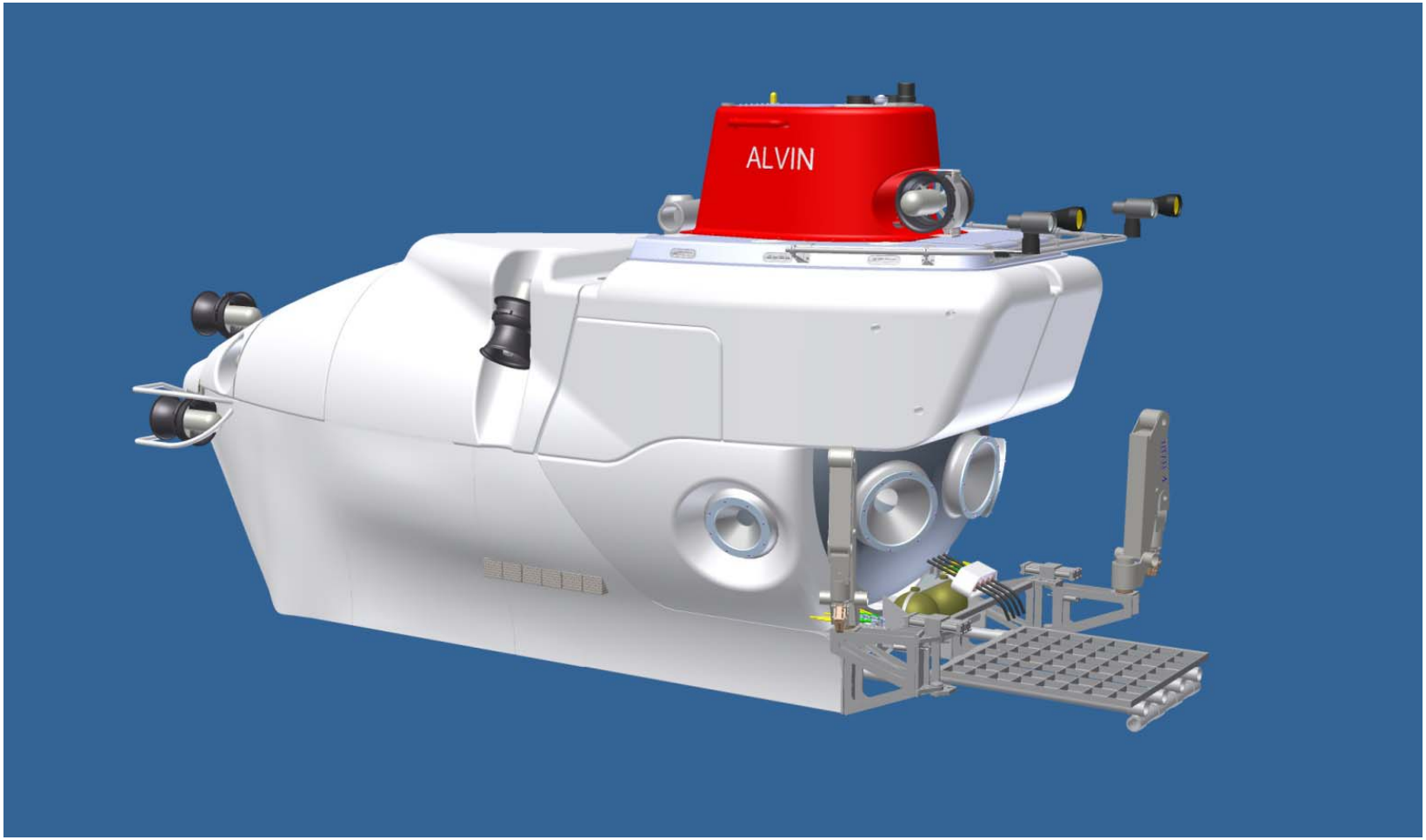
Alvin Upgrade Project: Status Report



Susan Humphris -- Principal Investigator
Kurt Uetz -- Project Manager

Capabilities Desired by the Scientific Community

- Increased depth capability to 6500 m
- Larger personnel sphere with improved interior ergonomics
- Increased battery capacity
- Increased bottom time at routine operating depths
- Better visibility with more observer view ports and overlapping fields of view between the pilot and two observers
- Improved interior electronics
- Increased science payloads
- Improved lighting and imaging systems
- Automated station keeping
- Increased thruster horsepower (improved maneuverability)
- Increased hydraulic plant capacity (improved manipulator performance)
- Improved data collection, logging, & instrument interface capability
- Improved mid-water research capability

Vehicle Upgrade

Sphere Construction

4500 m *Alvin* Upgrade

Stage 1

- New personnel sphere
- New syntactic foam
- New command and control system
- New data and power pressure housings
- New illumination system
- Upgrade to HD cameras
- New internal video infrastructure
- Upgrade to shipboard video duplicating system
- Upgrade to shipboard science video processing station

6500 m *Alvin* Upgrade

Stage 2

- New Li-ion batteries
- Increased horsepower thrusters and motors
- Upgrade of remaining components to 6500 m (e.g., variable ballast and HP air spheres)
- New ultra-high resolution digital still camera
- Addition of photomosaicing cameras

Stage 1 Design

	BASIC VEHICLE UPGRADE	Command and Control Enhancements; New Power and Data Pressure Housings	New 6500 m Syntactic Foam	Illumination Enhancements	Internal Video Infrastructure	Upgrade of Cameras to HD; Upgrade of Shipboard Data Duplication System	Ramped and Strobed LED Lights; External Still Image Storage Capability	Upgrade of Shipboard Science Processing Station	Stage 1 *Alvin*
Larger personnel sphere with improved interior ergonomics	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Increased Field of View for pilot's and observers	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Improved illumination	🔴	🔴	🔴	🟡	🟡	🟡	🟢	🟢	🟢
Improved imaging systems	🔴	🔴	🔴	🔴	🔴	🟡	🟡	🟡	🟡
Improved data collection, logging, and interface capability	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Improved interior electronics	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Automatic position keeping	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Increased thruster horsepower and better maneuverability	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Enhanced mid-water research capability	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Increased science payloads	🔴	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Increased battery capacity	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Increased on-bottom time	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Increased hydraulic plant capacity (improved manipulator performance)	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Increased operating Depth to 6500 meters	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴

Stage 2 Design

	Stage 1 *Alvin*	Still Image Mosaic Processing Tools	Ultra-High Resolution Still Camera; Mosaic Cameras	Addition of Software Tools for HD Editing	Variable Ballast Sphere Replacement	Li-ion Batteries	New Motors, Thrusters and Lateral Thruster	Upgrade of Remaining 4500m Components	Stage 2 *Alvin*
Larger personnel sphere with improved interior ergonomics	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Increased Field of View for pilots and observers	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Improved illumination	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Improved imaging systems	🟡	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Improved data collection, logging, and interface capability	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Improved interior electronics	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Automatic position keeping	🟡	🟡	🟡	🟡	🟡	🟡	🟢	🟢	🟢
Increased thruster horsepower and better maneuverability	🟡	🟡	🟡	🟡	🟡	🟡	🟢	🟢	🟢
Enhanced mid-water research capability	🟡	🟡	🟡	🟡	🟡	🟡	🟢	🟢	🟢
Increased science payloads	🟡	🟡	🟡	🟡	🟡	🟢	🟢	🟢	🟢
Increased battery capacity	🔴	🔴	🔴	🔴	🔴	🟢	🟢	🟢	🟢
Increased on-bottom time	🔴	🔴	🔴	🔴	🔴	🟢	🟢	🟢	🟢
Increased hydraulic plant capacity (improved manipulator performance)	🔴	🔴	🔴	🔴	🔴	🟡	🟢	🟢	🟢
Increased operating Depth to 6500 meters	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🟢	🟢

Science Community Design Input

- NSF created the Replacement HOV Oversight Committee (RHOC) to ensure community oversight and input:
  -- provide advice on the design, budget priorities, and scope of the project

- RHOC has bi-weekly communications with NSF and WHOI

- Other community input:
  - Surveys (viewports, science gear, interior ergonomics, imaging data storage formats)
  - Presentations (DESSC, AGU, other)

Community Response: Interior Ergonomics Survey

No. of Responses: 111

Disciplines

- 35 Geologists
- 29 Biologists
- 24 Geochemists
- 19 Microbiologists
- 5 Geophysicists
- 3 Engineers
- 2 Climate Change Scientists
- 1 Physical Oceanographer
- 1 Planetary Explorer
- 1 Scientific Illustrator
- 1 Pilot

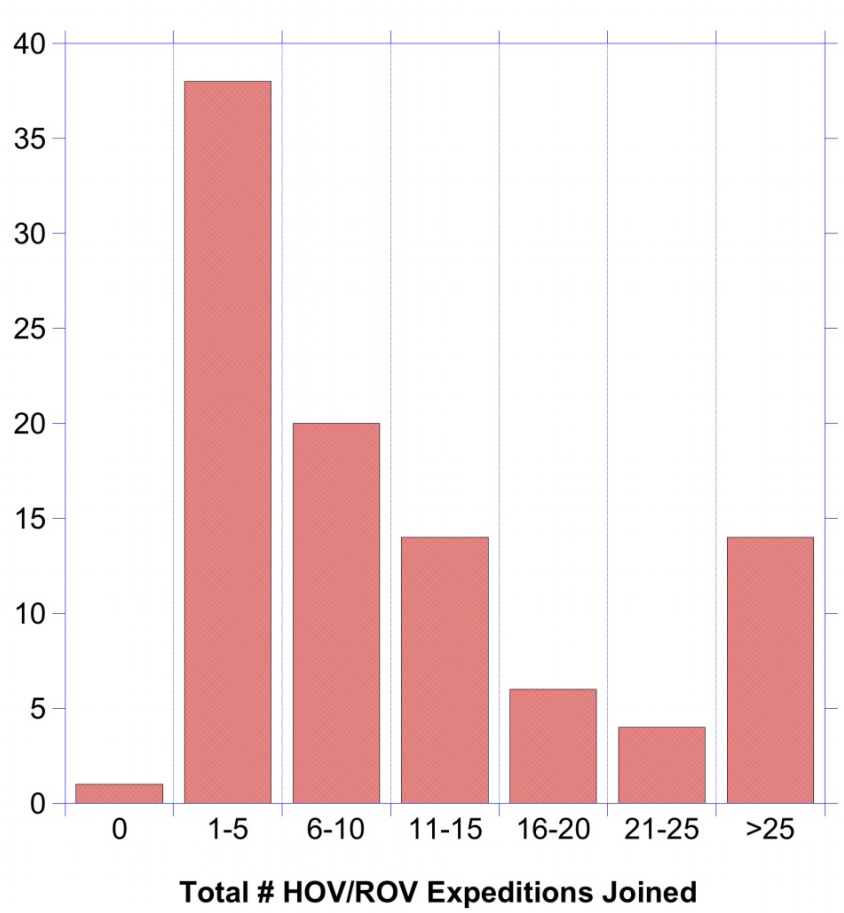
Vehicles Used

HOVs: 13
ROVs: 33

Community Response: Interior Ergonomics Survey

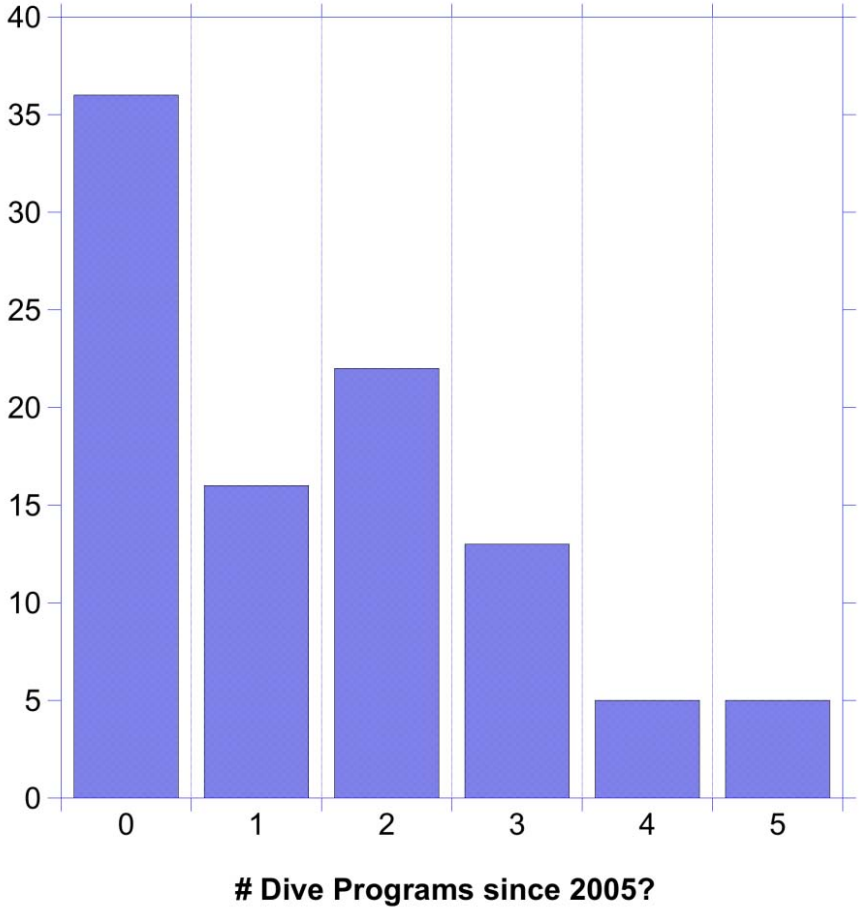
Prior Deep Submergence Experience

(103 Responses)

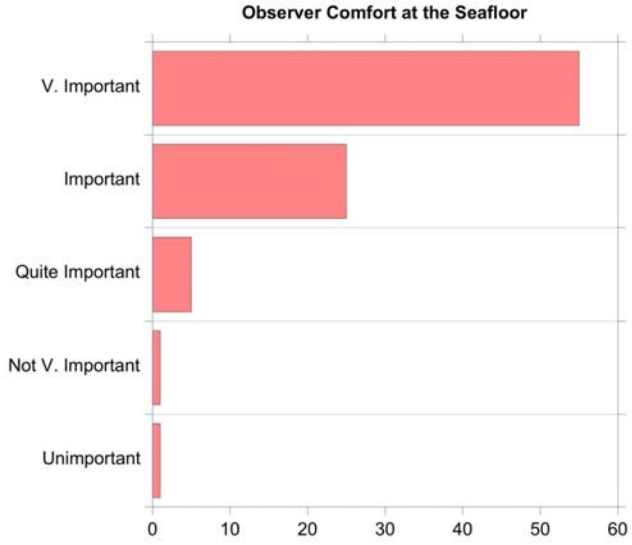


2005-2009 *Alvin* Experience

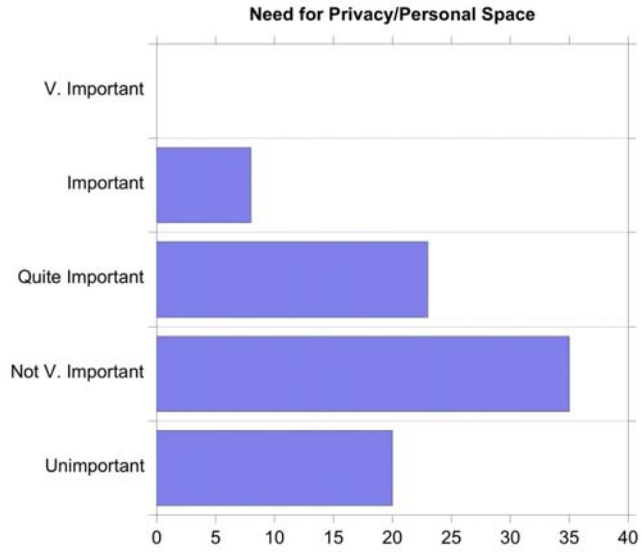
(98 Responses)

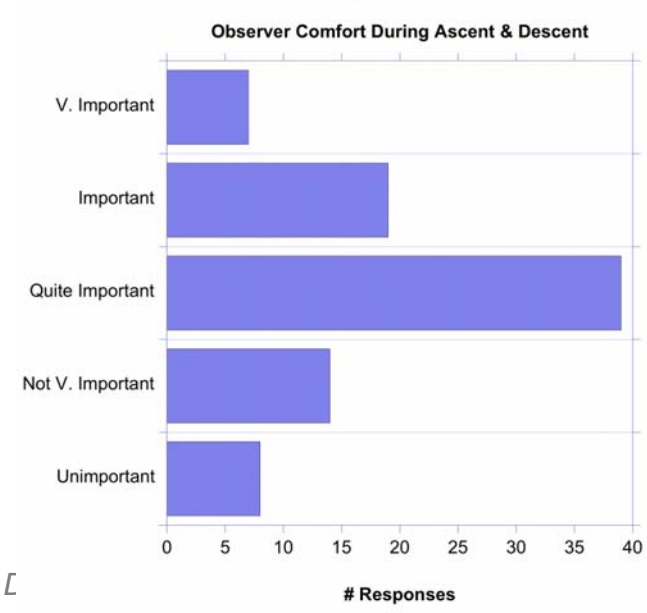


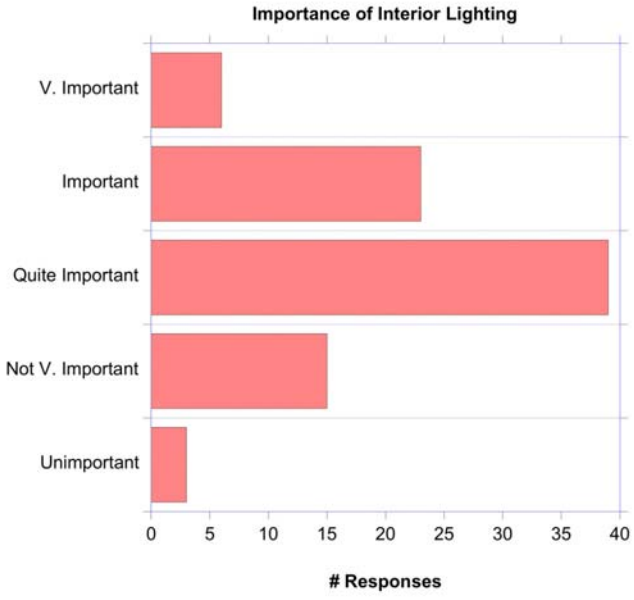
Community Response: Interior Ergonomics Survey



87 Responses







Community Response: Interior Ergonomics Survey

Observer & Pilot Positions

Pilot: Do whatever it takes to make pilots happy

Observers:

	Lie Flat	Kneel	Sit Up	Both Options
At Seafloor	13	15	--	50
During Ascent/Descent	7	--	31	38

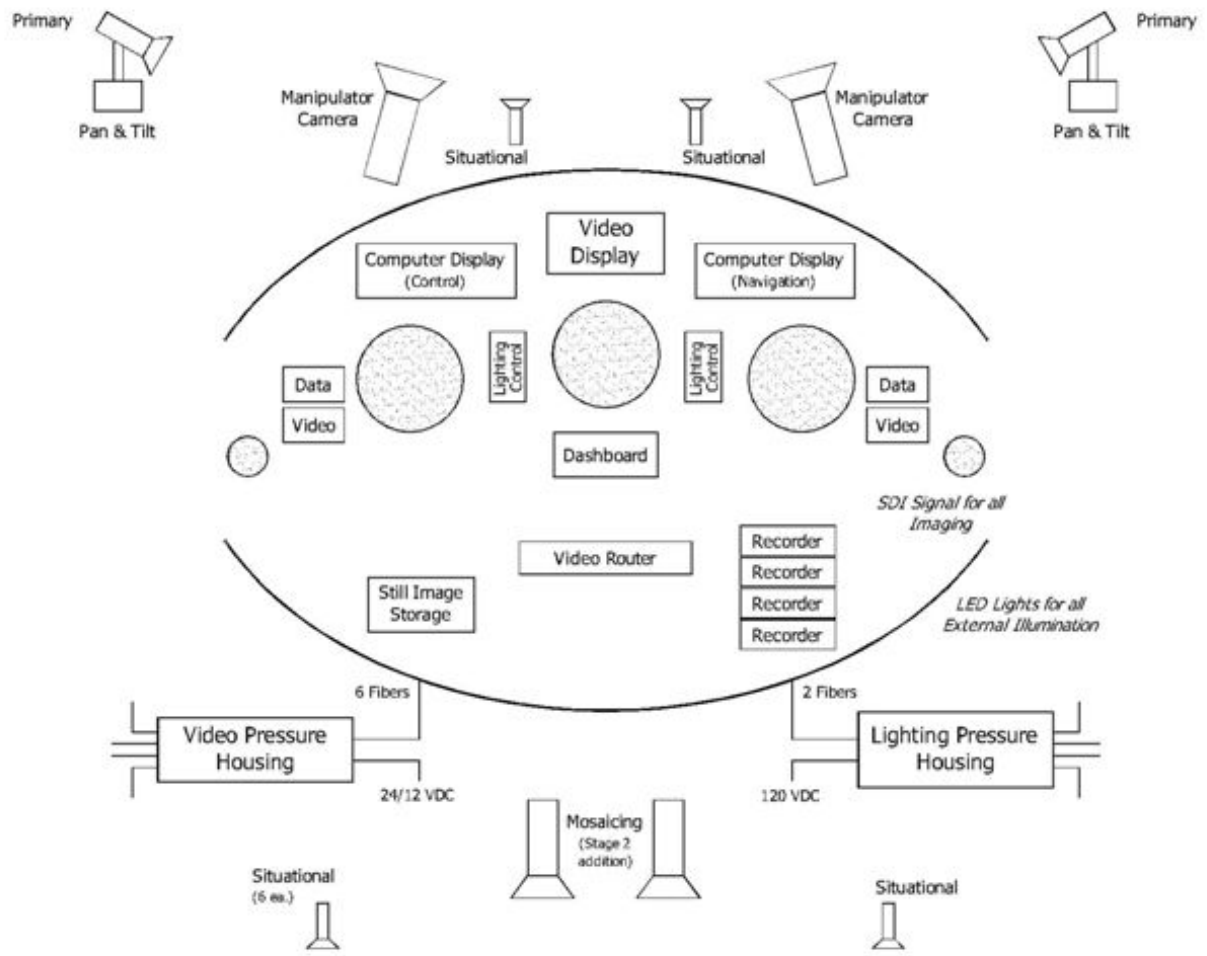
Sphere Mockup

Science Users Evaluating Mockup Ergonomics

Sphere Mockup

QuickTime™ and a
H.264 decompressor
are needed to see this picture.

Imaging and Illumination



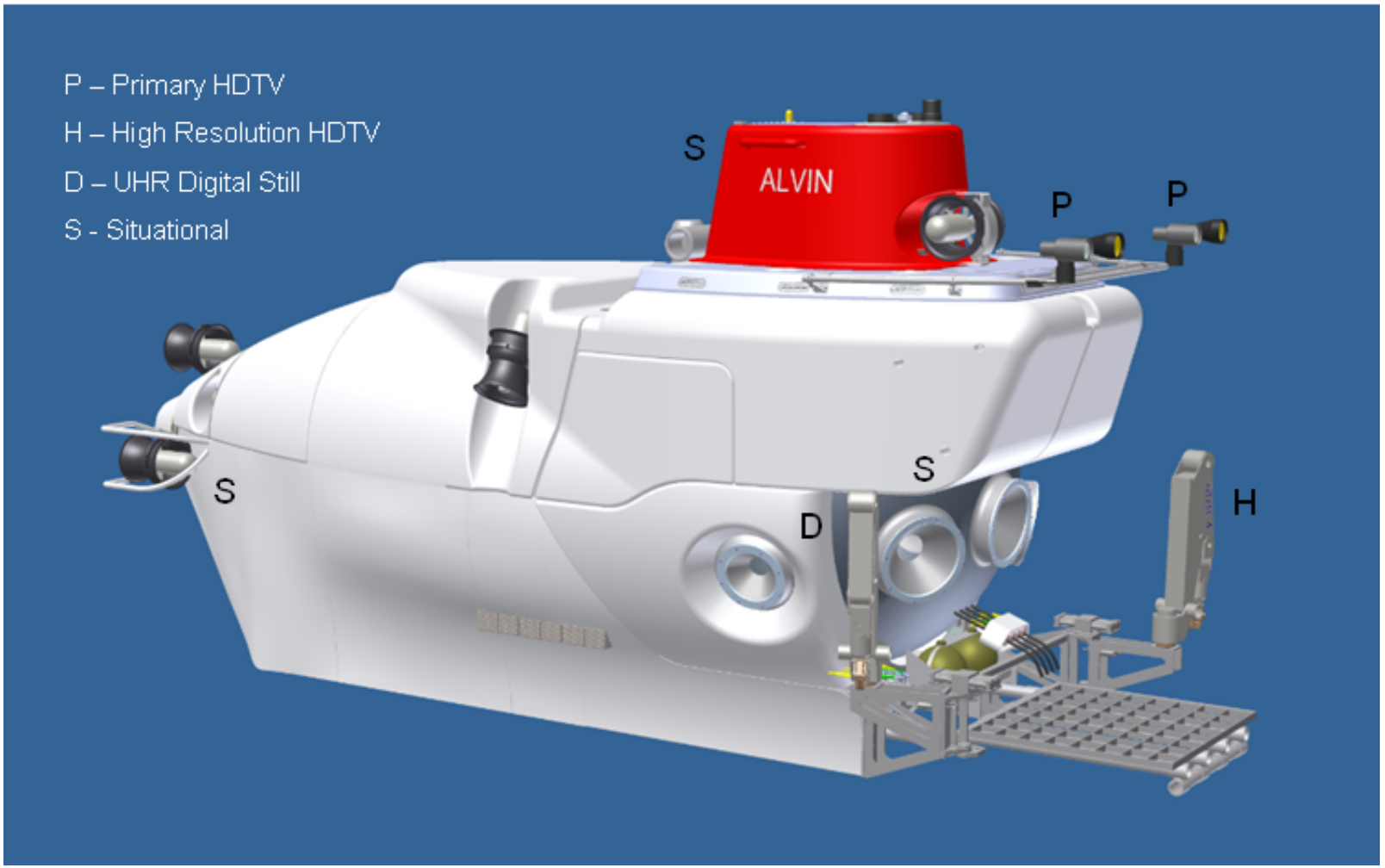
Lighting System

Goal

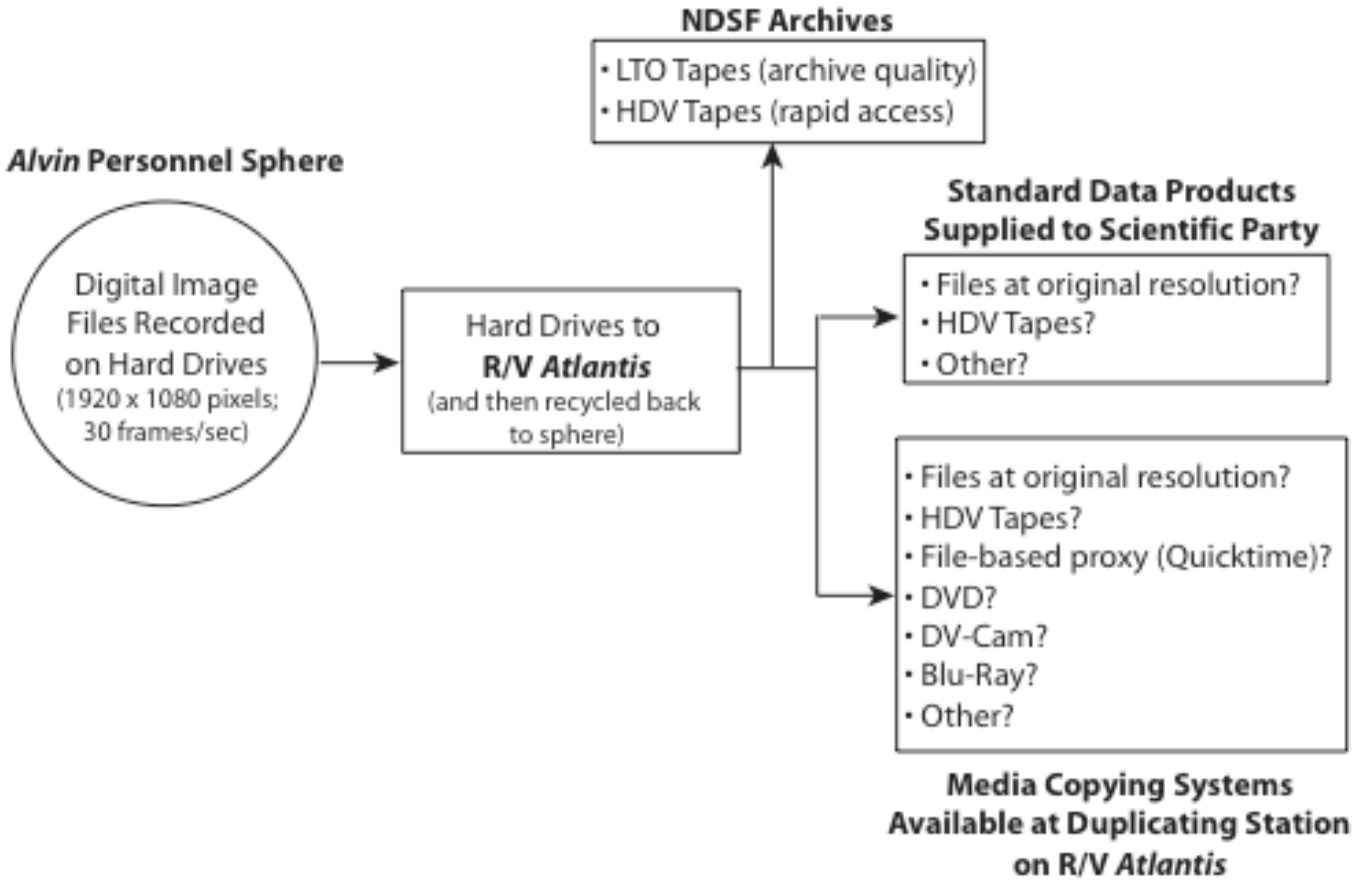
Double the Illumination Level of Current *Alvin* Lighting

- High power, high efficiency LED lighting system
- Low power-per-lumen light heads
- Lighting arrangement (5 zones)
  -- Forward wide, forward narrow
  -- Port, starboard
  -- Down-looking
- Operational modes: full-on, dimmable, ramped, strobed (for down-looking surveys)
- Color frequency, beam pattern, location -- under design

Camera Placement



Flow of Image Files



Community Response: Imagery Storage Media Survey

No. of Responses: 17

Uses of Imagery

• Quantitative analyses of scientific observations	15
• Scientific presentations at meetings/workshops	16
• Documenting methodologies and recording data	13
• Educational purposes	15
• Supplying footage to press and media	13
• Mosaicing imagery for overall views of areas	1

Community Response: Imagery Storage Media Survey

Standard Data Product for the Scientific Party

	Yes	No
1. Require a complete set of files at full acquisition resolution	7	10
2. HDV tapes sufficient as the standard data product	9	7
3. If no, preference for alternatives: File based proxy (e.g. Quicktime) Blu-Ray DVD DV-Cam (Standard Def)	No clear preference	

Community Response: Imagery Storage Media Survey

Available Formats at Shipboard Duplicating Station

	Yes	No
1. Require access to imagery at full acquisition resolution for copying	16	0

2. Preference for media duplicating equipment — No clear preference
   - HDV
   - File based proxy (e.g. Quicktime)
   - Blu-Ray
   - DVD
   - DV-Cam (Standard Def)

Alvin Upgrade Project

We Need Your Input!