Airborne Expendable Ice Buoy (AXIB) for Polar Ice Zone Deployment

"Where it came from and where it's going"

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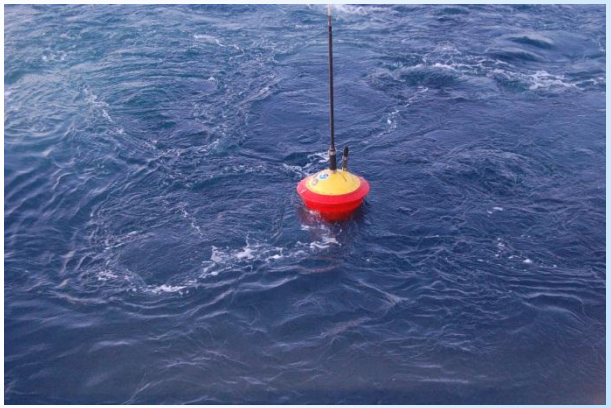
LCDR John Woods, USNA
MIDN 1/C Molly Solmonson, USNA
MIDN 1/C Phil Reynolds, USNA
MIDN 2/C Sharon Bong, USNA

The AXIB was developed under a NOAA SBIR Phase I and II, Pablo Clemente'Colon , Program Manager

- Must be robust and the form is designed to move rather than being crushed by the shifting ice without regard for orientation. Regardless of whether it is up side down or right side up.
- The sensor mast and barometer are designed to bend 90 degrees in any direction to avoid fracture.
- Multi-season platform constructed of a high strength isotropic composite hull.
- The hull is primarily designed for water deployment then allowed to freeze in.
- Long life Lithium Thionyl Chloride Battery Packs in the lowest point of the hull and thick foam layer above the batteries insulates them from the extreme temperatures and allows the warmer sea water to protect them.
- The original prototypes, deployed in August and September, 2008 survived and reported data for over 4 years



AXIBs in production

2008: AXIB Prototype Deployed from the USCG Icebreaker Healey

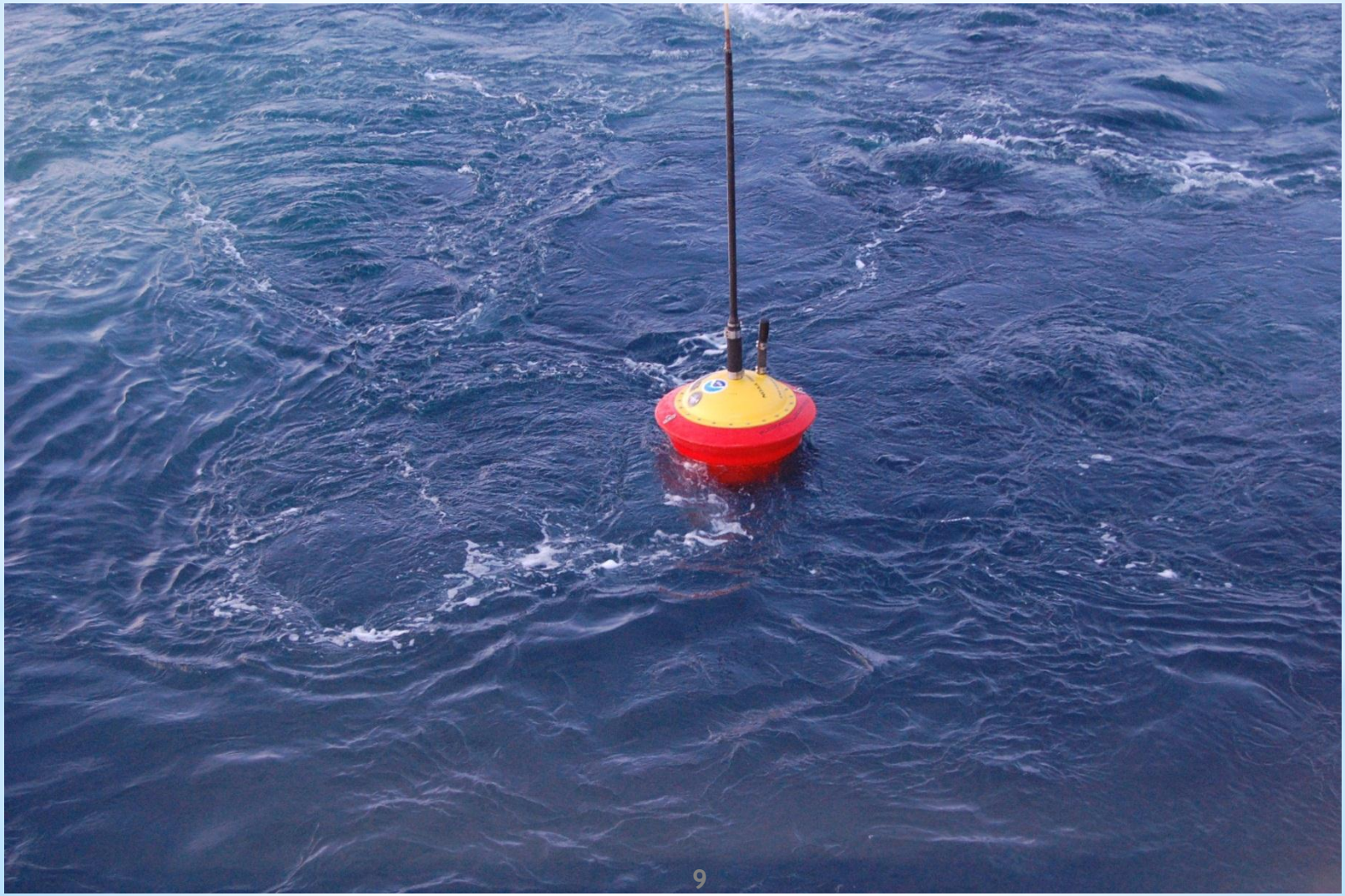
2008: AXIB Prototype Deployed from the USCG Icebreaker Healey

2008: AXIB Prototype Deployed from the USCG Icebreaker Healey

2008: AXIB Prototype Deployed from the USCG Icebreaker Healey On Multi-year ice

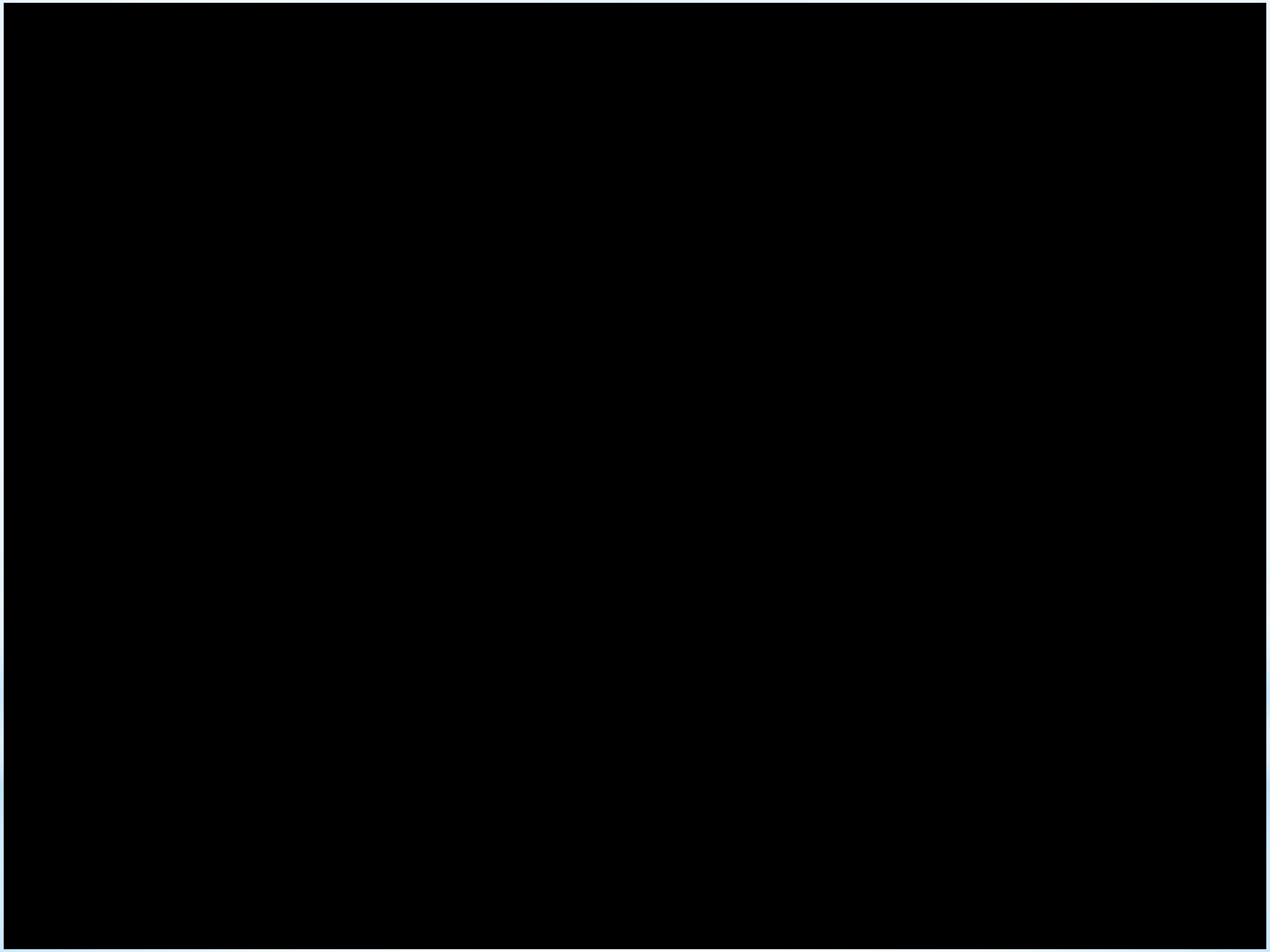
2008: AXIB Prototype Deployed from the USCG Icebreaker Healey

2008: AXIB Prototype Deployed from the USCG Icebreaker Healey In Open Water

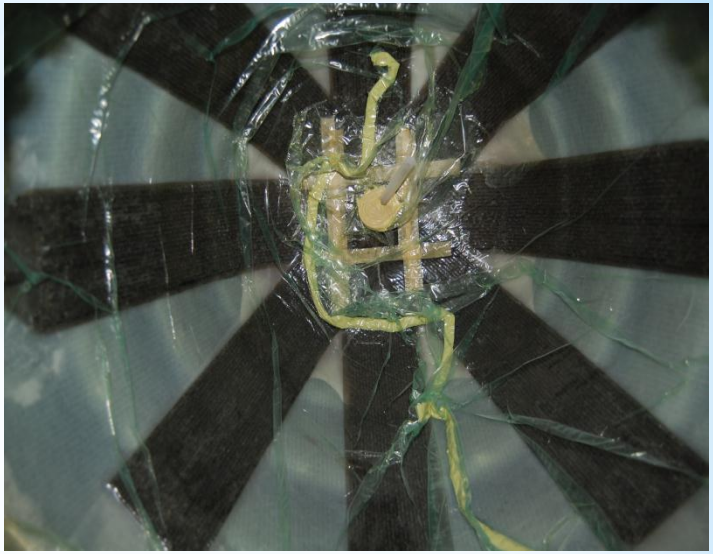


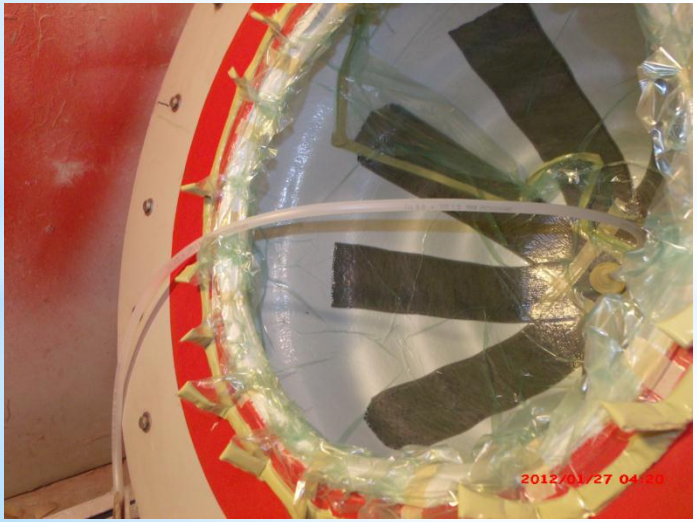
Air Deployment Test Video, 130 kts @ 300ft

Air Deployment Cone Release Test



Composite Fabrication Process Utilizing VRIM (Vacuum Resin Infusion Molding)





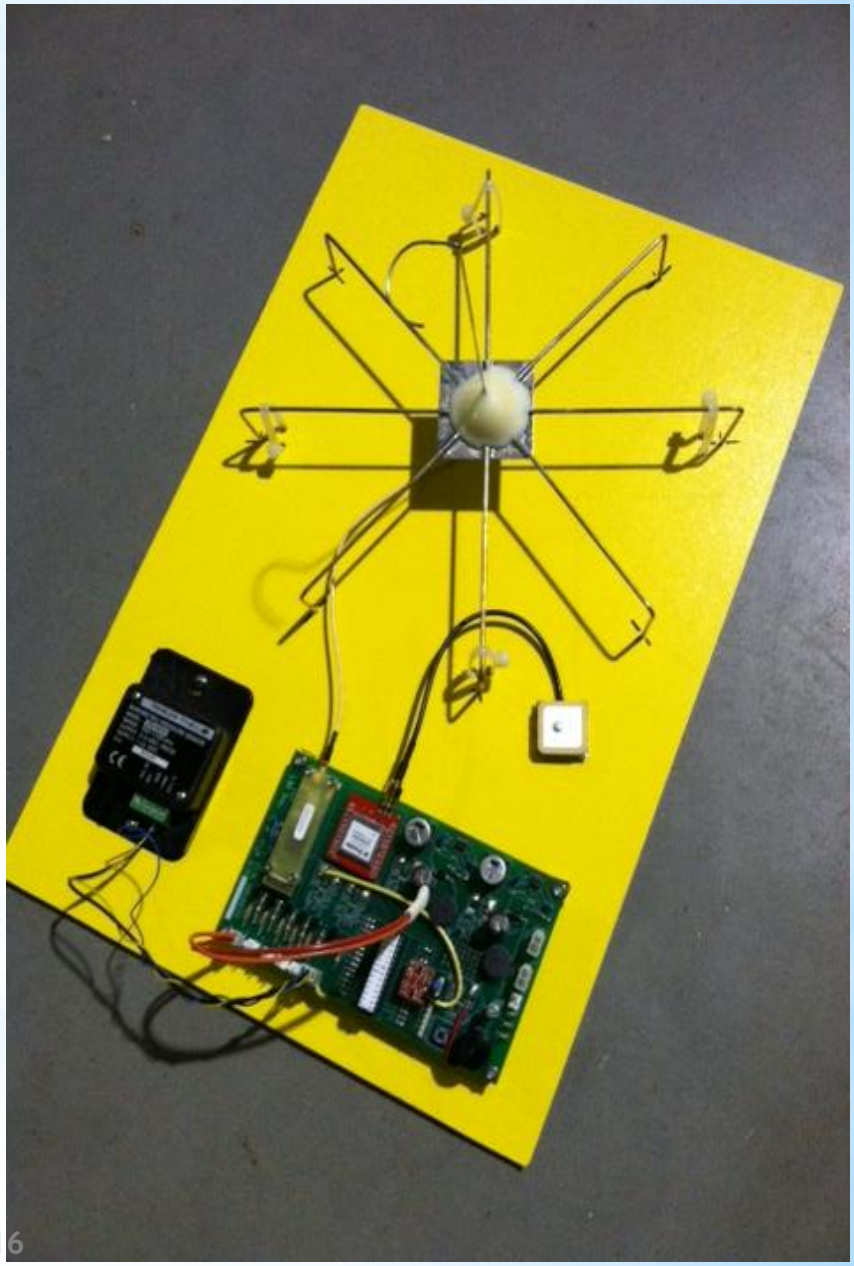
Thermistor Mast With Flexible Spring Mount

MetOcean ARGOS Telemetry Electronics Packages

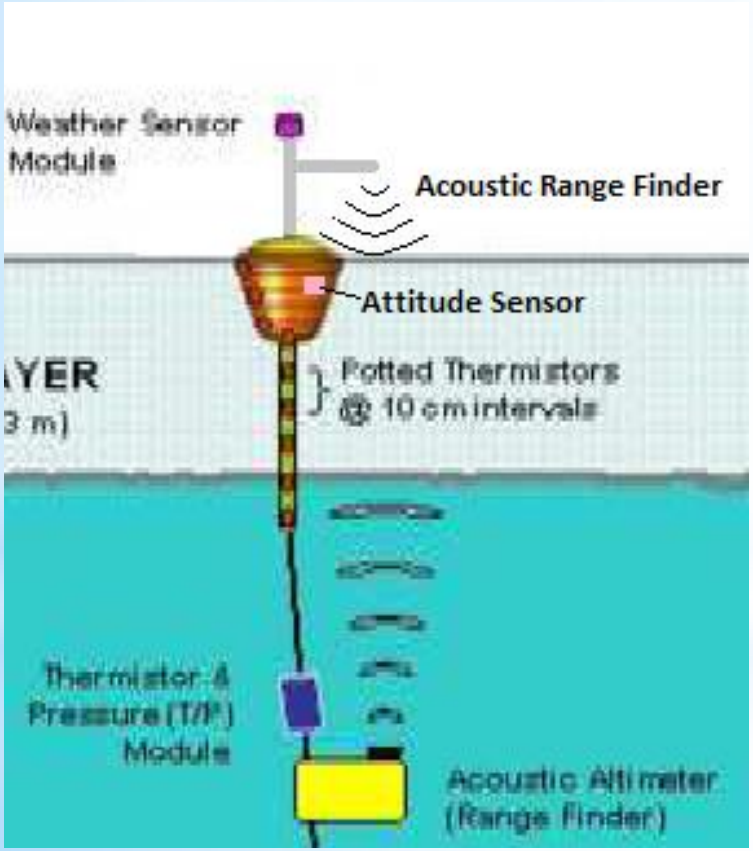
MetOcean Iridium electronics packages

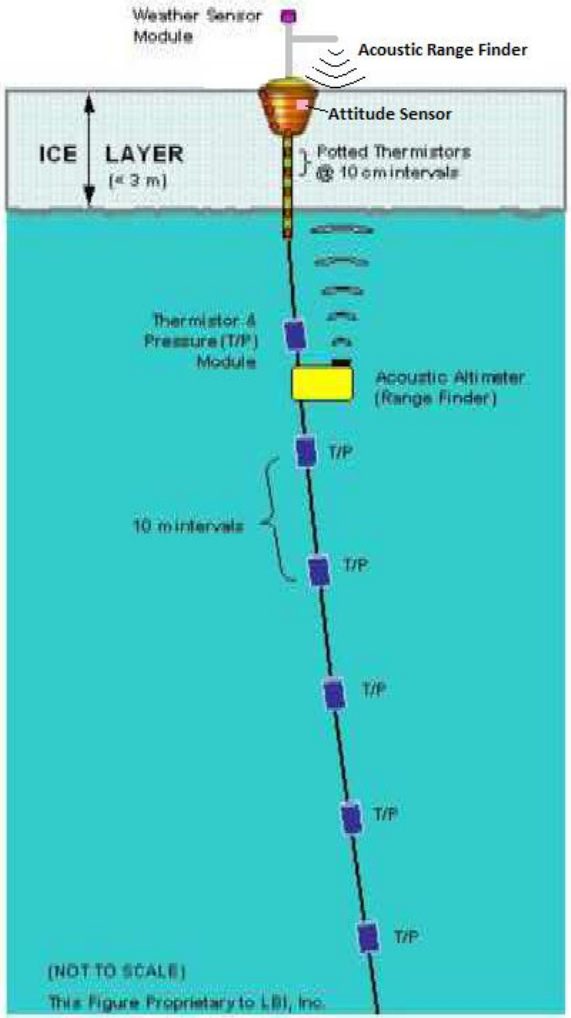
Configurable/Adaptable Electronics Package Prototype (Iridium/ARGOS)

- Utilizes widely available components
  Large open-source community
- Optimized For Low Power Operation
- Adaptable to a range of sensors

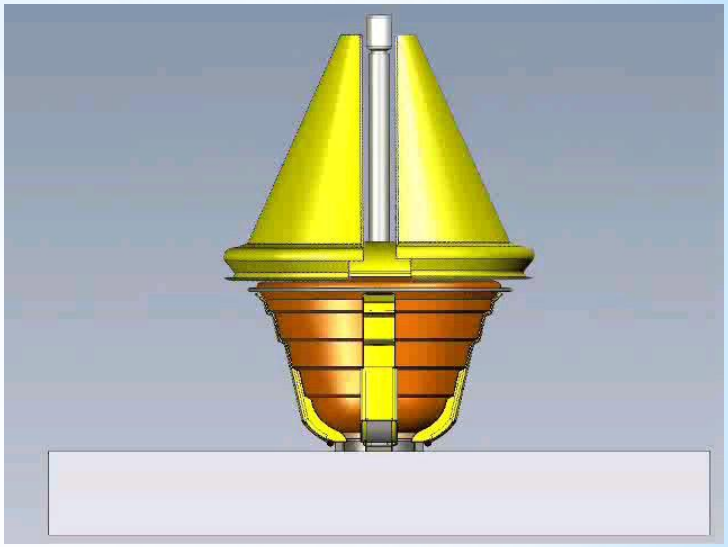


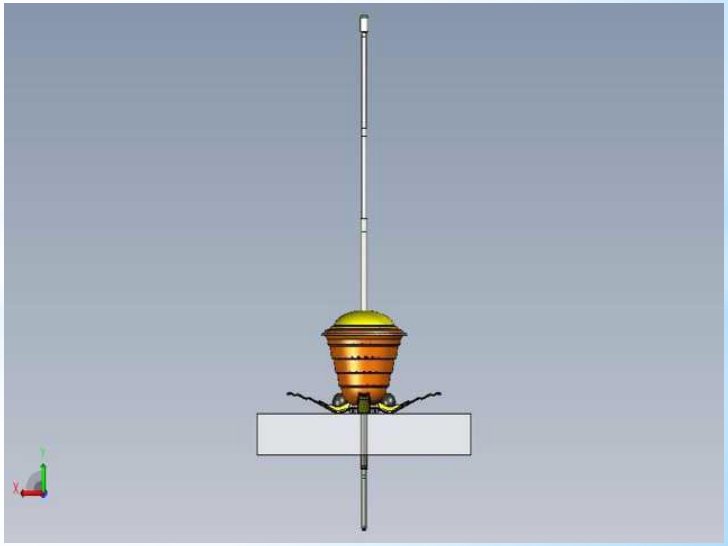
Ice Mass Balance Buoy Concept



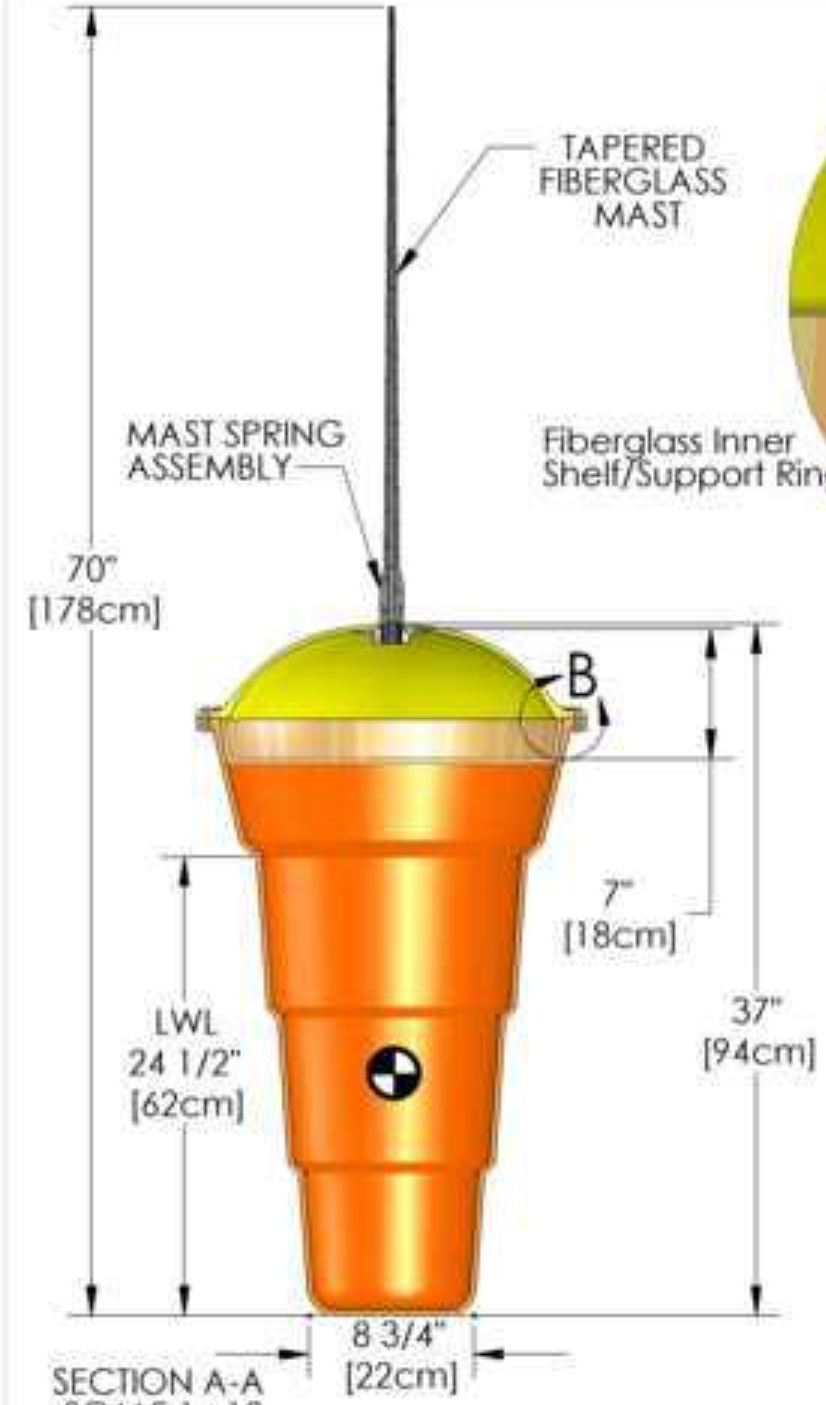


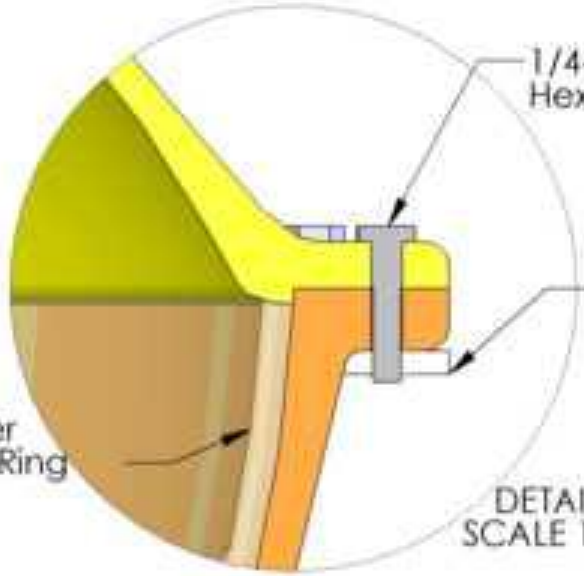
Self Erecting AXIB Buoy For On Ice Deployment

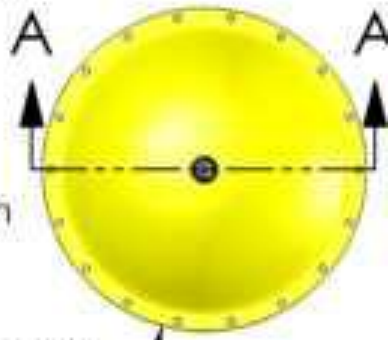




Self Erecting AXIB Buoy Test







NOTES:

1. WEIGHT: ~88 lbs [~40kgs]
2. MAST CAN BE BENT FOR FITTING INTO DEPLOYMENT TUBE.
3. PARACHUTE CAN BE FITTED TO OUTER RING.
4. SENSOR PACKAGE TO INCLUDE AIR AND SEA WATER/ICE TEMPERATURE THERMISTOR AND BAROMETER.
5. CAN ALSO BE CONFIGURED WITH A THERMISTOR CHAIN.

PRELIMINARY

UNLESS OTHERWISE SPECIFIED:		NAME	DATE
	DRAWN	F. PAGEL	08/07/08
	CHECKED	F. LEGHOS	08/08/08

LBI

TITLE #: AXIB TYPE 3

DATE 08/08/08

REV:

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL: VACUM RESIN INFUSION MOLDED (VIM) VINYLESTER FIBERGLASS

FINISH: GELCOAT

DESCRIPTION: TORPEDO TUBE DEPLOYABLE BUOY

SIZE A

PART NO. T30001

USNA Ocean Engineering Capstone Design Project

1/C Phil Reynolds

1/C Molly Solmonson

2/C Sharon Bong

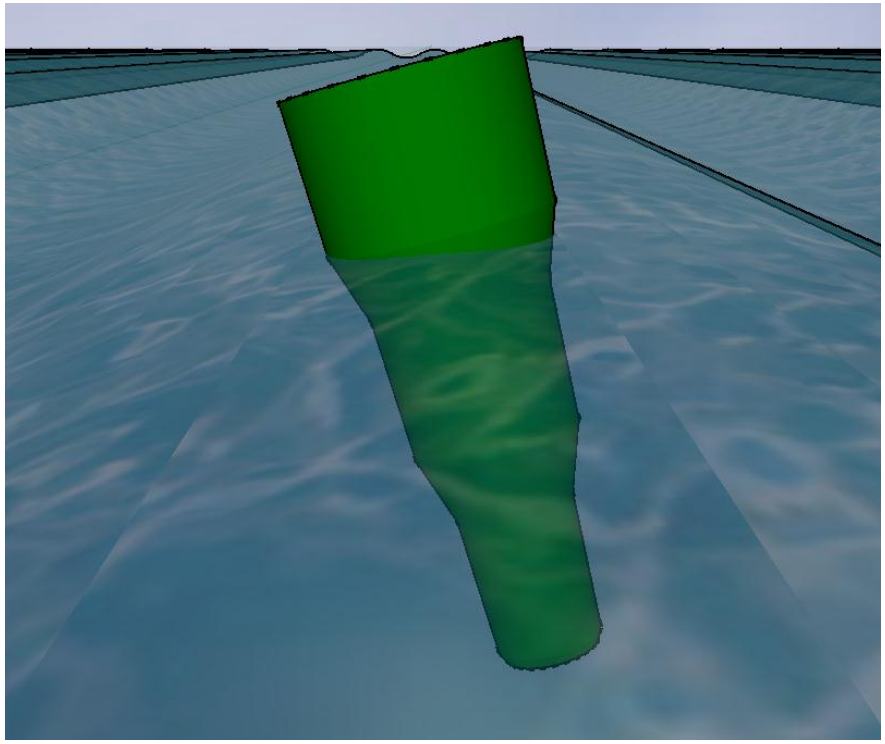
Team Introductions

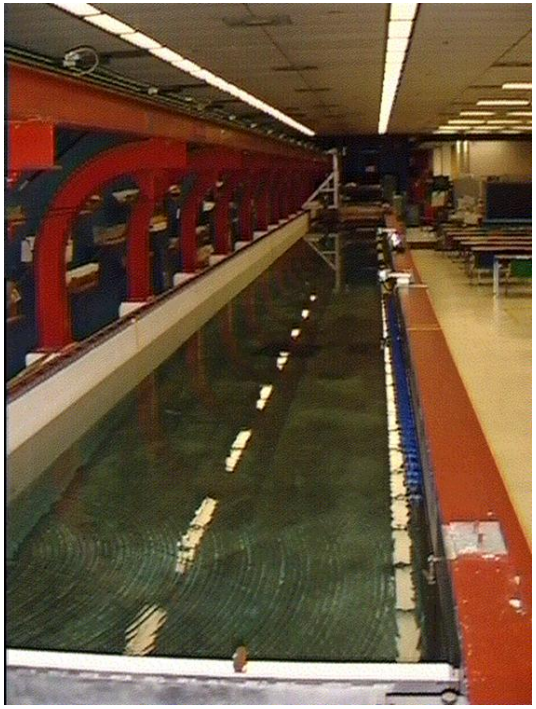
- 1/C Phil Reynolds
  - From Island Heights, NJ
  - Service Selection: Submarines
  - On Varsity Offshore sailing team
- 1/C Molly Solmonson
  - Born and raised in Anchorage, AK
  - Service Selection: Surface Warfare
- 2/C Sharon Bong
  - From San Diego, CA
  - Desired Service Selection: Marine Corps Ground

EN 462 Engineering Capstone Design

- Design a ocean engineering system
  - Work closely with team members and faculty
  - Utilize USNA facilities to incorporate engineering design, proposal writing, project management, and cost estimation into final project
  - Final oral presentation of design project takes place on April 24th in front of panel of faculty and engineers

USNA Arctic Buoy





- Future plans: place in wave tank at USNA to test in Arctic Ocean wave climate

USNA Arctic Buoy

- Design Parameters
  - Launch types: Air, Surface, Land, Sub-surface
- Submarine Certification
  - Has to meet SeaNav and SUBFOR Requirements
  - Could take 1-2 years for all certifications

Calculations

Component	Weight, w_i (lb)	x_i (in)	y_i (in)	z_i (in)	x_i*w_i (lb-in)	y_i*w_i (lb-in)	z_i*w_i (lb-in)
hull	98.6	0.0	0.0	27.4	0.0	0.0	2704.2
cover	8.0	0.0	0.0	49.0	0.0	0.0	392.0
hydrophone	1.0	0.0	0.0	0.0	0.0	0.0	0.0
vaisala T	1.4	0.0	0.0	21.0	0.0	0.0	30.0
gps	0.7	0.0	0.0	0.0	0.0	0.0	0.0
camera 1	1.0	-20.0	0.0	48.0	-20.0	0.0	48.0
camera 2	1.0	20.0	0.0	48.0	20.0	0.0	48.0
router	0.5	0.0	0.0	0.0	0.0	0.0	0.0
antenna	0.4	0.0	0.0	49.0	0.0	0.0	21.4
battery 1	12.0	0.0	0.0	3.5	0.0	0.0	42.0
battery 2	12.0	0.0	0.0	8.5	0.0	0.0	102.0
battery 3	12.0	0.0	0.0	13.5	0.0	0.0	162.0
ballast 1	20.0	0.0	0.0	-12.0	0.0	0.0	-240.0
ballast 2	2.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Wieght	**170.80**		**locatoin in inches**		**0.00**	**0.00**	**19.38**
Target wieght =	170.80						
CB =							22.5

- Calculate for each instrument and component of buoy:
  - Center of Buoyancy (COB)
  - Center of Gravity (COG)
  - Metacenter
  - Natural Frequency of Roll/Heave

Questions?