

NEEMO 16
Mission Days 8 & 9 - Status Report
Aquarius Reef Base, Key Largo, FL
June 18 - 19, 2012

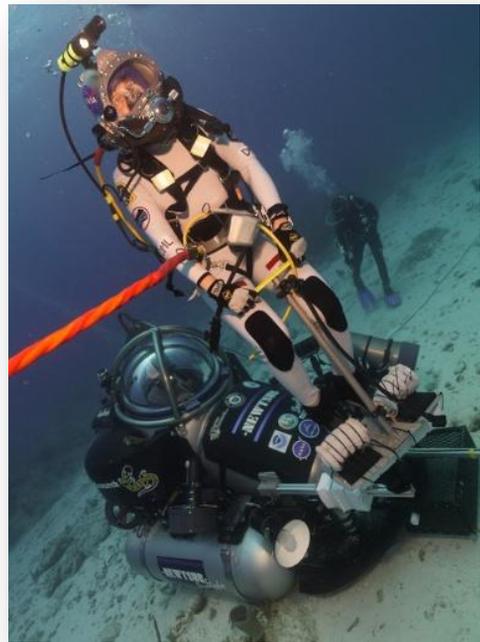


Aquanaut Steve Squyres translates via EVA jetpack, one of the free flying EVA techniques.

Free Flying EVA Techniques

Fundamental to the development of a capability driven framework for human space exploration is identifying the hardware systems that are required for the range of destinations being considered along with finding safe, affordable, and effective ways to develop and operate those systems. Integral to system design are the intended operational uses of the system, including the crew size associated with each space vehicle as well as the combination of vehicles and hardware needed for the various missions.

The NEEMO 16 Extravehicular Activities (EVAs) are focusing on evaluating various methods for translating around an asteroid and stabilizing a crew at a geological worksite so that rock and soil samples can be collected. Asteroids present a unique challenge for spacewalks because there is no significant gravity and composition is largely unknown. We are evaluating methods for utilizing cables tensioned between fixed locations to provide the crew with translation lines. We are also experimenting with an extendable boom, which is a semi-rigid beam that provides the crew with stability. This boom can either be installed on the translation lines or anchored to the asteroid surface.



Commander Dottie Metcalf-Lindenburger translates via the Deep Worker submersible.

Additionally, we are investigating what are known as free flying techniques, EVA techniques that do not assume the ability to anchor to an asteroid. Instead, the crew obtains the stability necessary to obtain geological samples through one of two ways. The first way is using a jetpack for both translation and stability when collecting free floating samples. In the second way, the crew uses a foot restraint attached to a positioning system on a maneuverable Multi-Mission Space Exploration Vehicle (MMSEV). For NEEMO 16, Deep Worker submersibles with foot restraints mounted on their bow are providing the capability that the MMSEV would supply during an asteroid mission.



Aquanauts work together to use the EVA boom, an anchored technique.

Communication Delay Challenges: Just in Time Training

One of the significant challenges that will arise for distant exploration missions is how to deliver highly detailed training to the crew quickly. We know that prior to a long-duration mission, it is impossible to think of and train the crew for every contingency. Additionally, the mission itself will last so long that even the things we did train the crew for initially might be forgotten. Because of the time-delay induced communication issues, the current proven method of the Mission Control Center (MCC) guiding astronauts through each step of the problem is not a good solution to time-critical activities. So how does an astronaut dig into the guts of – and fix– something that they either never had training on in the first place or, received training on but it was so long ago that they do not remember?

If it really were first time training, or you had no help from the MCC, how would you approach the problem? Our standard NASA procedures are great for actions that the crew is already familiar with; they ensure that each step gets done in the right order. However, they are an inefficient method for teaching something new. For this mission, we are applying a method that many people use regularly

on earth: watching videos on the internet. With a very detailed video, you can watch a step, pause, perform the step, and continue that cycle until you successfully complete the activity. In fact, a product that combines simple labeled pictures, video, and procedure steps could do it all. Part of the NEEMO 16 Mission is evaluating the use of this video method for “Just in Time Training” (JITT).



Aquanauts conduct Just in Time Training activities.

Since our NEEMO aquanauts do not have any training on Aquarius -- the professional Aquarius Reef Base aquanauts on the crew are responsible for the habitat -- Aquarius maintenance activities offer an excellent way to investigate this question. During our NEEMO 16 mission, we planned several complex, maintenance-type tasks on Aquarius for our aquanauts to perform using JITT. We provided the crew with training products that were simple enough to have been developed overnight and that used a mobile tablet device for viewing. The aquanauts used the videos to train themselves how to carry out these new tasks, and we captured data on the efficiency of this training method as well as lessons learned for improving the training.

Communication Delay Challenges: PAO

Public Affairs Outreach (PAO) is another area affected by time-delayed communications. Imagine the historic event consisting of the first manned mission on a space asteroid, broadcast to the entire planet. Now imagine that every time a reporter asks an astronaut a question, it takes a minimum of 100 seconds for that reporter to receive a response. Although the event may be exciting, the audience would have a difficult time staying engaged in the outreach with the continual delay in communications.

The NEEMO 16 Education and Public Outreach (EPO) and PAO personnel, with the assistance of the Communication Team, are conducting activities during the mission to evaluate various ways to provide exciting, engaging outreach while being constrained by time delays.

We have examined three different methods of conducting interviews while under a time delay constraint: (1) having a regular interview with the long, delay-induced pauses between each communication; (2) providing the crew with a list of questions prior to the interview that they answer, thus mostly mitigating the back-and-forth delay; and (3) a variation on the first item, where the pauses are edited out in post production. The results will be posted at “[www.nasa.gov.neemo](http://www.nasa.gov/neemo)”.

Communication Delay Challenges: Personal Communication

Time-delayed communications also brings difficulties into personal communication with one’s family. We all tend to take for granted the many ways that we can stay in touch with friends and family in today’s world. However, imagine trying to catch up with someone on a phone call where they will not hear what you are saying for 50 seconds and you won’t hear their response for another 50 seconds. That is not all: texting, email, and other forms of communication would also be restricted by the time delay.

For the NEEMO 16 mission, the crew is evaluating different methods of personal communication constrained by delays. These methods include delayed texting, chat rooms, and even specialized phone calls. This mission will provide valuable insight for what may work best for the crews that venture beyond earth orbit to remain in touch with all of us back on earth.



The Liberty Star deploys an underwater submersible into the water.

*The NEEMO Mission Management
and Topside Support Team*

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