NDSF NATIONAL DEEP SUBMERGENCE FACILITY

ALVIN

For 54 years Woods Hole Oceanographic Institution (WHOI) has operated the U.S. Navy-owned Deep Submergence Vehicle Alvin for the national oceanographic community. Commissioned in 1964, Alvin has made almost 5000 dives (as of November 2018), playing a major role in making important discoveries about the biological, chemical, and geological processes that shape our planet. Alvin carries two scientists and a pilot as deep as 4,500 meters (about three miles) and each dive lasts six to ten hours. The sub's most famous exploits include locating a lost hydrogen bomb in the Mediterranean Sea in 1966, exploring the first known hydrothermal vent sites in the 1970s, and surveying the wreck of RMS Titanic in 1986.

How did Alvin get its name?

The submersible is named for Allyn Vine, a WHOI engineer and geophysicist who was the prime mover and creative inspiration for the vehicle.

Recent Upgrade

The deep-ocean and seafloor beyond 4,500 meters water depth is this planet's last frontier. A critical asset in exploration of this region is a more capable human occupied vehicle (HOV) with state-of-the-art visibility, increased depth, neutral buoyancy capabilities, increased payload, extended time at routine working depths, and other important science and operational design features.

With funding from the National Science Foundation and the Office of Naval Research, WHOI has begun converting Alvin to a 6,500 meter capable submersible. The first step was completion of a major upgrade to the vehicle and many of its systems in 2013. A new titanium personnel sphere with improved ergonomics has been integrated into Alvin's modified frame, and other improvements have been made to provide:

- Increased fields of view (with 5 viewports instead of 3, and complete overlap with the pilot's field of view)
- State-of-the-art illumination and imaging systems
- Enhanced data collection, logging, and interface capability
- Increased payload for Alvin's basket for carrying samples and equipment.
- Faster ascent and descent rates enabling greater science sampling times

Final systems conversion for 6,500 meters is underway with operations to the new deeper depths beginning in Spring of 2021.

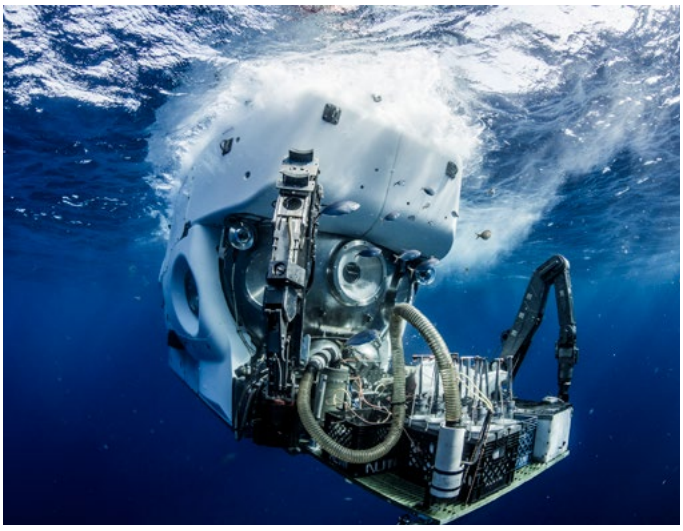
Stage 2 Upgrade

Efforts to improve available energy for dive operations are continuing and have lead to improvements to bottom times using the existing batteries. The program is evaluating new higher energy battery technologies and plans to progressively integrate new batteries once the conversion to 6500 meter operations is completed. This effort will offer significant operational improvements, and will enable long dive times especially to depths beyond 4500 meters. Additional science capabilities achieved in Stage 2 will include:

- Increased depth capability
- Additional improvements in imaging systems (i.e. 4K imagind and recording capability)
- Increased working time
- Increased thruster horsepower and better maneuverability
- Enhanced mid-water research capability
- Enhancing sampling capability sampling capabilities by installing an additional Schilling Titan-4 manipulator

Advantages of Alvin

There is no substitute for direct observation. Scientists working in Alvin consistently describe the perspective gained by examining the seafloor in 3-D through Alvin's multiple viewports, as unsurpassed by other remote sampling methods. Enabling the use of human eyes and brains, immersed in the ocean environments, is an essential component of the observer's ability to fully understand unique deep-sea ecosystems. 'I never expected it to look like that' is a constant dive refrain.



Specifications

Length	7 meters (23.1 feet)
Breadth	2.6 meters (8.4 feet)
Height	3.68 meters (12.1 feet)
Operating Depth	4,500 meters
Normal Dive Duration	6-10 hours
Gross Weight	20.4 metric tons
Science Basket Payload	181.4 kilograms (400 lbs)
Personnel Sphere Volume	4.8 cubic meters
Maximum Vehicle Speed (on site, within tether range)	1.5 knots forward, 0.5 knot lateral, 1.0 knot vertical (1 knot equals 0.5 meters/second)
Descent/Ascent Rate	30 meters/minute (98.4 feet/minute)
Propulsion	Six brushless DC electric thrusters, each providing 113 Newtons (250 pounds) of thrust

Observation

Five viewports: 3 forward (17" diameter), 2 side (12" dia.)

Electrical Power

Two banks of lead-acid batteries, each 120 V, 125 AH

Communication

Redundant acoustic telephones (voice or code)
Marine band (VHF) radio
Sound - powered phone

Imaging

Multiple in-hull HD video monitors with capability to access all external cameras for viewing
Frame-grabber dive image and meta-data system
Two Insite Mini Zeus HD cameras with individual pan and tilt
Two Kongsberg OE14-522 pan/tilt/zoom HD cameras near viewports
Additional situational cameras available
Three 7" HD LCD flat panel displays for in-hull viewing
HD video recorders
Optional HD video/still frame camera for mounting on manipulator
Sony Alpha 7SII mirrorless camera with a Sony Vario-Tessar T* FE 24-70mm f/4 ZA OSS Lens.

Lighting

Twelve lighting channels
36 available high intensity LED lamps (including two DSPL green LED lamps for distance illumination)
Situational and emergency lighting
Down-looking survey lighting
Lasers for optical size reference

Propulsion

Seven thrusters
Forward, reverse, lateral capability
Auto heading, altitude and depth
Auto X, Y position hold and incremental positioning

Vehicle Sensors

Fiber-optic gyrocompass: Octans or PHINS
Redundant depth sensors
Magnetometer and Seabird CTD

Acoustic Sensors

Imagenex 881 profiling sonar
Tritech Seaking S8540 dual frequency scanning sonar
Navigation:
Dedicated in-hull navigation with touch screen display
Bottom tracking Doppler velocity log
Sonardyne Homer Pro location beacons
Acoustic modem
Sonardyne Range USBL positioning system with SMS data transmission capability

Manipulators/Sampling

Schilling Titan 4: 7 degrees of freedom
ISE: 6 degrees of freedom
Sample storage: Forward 16 sq. ft. sample basket with payload of 181 kg (400 lbs)
Elevator sampler—Mission configurable:
Free ascent, Payload: 90 kg (200 lbs.)
Scientific sampling devices: Water samplers, tube corers and bio boxes

Scientific Instrumentation Support

Power: 12, 24 and 120 VDC switched circuits available
Hydraulics: 6 available hydraulic circuits
Full vehicle (internal/external) networked data system (fiber optic, ethernet, RS232, RS485)
Integrated data system

For more information please contact: **Anthony Tarantino**, ALVIN Operations Coordinator, atarantino@whoi.edu;
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