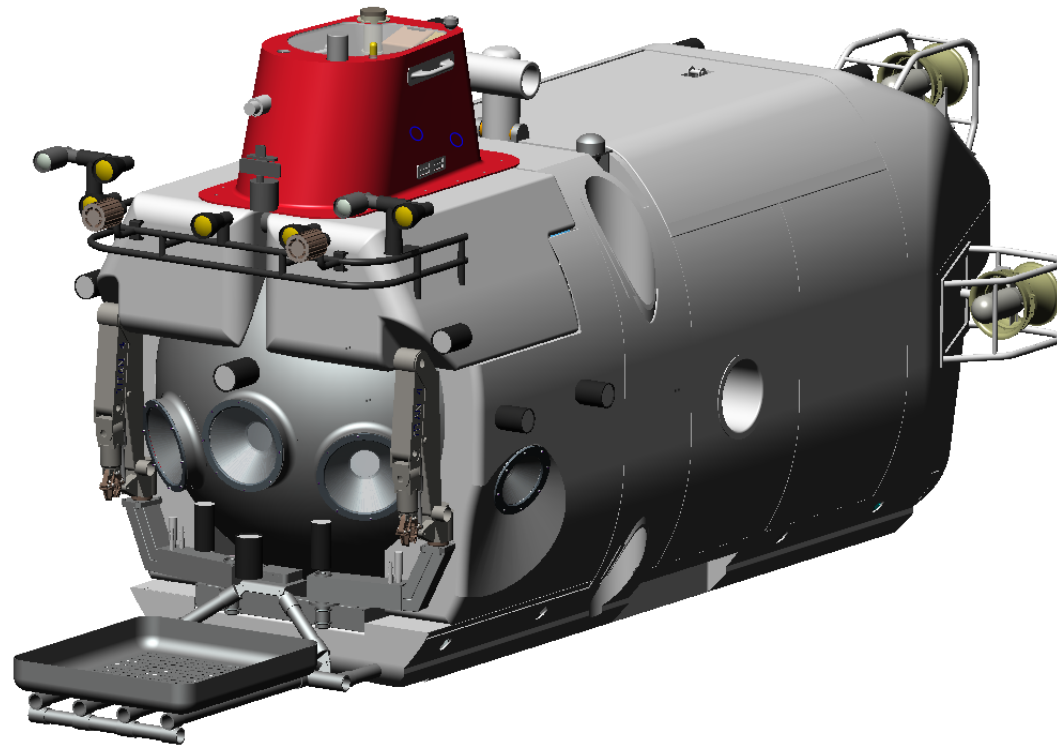


Status of RHOV Project UNOLS Annual Meeting

3 October 2008



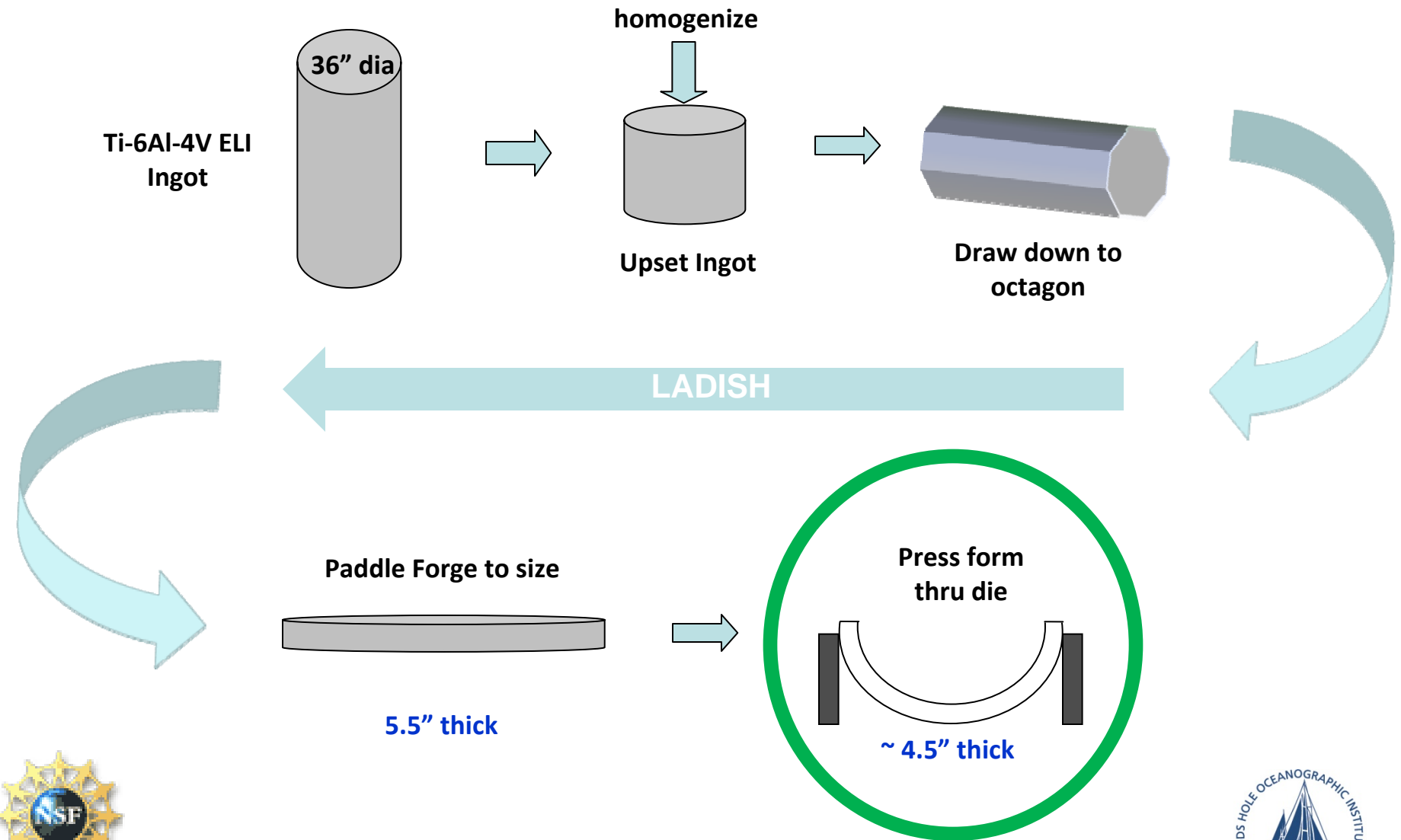
Key Events

- Successfully formed both hemispheres in June 2008
- Sphere insert forging process has begun
- Initial heat treatment of spheres has been completed
- Machining of spheres has begun
- Electron Beam (EB) weld procedure has been successfully tested, and scheduled for ABS approval
- Sphere completion on track for mid-July 2010



Workflow Diagram

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Titanium Ingots

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Two 36-inch Hemisphere Ingots (16,750 lb & 16,700 lb)
36-inch Insert Ingot (7,000 lb)



Forging Process

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HEATING INGOT TO 1500°C



Forging Process

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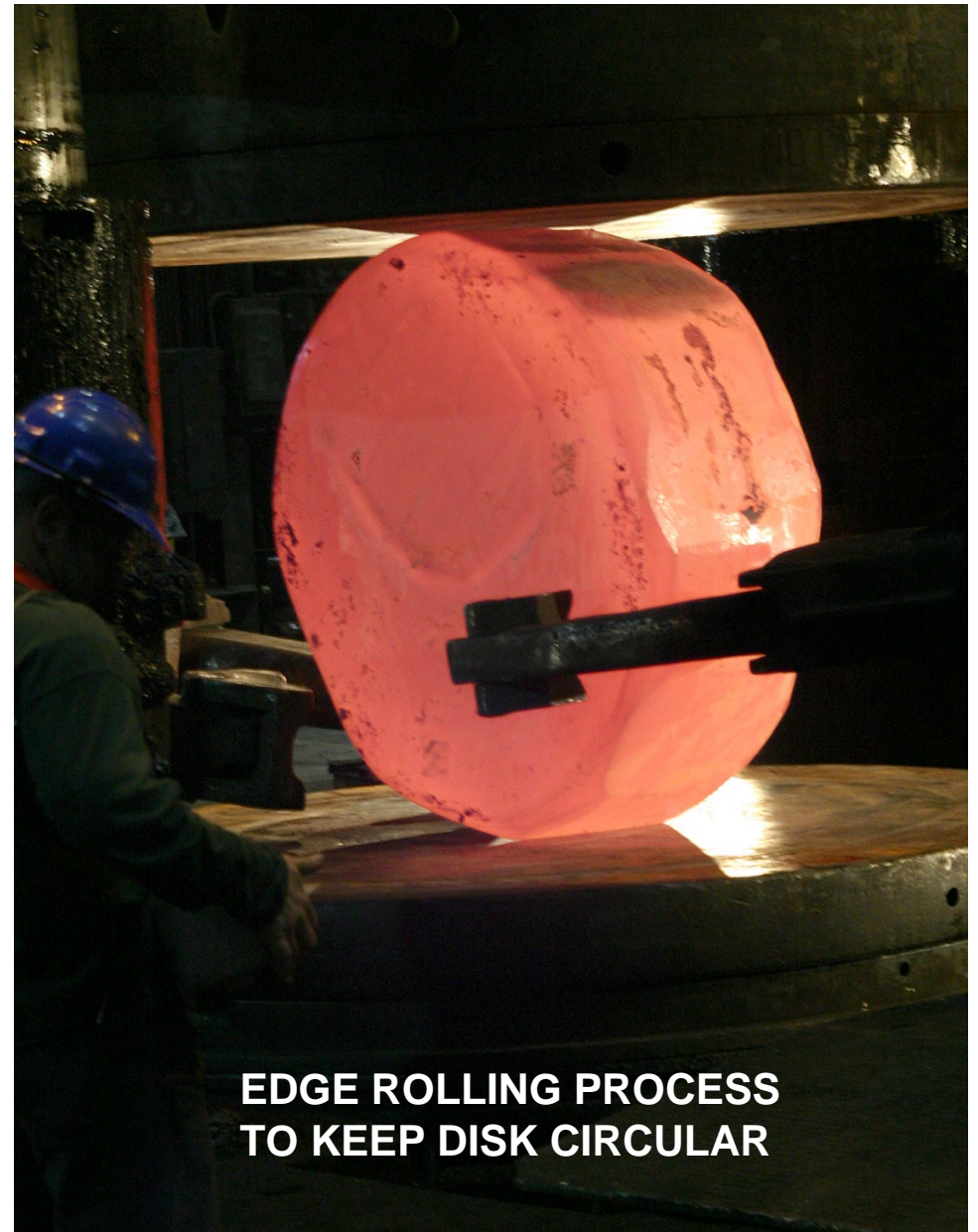


FINAL UPSET OF BILLET



Forging Process

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**EDGE ROLLING PROCESS
TO KEEP DISK CIRCULAR**



Forging Process

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PADDLE

HEMISPHERE DISK DURING THE 8th
PADDLING OPERATION

ROTATING
BASE PLATE



Forging Process

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TWO HEMISPHERE DISKS AFTER 8 PADDLING OPERATIONS
(Approx 108 inch OD x 8 inch at edge & 9.5 inch in center)



Forging Process

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FORGING OF HEMISPHERE June 24, 2008



Forging Process

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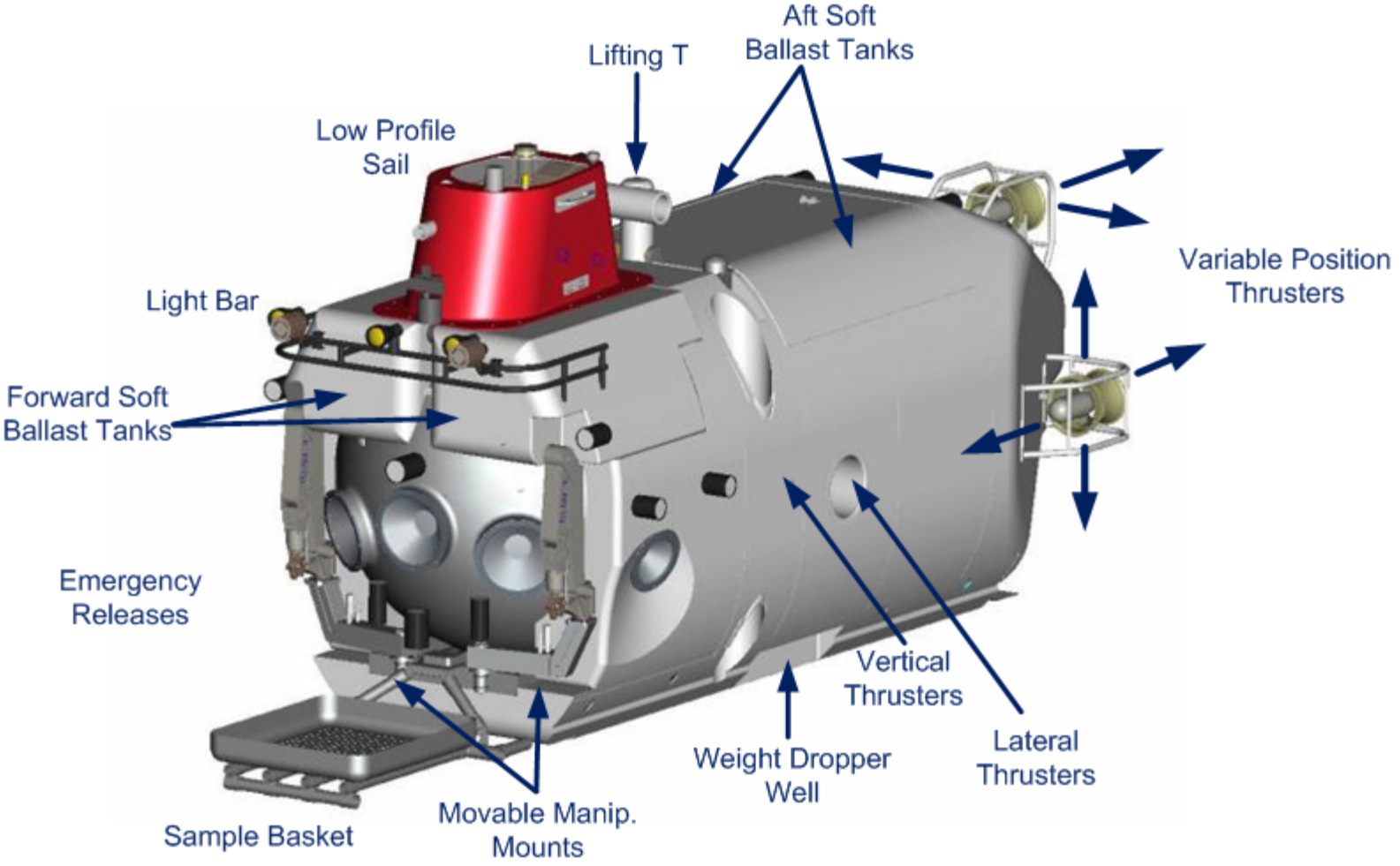


FORGED HEMISPHERE



Vehicle Design

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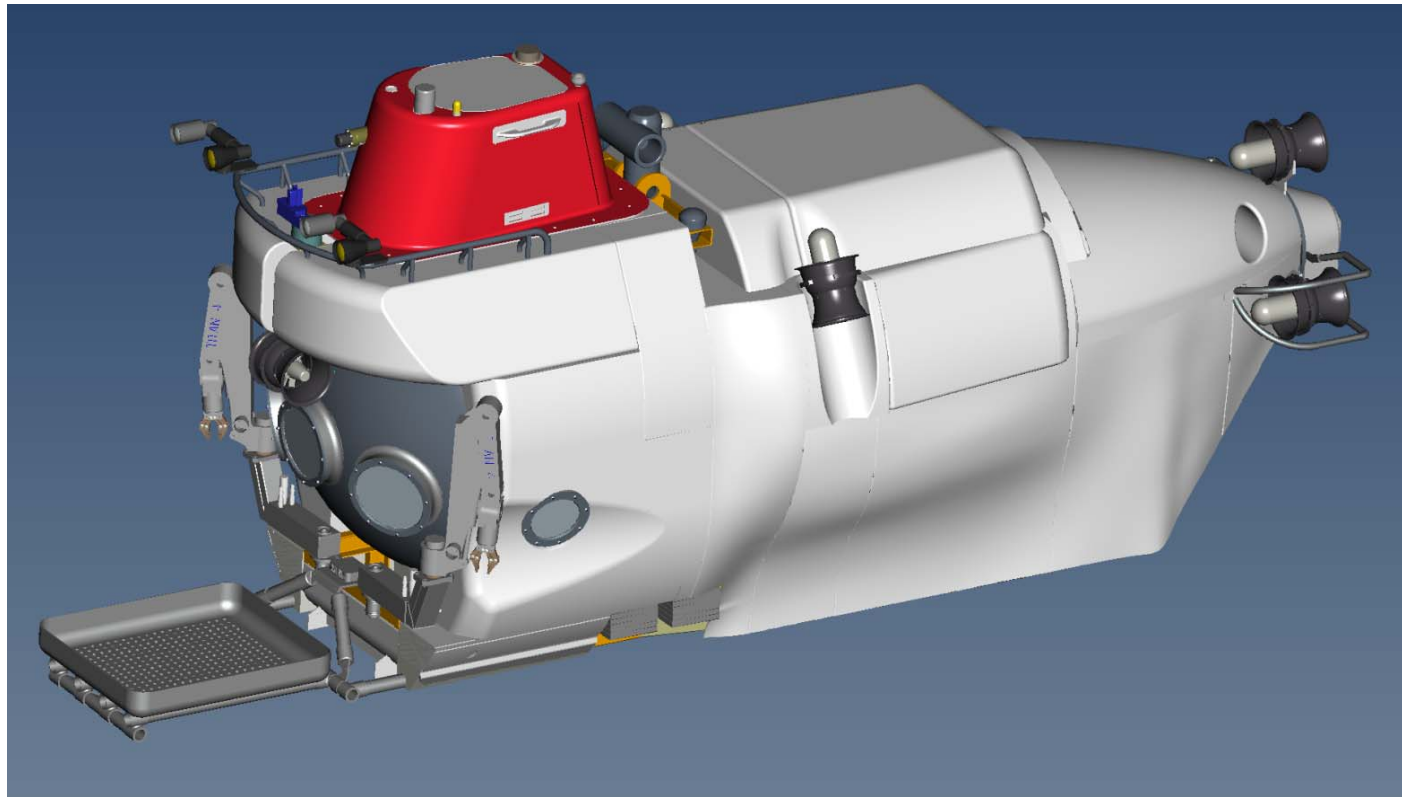


Key Events

6/8/07	Vehicle Contract Executed with L-M
7/24/07-7/25/07	System Requirement Review /System Design Review conducted at L-M
10/15/07-10/17/07	Design Team meeting with <i>Alvin</i> Pilots
11/13/07-11/15/07	Preliminary Design Review
1/25/08	Detailed Cost Estimate Received
2/20/08-2/21/08	RHOC/NSF Review of Cost Estimate
3/1/08- 6/08	Development of Conceptual Design for Phased RHOV Approach
6/9/08	RHOC/NSF meeting
8/8/08	Joint WHOI/NSF Decision to Pursue Phased RHOV Approach
9/31/08	L-M contract terminated



4500m RHOV (*Alvin* Upgrade)



Goals of Phased Approach

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Develop concept for *Alvin* Upgrade using the 6500m depth-rated personnel sphere now in production

- Satisfy as many RHOV design goals as possible
- Keep RHOV improvements
- Leverage RHOV design efforts
- Reduce total project costs
- Allow for later upgrade to full 6500m vehicle



Alvin Upgrade Capabilities vs. RHOV Goals

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RHOV Goals Accomplished:

- ✓ Increased on-bottom time
- ✓ Increased battery capacity
- ✓ Larger personnel sphere; more interior space and improved ergonomics
- ✓ Improved field of view for pilots and observers
- ✓ Improved interior electronics
- ✓ Automated position keeping
- ✓ Sampling basket load limits significantly increased
- ✓ Improved lighting and video systems
- ✓ Increased hydraulic plant capacity (improved manipulator performance)
- ✓ Increased thruster horsepower (better maneuverability)
- ✓ Improved mid-water research capability



Alvin Upgrade Capabilities vs. RHOV Goals

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RHOV Goals Not Accomplished:

- X Increased operating depth to 6500m
- X Reduced seabed disturbance (will continue to rely on drop weights for ascent/descent)
- X Multi-purpose, large capacity seawater ballast system (for trim, variable ballast, ascent/descent)
- X Elimination of mercury trim system

Enhancements still feasible with upgraded *Alvin*:

- ✓ Could upgrade later to operating depth to 6500m
- ✓ Could upgrade later with enhanced 3-D HiDef imaging system; microfiber cable for high bandwidth, two-way comms to surface

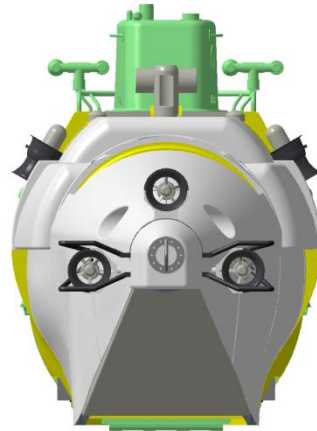


- Frame (Partial)
- Foam (50%)
- Thrusters
- VB pump, valves, and hydraulics
- High Pressure Air system
- Hydraulic Power Unit
- Motor Controller Cans (2)
- Aft Skins
- Aft Main Ballast Tank



Alvin Upgrade Design

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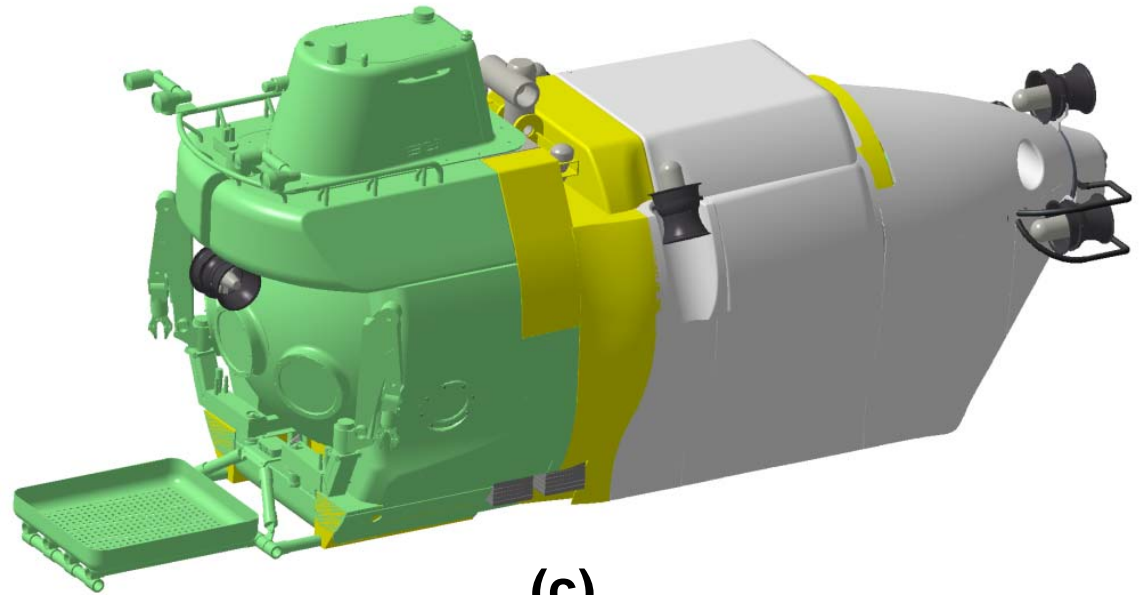
(b)



(a)

Color codes:

RHOV	Green
New	Yellow
Alvin	Grays

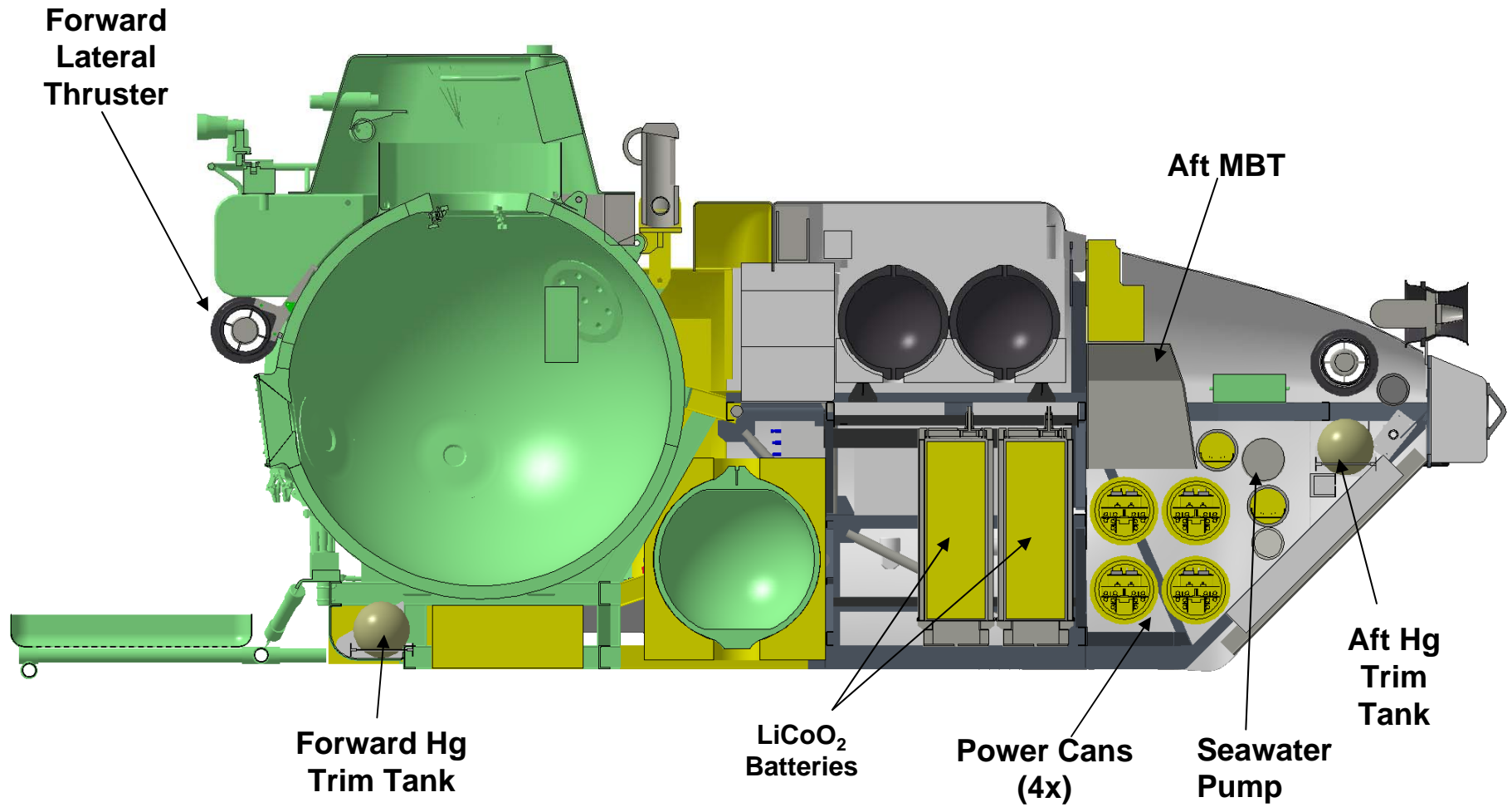


(c)



Cross Section

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Performance Specifications

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	<i>ALVIN</i>	<i>ALVIN Upgrade</i>
Max Depth	4,500M	4,500M
Hook Weight	36,000 lbs	37,313 lbs
Ascent/Descent Method (2500M)	Steel Drop Weights	Steel Drop Weights
Descent Time (2500M)	1.5 hrs	1.3 hrs
Ascent Time (2500M)	1.5 hrs	1.2 hrs
Bottom Time (2500M)	5-6 hrs	7-8 hrs
Pitch Trim System	Mercury	Mercury
Pitch Trim Angle	+11/-15 deg	+9.5/-19.0 deg
	<i>ALVIN</i>	<i>ALVIN Upgrade</i>
Energy Source	Lead Acid Battery	Lithium Battery
Battery Weight	5,300 lbs	3,100 lbs
Total Useable Energy	57.6 kWhr	84kWhr
Main Bus Voltage	120 VDC	240 VDC
Science Payload (Internal plus External)	400 lbs at release	400 lbs
Science Hydraulic Circuits	6 functions	6 functions
Science Power Available	1000 Watts (12 & 26 volts)	800 Watts Interior 1,000 Watts Exterior



New Risks

- NSF Approval to Re-scope Project
- ABS Certification Issues
 - Frame
 - Pressure Vessels
- Schedule Delays
- Management/Engineering Resources

Avoided Risks

- Foam
- Variable Ballast System
- A-Frame Capacity Issues



Next Steps

- Oct 15 2008: WHOI submits Management Plan, WBS, and Budget to develop Preliminary Design for 4500RHOV
- June 2009: Preliminary Design Review for 4500RHOV
- Fall 2009: Final Design and Cost Review for 4500RHOV
- Mid-2010: Completion of Personnel Spheres
- Fall 2010: *Alvin* taken out of service
- Mid-2011: 4500RHOV becomes operational

