Alvin Science Verification Cruise Objectives, Logistics, and Considerations:

The goals of Alvin Science Verification Cruise were to:

- Test and establish the science capability of the vehicle
- Conduct opportunistic science and exploration during testing
- Broaden the user base, involve early career scientists

DESSC recommended that this be the first user driven activity prior to normal operations. Schedule permitting, it was also recommended that the expedition be conducted with sufficient time to remedy any issues identified before the first fully funded science expedition.

As defined by the various community meetings and oversight committees, the required scientific capabilities for the *DSV Alvin* upgrade are as follows:

- Direct **observations** of the deep ocean and seafloor
- High---resolution **imaging**/documentation of observations
- Systematic **exploration** of new, uninvestigated regions
- Systematic **surveys** of seabed and overlying water column
- **Sampling** at the seafloor and in the overlying water column
- **Interaction with instrumentation** at the seafloor
- **Transit** between work areas

The Science Verification Cruise objectives were to test and evaluate these capabilities.

Cruise logistics considerations and recommendations:

- We recommend the expedition be up to 10 dive days in length, with transits as needed to accommodate the diversity of activities and geographic areas of interest and types of activities. This duration is recommended to enable sufficient testing of all scientific systems in a variety of settings, to enable thorough assessment by the shipboard evaluators during different operational scenarios, to accommodate the widest possible diversity of investigators, and to enable the testing of multiple, user-supplied instruments. Based on community experience at sea, we suggest it is unlikely that a full evaluation can be completed in a shorter time frame.

- We recommend that the majority of the proposed dive sites be within a day or two of a major port that has easy access in the event that significant engineering or other port facilities are needed for repairs.

- We recommend that four additional berths be dedicated to the science evaluators. Science evaluators will be dedicated to impartially assessing vehicle performance and assisting with mitigating any issues that arise. The evaluators will be focused on vehicle performance, and will not be conducting their own science. We suggest that the evaluators be the PI of the *Alvin*

upgrade, the Chief Scientist for Deep Submergence at WHOI, an RHOC representative, and a DeSSC representative.

- The evaluators, with input from the Science party, will be required to produce a comprehensive report that describes the vehicle's scientific capabilities and limitations, and must specifically address and comment upon the specific capability test (outlined below). This document will be made available to the broader community, and will be used to provide guidance to future users, and to address and resolve issues prior to the first, fully dedicated science expedition.

- The evaluators will also be required to write (or participate in writing) public articles, such as to *Eos* and *Ocean Technology News*, that present the capabilities of the *DSV Alvin* upgrade project. The evaluators will do so in consultation with DESSC and the NDSF, and will engage other members of the community in these activities as appropriate.

- It is our recommendation that participating scientists make their best effort to involve early career scientists in their proposed verification activities. Involving early career scientists at this stage allows them to better understand how expeditions are staged, provides a unique learning opportunity for early career scientists to play a role in expedition planning and operations with less risk than might be incurred on a full science expedition.

- Accordingly, there would be ~16 berths available to the science party.

Science Capabilities to be evaluated

Navigation and Data Collection

- Based on previous sea-trials, it is likely that thorough tests of the in-hull data logging systems and displays, as well as of the LBL, USBL, and DVL and HOMER navigation systems, will be conducted.
- Submarine data streams (e.g., time, altitude, depth, heading, navigation, and other science-oriented sensors), and storage and access to systems on board *RV Atlantis* to facilitate scientists' use of the collected data.
- Frame grabber system – functionality and ability to feed this type of metadata into the R2R data system being developed for all UNOLS vessels.

Power, speed, and duration capability

- Realized transit speed.

Seafloor Mapping

- Multibeam mapping in terrains from flat to rough, without artifact, including protocols for data acquisition, and shipboard capabilities for post-dive data

processing and production of gridded data.
- Comparison mapping (i.e. repeat mapping of an area).

Lighting & Imaging
- Illumination and its coverage is appropriate to collect "high quality" still and video imagery with all the standard cameras in their standard configuration.
- Verify the operations and "ease of use" of the recording systems.
- Assess the ease of producing video and still image data copies for science and archives.
- Optional: Assess the vehicle's capabilities to collect image series for photomosaicing (with the photomosaics to be made by the science party).

Sampling Capability
- Verify the ease of using the variety of standard NDSF HOV sampling systems and instruments (listing can be found at http://www.whoi.edu/page.do?pid=21075).
- Use of both manipulators for fine-scale sampling of sediments, rocks and organisms, as well as delicate manipulation of instrumentation.
- Assess the ease of using scientist-supplied samplers and sensors commonly employed in HOV-based field experiments (note: these must be compliant with HOV safety requirements)
- Use of a range of basket configurations and payloads that thoroughly assess the flexibility of the basket, accessibility by the manipulators, and its payload capacity.
- Verification of mid-water capabilities, including the ability to maintain neutral buoyancy and collect samples while hovering.

Instrument Interface
- Demonstrate and evaluate the capability to interface user---provided equipment/sensors to the vehicle, including power and communications and basket integration.
- Evaluate the vehicle's ability to interact with elevators to transport samples/equipment to/from the seafloor.

Ergonomics
- Evaluate how users interact in the personnel sphere with viewports, seating, camera and video controls and monitors, voice recording, other equipment and each other.
- Evaluate ease of mobilization and demobilization before and after each dive.