NASA Extreme Environment Mission Operations

by Mark Widick

I often dream, while soaring over a dive site, am I flying or swimming, drifting through inner or outer space? Tranquil, effortless and beautiful, set free… divinely free. We glide at will through the water, unencumbered by gravity. Soaring like raptors over a cliff updraft, we are as close as divers can get to the experience of a space walking astronaut. For me, it is a lazy fantasy.

For those charged with planning how we may make our next deep space journey this is an opportunity to stage full dress rehearsals. In October 2011 and June 2012 I became a team member of NEEMO 15 (NASA Extreme Environment Mission Operations) and NEEMO 16. I was charged with photo-documenting a full-up underwater simulation. The plan was the simulated, rendezvous and exploration of a near Earth asteroid.

Armed with my medium format Hasselblad camera, placed in an Ultima Digital housing, and the Nauticam housing for the Sony NEX 7, I set out to photo document the planned 12 day saturation dives at the Aquarius Reef Station (ARF) located about three miles south of Key Largo, Florida.

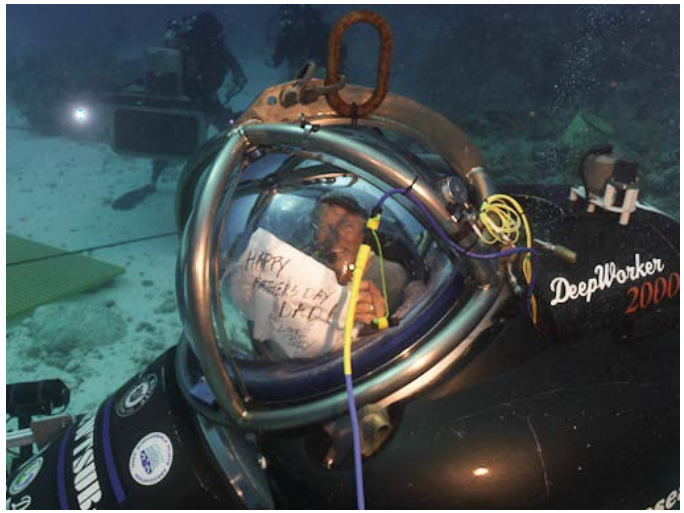
NEEMO has been a series of projects to further understand and prepare for issues relative to deep space exploration. Although the October mission was cut short due to an approaching tropical storm, the lessons learned contributed directly to success in the recently completed 12 day NEEMO 16 in June.

A "Killer Barracuda" nearly stops testing, but the brave crew weathers the attack in style. Many large animals were regularly seen including tarpon, goliath grouper, rays and a an ever curious loggerhead turtle. Hasselblad H3DII-°©_31, ISO 200 f/4.8, 1/60 sec, 28mm.

Splashdown on day one the aquanauts get photographed with the ARB before entering the wet porch. Aquanaut Team are: Dorthy Metcalpf-Lindenberger, NASA Astronaut Timothy Peake, European Space Agency Astronaut Kimiya Yui, JAXA Astronaut Steven W. Squyres Ph.D., NASA Goldwin Smith Professor of Astronomy, Cornell University Chair, NASA Advisory Council James Talacek, Habitat Technician Justin Brown, Habitat Technician (not shown). Hasselblad H3DII-°©_31, ISO 200 f/5.6, 1/125 sec, 28mm.

Tim Peak EVA activity using guide lines to translate across the "asteroid" surface. His task is then to drive a "Seismic Sensor" into the surface of the asteroid. Hasselblad H3DII-°©_31 ISO 200 f/5.6, 1/125 sec, 28mm.

Bill Todd in the Deep Worker Sub prepares to take mission commnder Dottie Metcalf Lindenbergger to a new exploration site. Hasselblad H3DII-°©_31 ISO 200 f/4 1/125 28mm.



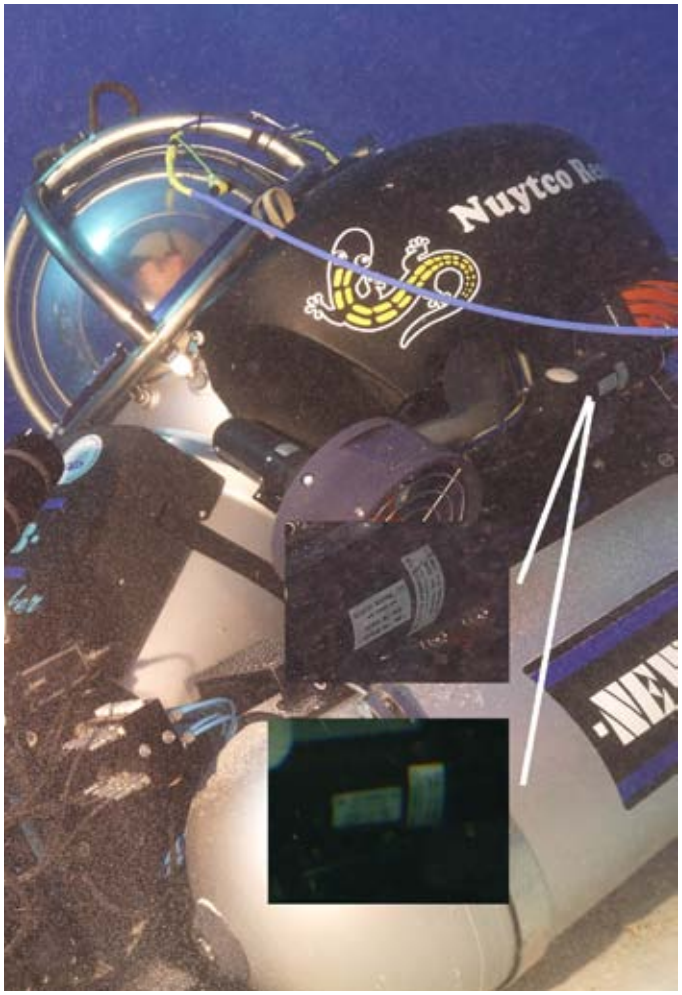
Billy Todd flashes a note to his dad on Father's Day. I am certain his dad Bill Todd Sr. understands his absence that day. Hasselblad H3DII-°©_31, ISO 200 f/4.8, 1/125 sec, 28mm.

NEEMO 16 was based on a steady progression, the complexity of the projects has increased to rival that of a true space flight. The NEEMO 16 project brought together an array of technologies including two Deep Worker Nuytco one man submarines, Pegasus Thrusters (tank mounted underwater torpedo shaped propulsion for divers), diving umbilical's, underwater communications, the Liberty Star NASA support vessel, numerous smaller surface support work boats, divers and a contingency of interested spectators including an IMAX film crew,

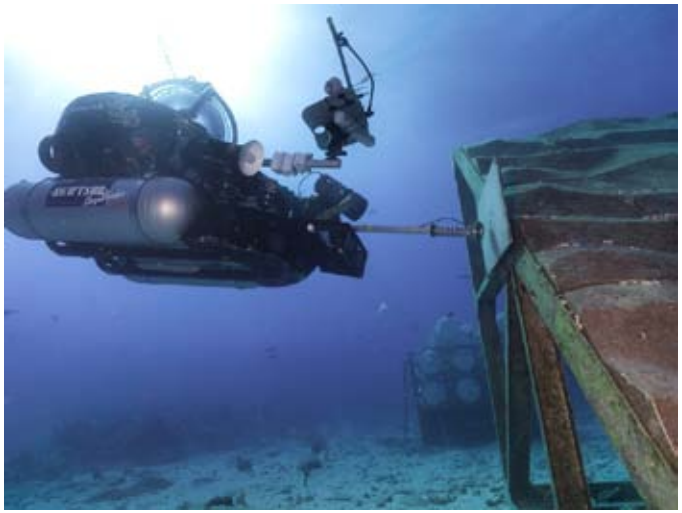
Land support, included a mission control trailer, with a "Cap-Com" running differing scenario's including simulated and real emergency management. The trailers are brought from the Kennedy Space Center prior to the start of the mission. To add to the realism, communication delays of up to 50 seconds were added to portions of missions just as would be dealt with in missions sufficiently distant from Earth.

Why bother with such an elaborate simulation? Many simulations are already done at the Neutral Buoyancy Laboratory (NBL) located at the Johnson Space Center in Houston? Mission director Bill Todd explains, that while much can be learned AT NBL; it lacks the intrinsic stress encountered in true space flight. "At the end of a test, if you make a mistake you can still go home and worry about it tomorrow". Real space flight, especially as we leave low Earth orbit is totally different. To best simulate that aspect, nothing quite matches the real stress and isolation offered by saturation diving. Each NEEMO mission involved a team working

Mission control van is loaded with sophisticated mission communications materials allowing realism when dealing with the offshore aquanauts. iPhone 4 ISO 125, 3.9 mm, f 2.8, 1/15.



Spacecraft may be used to navigate space walking astronauts around the surface of an asteroid.



Sub Docking was achieved by an electromagnet and an iron plate. Pilot is Mike Gernhardt, a four Space Shuttle Flight Veteran. Asteroids may have sufficient iron content to allow for this type of attachment. Hasselblad H3DII-°©_31 ISO 200 f/4 1/350.

The medium format H3D Hasselblad has resolution to an extreme. The inset above the image was taken with the Hasselblad, the inset below with the Sony NEX 7 at similar distances from label.

together. Two "Hab Techs" provide technical support during the mission and join four aquanauts that carry out the simulated extra vehicular activities "EVA's". During EVA activity, dives of four of more hours are completed engaging in interacting with equipment simulating what could be expected during and actual interaction with the surface of an asteroid.

Unlike the moon missions, an asteroid has little mass and as a result, little gravity. In order to do meaningful work, one needs a means to anchor to the surface. Without an attachment you would just float away from the asteroid. Several means of coping with this issue were tested including driving an anchor into the surface and translating across the surface with ropes or rotating beams, personal "jet packs" simulated by the Pegasus thrusters and finally locomoting at the end of a foot restraint attached to the Nuytco submarine. The sub representing a surrogate for an space vehicle with propulsion ability.

It was during the EVA portion of the testing that I had my chance to contribute. Photography becomes an invaluable tool in the documentation of the test results. High quality images allow the review of the challenges and how they were solved. This hopefully then may suggest a means to do things better. Engineering new tools and techniques may fall on those who were not present at the testing site. Still and video documentation can stand in for their personal involvement.

What was it like getting this close and photographing the NEEMO missions? Incredible! I wanted to maximize my documentation, so I attached a Go Pro to the dome port of the Hasselblad housing. This allowed continuous video capture of the EVA's. The engineers were interested

in a running video of the tests.

In order to satisfy everyone, I needed to create detailed engineering photos for analysis and eye catching action shots that would play well to the NASA PAO need for keeping the public engaged and excited in what was happening. I found the Hasselblad H3D 31 medium format a quite capable tool when pared with the 28 mm wide-angle lens. The water quality at Aquarius Reef station varied considerably, and the lens allowed a field of view large enough to include divers and equipment while approaching close to the subjects to limit backscattering from the two Sea & Sea YS-250Pro TTL strobes.

NASA had gone to considerable effort to provide realism in all white wet suites and I intended to keep them looking white and not blue even at 65 feet. Through considerable testing, I was able to strike a balance illuminating the stainless steel superlight dive helmets worn by the aquanauts and the less reflective dive gear. Focus was not difficult as long as the center focus was aimed at an area of sufficient contrast. Some areas on uniform color on the wet suites would prevent focus lock. The very high shutter speeds (at 1/800 sec) that stills synchronize with the flash allowed me to create a outer space look by vastly underexposing the background while throwing enough flash to illuminate the fore ground. The trick did the job awarding me the distinction of NASA image of the day during NEEMO 15.

The NEX 7, with its more liberal search for areas of focus outside the center of the viewfinder proved quite capable as well. Background "Black Out" was less satisfactory with synchronization limited to 1/180 second. The Sony provided RAW conversion software proved less than intuitive when

Inside view of Deep Worker Sub piloted by Steve Chappell.

doing large numbers of images, and I found my version of Adobe Bridge CS3 incapable of opening the ARW format. For images required the day of the dive, I was forced to color balance with the JPEG files I had the camera set to output in addition to the RAW format.

Very limited time was available to work through unfamiliar software at the end of the day. I had to get equipment turned around and deliver imagery at the end of each day. I shot on average 300 images a day. We left the dock at 7 AM after a 6:45 briefing and usually would return 12-°©_14 hours later. Dive gear, Nitrox testing and provisions (late night run for Publix sandwich and chips, image processing and battery charging followed.

Here Hasselblad "Phocus" software is clearly superior allowing me to quickly color balance large numbers of very large RAW photos. Fine image resolution was nothing short of spectacular with the Hasselblad, and very good to great with the NEX-

Kimiya Yui and Timothy Peake the Aquarius Reef Station in baclground. Image Sony NEX-°©_7. ISO 100, Lens 18 mm (18-°©_55 zoom), F/5, 1/100 sec.

7. I suspect upgrading to CS5, will likely solve the RAW file conversions, just may now be the time to take the plunge with CS5.

The significantly heavier Hasselblad housing was quite stable and easy to handle. I found the two Sea & Sea strobes to act as equalizers in handling due to their significant size on the surface and in a strong current. What was it all like? I felt like a member of a James Bond film underwater crew crossed with a true Space Shuttle Launch. (Another area of my special interest and a reason I shoot Hasselblad cameras… see additional images at MarkWidick.com).

I am used to having the largest camera in the dive group, but there was this group from IMAX 3D shooting really big gear that appeared throughout

This support vessel is equipped with a portable one diver decompression chamber and is named after an icon in saturation diving development.

the mission.

Anyway, the mission was an astounding success. What is next for the ARB? There is only one confirmed Aquarius Reef Station mission this year. Primary intent is demonstrating the unique abilities of research during saturation diving. It is starting mid July and is featuring National Geographic explorer-in-residence Sylvia Earl and videographer D.J. Roller in saturation dive mode. A priority will be study of the role of sound pressure waves emitted by Goliath Groupers while feeding.

The future of ARB needs our help. Like so many of the inspirational science efforts the funding is in jeopardy. This mission is to reach out, educate and try and engender enough support to keep space, ecologic and marine science continuing at ARB.

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