HROV Update

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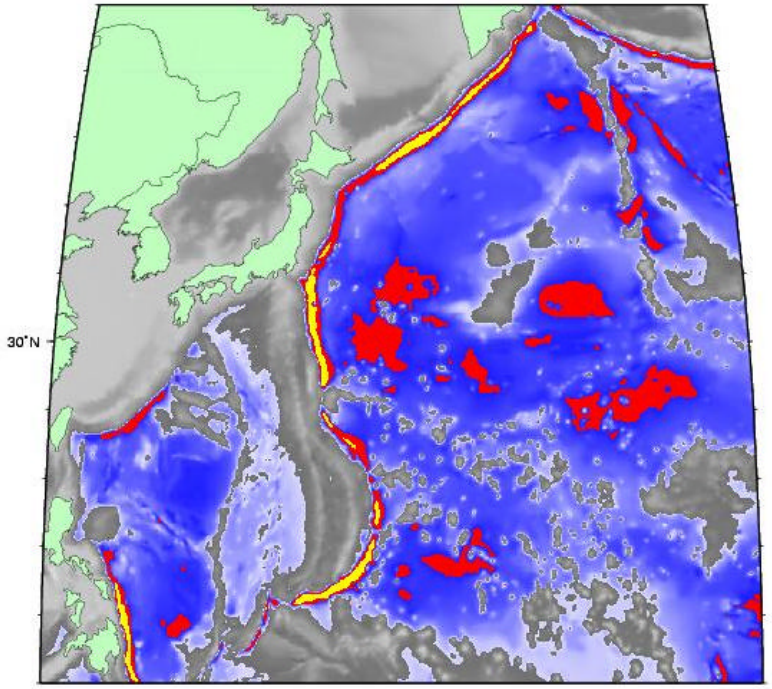
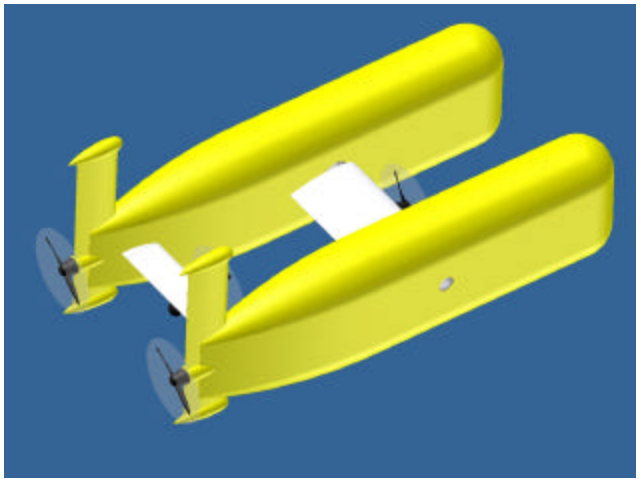
DESSC
November 2006

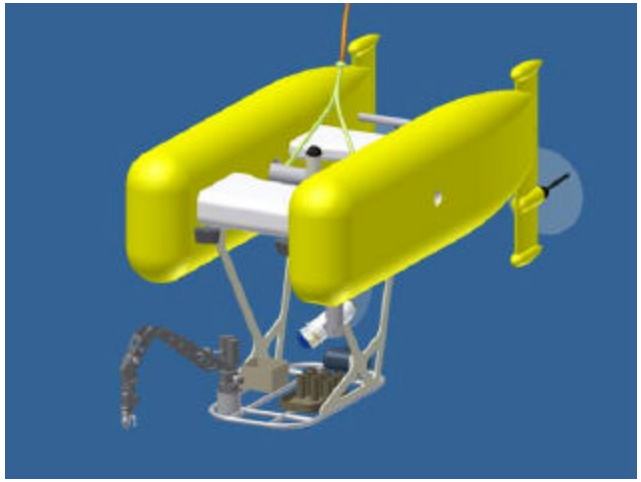


Global Ocean depth chart

Robinson projection

-10000 -7000 -6000 -4500 0

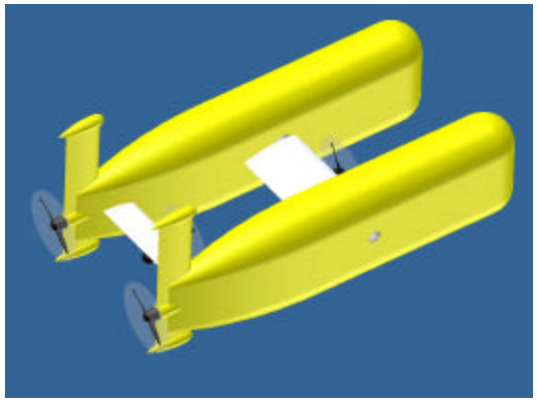




HROV: Recent Highlights

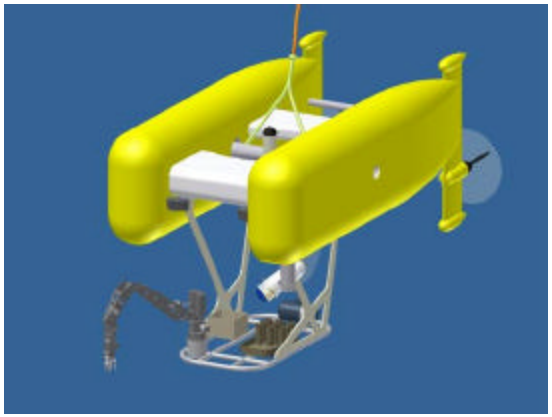
- HROV renamed *Nereus* through a student competition
- Successful deep fiber optic link tests, June 2006
- Buoyancy and pressure housings tested
- Vehicle structure in fabrication
- Battery packs: bench testing
- Manipulator and power pack: bench testing
- Electrical design near completion, tests on riskiest elements underway
- Imaging system and telemetry: bench testing
- LED lighting: in development
- Progress reported in Oceans 2006 proceedings

Nereus: AUV and ROV capabilities



AUV

- Survey speed of up to 3 knots
- 70 KM of coverage (sonar)
- Lower altitude photo coverage at slower speed increases mission duration



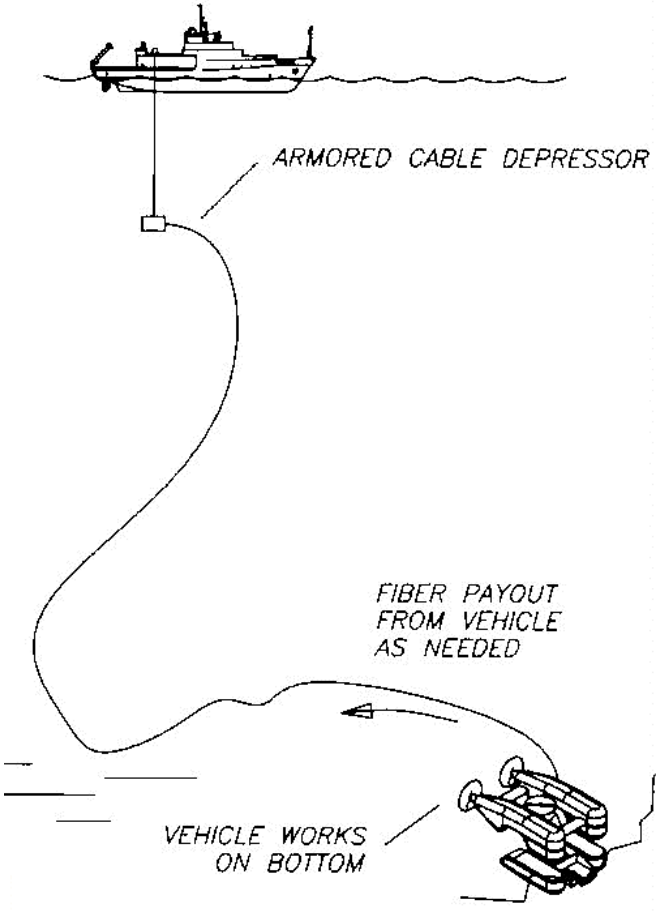
ROV

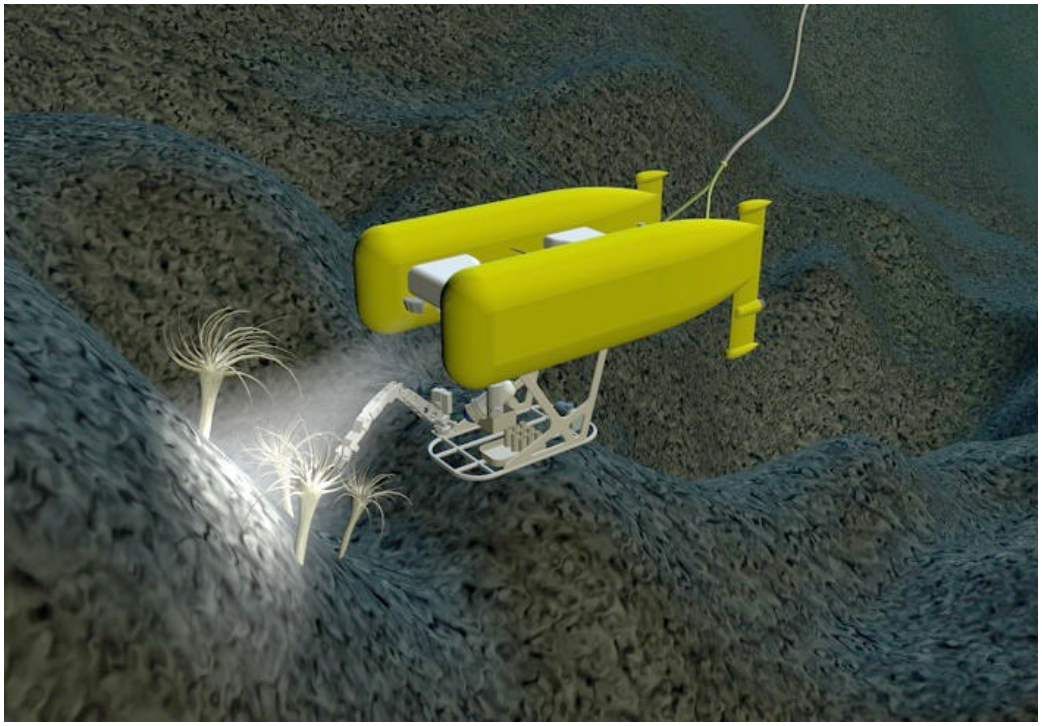
- 4 sample sites (typical)
- Up to 7 KM of transits
- Projected bottom time of 8 hours
- Each sample site assumes high resolution imaging and sample collection

Sensor Suite and Expansion

- **Basic Sensor Suite**
  - Two Seabird 49 FastCat CTDs
  - Magnetometer
  - Optical Back Scatter
  - Profiling Sonar
  - Imaging Sonar
- **Additional Capabilities**
  - 6 science bus ports distributed between port, stbd, and work package junction boxes.
  - RS-232 x 6
  - One Ethernet
  - Supply voltage nominal 24VDC (48V & 12V configurable), 685 Whr
  - Up to 4A per channel
  - Available in all vehicle configurations

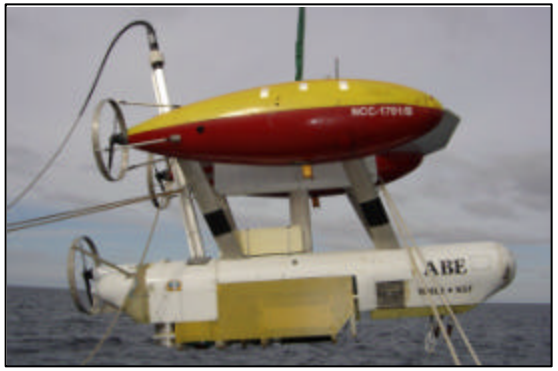
Deep Fiber Optic Tether Methodology

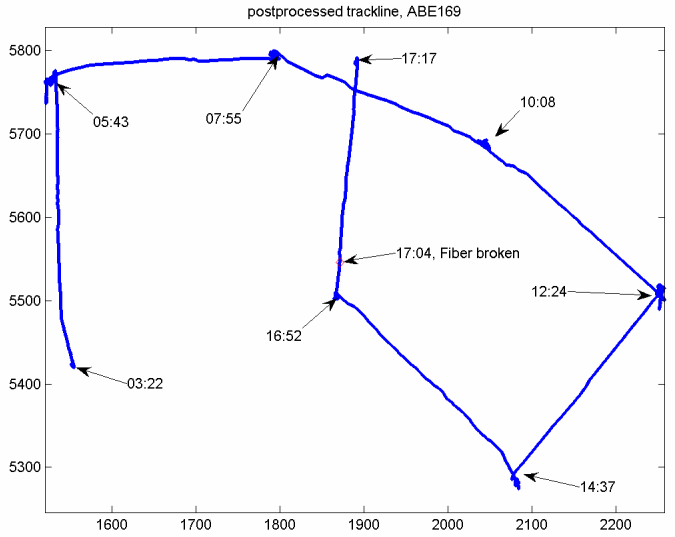




Vehicle working on the seafloor in ROV mode

Fiber Optic Tether Tests with ABE: Dec 2005





- December 2005
- Tested to 2000m
- Longest dive >16 hrs
- Valuable operational lessons

- Simulated sampling operations: short moves with long stationary periods
- Fiber survived on the seafloor
- Over 16 hrs survey time

Fiber Optic Tether & Depressor Tests: June 2006

Snag-resistant depressor

Elevator with spool

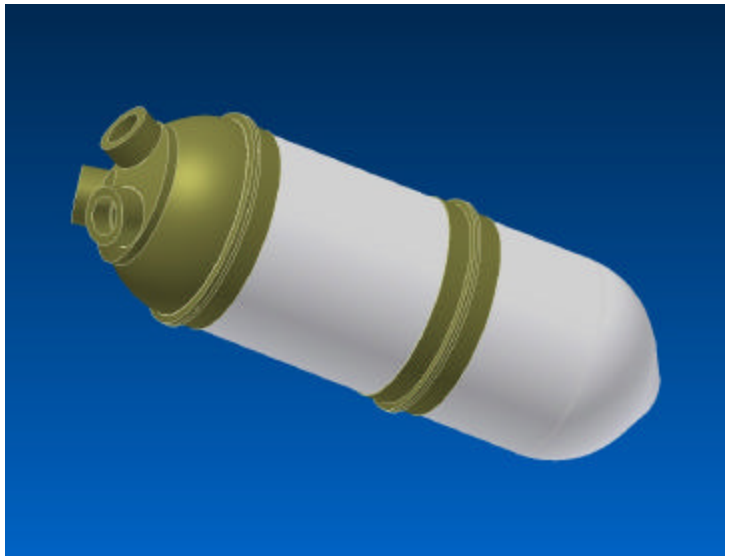
4 deployments to 4000m, no failures on last 3

Longest deployment >16 hrs

Launch/descent configuration verified

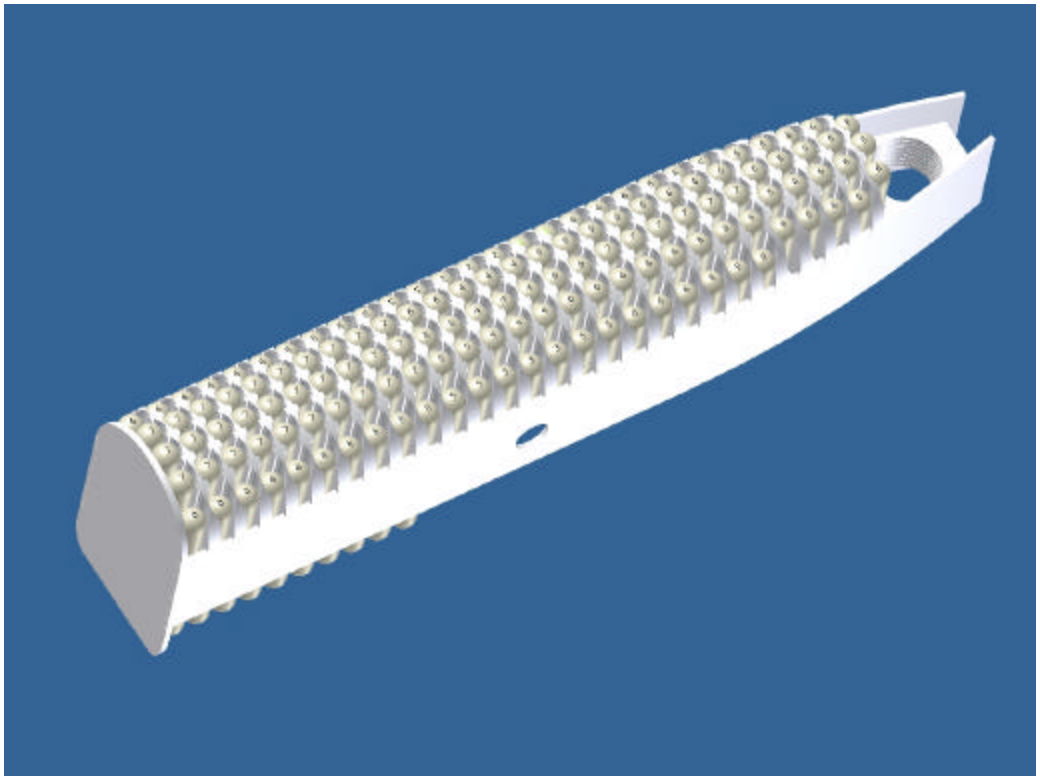
Buoyancy Spheres and Ceramic Pressure Housings

- 3.5 inch dia. alumina ceramic buoyancy spheres have a S.G of .37
- Collapse pressure in excess of 30,000 psi (close to a 2X safety factor for HROV)



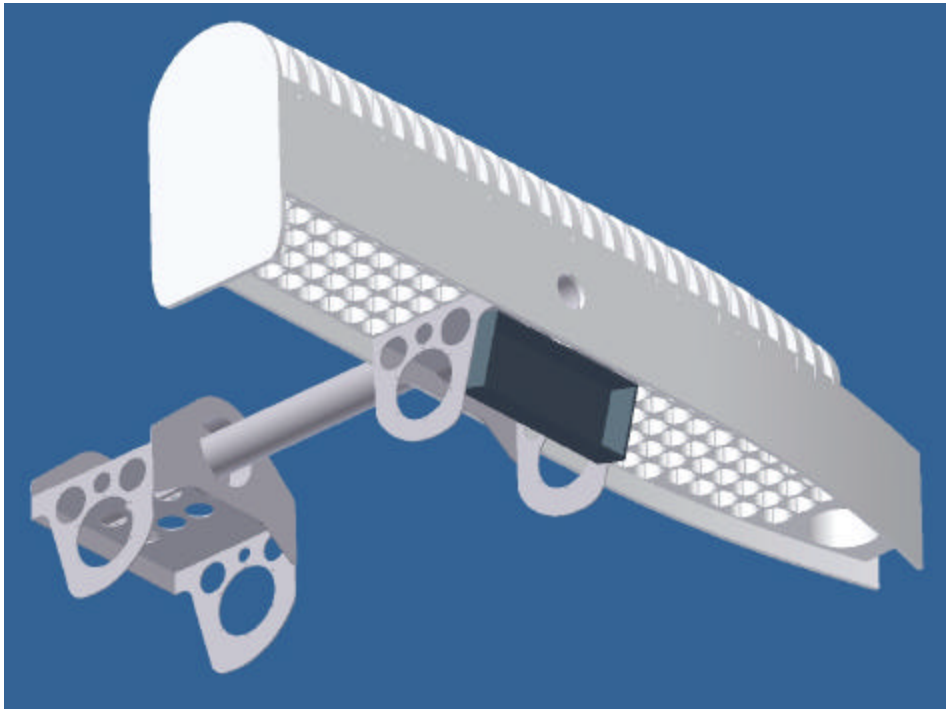
- Main housings for electronics and batteries
- Alumina Ceramic/Grade 5 titanium
- Total in-water weight savings of approximately 730 lbs over titanium

Buoyancy Packaging



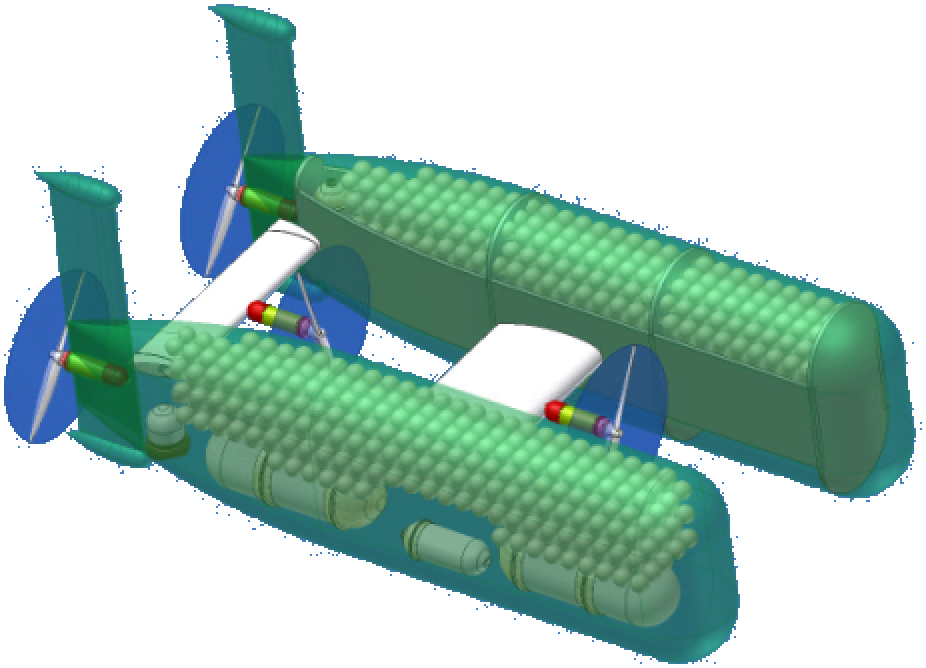
750 jacketed ceramic spheres arranged within hull structure

Internal Structure

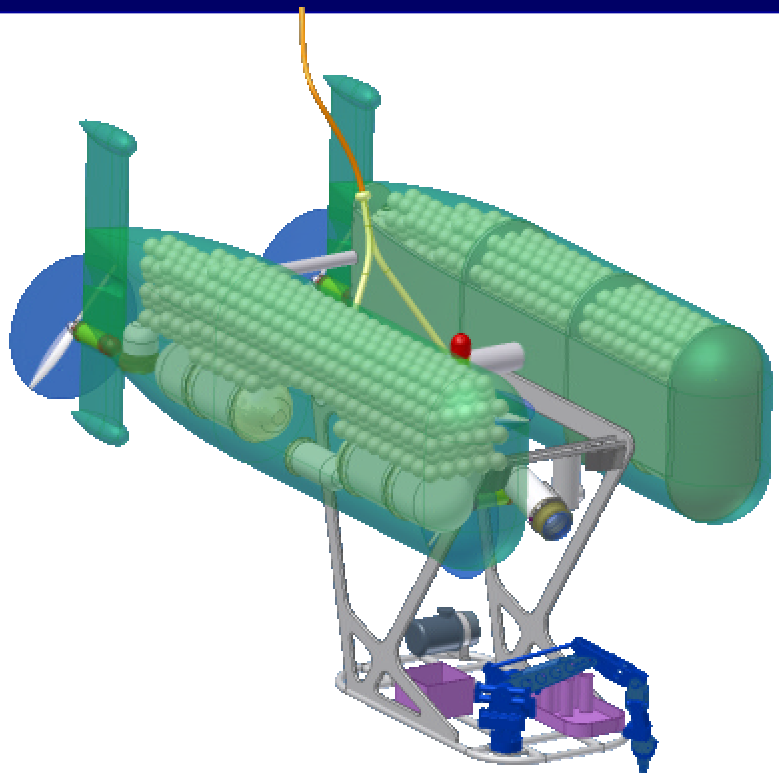


Main structural elements: welded metallic cross structure, polyethylene hull core/flotation matrix

Vehicle Configurations

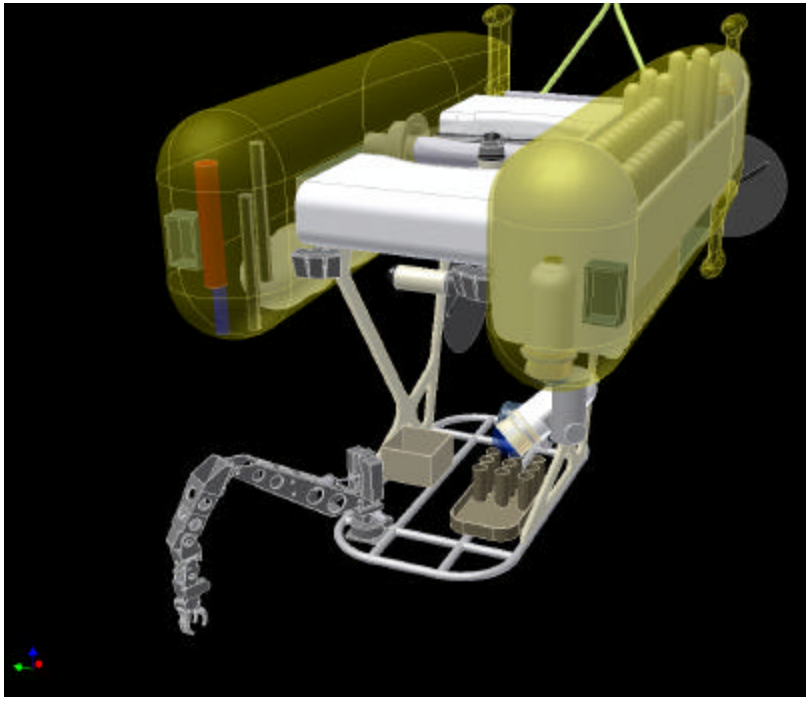


AUV mode



ROV mode

Manipulation and Sampling



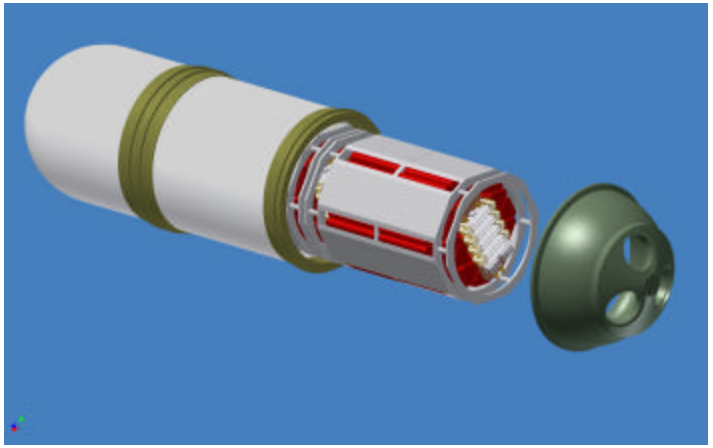
- Manipulator work package suspended from the core vehicle structure
- Flexible sample storage facilities will reside within the frame of the ROV work package
- Pan and tilt will be on the opposite side of the manipulator for good visibility of the workspace
- Will have 2 utility cameras used to see into the frame and sample storage facilities
- Workspace optimized through the use of CAD
- Much of this development is based on lessons learn with the *Alvin*, *Jason I* and *Jason II* systems

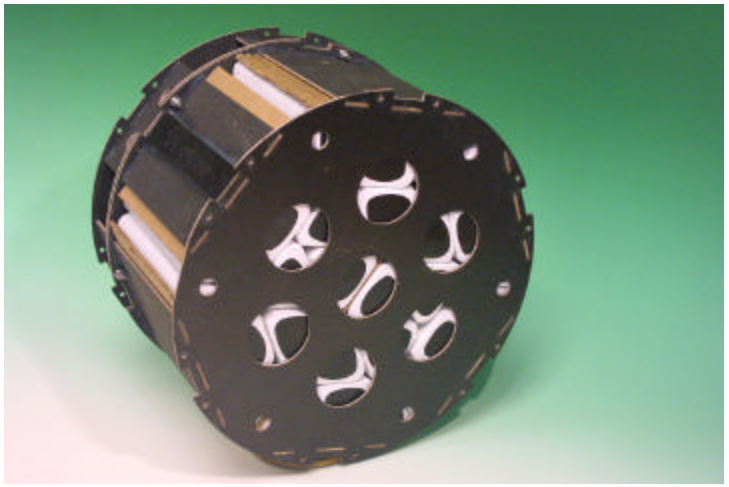
Manipulator and Power Pack

- Hydraulically powered
- 6 degrees of freedom, 7-function master/slave
- Horizontal reach of 66” with minimum lift capacity of 30 lbs
- Grip closure force (controllable) 0-100 ft-lbs
- Highly efficient adaptive hydraulic power system
- Auxiliary output for science payloads
- Arm and power pack presently operating in the shop

Nereus Batteries

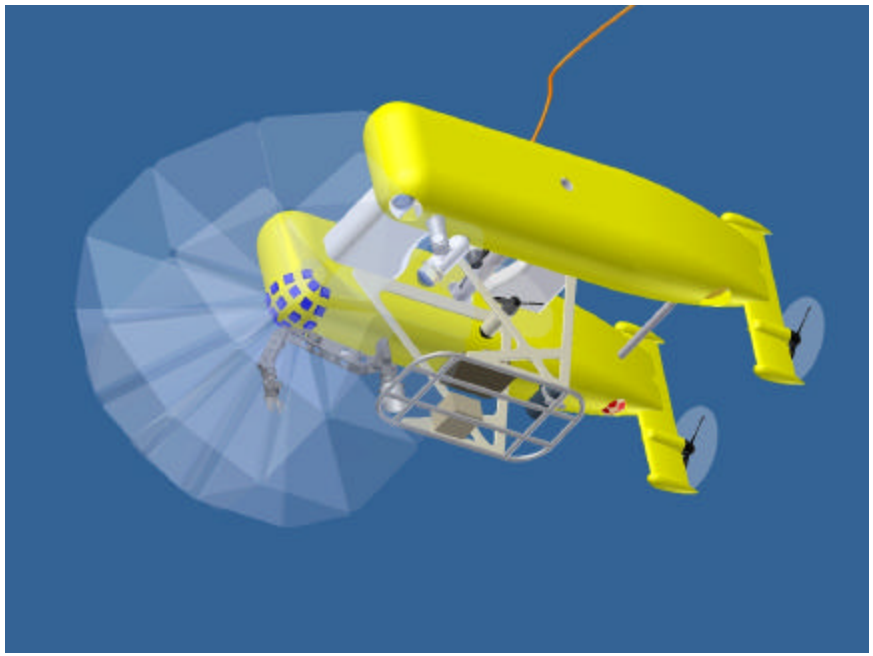
- 18 KWh total capacity
- 50 volt buss, 3KW charge/discharge
- 270 lbs weight
- Formal hazard analysis complete with external review
- Packs presently undergoing U.N. testing





Segmented LED arrays

- Ability to strobe
- High electrical to optical conversion efficiency
- Pressure tolerant design
- Ability to create a spatially flat illumination field to match the camera field of view
- Discrete color for best “effective transmission” through water



Summary

Nereus will provide a new level of accessibility for deep ocean research, with prototype testing in 2007