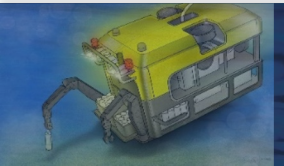
Greensea IQ
Intelligent Ocean Solutions

WOODS HOLE OCEANOGRAPHIC INSTITUTION

MROV Update
DeSSC December 2025

14-Dec-2025

Molly Curran, Mechanical Engineer
mROV Technical Lead
Deep Submergence Lab
Woods Hole Oceanographic Institution



mROV MEDIUM-CLASS DEEP SUBMERGENCE REMOTELY OPERATED VEHICLE

Technical Update

Note: All screenshots are for demonstration purposes only and are considered preliminary.

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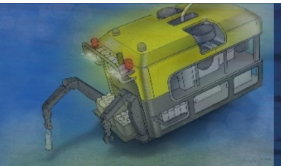
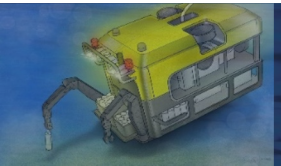


What is MROV?

Goal: Expand access to the deep ocean for high impact science and research with the build of two medium-sized ROVs.

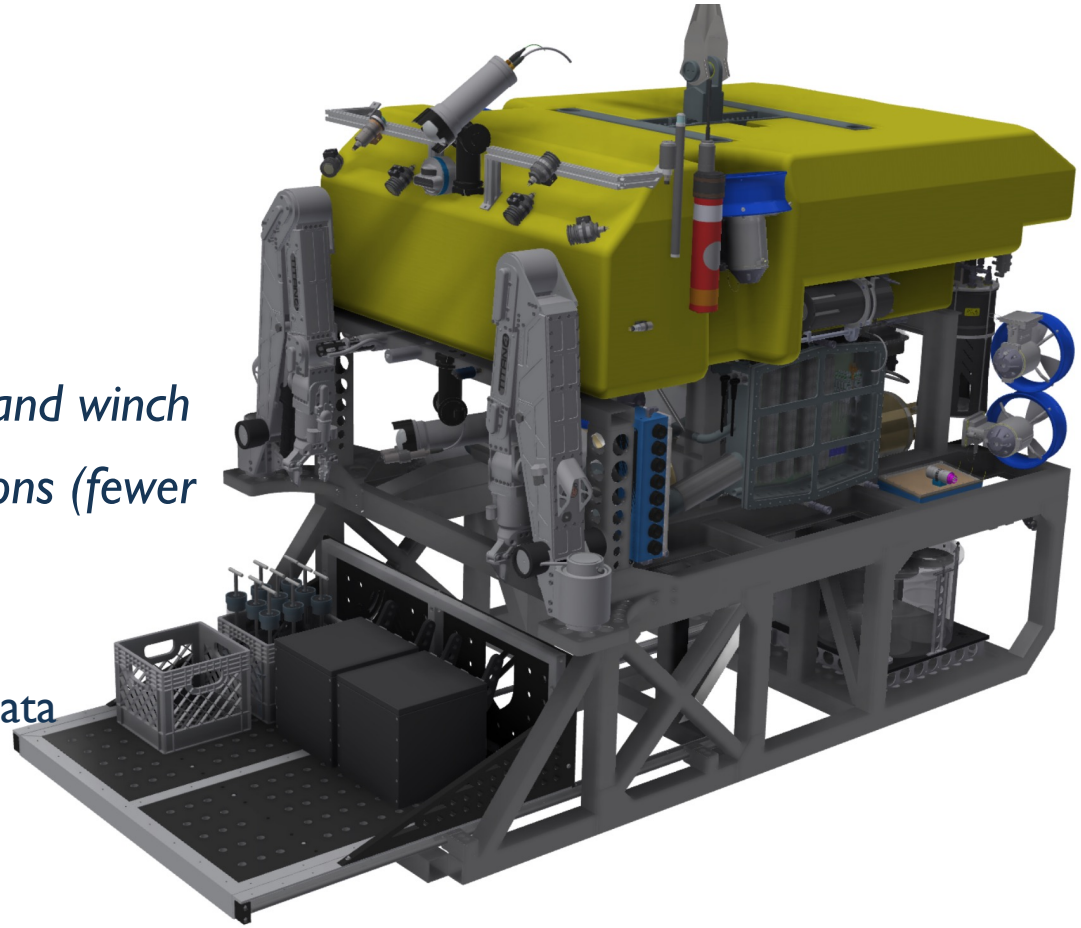
- *Qty (2) vehicles being built simultaneously – one for NOAA (Live at USM) and one for NSF (Will live at WHOI)*
- *Compatibility with NOAA vessels of opportunity, RCRVs and US ARF - Maximize use of shipboard equipment.*
- *Adaptable for current and future scientific equipment.*
- *Leverage proven designs: reusable and modular WHOI/GSIQ supplied components & off the shelf components*
- *Operational autonomy and scalability*
- *Democratizing deep sea research with an optimized system concept*
  - Providing ~85% Jason capability in reduced footprint
  - Reducing operational costs
  - Remote operations
  - Reduced size and deck space



Design Overview

WHOI & Greensea IQ Collaboration

- *4000m rated ROV*
- *~85% physical size of Jason*
- *~7000lbs vehicle weight*
- *Single body - Launched with Aframe using ship's .681 cable and winch*
- *mROV provided docking head for safety and ease of operations (fewer people)*
- *Designed for remote operations*
  - Smaller ops team, data flow to shore, easier access to data
- *2 vans total, only 1 needed on ship*
- *Greensea IQ software and UI*
- *Data package built to NDSF data package standars*

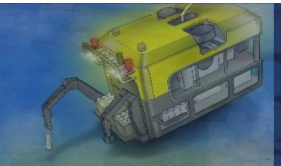


Town Hall at Ocean Sciences 2024

"Increasing Accessibility to the Deep Sea Through the Acquisition of a Medium ROV for Regional UNOLS Vessels"

Summary of requests and how they are addressed:

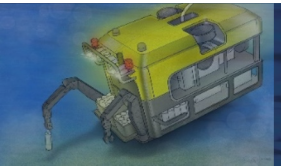
- *Smaller size: Smaller size, weight, deck footprint, and shipping footprint than ROV Jason.*
- *Increased ability/capacity: Similar sampling/cameras capabilities to ROV Jason, added remote operations, decreased equipment/deck space.*
- *Increased use by early career researchers: Lower day rate, added remote operations capabilities*
- *Smaller vessels: Utilizes on board equipment, only 1 van required on ship. RCRV Compatible.*



Town Hall at Ocean Sciences 2024

"Increasing Accessibility to the Deep Sea Through the Acquisition of a Medium ROV for Regional UNOLS Vessels"

- ***General***: *1-2 manipulator arms with 7-function; USBL; modular, spacious sled; bumper and wall anchors for vertical work; make it pink, rainbow, or glitter; cross-decking with other vehicles; low noise; ability to work in steep terrain; ability to handle currents >3 knots; non-Western mythology name*
- ***Sampling***: *bioboxes; push cores; Niskins, suction sampler; integrated fluid pumping (like Universal Fluid Obtainer); built in eDNA sampler; baited traps; hard rock sampling.*
  - Can accommodate all of these.
- ***Lighting***: *multifrequency lighting; "good" lights that are modular and adjustable*
  - New Lighting Control Unit from DSPL that can accommodate up to 10 lights. Standard DSPL LSL2000
- ***Visual***: *4K cameras; science still camera; stereocamera for 3D photogrammetry*
  - Can accommodate all (provided fiber and ethernet connections for science provided dsc).
- ***Sensors***: *pH/DO/Fluor CTD; Multibeam; Lidar*
  - Can accomodate all.
- ***Telepresence***
  - OTH capabilities.
- ***Personnel:*** *experienced operators and pilots*
  - ROV Jason personnel & TBD USM team.



Core Component Selection

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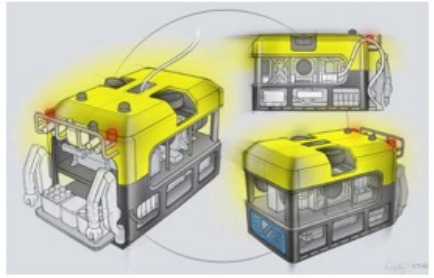
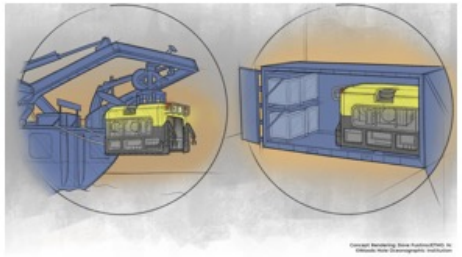
mROV

New Medium-Class Remotely Operated Vehicle



Diversify Access to the Sea

Increased participation of and use by early-career researchers through an operational model adaptable for a broader range of smaller vessels of opportunity.



Forging New Partnerships

WHOI and Greensea IQ are partnering to deliver a robust and fully supported topside and software solution, combining the reliability of a commercial solution with the adaptability of a science driven research ROV.

Remote: Operations, Monitoring, and Component Lifecycle Management

mROV will incorporate an advanced and resilient system for long-range remote operations, enabling comprehensive component monitoring, expanding land-based accessibility, and using automation to enhance both performance and consistency.

Optimized Operational Model

By utilizing shipboard facilities, over-boarding equipment, and personnel, mROV will ship in 2 standard 20' containers and require only 1 container and a docking head on the vessel. This model requires decreased deck space, shipping costs, and personnel needs.

WHOI's Pioneering Development of ROVs

mROV pulls from decades of operational experience, while leveraging the expertise and pedigree of JASON, the science community's workhorse ROV and the gold standard in deep ocean exploration and research.

mROV Press Release

mROV MEDIUM-CLASS DEEP SUBMERGENCE REMOTELY OPERATED VEHICLE

mROV

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Payloads, Sensors, & Technical Details

*Preliminary design—pending finalization.

General Specifications

Depth	4000m
Size	Roughly 93"Lx62"Wx83"H
Weight*	7000lbs
Speed	.5m/s fore/aft, .2m/s lat, .5m/s vert

Sensors and Sampling Payload

CTD	Seabird SBE 49 FastCAT
Sound Velocity	Valeport miniSVS
Oxygen Sensor	Aanderaa Optode
Temp Probe	WHOI-NDSF Design
Magnetometer	APS 22-bit 3-Axis Fluxgate
Additional Payload Cap.	300lbs wet weight

- Dual 7 function manipulator arms
- Extendable basket and aft payload bay
- Multi-chamber suction sampler
- Bio-boxes & push-cores
- Power, communication, and hydraulic ports for auxiliary sensor and sampling integration

Navigation

Hardware INS	IxBlue Rovins Nano
DVL	Nortek 500
Heading Reference	Fiberpro FG150
Backup AHRS	Sparton M2
USBL Transponder	Sonardyne WMT6
Depth Sensor	Paroscientific
Altimeter	Kongsberg 1107
Surface Recovery	Xeos Nemo-X

Lighting and Imaging

Imaging Sonar	Blueprint Oculus MD750d
4k Camera	Insite Pacific Mini Zeus 4k
HD/SD Cameras	DSPL Multi Seacam
Pan & Tilts	ROS Accu-Positioner
Scaling Lasers	SubC Imagining Mantaray
Lights	DSPL SLS-7200

Propulsion

Mission specific thruster configuration
Sub-Atlantic (FET) Brushless 5kW thrusters (qty7-9)

Software

Greensea IQ (GSIQ) OPENSEA® Software Platform

- OPENSEA Library.
- OPENSEA Applications
- Collaborator Applications
- Cross platform compatible

Data

National Deep Submergence Facility Standard Data Package
Utilizing relational databases to generate data package.
Communications managed using abstracted Publish/Subscribe protocol using LCM. Can accommodate ROS/DDS bridge.

Remote Operations

GSIQ long range Standoff Command & Control (SAFE C2) technology.
Remote performance monitoring and control experience.
Remote video, audio, and pilot control.

Shipping

The entire system will ship in (2) 20' shipping containers.

Over boarding

The system will utilize shipboard equipment whenever possible such as the winch, cable, and A-frame.

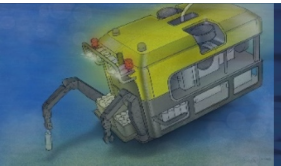
- Deploys on .681" UNOLS EOM cable (up to 10km)
- Custom docking head to increase safety and reduce deck personnel during L&R.

Electrical/Telemetry

16.5kW total vehicle power budget
Moog Focal 914 multiplexer system
Science ports: 24Vdc, serial, Ethernet

Hydraulics

2500 PSI @ 2.5 GPM
1500 PSI @ 4.25 GPM
QTY: 5; Bi-Directional Flow Control Valves with Adjustable Pressure to 2500 PSI



mROV MEDIUM-CLASS DEEP SUBMERGENCE REMOTELY OPERATED VEHICLE

Big Picture Design Update

- *Deep into subsystem critical and preliminary design reviews*
  - (last steps before fabrication / locked designs)
- *Most components purchased*
- *Internal designs starting to go out for fabrication*
- *Testing components as they arrive*
- *Continuing integration of software as components arrive*

Systems Engineering

Updates

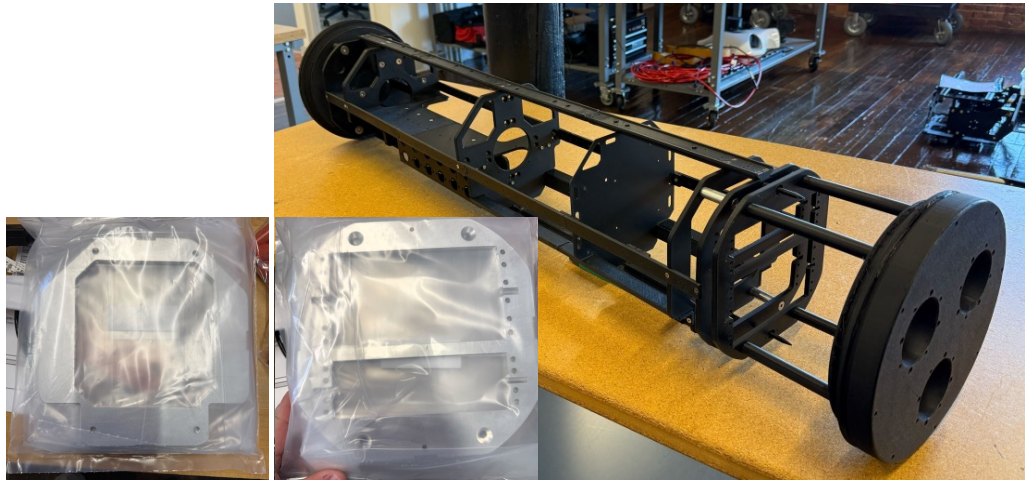
- Continuing to refine validation and verification plans by subsystem
  - *Populating test cases for traceability in the system overall*
- Supporting subsystem critical design reviews with:
  - Requirements and newly derived constraints
  - Review critical design outputs (diagrams, BOMs, etc)
  - The addition of any newly defined risks and mitigation plans

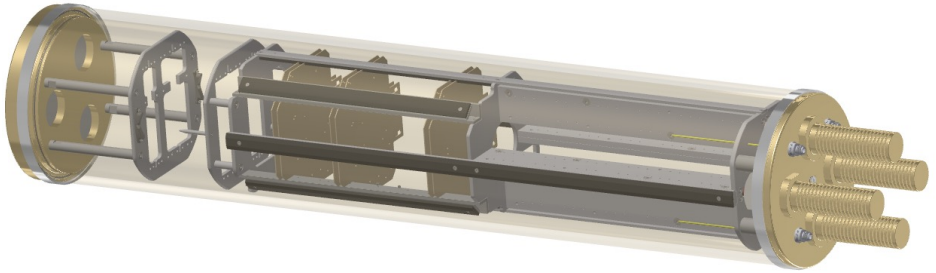
Electrical

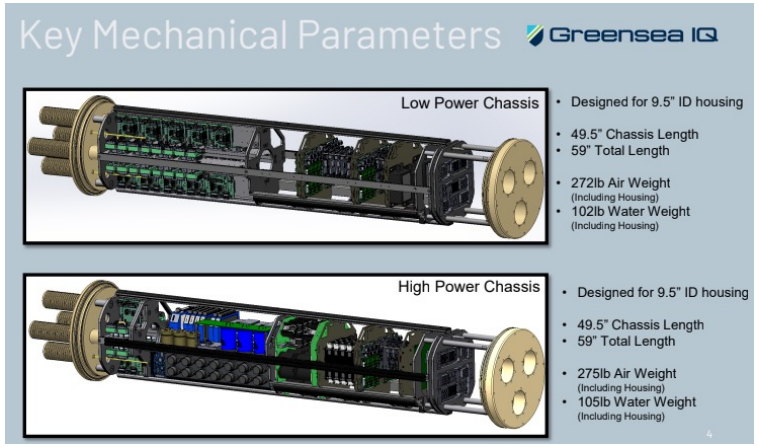
- *Jbox Electrical PDR complete*
- *Housing chassis mechanical final design reviews complete*
- *Housing chassis electrical final design reviews complete*
  - *Low risk items purchased from bill of materials (BOM)*
  - *Chassis 3D printed, fabricated parts starting to arrive*
  - *Mechanical assembly has started for chassis*
- *Power design review complete complete*
- *Steady progress on Junction Box electrical design and down selections*
  - High Power, Low Power, Transformer, Termination, and Auxiliary(Science)
- *Telemetry design complete and working with vendor for detailed design and fab*
- *Steady progress on wiring & pin to pin details.*

Critical Purchases Complete:

- *PDU, transformers, all cables and connectors, long lead chassis components, chassis mechanical components, blind mate connectors, housing connectors(Kemlons), and the telemetry system*

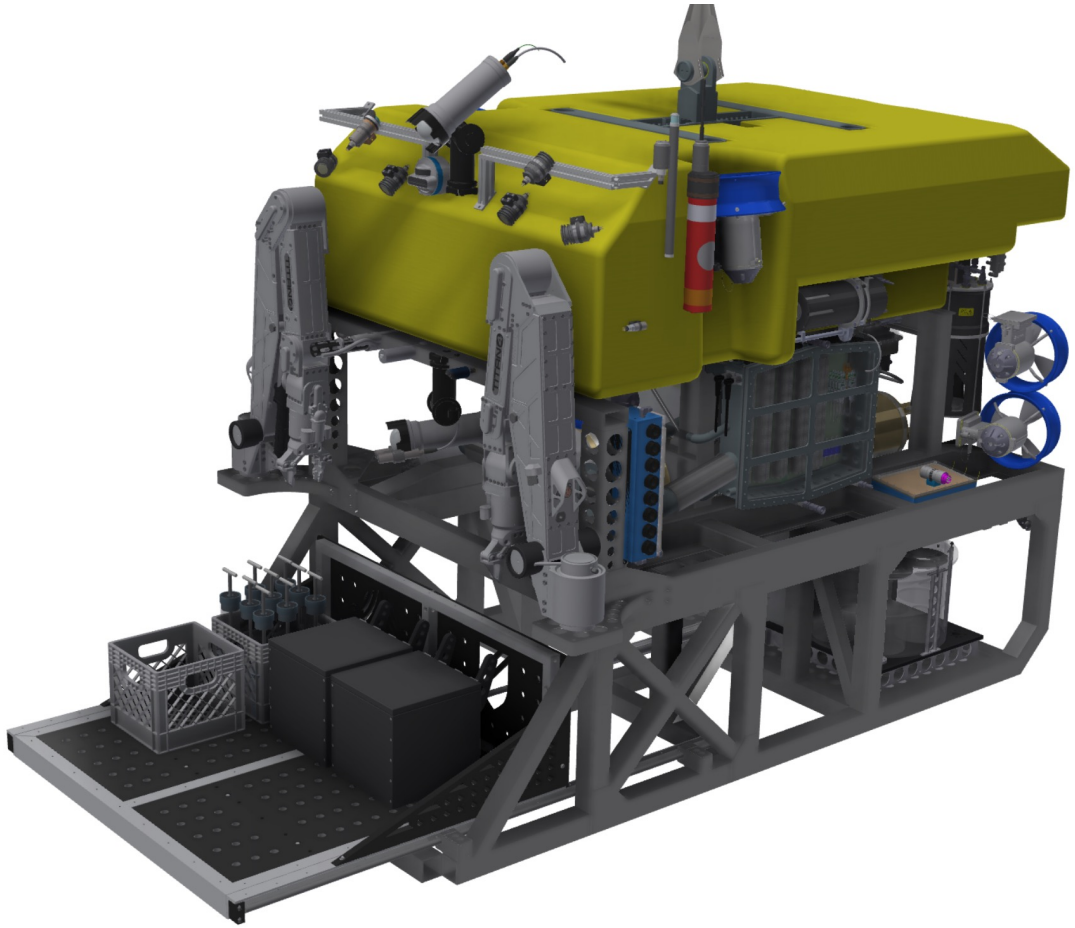


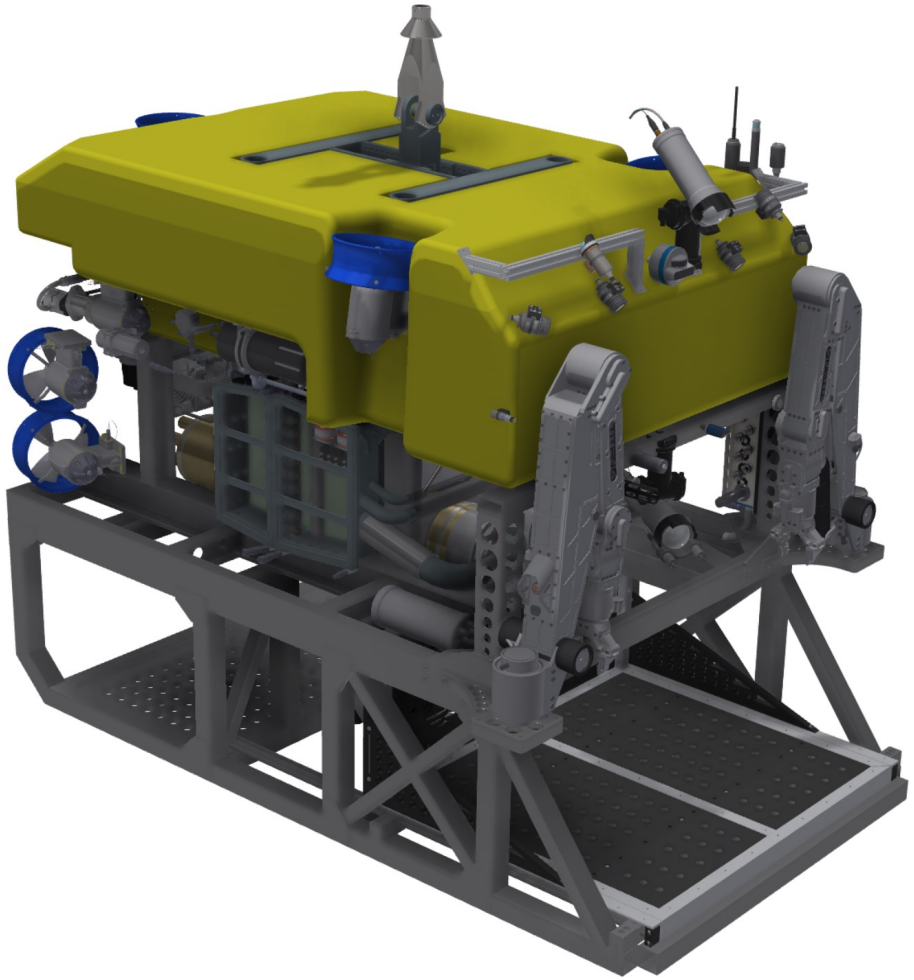




Mechanical

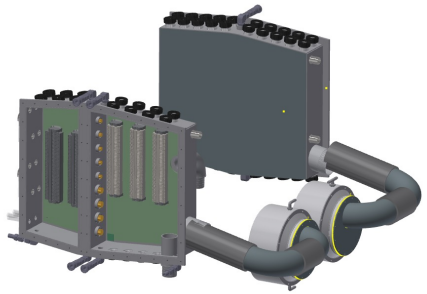
- *Size: 116” x 64” x 84”*
- *Weight: <7900lbs with science (cable constraint)*
  - Target vehicle weight 7000lbs

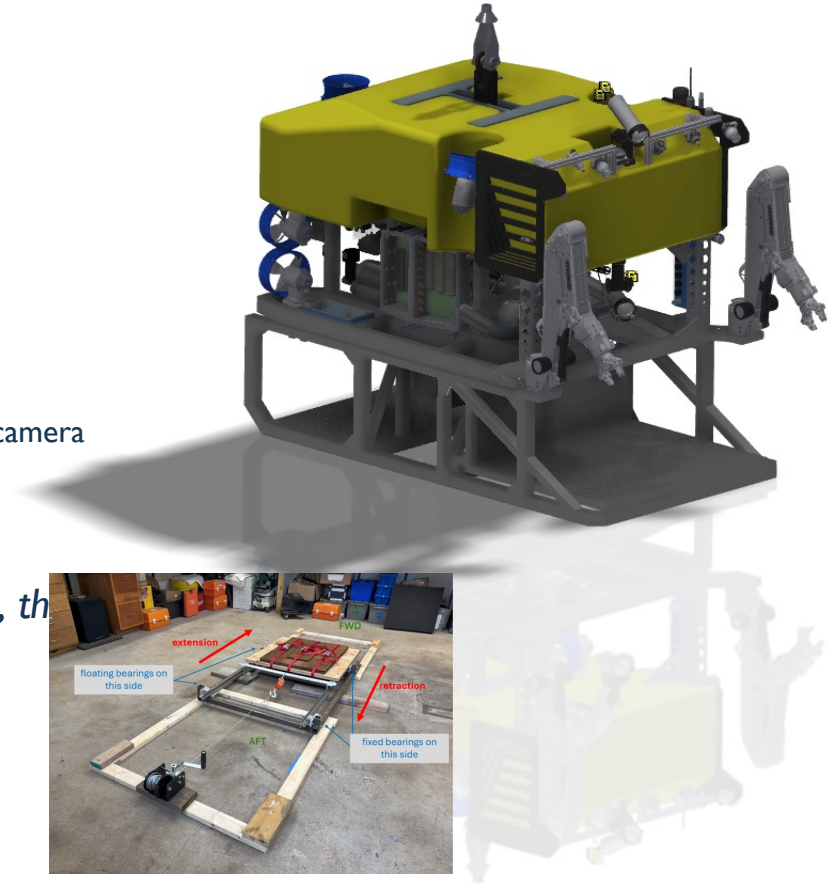




Mechanical

- *Hydraulic , Oil compensation, and Junction Box mechanical final design reviews complete*
- *Weight and balance macros and spreadsheet configuration complete.*
  - Huge step and critical milestone for overall vehicle design.
- *Foam refined based on weight and balance*
- *Component placement refinement based on weight and balance*
- *Preliminary bullet design complete & presented to CLARS*
- *Steady progress on frame design*
- *Steady progress on basket/tool skid design*
- *Valve pack preliminary design presented from Vendor*
- *Testing complete:*
  - Thruster pressure test, HPU flow and pressure testing, Manip testing, Basket load testing, Pan and tilt camera load testing





Critical Purchases Complete:

- *Syntactic foam, thrusters, manipulators (2), all compensators, all major hydraulic components, th hydraulic valve pack.*

Science / Other Components

Updates

Design outputs related to science:

- *300lb wet weight capacity*
- *800+lb dry weight capacity*
- *Basket: 56” x 46” x 23”*
  - For reference, ROV Jason basket area: 58” x 37” x 23”
- *Aft Science Bay: 36” x 24” x 65”*
  - Fits all aft bay equipment that has previously been installed on ROV Jason

Critical Purchases Complete:

- *All cameras and lights, navigational sensors, science sensors*

LARS

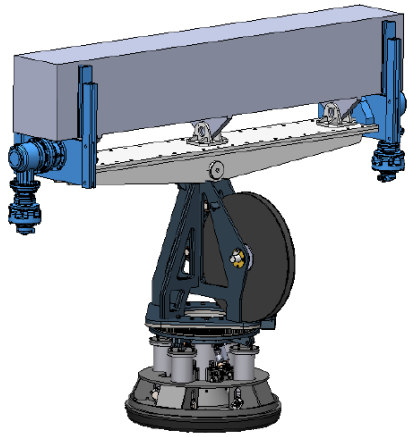
General Update

- *Docking head being designed and fabricated by CLARS*
  - Objective: **Increase safety, decrease # personnel for L&R**
  - Requirements: Fly away portable, Sea State 5, Single Body conops with .681 umbilical, swing/sway damping, slew, Multiple safety features/e-stops
  - Went through extensive bid process with 9 different vendors – CLARS was obvious choice.
  - Docking head design underway
  - Preliminary design review with C-LARS complete, critical design review scheduled for before new year.
- *Continue to work with RCRV team for smooth integration.*
  - Meet bi-weekly
- *Continue to work with Nancy Foster crew for smooth integration.*
  - Exploring direct drive winch solutions. Good solution for winch, exploring options for cable.
  - Plans for dry dock
    - A Frame and deck modifications

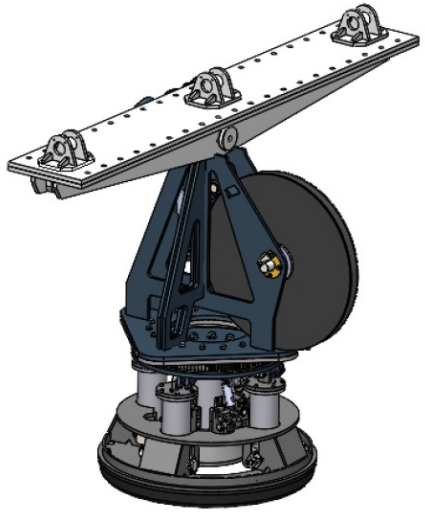
Critical Purchases Complete:

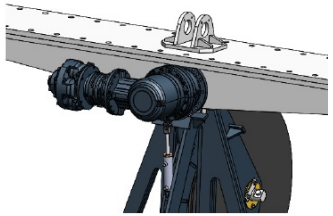
- *Docking Head*

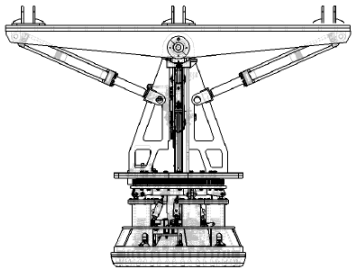
LARS

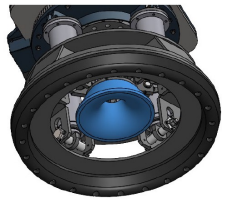


Swing Damping

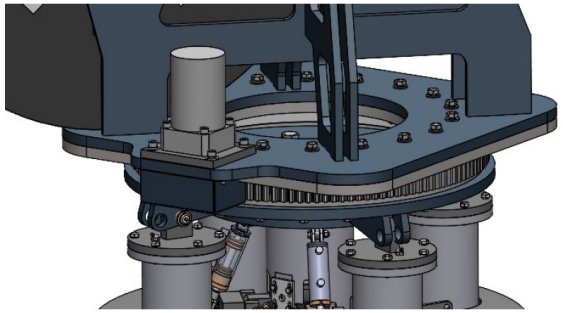




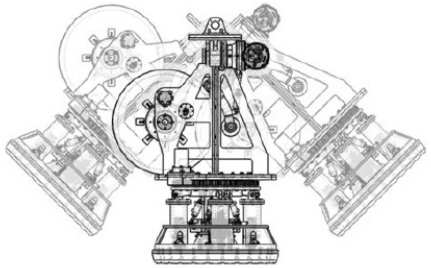


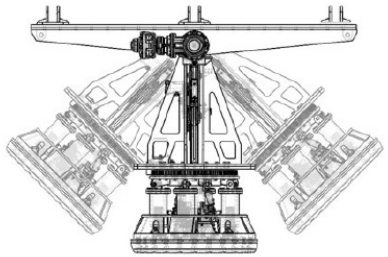


Slew



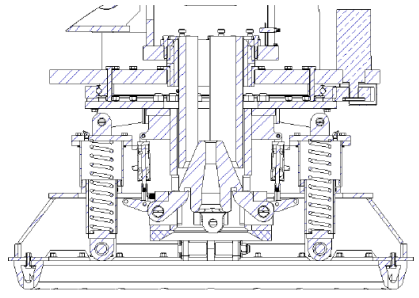
Sway Damping





Control Box

Anti two-blocking



Software/Data/Networking & OTH

Update

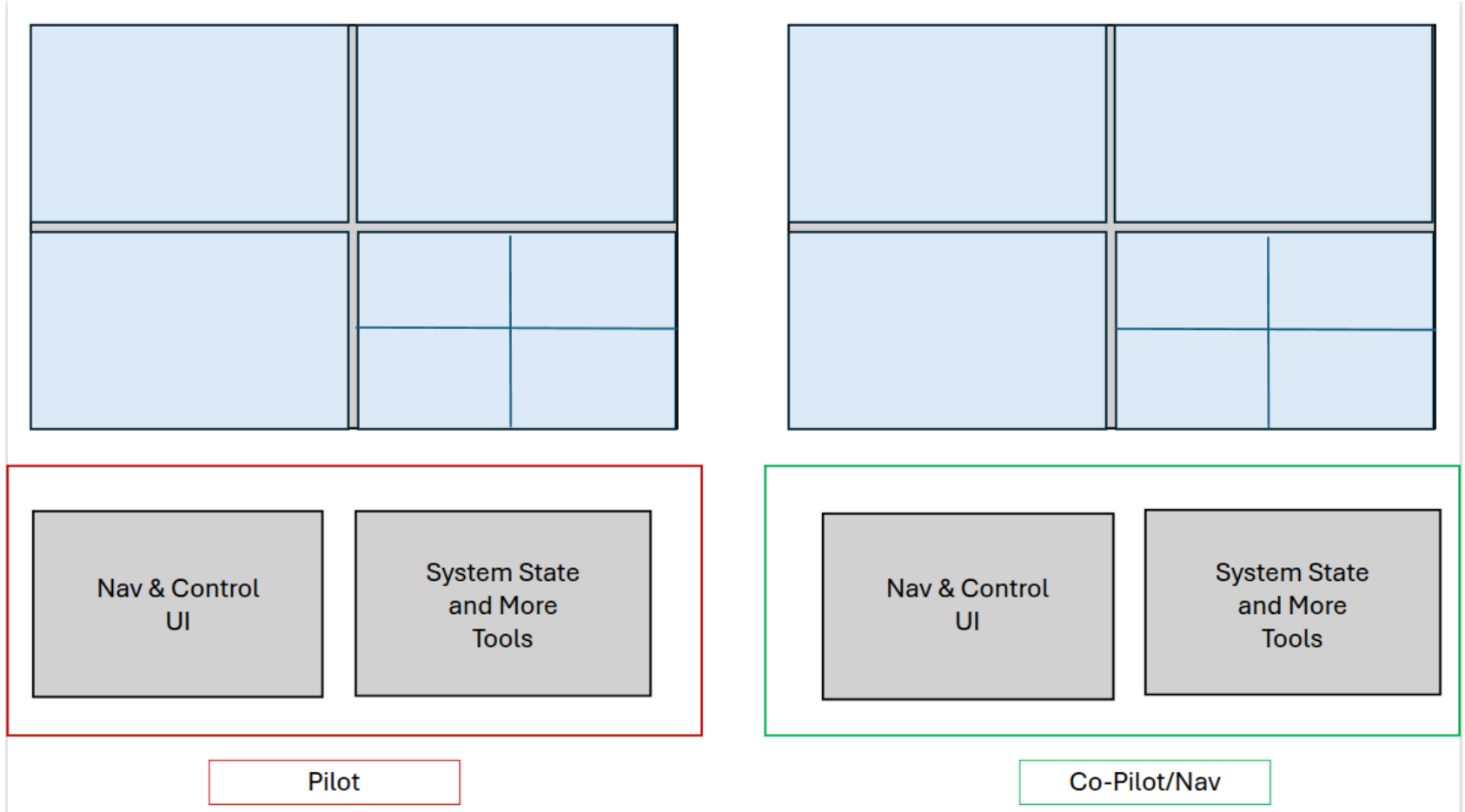
- *Audio/Video(AV), networking, Software/User Interface(UI), Over-the-Horizon, & Topside design reviews complete*
- Subsea chassis hardware integration and bench top testing
  - GFD circuitry : isolated vers bused circuits
- Chassis component bench integration started
- Component interface, integration, and testing work: altimeter, O2, P&T, cameras, etc.
- Demonstrations of mROV SeaLog and GS Playback Workspace
- Demonstrations of AV system (deck cam management, network definitions, database iteration, router management)
- Up Next:
  - Complete purchasing AV & Networking components as downselected – start building out racks
  - Set up MROV computers and start testing with vehicle equipment as opposed to build laptops

Topside

Pilot console design underway

Refining operations:

- What lives in the vans
- What lives in the lab
- Operational layout and access



Three operational seats total. Not shown: science and data

Vans

2 vans

- *Vans preliminary design review complete*
- *Van options have been quoted for in house and vendor built options*
- *Likely going with vendor built option*

Vehicle Shipping Van

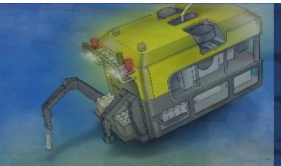
- *Basic container for shipping vehicle and docking head*
- *Can be left on the dock*
- *mROV team highly recommends a hi-cube for vehicle shipping container*

Tool / Power / Rack Van

- *mROV team recommends a hi-cube for extra storage (still under consideration)*
- *This will be classified as a "storage" van and can not be "normally occupied"*

1-2 Trucks

- *Weight of system will likely drive need for 2 trucks.*



Notional Schedule

Jan
- Fabrication
- Subsystem testing

Feb
- Fabrication
- Subsystem testing
- Subsystem assy

Mar
- Subsystem testing
- Subsystem assy

April
- Subsystem assy & testing
- Subsystem vehicle integration

May
- Vehicle integration and tank testing
- Dock testing

June
- Dock testing
- NOAA Sea Trials
- Modifications/improvements for science verification

July
- NOAA Science Verification TBD

Aug/Sept
- NSF Sea Trials (Armstrong)

Oct/Nov
- Modifications/improvements for science verification

2027
- NSF Science Verification
- Normal science operations

Both vehicle built and tested at WHOI, with some subsystem build out at GSIQ

Ready for science use:
NOAA ~ late 2026 // NSF ~ Early 2027
(Both pending science verification cruise timeline)

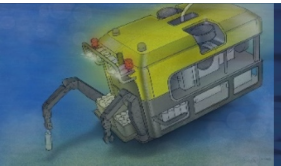
Upcoming Test Events

December

- *Software calibration and integration of APC Boards for isolated circuits*
- *Start Chassis subassemblies*
- *Mechanical Layout design review*
- *Hydraulic Layout design review*
- *Frame & Lift point FEA & design review*

January 2026

- *Data and AV System Testing Event #3*
  - *Continued database iteration and integration – live version shared with WHOI*
  - *Integration with MROV Sealog*
  - *Deck camera management*
  - *Router management of ROV network*
  - *ROV network definitions*
- *Thruster integration and testing (into Feb/Mar)*



Questions?!

Thank you!

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Science Advisory Committee
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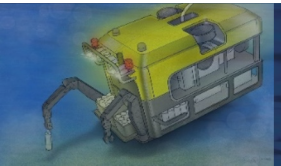
Roxanne Beinart – University of Rhode Island
Jill McDermott – Lehigh University
Jason Sylvan – Texas A&M University
Amanda Demopoulos – USGS
Jeff Beeson – NOAA
Geoff Wheat - MBARI

And huge thanks to all the engineers on the mROV team, GSIQ team, engineers at DSL, ROV Jason team, PMs, admins, communications teams, mROV Science Advisory Committee, WHOI Project Management Advisory Committee, NSF, NOAA, MDBC, USM, URI, OECI… and many more.



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