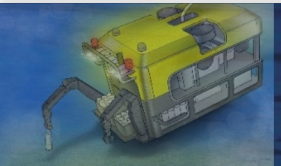
Greensea IQ
Intelligent Ocean Solutions

WOODS HOLE OCEANOGRAPHIC INSTITUTION

MROV
UNOLS New User Workshop Update

12-Dec-2025



mROV MEDIUM-CLASS DEEP SUBMERGENCE REMOTELY OPERATED VEHICLE

NSF NOAA

mROV Town Hall and a White Paper

UNOLS DeSSC

ROV Jason is oversubscribed

-2015 Sea Change Report

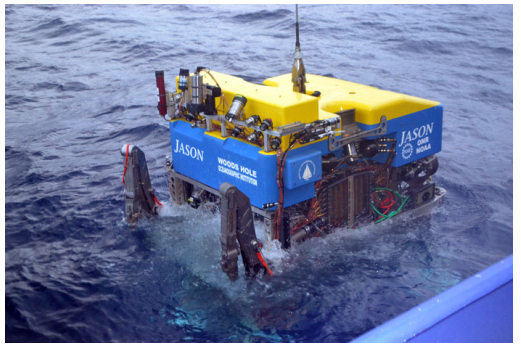
Smaller vessels (including RCRVs) are not ideal for use with JASON (and vice versa)

A slightly smaller but highly capable ROV would increase access to coastal and more diverse stakeholders

Deep Submergence Science Committee Recommends Acquisition of a Medium-Sized Remotely Operated Vehicle (mROV) to the National Deep Submergence Facility

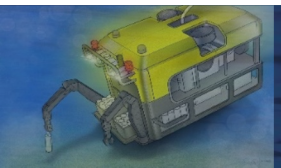
The Deep Submergence Science Committee (DeSSC) strongly encourages the addition of a working-class, medium-sized Remotely Operated Vehicle (mROV) to the National Deep Submergence Facility (NDSF). The addition of an mROV would facilitate greater accessibility of deep-sea research, provide redundancy for a heavily used asset, and facilitate increased inclusion and accessibility across a diverse user group and suite of stakeholders. In particular, we propose an ROV of similar capability to ROV Jason, but designed for use on smaller research vessels, including the Regional Class Research Vessels (RCRV). This vehicle would also allow new avenues of research through being available for extended research cruises; long duration ROV cruises are often in conflict with the diverse suite of science already supported by ROV Jason and, thus, a second and highly capable ROV would facilitate research in polar or otherwise difficult to support regions of the globe.

ROVs are a cornerstone of deep-ocean research across disciplines, are heavily utilized in ocean science at all latitudes, and are supported by a wide variety of funding streams including NOAA, NASA, ONR, private donors, and NSF. Of note, ROVs are critical for supporting diverse large-scale projects, which includes providing the required annual service of the Ocean Observatories Initiative (OOI) regional nodes. As highlighted in the 2015 Sea Change report, the NDSF Asset ROV Jason is used for much of this research and has been fully scheduled and oversubscribed for decades. In recent years, even during the SARS-CoV-2 pandemic, RO
the limit of what the vehicle can
Jason requires, depending on the
support (e.g., the Canadian Scier
unable to meet the funded resear
has previously led to last minute
significant risk to the use of non-
default meet the established UNC
the NDSF.



"It is apparent that realizing the vision of deep ocean research will require access to a broader mix of more capable vehicles than are currently available through the NDSF"

NRC study - 2004

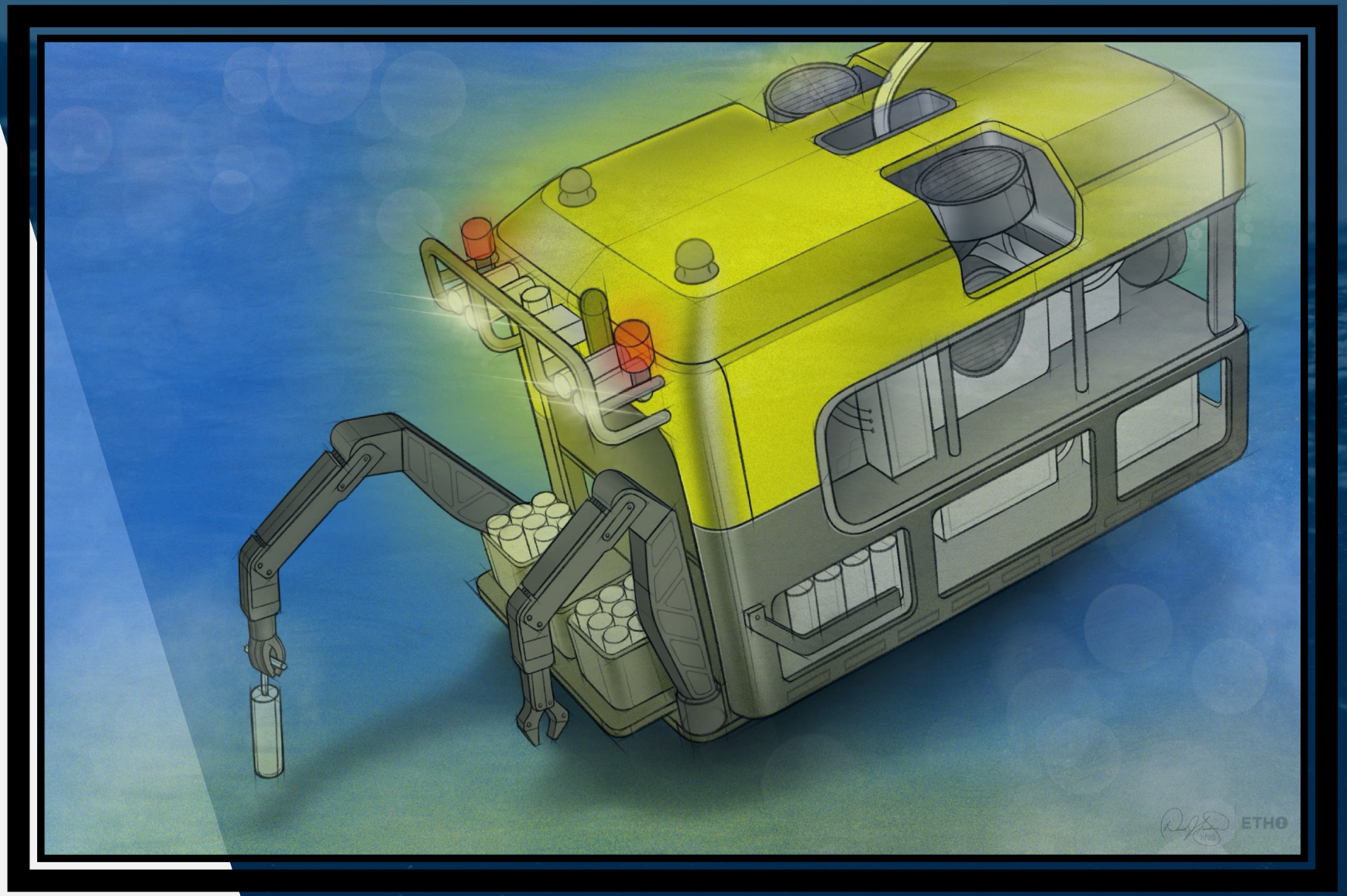


mROV MEDIUM-CLASS DEEP SUBMERGENCE REMOTELY OPERATED VEHICLE

System Goals

Increasing availability for high impact science and research

- Leveraging cutting edge technology
- Open architecture: A user-centric approach
- Operational autonomy and scalability
- Democratizing deep sea research
- Reducing operational costs
- Optimized system concept



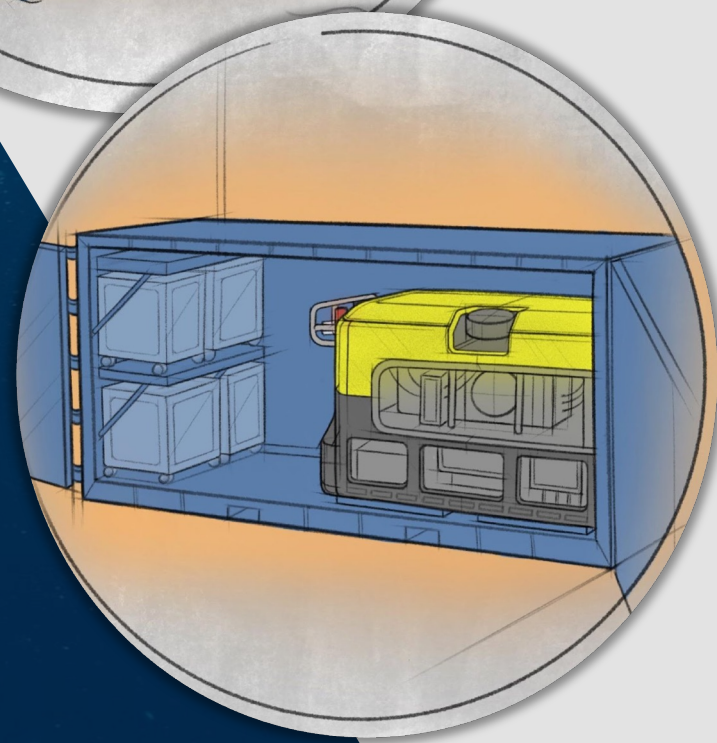
System Concept

Operational Model

- Decreasing shipping & deck footprint
- Minimizing need for specialized expertise
- Decreasing personnel for operations and maintenance

While still…

- Delivering the highest capacity of functionality



Single-body 4000m ROV design focusing on

- Modularity
- OTS components
- Deep-ocean science payloads
- Integration with Greensea IQ’s OPENSEA platform

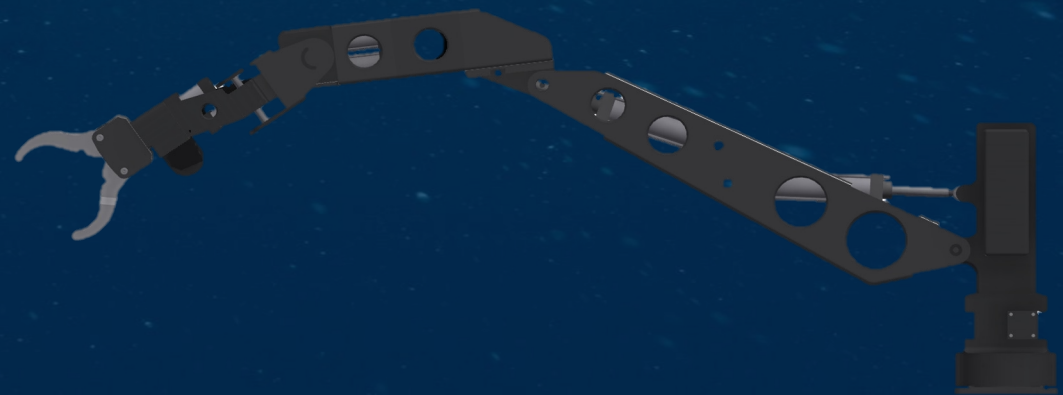
The Science Community Need

How Do We Achieve That?

Foundational Objective

Expanding effective and diverse scientific **access** into the deep ocean via the application of **principles and technology** intended to set a course for the future through open exchange of knowledge made possible by teaming and collaboration.

- Combability with NOAA Vessels of opportunity and RCRVs
- Adaptable for current and future scientific equipment to best study benthic communities in the Gulf of Mexico.
- Reusable and modular components
- Operational efficiency
- Remote operations



The partnership between WHOI and Greensea IQ leverages the extensive experience and resources of both entities supporting the subsea community.

High Impact

A 4000 m rated mROV can support 90%-95% of deep-ocean research dives and increase the availability for high-impact oceanographic science and research.

Optimized for Science

A lightweight, remote operations–capable, fly-away mROV system minimizes operational costs without compromising mission capabilities and is also exceptionally adaptable for science operations.

Simplified yet Modular

Focusing on a modular system design and commercial components produces a practical solution that simplifies system maintenance and logistics.

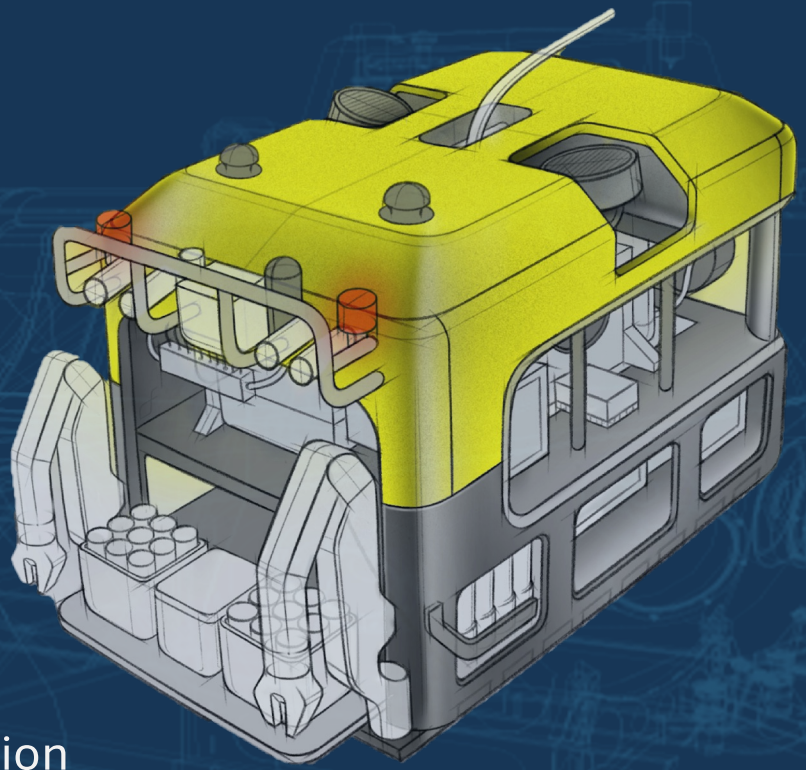
Turn-Key

The Greensea IQ/WHOI vehicle partnership support of the mROV platform can provide a system ready to meet science requirements on its first day of operation and advances.

NDSF NATIONAL DEEP SUBMERGENCE FACILITY

Vehicle Design

- Remote Operations
- Reduced Size & Deck Space
- mROV Capital Expenditure
- Minimize Operational Costs
- High Availability & Low Complexity
- Component Lifecycle Management
- Open Architecture Software & Standardization
- Community best practices for data tools and services



NDSF NATIONAL DEEP SUBMERGENCE FACILITY

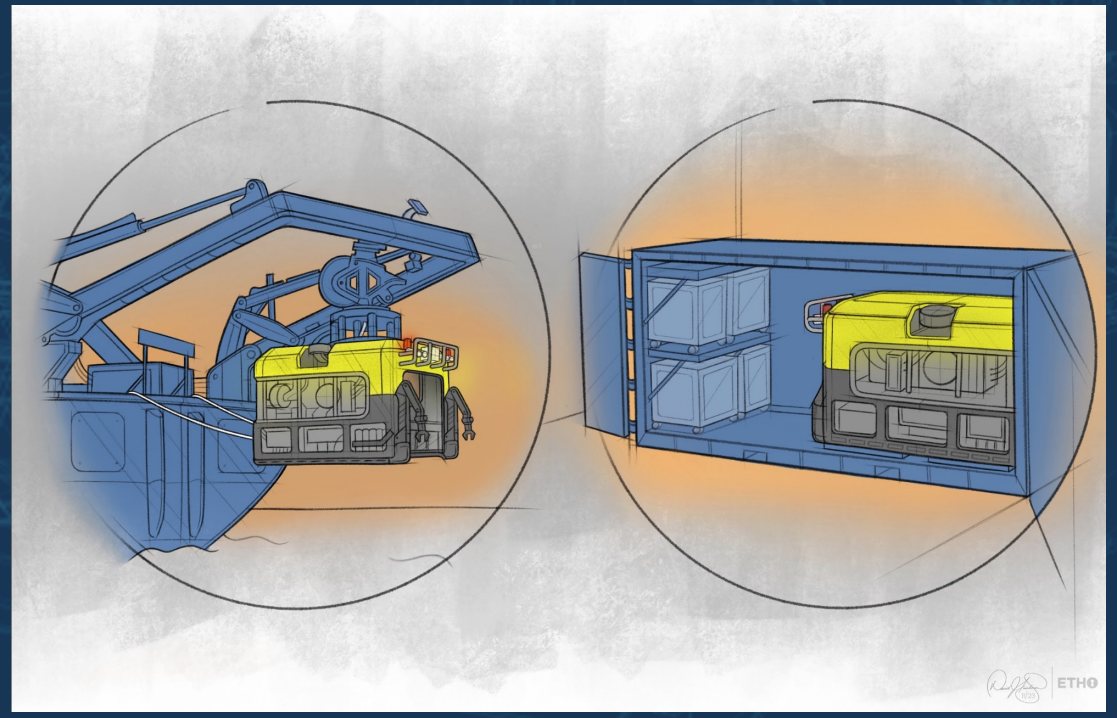
Vehicle Design

Payload Integrations
Designed to allow optimal flexibility

Open Architecture Ecosystem
Integration with OPENSEA leverages an existing modular integration database

Logistics & Maintenance Goals
Flyaway system operating with max (2) 20’ shipping containers

LARS Considerations
Designed to use standard UNOLS cables



NDSF NATIONAL DEEP SUBMERGENCE FACILITY

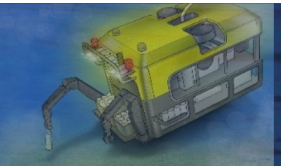
Science Advisory Committee (SAC)

Engagement of the scientific user community in the mROV development
Led by NDSF Chief Scientist for Deep Submergence - Anna Michel.

- *Diverse group of deep submergence scientists, current NDSF users, and members of the stakeholder community and include representation from the UNOLS Deep Submergence Scientific Committee (DeSSC) with attendance of the NSF Program Manager and other Foundation representatives*
- *Members from different US geographic regions, career stages (including early career), and oceanographic disciplines (e.g. biology, geology, chemistry)*
- Meet bi-annually in person at WHOI plus additional virtual meetings
- *Briefed by the Project Management Team*
- Provide advice on all issues related to meeting the project's scientific goals.

SAC Membership

Jeff Beeson
Amanda Demopoulos
Jeff Wheat
Jason Sylvan
Jill McDermott



High Level Requirements Review

- *Can the entire system, with docking head, fit in 2 shipping containers - Yes*
- *Can we operate with a total of 1 container on the ship - Yes*
- *Will we have capacity for 300lbs wet payload for science – Yes*
- *Will we have Over the Horizon capabilities - Yes*
- *Can we achieve 85% of the science sampling capabilities of ROV Jason – Yes*
- *Can we operate from a ship of opportunity – Yes, with restrictions.*
- *Can we utilize the ships over boarding equipment – Yes, feasible with an mROV Docking Head*
- *Can we operate off a .681 cable? Yes*
  - Is the vehicle under 7900lbs in air? Yes

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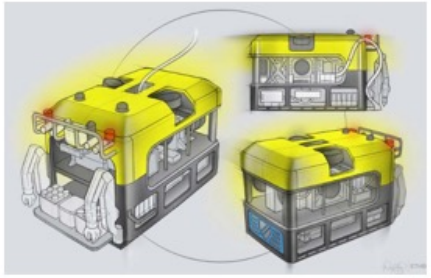
WOODS HOLE OCEANOGRAPHIC INSTITUTION

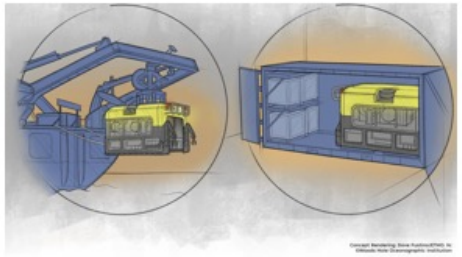
mROV

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

Greensea IQ
Intelligent Ocean Solutions

WOODS HOLE OCEANOGRAPHIC INSTITUTION

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.

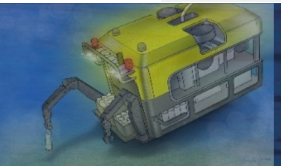
- Deploys on .681" UNOLS EOM cable (up to 10km)
- Custom docking head to increase safety and reduce deck personnel during L&R.

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



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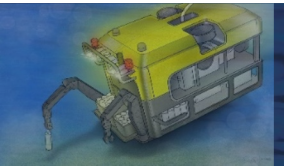
NDSF mROV Production and Testing Schedule

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



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