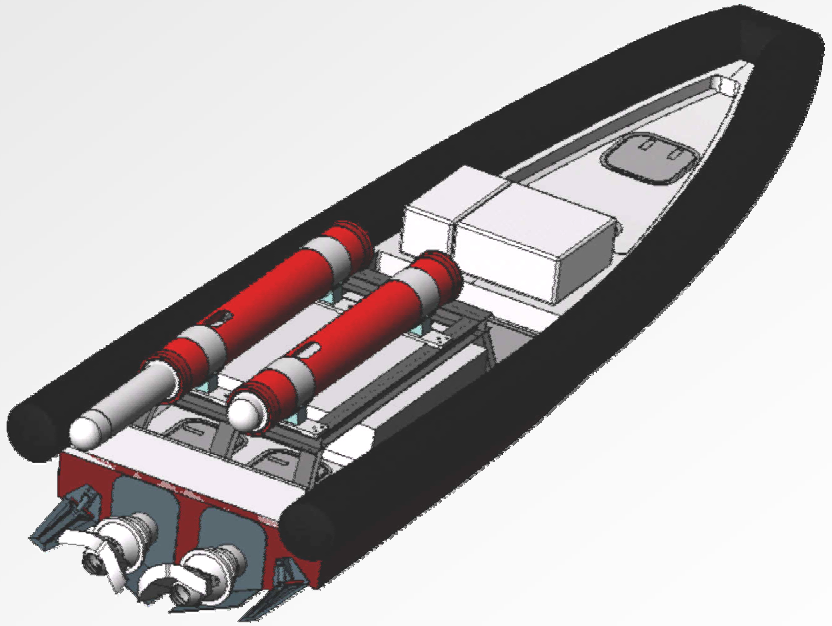


Sample of Motion Master Rate Sensor Data



JAN 05
11M RHIB/ASL Test Objectives

- Demonstrate 11M RHIB capability to support ASL launch dynamics
- Evaluate ASL performance with:
  - various launch platform speeds
  - various test shapes
  - various launch exit velocities



11M RHIB/ASL

Land Based Prerequisite Testing Summary

DAY	LNCH #	SHAPE	WEIGHT	INFL TYPE APH-1A	INFL TYPE ASH 2.2	MAX PRESSURE (PSI)	MAX REACTION FORCE (LBS)	EXIT VELOCITY (FT/SEC)	COMMENT
ONE 10/27	T-0	AIR-SLUG	N/A	5	1	N/A	N/A	N/A	
	T-1	50L	440	3	1	28.8	3675	34.8	
TWO 10/28	T-2	50L	440	3	1	28.3	3611	34.8	
	T-3	50L	440	3	1	32.1	4096	35.7	
	T-4	46H	518	3	1	27.9	3560	31.3	
	T-5	50L	440	3	1	29.4	3752	34.5	Confirm booster drops Max pressure by 2-3 psi when compared to T-1 and T-3.
THREE 10/29	T-6	50L	440	3	0	30.2	3854	34.5	Without Booster. Repeat of Millennium shot with heavier LWT.
	T-7	54H	606	3	1	26.6	3394	30.3	Motion Master trigger point not reached.
	T-8	54H	606	3	1	26.9	3433	29.4	
	T-9	50H	753	3	1	32.7	4173	25	
	T-10	54H	606	5	1	27.3	3484	45.5	
FOUR 11/1	T-11	54H	606	5	1	27.8	3548	43.5	Noticed 3rd peak about 2 psi lower then T-10. Believe due to inflator KPA variation.
	T-12	50H	753	3	1	30.1	3841	24.4	Measured Strain on Breech Plate.
	T-13	50L	440	4	1	30	3828	55.6	Measured Strain on Breech Plate.
	T-14	50H	753	5	1	31.3	3994	41.7	Measured Strain on Breech Plate.
FIVE 11/2	T-15	50H	753	5	1	30.3	3867	40	
	T-16	46H	518	5	1	29.7	3790	47.6	With pinger attached to propeller using muffler bracket. No damage to pinger.
SIX 11/8	T-17	46H	518	5	1	27	3445	47.6	With pinger attached to propeller using muffler bracket. No damage to pinger.
			TOTAL:	69	17				

Grey shade indicates low speed Time Delays for SPARTAN Testing

Purple shade indicates high speed Time Delays for SPARTAN Testing

Test Parameters

- Payload Configurations
  - Torpedo shapes 440-750lbs
  - CM shape @ 140lbs
- Low and High exit launch velocities
  - 25 ft/sec → 59 ft/sec
- Various Boat Speeds
  - Dead in the Water (DIW) to 10kts
    - Constraint of 10kts due to current test support fixture design
    - Expect flank speed capability in future testing

11M RHIB/ASL JAN 05 Demo Run Table/Results Summary

LNCH #	SHAPE	WEIGHT	BOAT SPEED (kts)	# INFLATORS		MAX PRESSURE (PSI)	ACTUAL EXIT VELOCITY (FPS)	SHAPE MAX G's						11-M RHIB MAX G's		
								Launch			Water Entry					
				APH-1A	ASH 2.2			X	Y	Z	X	Y	Z	X	Y	Z
T-0	N/A	N/A	5	5	1	N/A	N/A									
T-1	50L	440	5	3	1	29	34.8*									
T-2	54I	608	5	3	1	25.9	29.4	5.3	0	0	0	3.1	0	0.5	0.7	0.6
T-3	50H	753	5	3	1	27.8	24.4							0.8	1.8	3.2
T-4	50L	440	10	4	1	27.3	55.6*							0.8	2.1	1.2
T-5	54I	608	5	5	1	27.8*	43.5*	5.7	0	0	0	1.7	0	0.5	1.2	1
T-6	54I	608	10	5	1	27.8*	43.5*	5.8	0	0	0	2	0	0.7	1.9	1.6
T-7	50H	753	10	5	1	30.3*	40*							0.8	3.2	3.9
T-8	54I	608	DIW	5	1	25.9*	29.4*	5.2	0	0	0	3.2	0	0.4	1.3	1.5
T-9	50H	753	DIW	5	1	30.3*	40*							0.8	1.5	2.2
				ASH 2.2	ASH 2.1											
CM-0	ITD	140	DIW	2	1	N/A	N/A									
CM-1	ITD	140	5	0	1	73	27									
CM-2	ITD	140	5	1	1	110.3	43.5									
CM-3	ITD	140	10	2	1	110.4	58.8									

* No pressure & velocity data available (used DTF data)

Axes Definitions:

X: Fore/Aft

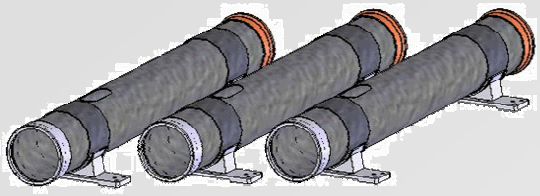
Y: Athwartships

Z: Vertical

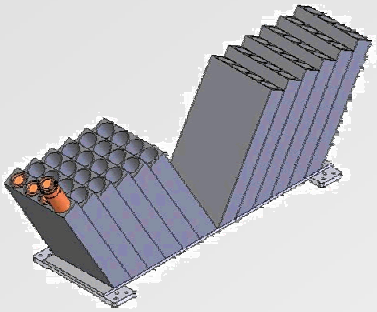
11M RHIB/ASL JAN 05 Demo Video

LCS ASW Mission Module Component Options

Launched Payloads *Common Mechanical Footprint + Common Electrical Interface to USV*

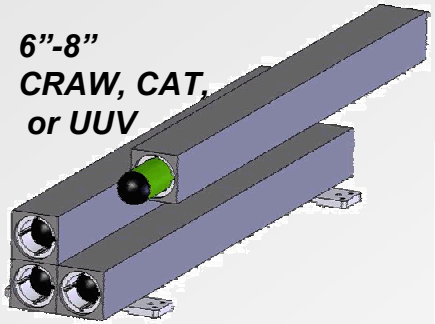


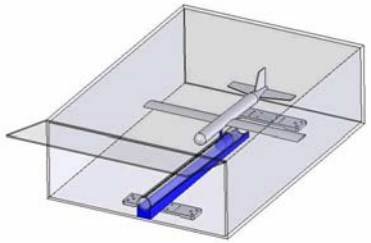
Mk 54 Torpedoes or 12.75" UUVs



Sonobuoys
EMATTs
or UAVs

6"-8"
CRAW, CAT,
or UUV

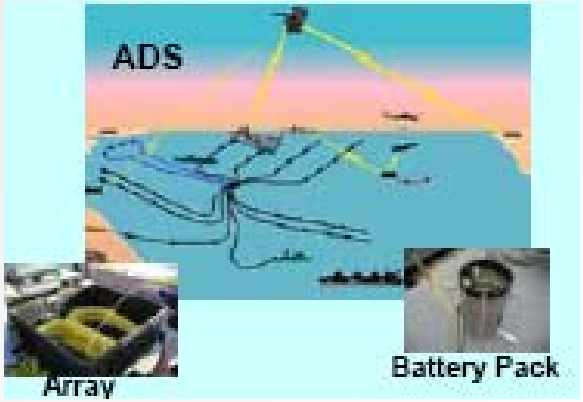




UAV

Sensors *Deployable from MH-60R, same USV, other USV, or LCS host*

ALFS



Towed Array

ASW Mission Module Component Options (cont)

- **Many combinations exist for equipping USVs with ASW components**
  - **USV payload weight constraint**
    - **Tradeoff with fuel capacity/USV range/duration/Sea Frame constraints**
  - **ASW mission must be modeled/optimized to choose best mix of components for deployment on USV**

For any combination of launchable payloads:
The ASL Team can design/build/prototype/test any combination that will be reliable for autonomous launch from a USV.

ASL Team recommendation: Out of the 90+ combinations of USV ASW components, focus on ~10-15 and design the structural interface to the USV for "plug & play" for those combinations. Give the warfighter flexibility in theatre.

ASL Road Ahead Summary

ASL Configurations
Block Definitions

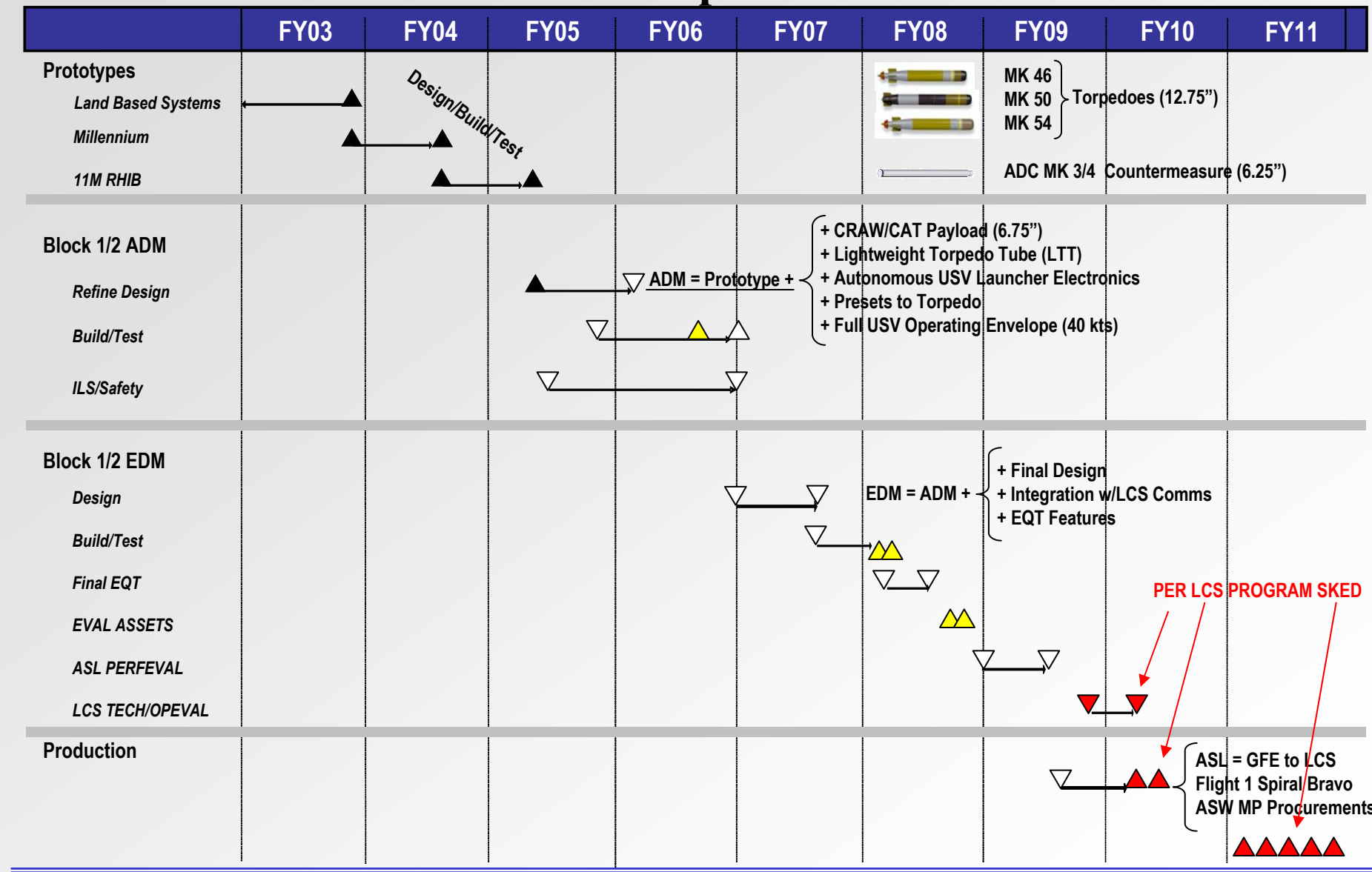
Prototype → ADM → EDM → Production

ASL Block 1 = Mk54 torpedo capability from an 11M USV

PLATFORMS

PAYLOADS				USV	DDG 51	LCS	DD(X)	TBD
	TORPEDOES		MK 54	*1*	*3?*			
			MK 50		*3?*			
			MK 46					
	6X	6.75	CRAW	*2*				
			CAT	*2A?*				
		6.25	ADC CMs	*2*				
	SLC		Sonobuoys					
			EMATT					
	UAVs		SLC (Coyote)					
			SWARM					
	3X		ADC CMs					
			SSXBT / SSXSV / Others					
			Pyros / Smokes					
	UUVs		MARV					
			UUV TBD					

Advanced Surface Launcher (ASL) Block 1 Development Schedule



Current ASL Developments

- **Currently working on the following ASL ADM Block 1 development tasks:**
  - **New 11M RHIB (USV) ASL mounting structure**
    - **Supports full USV operational envelope (35kts+ and sea state 3)**
  - **New ASL Electronics**
    - **Supports autonomous USV torpedo preset and launcher control**
  - **New Lightweight Torpedo Tube (LTT)**
    - **Same principle as internal torpedo tube used in JAN 05 demo**
      - **Without Outer Canister Assembly (OCA)**
      - **Lighter weight**
  - **New lightweight 6.25" payload (ADC Mk3/4) launcher development**
  - **New lightweight 6.75" payload (CRAW/CAT) launcher development**

Summary

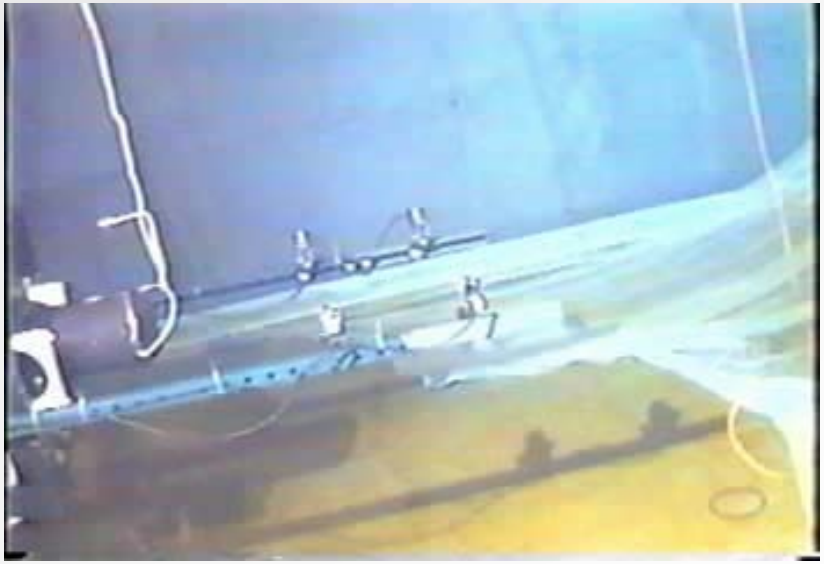
- **ASL Concept of Launch:**
  - **Optimal for autonomous and reliable launch operations**
  - **Proven through at-sea testing**
  - **Capable of being configured for multiple payload types**
- **ASL development for other payloads can be done simultaneously as current Block 1 initiatives**

UMV Applications

- 12.75” UUV (MARV)
  - Easy adaptation of existing torpedo configuration to MARV
  - Must accommodate antenna or redesign retractable antenna
- Other UUVs or UAVs
  - Given payload launch exit velocity and max acceleration, ASL can accommodate virtually any payload size/shape from any platform

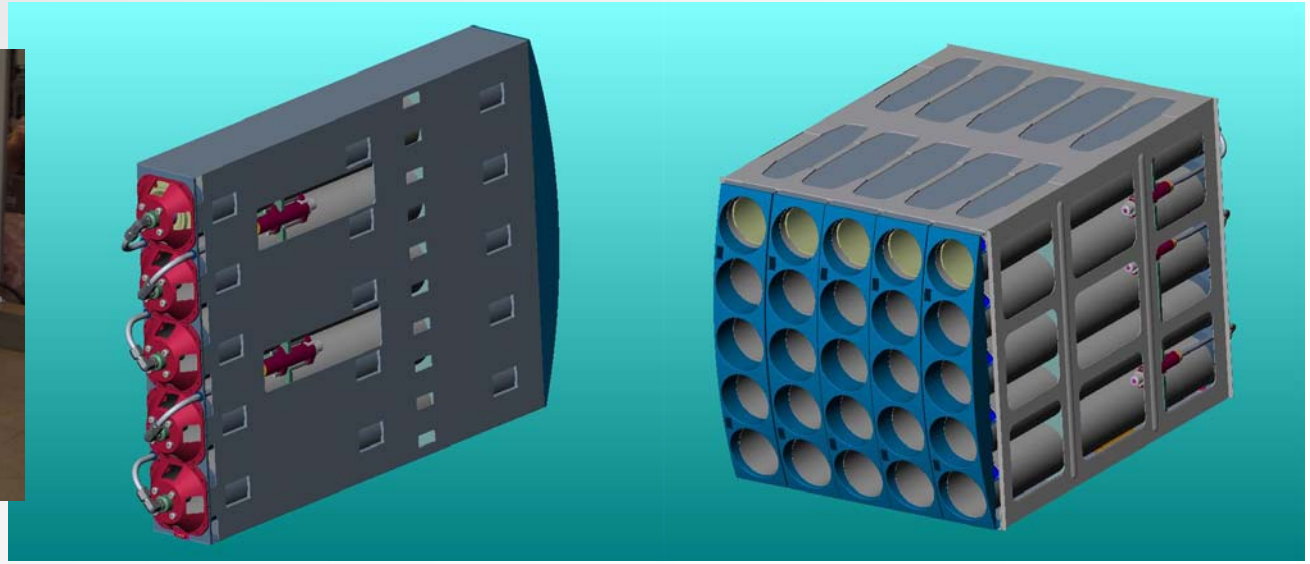
UMV Applications (cont)

- **Underwater Launch**
  - **During SBIR Phase II, SEA CORP designed/built a pressure balanced launcher for a 6.25” ADC countermeasure shape (164 lbs)**
    - **Exit velocity at ~35 fps at 15’ depth**
    - **Capable of going higher if required**



UMV Applications (cont)

- **Sonobuoys and other SLC payloads**
  - **Through a SBIR Phase II with NAVAIR**
    - **SEA CORP is currently designing/building a modular launcher for the MH-60R helicopter**
    - **First launch tube built/tested**
    - **Working on networked 25 tube modular system**



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