

Northwest National Marine Renewable Energy Center

University of Washington, Seattle, WA 98195

Research Cruise Report

Admiralty Inlet, Washington

February 8-11, 2010

R/V Jack Robertson, University of Washington Applied Physics Lab



Survey Crew

Capt. Andrew Reay-Ellers, University of Washington, Applied Physics Lab

Jim Thomson, University of Washington, Applied Physics Lab (PI)

Brian Polagye, University of Washington, Mechanical Engineering (co-PI)

Joe Talbert, University of Washington, Applied Physics Lab

Chris Bassett, University of Washington, Mechanical Engineering

Jeff Epler, University of Washington, Mechanical Engineering

Cruise Summary

From February 8-11, 2010 the R/V Jack Robertson was on station in northern Admiralty Inlet conducting studies in support of Snohomish Public Utility District's license application for the deployment of 1-2 OpenHydro hydrokinetic turbines. In addition to contracted water quality and shipboard acoustic surveys, NNMREC conducted a racetrack velocity survey to help resolve tidal amplitude and phase around the potential turbine deployment site and deployed a spar buoy to measure noise and wave action. The instrumentation tripod was recovered from the seabed by acoustic release and redeployed for continued site monitoring. The configuration and hardware on one of the two acoustic releases was modified to improve recovery action.

1 Daily Operations Summary

1.1 February 8, 2010

R/V Jack Robertson departed APL dock (1315) and transited with an ebb tide to Port Townsend (1800). A temporary mooring for BioSonics, Inc. acoustic surveys was successfully deployed around 1715.

1.2 February 9, 2010

R/V Jack Robertson underway at 0700 and began instrument tripod recovery operations at 0800. Attempts to trigger either acoustic release and bring float and recovery line to the surface were unsuccessful and recovery operations were suspended around 1000. Sea state was calm, with relatively slow, flooding currents (period of diurnal inequality) and good visibility.

Conducted CTD cast from 1020 – 1040. Wet chemistry from cast completed around 1140.

Resumed recovery operations at 1100, alternating between the codes for the two releases. Several passes over recorded tripod deployment location but retrieval floats were not spotted on the surface. At 1230, the ROV was deployed with boat hook and spectra recovery line to look for tripod. The ROV was recovered at 1245 and spectra line removed due to difficulty controlling ROV with multiple lines in the water. The ROV redeployed and located tripod ~30m NW of recorded deployment coordinates. ROV camera footage confirmed tripod to be intact with both release floats still sitting in their cradles. Recovered ROV to the surface and suspended recovery operations at 1400.

Ambient noise surveys were conducted from the deck of the R/V Jack Robertson from 1410 – 1520 (free drifting).

Returned to Port Townsend around 1600.

1.3 February 10, 2010

R/V Jack Robertson underway at 0715. Obtained three additional deck boxes while in port on the evening of 2/9, including two deck boxes that had been successfully used during previous recoveries under the assumption that the release problem root cause was the new deck box.

Tested racetrack velocity survey pattern (shipboard ADCP) from 0745 to 0810.

At 0815, set up for tripod retrieval and then spotted retrieval float on surface before attempting to fire release. Brought float aboard and conducted retrieval operation, with tripod back on deck around 0840. Additional commentary follows further on in this report.

Temporary anchor for BioSonics, Inc. surveys recovered at 0900.

R/V Jack Robertson returned to Port Townsend at 1000 for tripod instrumentation turnaround.

R/V Jack Robertson underway from Port Townsend at 1420 for SWIFT survey and velocity survey.

SWIFT buoy deployed at 1510 on strong ebb tide, at southern end of potential turbine deployment area. Buoy performed well in sustained winds of 20 knots and was recovered successfully at 1540.

Began racetrack velocity survey (shipboard ADCP) at 1550 and conducted 13 laps in relatively rough seas over the peak of the ebb tide.

Returned to Port Townsend around 2045.

1.4 February 11, 2010

R/V Jack Robertson underway at 1020. David Mora from WA Department of Ecology aboard to turn around CTDO and collect water samples for sensor calibration.

Tripod redeployed around 1110. Landing approximately 145m SE of target (48 09.007N, 122 41.172W) due to challenging sea state and stronger than expected currents. The landing was clean and everyone worked safely and efficiently to complete the redeployment.

R/V Jack Robertson departed Admiralty Inlet at 1120 and returned to APL dock at 1645, via Port Townsend canal.

2 Shipboard Surveys

2.1 Water velocity

Thirteen racetrack velocity surveys were conducted over a strong ebb. These surveys were repeated over two legs of a relatively short (600m x 400m) survey track to better understand phase and amplitude variations in the tidal currents within the survey area. The survey track was adjusted from November, 2009 to pass over two stationary ADCP deployment locations and was modified to a triangular pattern (one long leg, one short leg, and then return via hypotenuse of triangle to origin) due to ADCP return problems in the rough sea state.

2.2 Water quality

As during previous cruises, a duplicate water quality cast was conducted, during which water samples were collected near the seabed, at 30m from the surface, at 10m from the surface, and at 3m from the surface, in accordance with Snohomish Public Utility District's water quality study plan. Wet chemistry was performed on board to preserve the samples for transit back to the University of Washington's marine chemistry lab.

2.3 Ambient noise

An ambient noise survey was carried out over the side of the R/V Jack Robertson with the ship drifting with strong ebb currents in accordance with Snohomish Public Utility District's background noise study plan.

2.4 SWIFT buoy

A spar buoy equipped with a high frequency ADCP, recording hydrophone, and camera was deployed on an ebb tide during a period of white capping. By deploying the hydrophone in a drifting configuration, measurements should not be contaminated by flow noise, even during periods of high currents. The SWIFT buoy performed well, riding white capping waves in sustained winds of 20 knots and was deployed and recovered without incident. The prototype AIS transponder supplied by Shine Micro, Inc., performed well.

3 Instrumentation Package

3.1 Instrument status

During this deployment, tripod instrumentation consisted of:

- ADCP (300 kHz RDI workhorse, 0:45 ensembles): velocity
- CTD (Star Oddi DST): salinity, temperature, pressure
- CTDO (SeaBird 16+): salinity, temperature, pressure, dissolved oxygen (on loan from WA Dept. of Ecology)
- Fish tag receiver (Vemco VR2W): fish tag detections (on loan from NOAA: National Marine Fisheries Service)
- Echolocation hydrophone (Chelonia TPod): analog echolocation hydrophone
- Echolocation hydrophone (Chelonia CPod): digital echolocation hydrophone
- Hydrophone (Loggerhead, 7 seconds continuous recording every 10 minutes): ambient noise
- Sediment trap

Upon recovery, all instruments were functional and data were offloaded successfully. As with other deployments, the housing for the DST was somewhat fouled by sediment, but the conductivity sensor contacts were clear. The ADCP shut down on January 29th, due to low battery voltage.

3.2 Instrument replacement/reconfiguration

Limited changes were made to instrument configuration and no new instruments were added to the package:

- Fish tag receiver exchanged for an identical unit from NMFS
- CTDO exchanged for identical unit from WA Dept. of Ecology
- ADCP reconfigured to store ensembles every 1:00
- CTD (Star Oddi DST) reconfigured to sample every 10 minutes (had been 5 minutes)

3.3 Platform condition

The tripod platform had limited biological fouling during this deployment, likely due to reduced biological productivity during the winter months. Two shrimp, approximately 2 inches in length were found behind one acoustic release. Stainless steel mounting hardware generally showed little corrosion; the exception being a U-shaped hook which was structurally compromised by contact with tarred seine twine. Aluminum mounting rails continued to corrode, with the mount for the CTDO corroding at a much faster rate than the mounts for the retrieval line canisters.

Stainless steel hardware on acoustic releases showed some corrosion and should be replaced after recovery in May. The orientation and float on one acoustic release were modified, as described in the discussion below.

4 Lessons Learned

4.1 Acoustic releases

The instrumentation tripod is recovered by transmitting a coded acoustic pulse at a specified frequency down a receiver mounted on the tripod. On receipt of signal, a metal arm on the release swings free. This allows a positively buoyant float to rise to the surface, trailing a ¼” spectra retrieval line. The retrieval line is then shackled to the R/V Jack Robertson’s utility winch and the instrumentation package lifted to the surface. On Tuesday, February 9, attempts to recover the tripod were unsuccessful. The root cause for this failure was presumed to be the release deck box, which had just arrived from the factory at the Applied Physics Lab. This hypothesis was reinforced by previous problems with release deck boxes and visual confirmation by ROV survey that both release floats remained in their cradles. However, because

both floats were on the surface on the morning of Wednesday, February 10, (prior to transmitting release codes) it is much more likely that the releases did successfully fire on the 9th, but the shackles attached to the retrieval floats were unable to work clear of the release arm until a strong ebb and flood cycle over night. This hypothesis is supported by corrosion on the release hardware, which may be causing some binding, which might only be overcome by the forces generated during strong tides. Considering that both buoys were released for over twelve hours without any fouling of the two retrieval lines, previous concerns about line fouling may be overstated.

In order to prevent future mechanical problems, the configuration of one release was altered. The acoustic release, which had been mounted horizontally along one side of the tripod is now positioned flush along a tripod leg (vertical orientation), directly beneath the release float. Deck testing indicates this orientation reduces the potential for binding between the retrieval float shackle and release arm. The float for this release was also switched out for one with 40 pounds of additional buoyancy. Tripod ballast was increased accordingly such that there was no change in net buoyancy for the tripod.

4.2 Tripod recovery

Attempting tripod retrieval during a period of diurnal inequality is preferable to attempting retrieval during a short slack period. Since during a diurnal inequality, a weak ebb-flood cycle is followed by a strong cycle, this operational timing allows for a less time-constrained instrumentation package retrieval, which still allowing surveys (velocity measurements, acoustics, etc.) to be conducted during periods of intense tidal currents. While tripod retrieval was not successful during the diurnal inequality on February 9th, the extended period of weak currents provided time to diagnose the problem and, ultimately, send down the ROV to look for the tripod.

4.3 Tripod deployment

The tripod was redeployed on the morning of February 11th in rough seas (2-3 foot wind waves, 40 knot wind gusts), with surface currents exceeding 1 m/s. These were considerably more adverse conditions than encountered during previous deployments. However, redeployment was carried out safely and effectively with a single, obvious landing on the seabed. While not ideal, this does demonstrate that the tripod can be successfully deployed in rough conditions. However, hitting a target in rough seas remains problematic. The instrumentation tripod requires approximately 6 minutes to be lowered to the bottom, during which time the R/V Jack Robertson has limited maneuverability and is being forced by both surface winds and tidal currents. This highlights the need for fixed node for post-installation near-field monitoring of a tidal turbine.