Subject: Shipboard transducer removal & installations in the water
Date: Tue, 23 Mar 2010
From: Christopher M. Griner (WHOI)

I would like to get an overview of how various UNOLS vessels (or others) may be configured for removing and installing transducers with the ship in the water.

I think that many vessels may use an airlock in which personnel are under pressure with all tools and equipment at the ready and the transducer or plate is vented, removed and replaced as quick as possible.

Of course this is typically done in a tight compartment, heavy steel plates and ducers and the pressurization and depressurization can be uncomfortable to personnel under this pressure.

Are there other ways of accomplishing this (ie. better, safer)? I have heard of a cofferdam arrangement but have never seen it.
What (if any) provisions are being made for transducer wells on the AARV Sikuliaq or for the new Oceans class vessels?

Thanks in advance for any input.

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Christopher M. Griner
Engineering Assistant
Shipboard Scientific Services Group
Woods Hole Oceanographic Institution
MS 17
Woods Hole, MA 02543
USA

From Tom Wilson, Stony Brook:

Hi Chris,

Two approaches we have used:

1) To mount an ADCP on the 300 foot P.T. Barnum car/passenger ferry, we built a small "top hat" transducer well in one of the void spaces and ran a couple of pipes 3 up above the waterline. The ADCP fits on a mounting plate with projecting ears and downward-facing bolt studs that mate with ears welded to the inside of the top hat. The ADCP and plate is raised up into the well rotated 45 degrees from the deployment position to let the ears clear each other, rotated to deployment position, dropped into place, and bolted. We then bolt an acoustic window into place to provide a smooth bottom (the ferry cruises at up to 18 knots).

To mount the ADCP when the boat is in the water, we drop an extra long ADCP connection cable (with dummy plug) down the pipe and back up the side of the ship. We connect the ADCP above the waterline, have a diver swim down and mount the ADCP, then pull the extra cable back up into the hold.

The pipe is sealed with a standard MCT Brattberg transit. The acoustic window allows us to flush the ADCP space with fresh water, this keeps down corrosion and biofouling. The window is strong enough to withstand the hydrostatic head either direction, so no worries when the ship drydocks.

This approach does require a diver but is simple and relatively inexpensive. It is also extremely palatable to Coast Guard safety inspectors and the owners of ships of opportunity, who are understandably leery when a scientist asks to cut a big hole in the bottom of their boat.

The only thing I would change if I did this again is to make all fasteners 1/2 inch minimum for ease of manipulation by gloved divers.

2) The 80-foot R/V Seawolf uses a moon pool that runs vertically from the ship bottom up above the waterline to a hatch in the wet lab. We have several interchangeable transducer frames that slide onto mounting pins at the bottom of the moon pool. A frame is held in place by a substantial pipe and bar arrangement that connects at the top of the moon pool just below the hatch. A small hatch in the roof of the wet lab lets us use the cargo boom to pick up and drop down transducers. A standard transit exits cables out the side of the moon pool. The system has worked well for both multibeam and ADCP. Changing transducers takes an hour or two and the only things that get wet are our hands.

Tom

**********Thomas C. Wilson / Instrument Lab / School of Marine and Atmospheric Sciences
Stony Brook University / Stony Brook NY 11794-5000 USA

From Capt. Daniel S. Schwartz, UW

Hello, Chris.

We're struggling with the very same question here. We get requests for different types of ADCPs (as one example) by individual scientific groups, and short of drydocking the ship for a single cruise's requirements, we face the same issues. The risks of working someone in a pressurized below-the-waterline compartment are obvious. The retractable transducer stem on the AGORs is, unfortunately, too small in diameter for many applications, so there is no obvious answer. We'll be interested in seeing the response your query gets.

Thanks and best wishes,
Dan

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Capt. Daniel S. Schwartz
Manager of Marine Operations University of Washington
School of Oceanography, Box 357940
Seattle, WA., 98195-7940

From Rich Findley, U. Miami

On the Seward Johnson and the Walton Smith all of our transducers are behind acoustic windows and are removable from the inside. The 3.5 kHz windows are made of 1" thick fiberglass. With this thickness there really isn't any concern of catastrophic failure. This allows the top of the transducer box to be removed for access to the transducers without any other major concerns. Obviously the window should be a inspected by a diver to ensure that the window has not been damaged.

The ADCP and 12 kHz depth sounder transducer windows on the Seward Johnson are made of 3/4" Lexan. In theory this should be strong enough to allow removal of the transducer from the inside but because it is a single layer instead of laminated fiberglass it is more prone to catastrophic failure. To deal with the possibility of catastrophic failure an aluminum plate and gasket is bolted to the outside of the hull over the window using permanent attachment points. While this arrangement would probably not be 100% watertight it is believed to be sufficiently watertight to allow the replacement of the transducer if the window were to fail.

Rich

From Steven Hartz, UAF/SMC

Christopher

Please find Attached Sikuliaq's Center Board drawings, Sonar arrangement slides in pdf and photos of the Alpha Helix ADCP installation. Transducer center board was borrowed from NOAA, GO Sars, Sharp, UK vessels,,,,,. Center board allows transducer change out while ship is in water. There is service access to the retractable centerboard on the main deck. Center board also allows deployment of transducers below bubble sweep. In image DSCF0040 you can see the outer bolt pattern for a bottom plate that was installed by a diver. We added foam to the bottom plate to make it neutrally buoyant. ADCP was top hat mounted. With bottom plate in place tophat assembly was removed and we installed a top plate while transducer was serviced. Pressurized transducer void was considered in Sikuliaq design but, time to pressurize the large transducer void was too long. There was also discussions concerning safety airlock escape.

Steven Hartz
UAF/SMC

DSCF0040.JPG

DSCF0044.JPG

DSCF0049.JPG

Arrv tech slides sonar revision(2).pdf
[Note – Contact Steve or the UNOLS Office for copies of the pdf documents.]

From: Dave Nelson (URI)

Hi Christopher

The Endeavor (and the two other Oceanus class vessels, Oceanus and Wecoma) use a pressurized well approach to handling transducer swapout.

There are two separate chambers, one above the other. In normal operations the hatch between the two chambers is kept open. Once the main hatch is secured the chamber is pressurized to 8 psi nominal. On Endeavor, TV cameras and sound powered phones allow the chamber operator to stay in constant contact with individuals in the well. If all goes smoothly the transducer work is accomplished and the pressure slowly relieved while checking for leaks.

In case of emergency, the occupants of the well can retreat to the upper chamber, close the hatch and be depressurized. This allows egress from the chamber while maintaining pressure to the lower chamber in the event that there is still an open hole to the sea.

We have added a six in diameter pipe that has pipe caps on both ends and pressure relief valves and gages. This allows for additional tools or other items to be passed into the upper chamber without complete depressurization.

Confined space procedures are followed prior to entering the well to verify breathable conditions.

We have also recently replumbed the air feed to the lower chamber so it is down where the people are actually working instead of feeding the fresh air in to the lower chamber at the top of the ladder.

The main problem with this setup in an injured/unconscious man scenario. I have spent many hours working in the chamber, the longest contiguous period being thirteen hours. We contacted the Navy Dive Center to verify that no decompression was required. They assured us this was the case since we were only working at 1/2 atmosphere pressures.

It is certainly an unusual experience to watch fish swim by underneath a 21" hole in the bottom of the ship while working there and the occasional cloud formation if conditions are right while depressurizing is also interesting.

Dave Nelson
Marine Technician IV
R V Endeavor

From: Robb Hagg (UW)

Dave Nelson,

Do you use ships air to pressurize the ducer void? If so, Do you use a special filter system to clean the air?

The TGT has the ability to pressurize our ducer void, although we never use it to swap ducers.

We pressurize with ships supply, the feed to the ducer void is regulated down to where it takes too long to come up to a resonable pressure to keep out the water.

I've considered ways to make pressurizing that space practicle for swapping ducers.

I like the two chamber idea. That may be possible for us.

Robb

From: Dave Nelson (URI)

Hi Robb

Yes, we do use the ships supply to pressurize the chambers of the well. There is a pressure regulating filter made by Bullard, Model 41P2. This was added to the system many years ago. I believe the system as built had no filter. There is a steel pipe supply line connected directly to the compressors in the engine room. There are two separate pressure regulators after the filter, one for each chamber. Two separate bleed systems use

larger diameter pipe than the feed and pressure safety valves set at 9 PSI to prevent over pressurization of the space. There are two non regulated feed valves, but these are kept safety wired closed. Diagonal cutters are kept on hand during well ops. Should the need arise to feed more air in an emergency. This would only be done if the ship is open to the sea via a large hole and even then would only be necessary if the both pressure regulators failed. There is also a valve to connect the two chambers externally to allow for pressure equalization between the two chambers while under pressure. This is necessary so the intermediate hatch can be safely opened after a lockout situation has occurred.

Dave Nelson

From: Dave O'Gorman (OSU)

During the past few years we have had several instances of people wanting to mount high frequency (600k and up) ADCP's using an over the side pole. I know this isn't a permenant sort of solution but it is something we have seen repeatedly so I thought it worth mentioning.

We recently had to work up some drawings for another project:
http://tangle.coas.oregonstate.edu/martech/dave/DesignFiles/ShortPole/Complete%20Pole%20Setup%20-%20export.pdf
The real version has guy wires to fore and aft stays and there are two different main poles, one that can be adjusted to 'just below the surface' and another one that is long enough to go deeper than the keel.
Some of the PI's have different adaptor plates and this has enabled us to mount a rather wide variety of equipment (often simultaneously) to the end of the pole.
Dave

David O'Gorman
Marine Instrumentation Engineer - COAS
130 Burt Hall
Corvallis, OR 97331

From: Bill Byam, UDEL

Chris,

The Sharp has a moon pool with a retractable keel. In the keel are located four bays for science instrumentation. Two usually have our ADCP and Multibeam. The third our Knutson Deep water sounder. We can reach into the keel with our crane (the tops are above the water line with the keel up, and pull out one or more inserts to change instrumentation. The problems are the bays are small, 24" square, and the minimum depth is about 10' below the sea surface.

We also have a pole for mounting equipment but it very much limits ship speed.

Bill Byam, UDEL