SVC Summary report:

Instrument Interface and manipulation

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1. Instrument Interface

The **user instrument systems** tested during the SVC were those of Kang Ding and Bill Seyfried (University of Minnesota). These systems make pH, temperature and eH measurements using the ghostbuster; data are stored on a flashcard in the instrument on the basket and on a computer inside *Alvin*. The gas tight sampler for taking fluid samples was also tested. Also tested were in situ voltammetric systems from Donald Nuzzio (Analytical Instrument Systems, Inc. or AIS) and George Luther (University of Delaware). Two systems were tested that perform *in situ* voltammetry using the RS232 AIS SEA III system and the network (internet cable) AIS SEA V system. Both groups tested the power and communication systems to operate science user provided instrumentation from DSV *Alvin*. The ground detection procedure is similar to the previous *Alvin*.

***Alvin* now has three hard wiring modes for bidirectional communication** through the new port and starboard J-boxes located on the aft section of the science basket of *Alvin*. They are (1) RS232 (RS422), (2) network / internet and (3) the 0.681 optical fiber. The J-boxes allow for very short wiring from the (serial) port of an instrument to the science serial bus on *Alvin*. Also, 12 V DC power can be supplied via the J-boxes. This setup should not be an issue for the user, but may need to be checked as noted below under RS232.

Power – 24 V DC

The University of Minnesota systems operated on 24 V DC power from outside the sphere and used RS232 serial communication on the port side basket j-box between a computer in the sphere and an internal computer in the instrument on the *Alvin* basket for uni-directional and bi-directional communication.

Power – 12 V DC

The University of Delaware systems operated on 12 V DV isolated power supplied from inside the sphere of *Alvin* to the J-box. These systems used bi-directional communication supplied by the hardwire RS232 serial or Ethernet communication on the starboard side basket j-box between a computer in the sphere and an internal computer in the instrument on the *Alvin* basket.

1.1 RS232 systems

1.1.a Hard ground tests

Before operation of equipment from *Alvin* at depth, tests were done through the sphere on the deck under dry conditions; all instruments were successfully tested. The AIS ISEA III

was first tested in the water via *Alvin* on the first dive (4679), but a hard ground developed due to the configuration of the power and communication hook-ups. This caused the communication port of the internal ISEA computer to become non-functional. Another system was available and modifications were made to address the issue. First, the initial hard ground detected in the sub was fixed by eliminating the common digital ground from the return of power as the communications and power of the ISEA instrument were protected using an RS232 optical isolator device, which was installed inside the ISEA instrument. This protection was not necessary when used on *Alvin* since 1999-2000 and ROV *Jason II*. A deck test using water showed no hard ground problems.

1.1.b Serial port timeouts:

On dive 4682, the AIS ISEA system was fully tested at 1100 meters and no hard grounds occurred, but serial port time outs occurred between 4 to 7 times an hour (about 5 % data loss). As the instrument performs error checking, it continues to try to communicate for 30 seconds after an error is reported. Communication could be established after the error was reported without rebooting the program; however, 30-second clips of data were lost when the timeout occurred. The nature of the interruption in data communication from the outside instrument and the computer in the sphere are not known.

On the evening prior to dive 4680, water tests of the University of Minnesota system showed a hard ground on deck prior to diving. This was corrected by *Alvin* personnel prior to the dive. However, serial port time outs also occurred randomly on the port side on dives 4683, 4684 and 4685 with data loss of 6-33 %.

1.1.c Recommendations for checking communication with user supplied equipment:

Tests on the deck showed no serial timeouts so this problem occurs during the dives. Serial communication can be tested with simple loop back experiments on the surface. This can be set up overnight and checked in the early morning to see if serial dropouts are occurring.

A better way to test communication is to have a bidirectional instrument outside the sub and connected like a piece of science gear. This then can be run in the background during a dive or several dive sequences and not impact science but give information on solving this potential problem.

1.1A RS422 systems

This option is not available on the upgraded *Alvin* because a new interface system similar to that used on *Jason II* was implemented. The new 0.681 fiber optic capability should eliminate the need for using RS422.

The original AIS ISEA instrument from 1999 worked flawlessly via RS232. After 2003, the previous *Alvin* was also wired with RS422 when the length of the RS232 cables from the

penetrators was not reliably controlled. RS232 communication works best at higher baud rates when the wire length is short. RS422 communication is less sensitive to wire length.

1.2 Ethernet Communication

AIS built a new instrument (AIS ISEA V), which is designed for Ethernet communications. The system utilizes standard Ethernet protocol, which is the future of communications on Ocean Observatory Initiative (OOI) assets as well as HOV and ROV systems. Dry and wet tests on the deck using *Alvin* power showed that it worked. One communication test was done on *Alvin* in 2600 meters of water on dive #4683 to show that the computer in the sphere communicated with the instrument on the basket, but only for a short period of time. However, the test was done with a person who does not know how to use the system, so no data could be obtained as SVC lost the last 2.5 dives. Thus, a valid assessment of this capability cannot be given; e.g., we do not know if this communication system will have timeouts over longer periods as observed with the RS232 system. Further testing on a continuous basis needs to be done in order to fully test the Ethernet capability of the *Alvin* interface protocol.

1.3 Optical fiber

Although *Alvin* has optical fiber communication possibility, a way to connect to it from the basket was not available at this time, which we believe is due to a lack of a breakaway link between the sub and the basket. Thus, a valid assessment of this capability cannot be given.

2. Manipulators:

The manipulators worked well for sampling and using user probes. The port manipulator had a hard ground on dive 4680 and was corrected so it could be used on subsequent dives.

The positioning of the manipulators can be done easily so the observers can see through the view ports easily.

3. Need for further testing not accomplished on the SVC.

The RS232 system still experiences serial timeouts on depth with data loss. The Ethernet has not been fully tested. Fiber optics communication has not been tested.