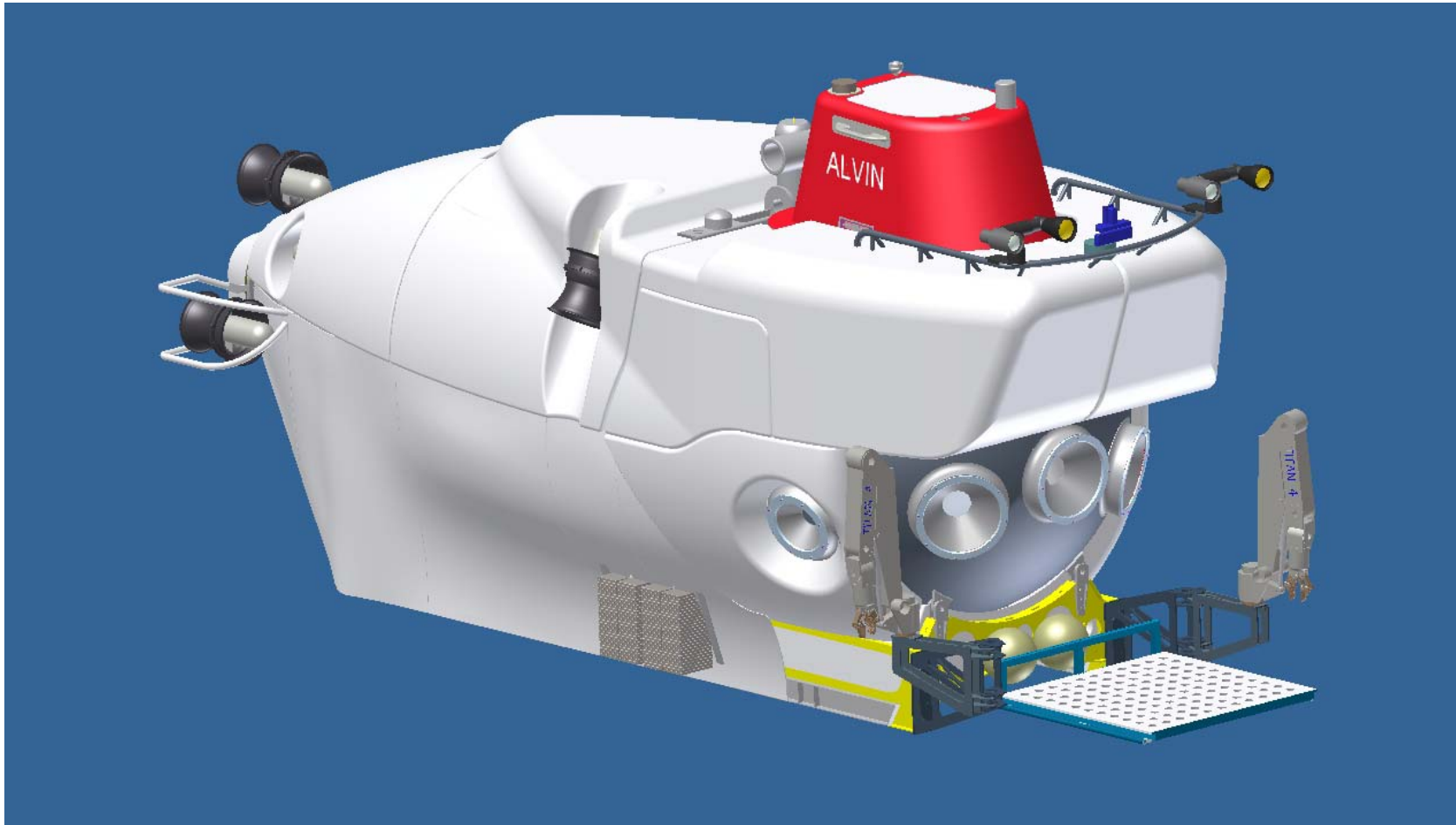




Alvin Upgrade Project Update



DESSC Meeting -- 18-19 May 2010



Alvin Upgrade Project Staged Approach



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

- Satisfy as many original replacement HOV design goals as possible
- Leverage replacement HOV design efforts already undertaken
- Reduce total project costs
- Allow for later upgrade to full 6500m vehicle

Phase I - Sphere

4500m *Alvin* Upgrade

Stage 1

6500m *Alvin*

Stage 2



Alvin Upgrade Project Project Schedule



- Preliminary Design Review December 2009
- Final Design Review September 2010
Begin Procurement and Fabrication
- Sphere Delivered to WHOI March 2011
- *Alvin* Delivered to WHOI April 2011
- Begin Disassembly April 2011

- Begin Assembly July 2011
- Begin Sea Trials September 2011
- Science Shakedown Cruise November 2011



Alvin Upgrade Project Preferred Design



Added Science Capabilities



	BASE VEHICLE	Command and Control Enhancements; New Power and Data Bottles	All New 6500 Meter Syntactic Foam	Illumination Enhancements	Imaging Option 1 - Internal Video Infrastructure	Imaging Option 2 - New HD Camera, Upgrade of Existing Camera; Upgrade Shipboard Data Duplication System	Imaging Option 3 - Ramped and Strobed LED Lights; External Still Image Storage Capability	Imaging Option 4 - Upgrade of Shipboard Science Processing Station	PREFERRED A-4500 HOV
General Information/ System Engineering	-	\$135,927							\$135,927
Fixed Buoyancy Assemblies	-		\$1,097,088						\$1,097,088
Penetrator	-	\$64,306							\$64,306
Power Bottle	-	\$68,253							\$68,253
Data Bottle	-	\$149,796							\$149,796
Junction Boxes	-	\$22,070							\$22,070
Illumination and Imaging	-			\$197,427	\$568,560	\$356,660	\$479,053	\$91,750	\$1,693,450
Science Data Systems	-	\$74,151							\$74,151
Command, Control & Computing	-	\$598,004							\$598,004
Upscope Cost Subtotals	-	\$1,112,506	\$1,097,088	\$197,427	\$568,560	\$356,660	\$479,053	\$91,750	\$3,903,044
Total Material and Labor Cost (Cumulative Totals)	\$27,134,836	\$28,256,342	\$29,353,430	\$29,550,857	\$30,119,417	\$30,476,077	\$30,955,130	\$31,046,880	\$31,046,880
								Escalation	676,014
								Contingency (95% Level of Confidence)	3,452,000
								Total	\$35,174,894

Subtotals Are For FY2009 dollars
Escalation is estimated at 4%/year
Confidence Level estimated for preferred A-4500M HOV only

	BASE A-4500 HOV	Command and Control Enhancements; New Power and Data Bottles	All New 6500 m Syntactic Foam	Illumination Enhancements	Imaging Option 1 - Internal Video Infrastructure	Imaging Option 2 - New HD Camera, Upgrade of Existing Camera; Upgrade to Shipboard Data Duplication System	Imaging Option 3 - Ramped and Strobed LED Lights; External Still Image Storage Capability	Imaging Option 4 - Shipboard Science Processing Station Upgrade	PREFERRED A-4500 HOV
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	●	●	●	●	●	●	●	●	●
Upscope cost impact	—	\$1,112,506	\$1,097,088	\$197,427	\$568,560	\$356,660	\$479,053	\$91,750	\$3,903,044



Alvin Upgrade Project Post-PDR NSF Requirements



- Final Design Review: 21-23 September 2010
 - WHOI to provide a Hazards Analysis that articulates how operational hazards will be eliminated, mitigated or accepted (e.g. consider releasable thrusters)
 - WHOI to reassess the project schedule, budget & risk with particular attention to sphere schedule risk, costs of ABS Classification, and contingency schedule & budget



Alvin Upgrade Project Personnel Sphere Construction



Ti Ingots



June 2008



August 2009



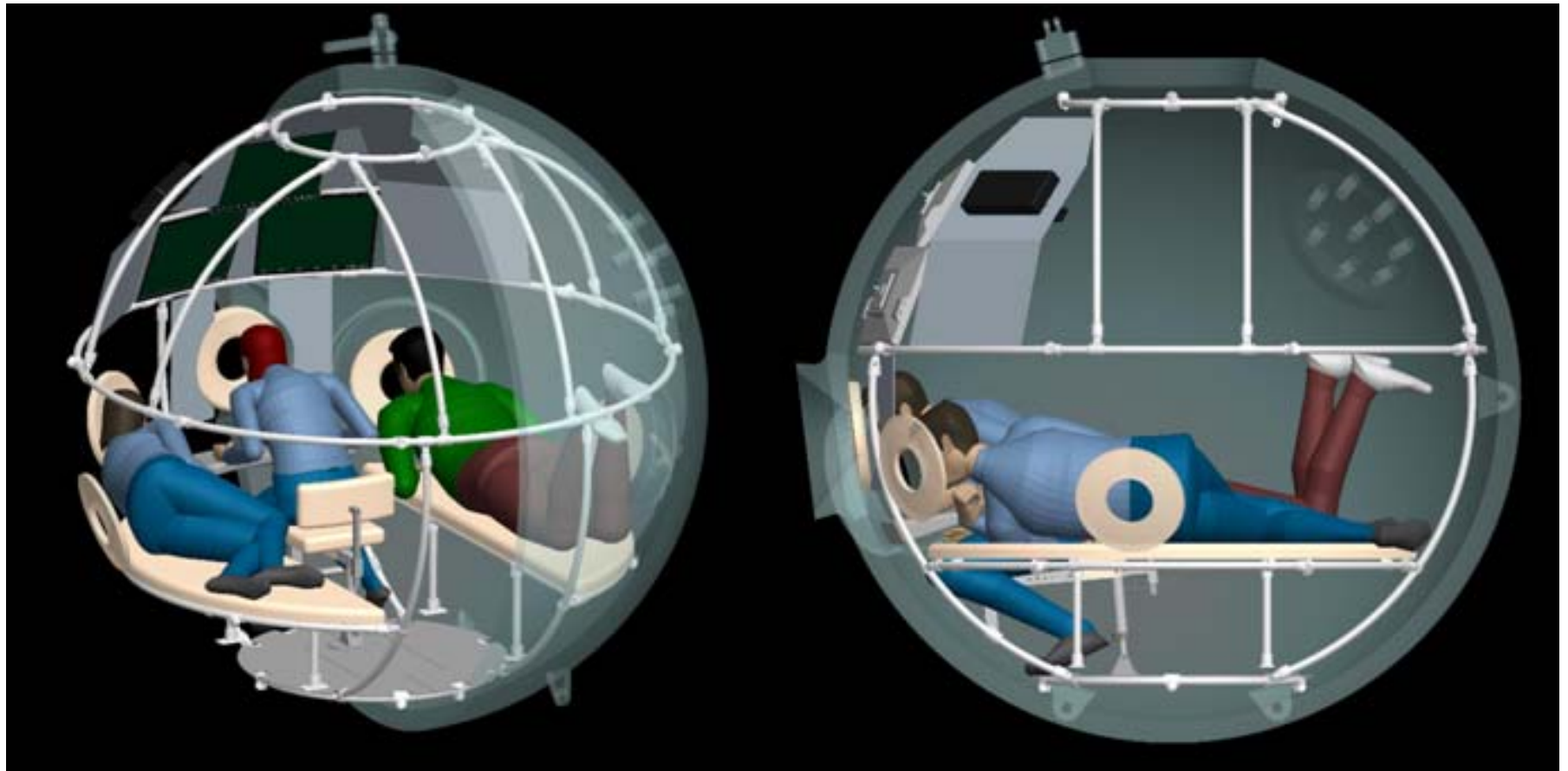
Alvin Upgrade Project Personnel Sphere Construction



May 2010

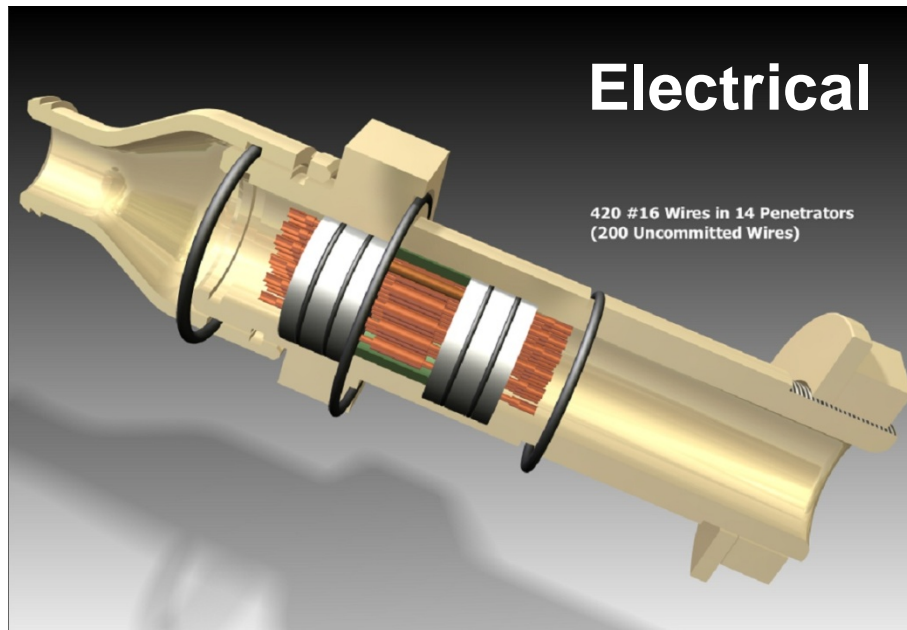


Alvin Upgrade Project Interior Ergonomics



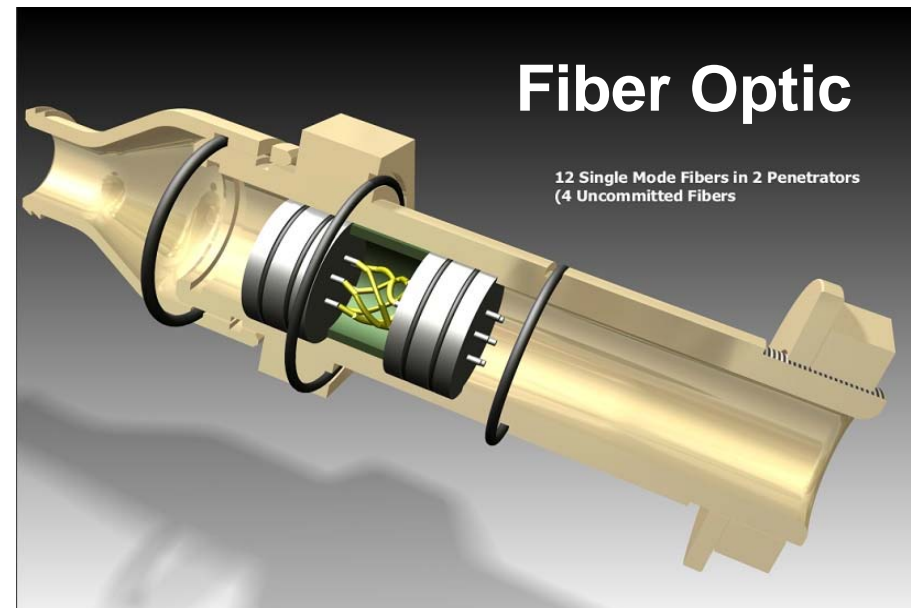


Alvin Upgrade Project Penetrators



Purchase order for 3 (of 18)
issued to Kemlon

Purchase order for 5 (of 5)
issued to Lancer





Alvin Upgrade Project Syntactic Foam



Materials:

- 36 lb/cubic foot syntactic foam
- Produced in 0.5 cubic foot blocks that will each be pressure tested before shaping

Procurement Schedule:

- Two companies: CMT; Trelleborg/Emerson and Cuming
- QA testing to be completed by end of May
- Early June: PO for 100 cubic feet issued to each company
-- check on production capability



Alvin Upgrade Project

ABS Classification Requirements



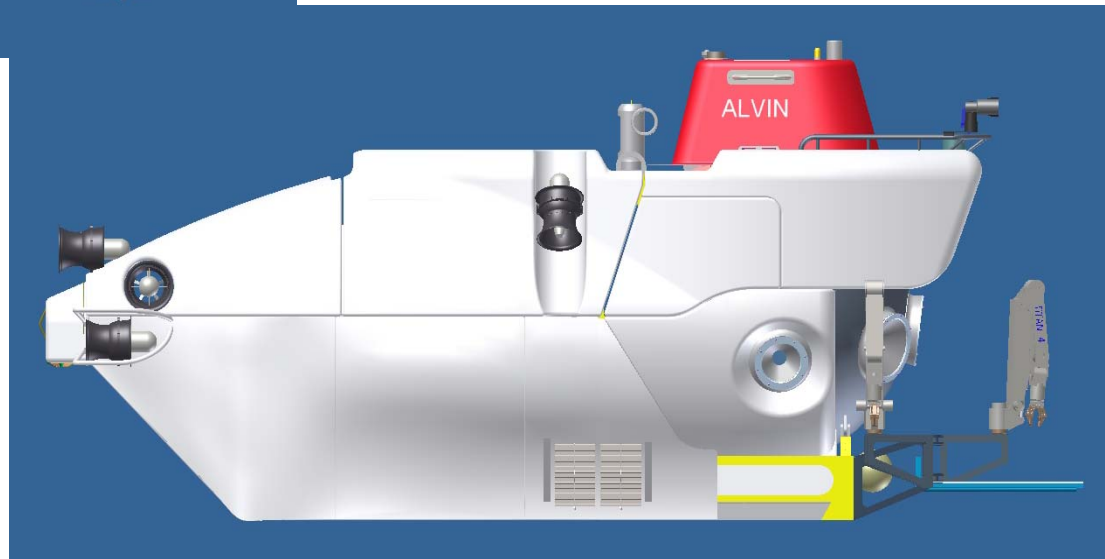
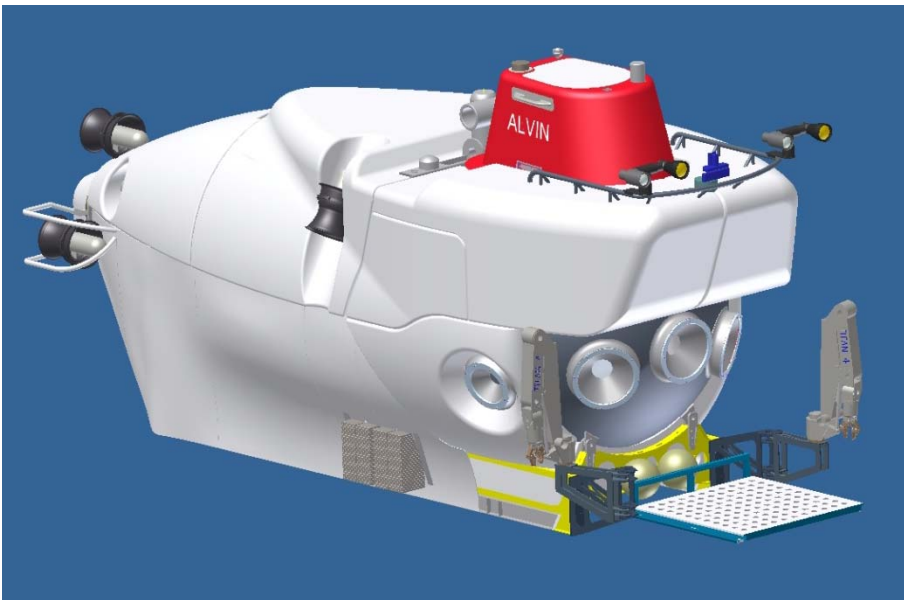
Applicable Rules: *ABS Rules for Building and Classing Underwater Vehicles, Systems and Hyperbaric Facilities*

- Variable ballast spheres package submitted
- Alternative arrangement request for bathtub combing height submitted
- Meeting with ABS at WHOI in July
 - Present overall upgrade plan
 - Present systems that will be cross-decked (all packages ready for submittal)
 - Present designs of new components/systems



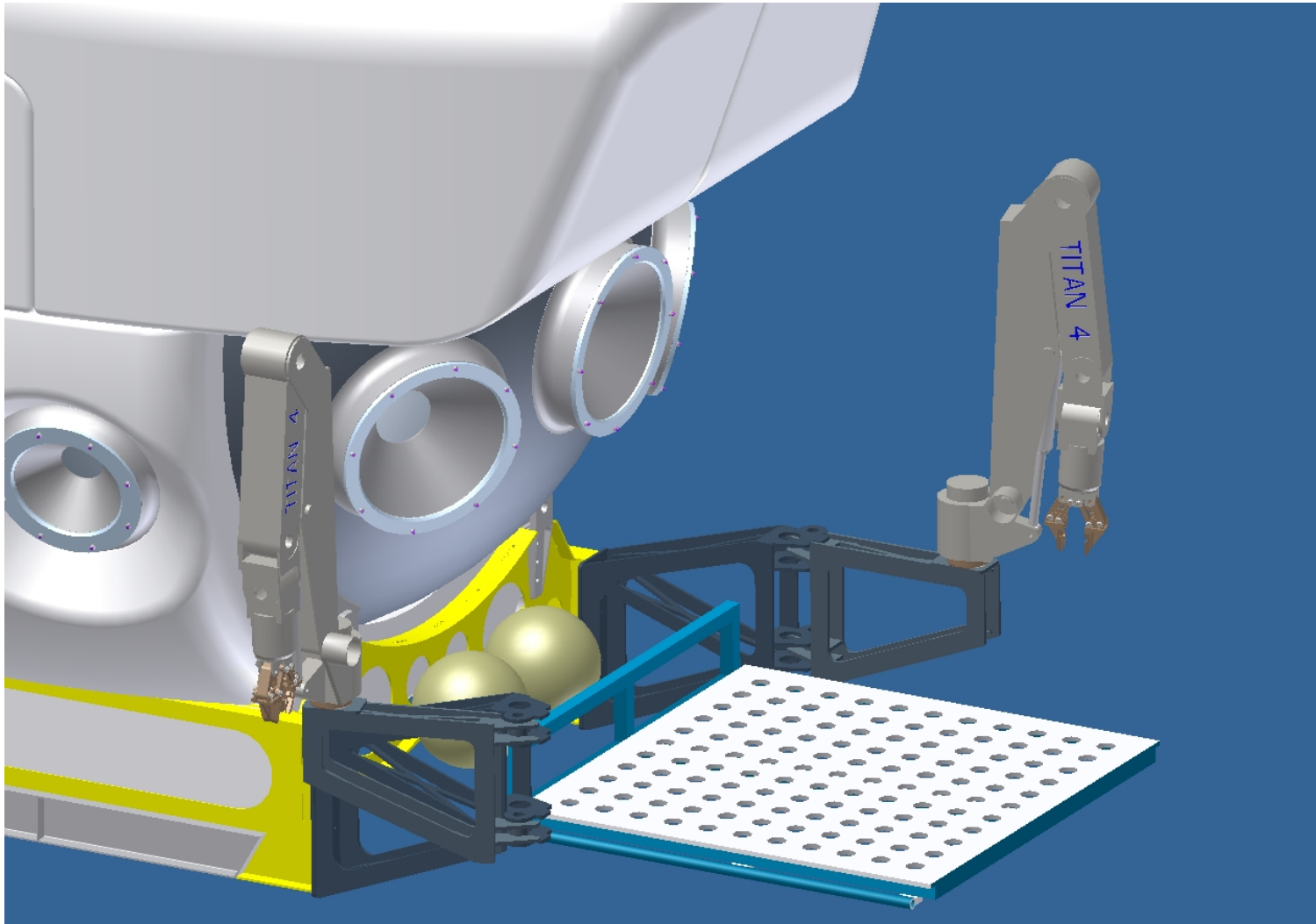
Alvin Upgrade Project

Manipulator Arrangement





Alvin Upgrade Project Manipulator Arrangement





Alvin Upgrade Project Science Shakedown Cruise



Schedule

- January -- WHOI submits Criteria & Requirements Document to RHOC
- February -- RHOC endorses the Document and recommends to NSF
- Post-FDR -- NSF to issue a “Dear Colleague” letter requesting participation
- Nov. 2011 -- Shakedown Cruise

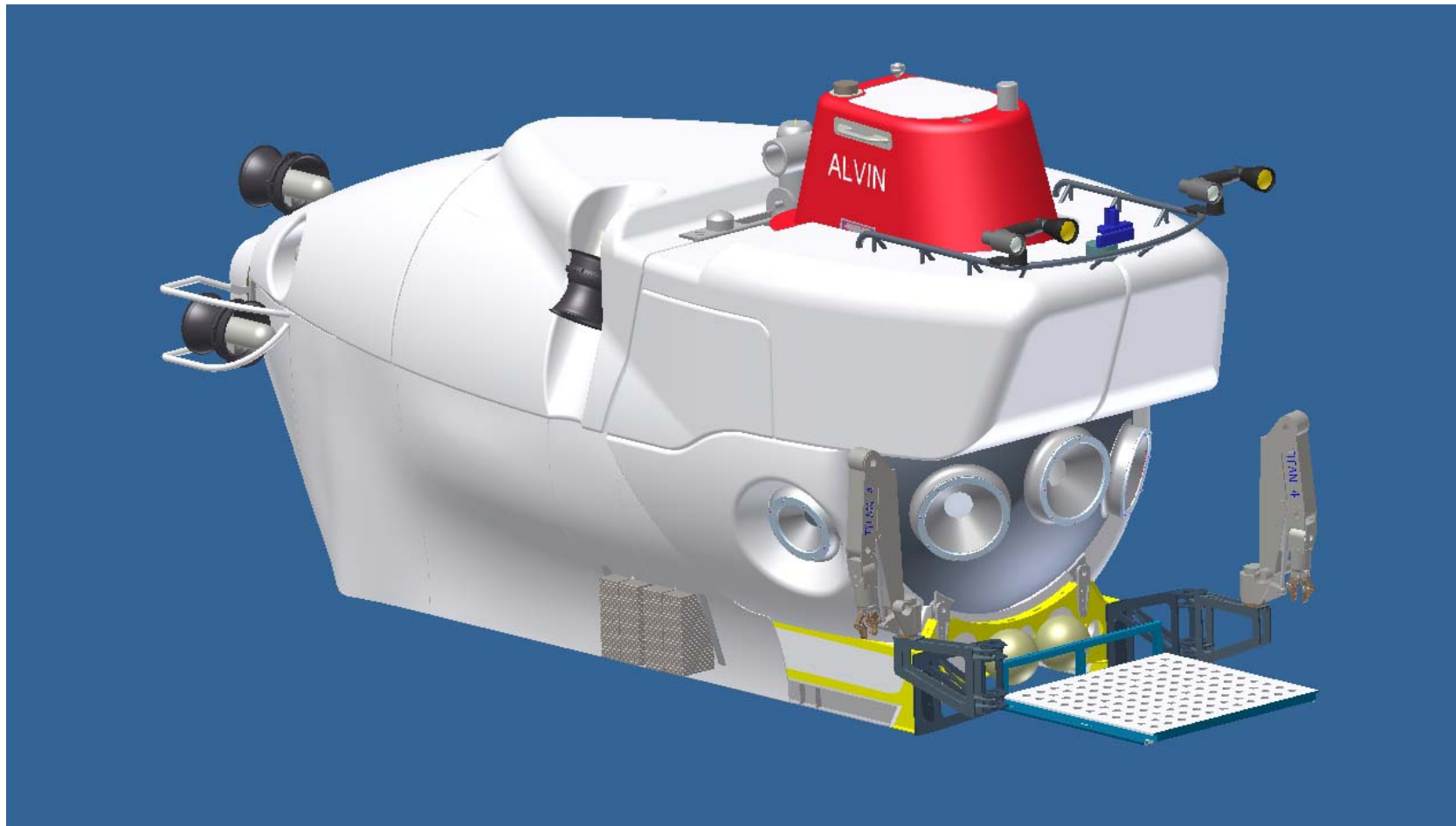
Limitations, Requirements

- 30-day cruise out of Bermuda: 10-12 days transit to accommodate diverse scientific areas & terrain types; some of dive sites close to port
- Capabilities to be tested to include:

Navigation	Data logging & science access to data
Seafloor mapping	Lighting & imaging
Sampling (variety)	User-provided equipment interface
Elevator use	Ergonomic design



Alvin Upgrade Project Update



DESSC Meeting -- 18-19 May 2010



Alvin Upgrade Project

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



Alvin Upgrade Project

Science Equipment



Temperature Measuring Devices

High and Low Temperature Probes

Inductively Coupled Link (ICL) Temperature Probe

Heat Flow Probes: 1 meter and 0.66 meters

Sampling and Data Collection Equipment

Magnetometer

Major Ti - Water Samplers

Niskin Bottles

Portable CTD

Push Cores

Scoop Nets

Small Capacity Slurp Samplers

Large Capacity Slurp Samplers:

- 1) Multi-chamber Rotary Collection Sampler
- 2) Single Chamber Slurp Sampler
- 3) High Volume Fish Sampler

Hydraulically-driven Slurp/ Fluid Pump



Alvin Upgrade Project

Science Equipment



Internal Cameras

2 ea. Observer DSC Canon Power Shot G7 cameras

1 ea Nikon D1 SLR DSC

2 ea Sony HDR-HC9 MiniDV HiDef video cameras

Profiling Sonars

Reson 7125 SeaBat multi beam sonar

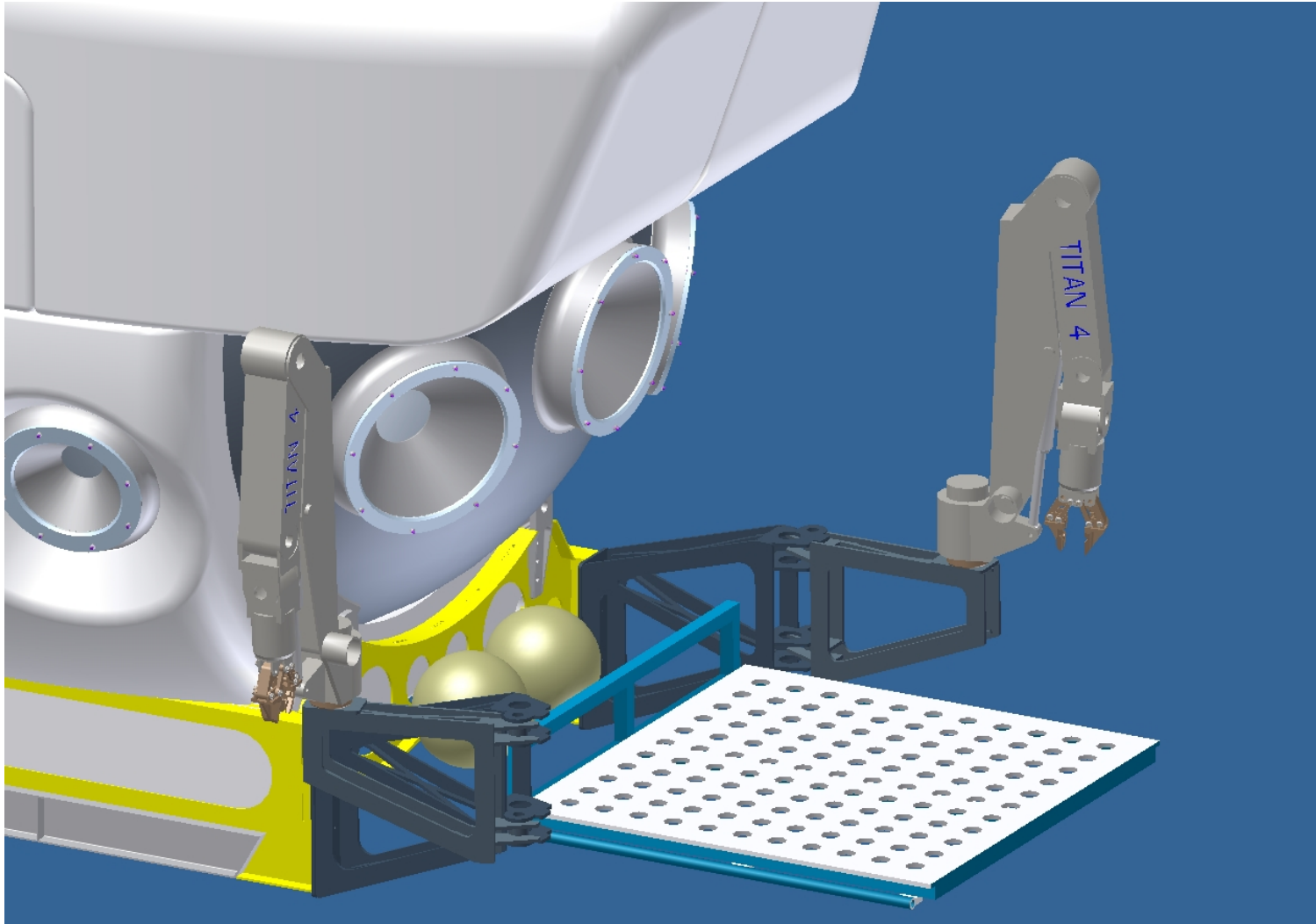
1 ea. (spare) Imagenix 881 profiling sonar

Sun West CTFM fwd scanning sonar

1 ea. (spare) Tritech Seaking S8540 dual frequency scanning sonar

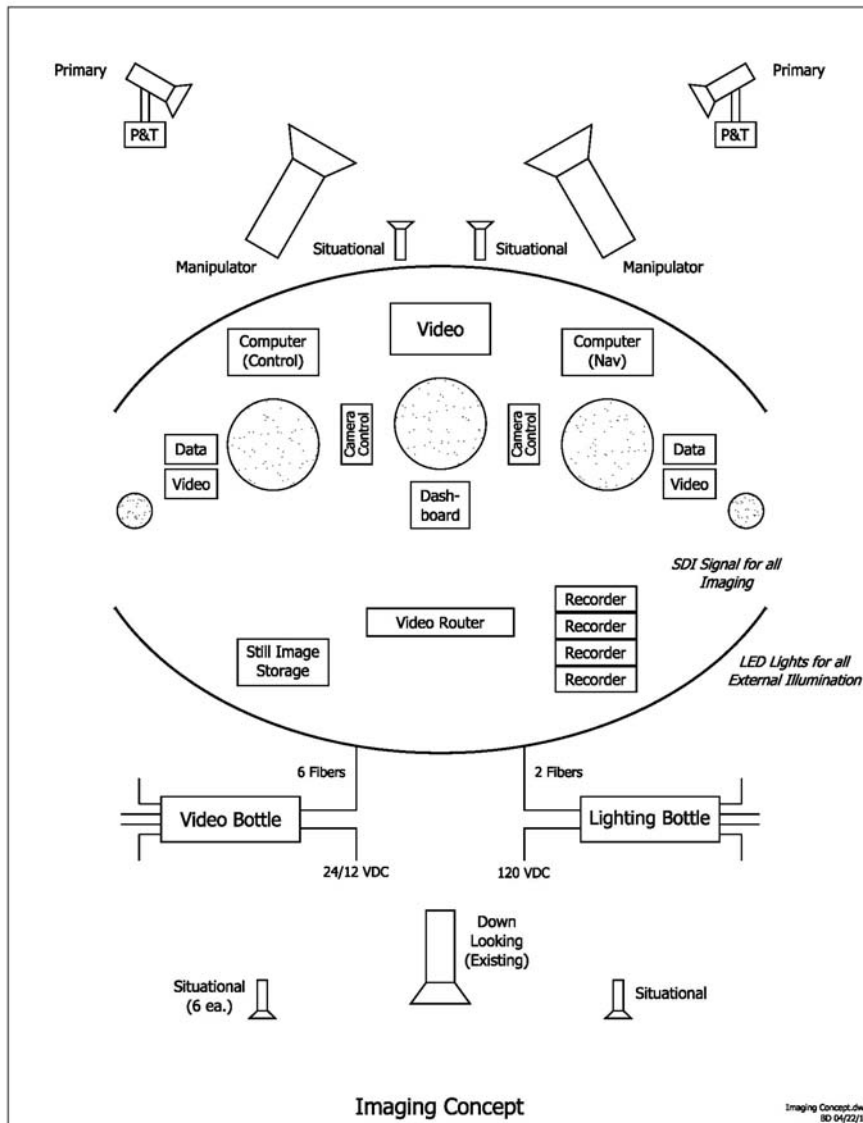


Alvin Upgrade Project Manipulator Arrangement





Alvin Upgrade Project Imaging System

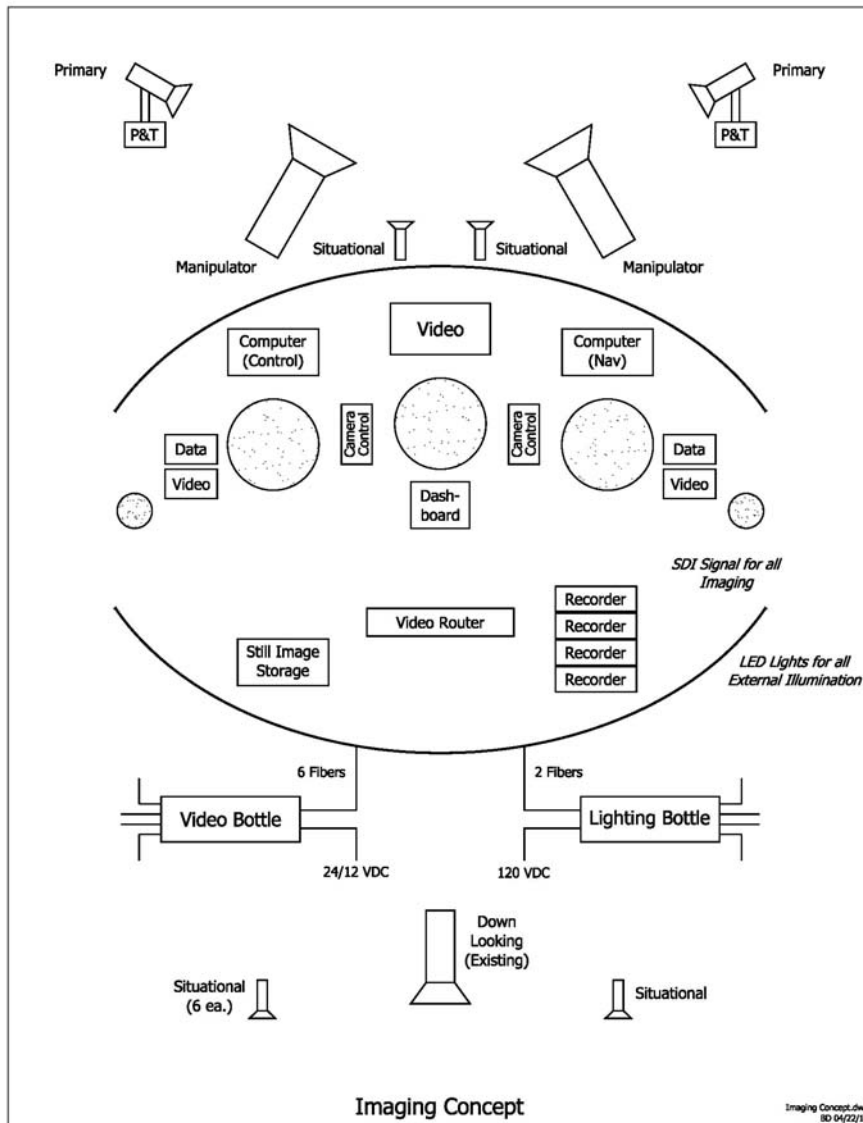


Components:

- Lighting System
- Camera Systems
- Telemetry Systems
- Control Systems
- In-Hull Video Plant
- Recording Systems



Alvin Upgrade Project Lighting System

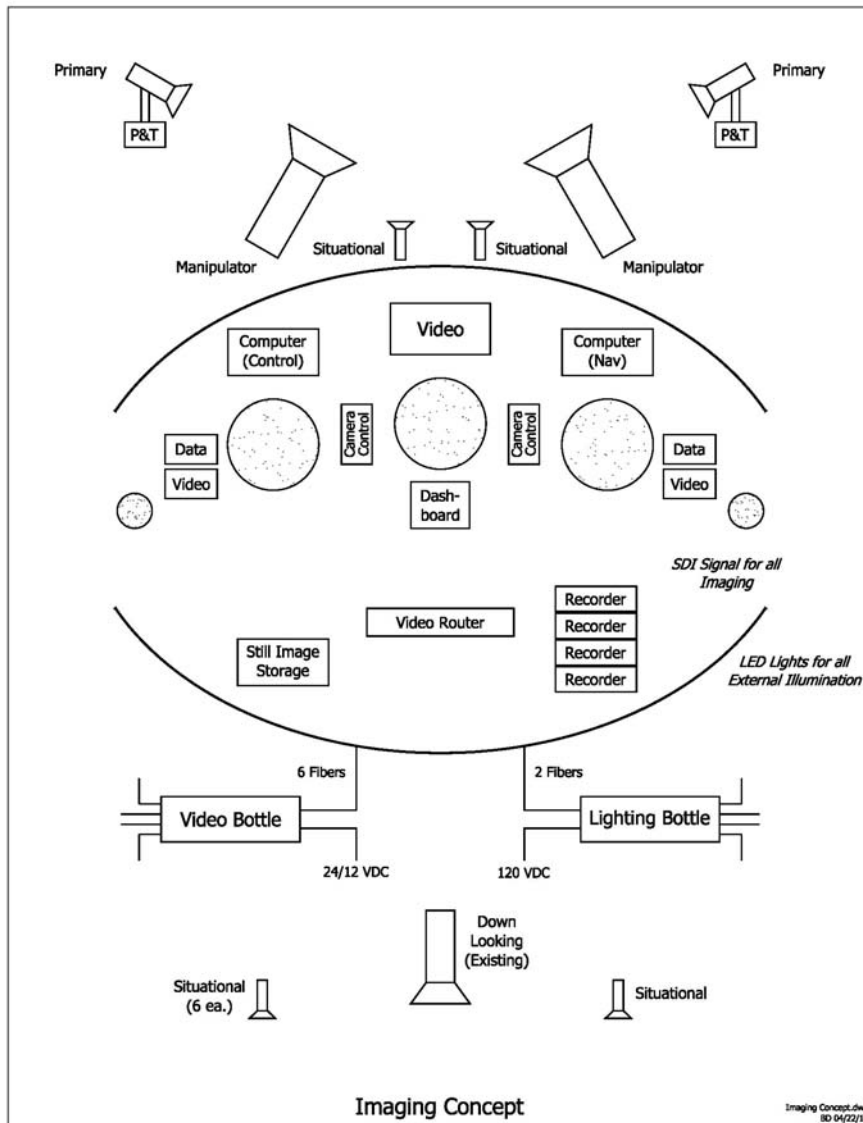


Goal: Double the Illumination Level of Current *Alvin* Lighting

- 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



Alvin Upgrade Project Camera Systems



- **Primary Cameras**

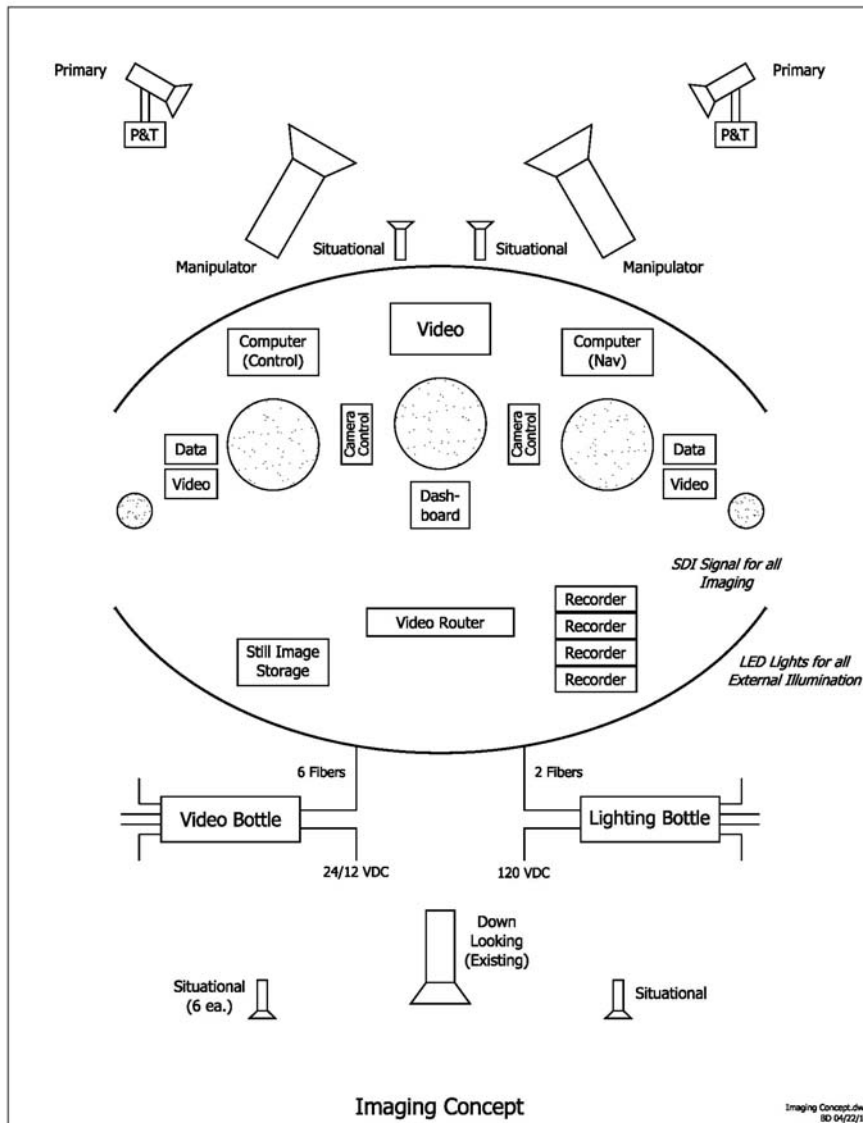
- 2 HDTV cameras mounted on pan & tilt systems
- Location port & starboard sponson
- HDTV motion output 1080 59.94i
- Low light camera sensor
- Use existing pressure housings

- **Manipulator Science Cameras**

- 2 HDTV or higher resolution cameras
- 1 NDSF design with imager upgrade
- 1 TBD with enhanced higher resolution still image capability
- High optical resolution



Alvin Upgrade Project Camera Systems



- **Situational Cameras**

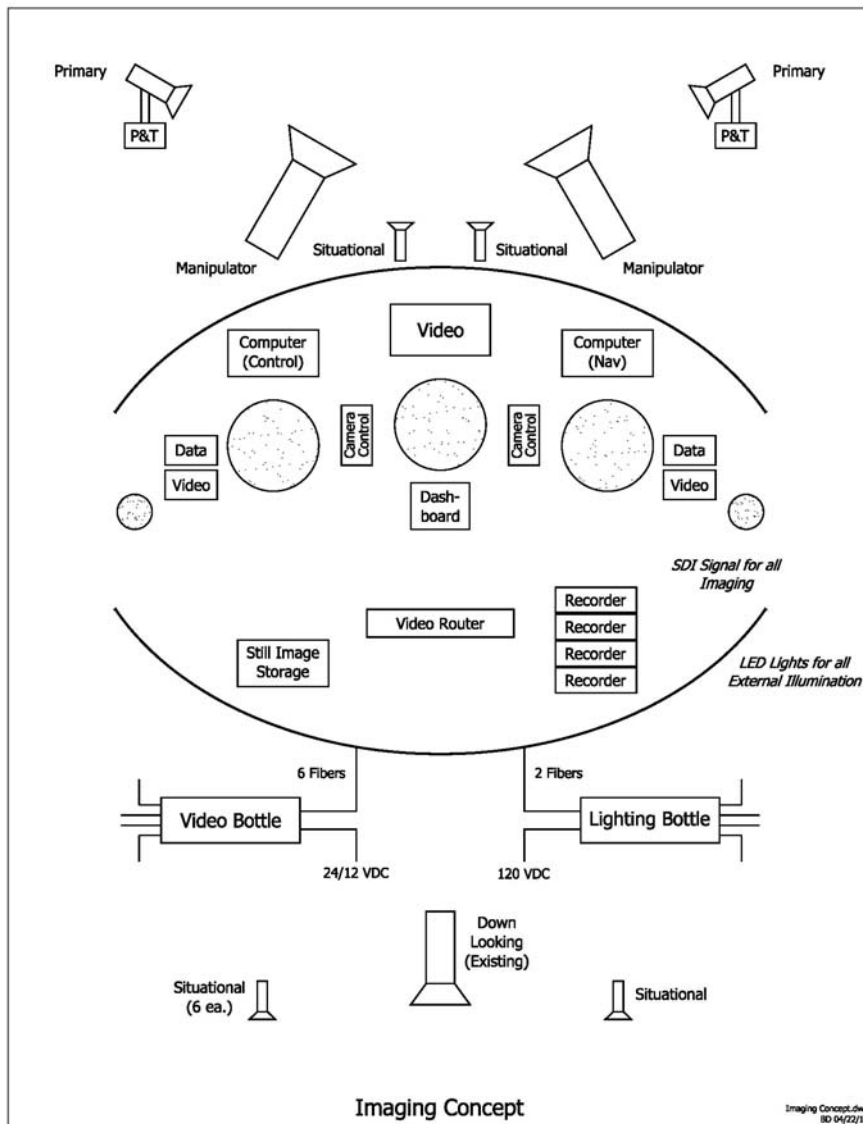
- Piloting and situational awareness cameras
- Standard definition
- Low light
- Location and number TBD
 - Forward, basket, down-looking, tail, sail port & starboard

- **Mosaic Cameras (later addition)**

- 1-2 motion/still cameras; color/BW
- Down-looking inside frame of vehicle
- 1920x1080 progressive or higher imagers
- Synced to strobe LED array



Alvin Upgrade Project In-Hull Video System



- All video signals will be digital and conform to the SMPTE serial digital interface specification
- A digital 32 input x 32 output router will distribute and direct signals to appropriate destinations
- 5 HD video monitors (1 for piloting, 4 for observers)
- Master sync and time code system
- Digital HDTV recording system -- TBD



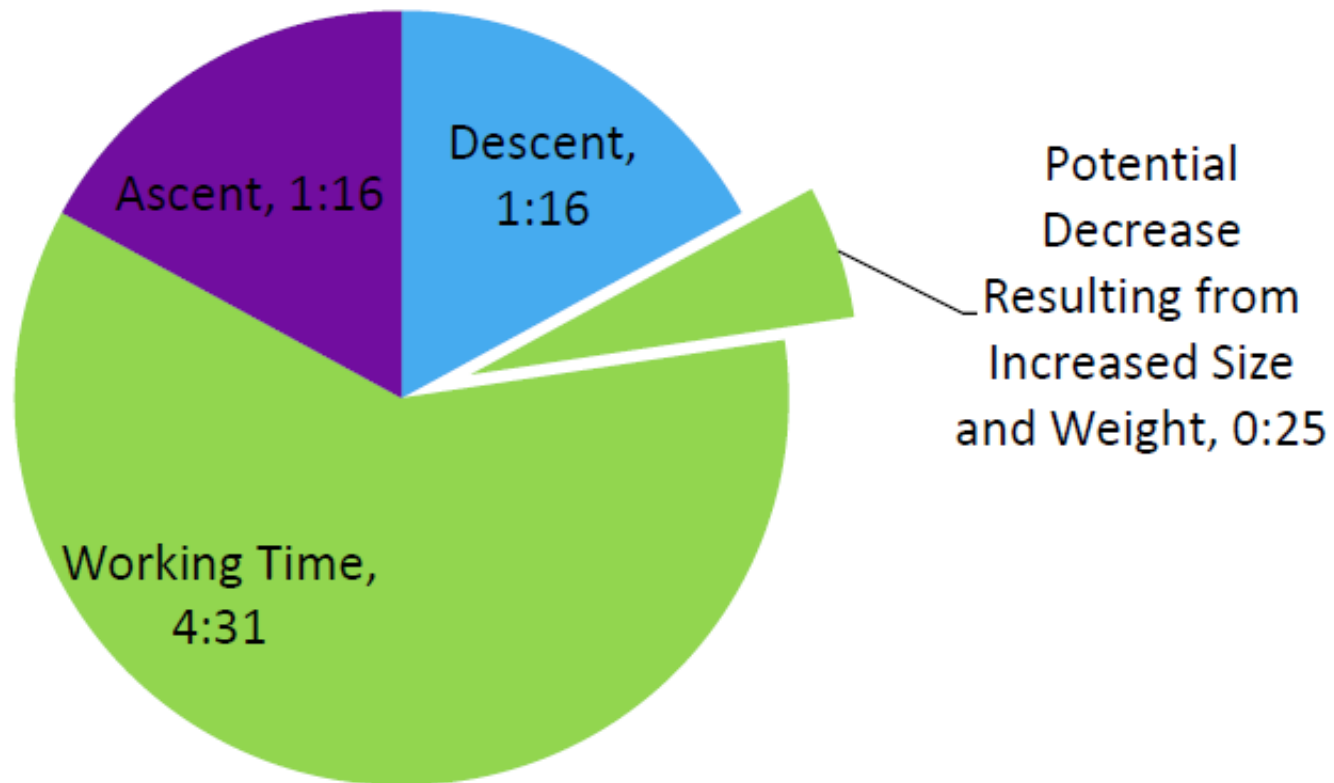
A-4500 HOV



Dive Time Reduction Estimate

Dive Time - 7:30 total

Change due to increased energy needs





A-4500 HOV

Budget for Preferred A-4500 HOV Design



A-4500 HOV Cost of Preferred Design	\$31,046,880
With Escalation	\$31,722,894
Contingency	\$ <u>3,452,000</u>
<i>Total Cost Estimate</i>	\$35,174,894

Current Funding

NSF	\$22,910,000
WHOI	\$ 5,000,000
Ship Modifications	\$ <u>200,000</u>
<i>Total Funding Available</i>	\$28,110,000

Funding Variance **\$7,064,889**