Selecting an Acoustic Release for a Mooring or Lander

Rob Morris *(Author)*
Product Line Sales Manager
EdgeTech
West Wareham, MA, USA
<rob.morris@edgetech.com>

Kevin Hardy *(Author)*
CTO
Global Ocean Design LLC
San Diego, CA, USA
<kevin@globaloceandesign.com>

***Abstract*—Moorings with a subsurface float or a benthic lander with onboard positive buoyancy are often coupled to a heavier expendable iron anchor to hold position on the seafloor. Releasing the weight is the critical first step of a mooring or benthic lander recovery. This paper describes a hierarchal selection process to identify the optimal acoustic release configuration for an application.**

Keywords—acoustic release; mooring; lander; benthic lander; anchor release; strongback; dual release; tandem release; Edgetech; Global Ocean Design; hadal; deep sea; deck command unit; purge; desiccant

I. Introduction

Selecting the optimal acoustic release involves a limited number of primary factors. These include:

- Identifying the platform type such as mooring or benthic lander;
- water depth;
- duration of the deployment;
- ability to lift the full air weight of an anchor;
- expected ambient noise;
- areas where biofouling or silting can be a problem; and
- isolation of dissimilar materials.

Secondarily, designers must consider:

- Water weight of the acoustic release, and whether additional buoyancy must be added;
- Cost of releases vs cost of instruments or lost data;
- Removing entrained moisture and sealing with a partial pressure;
- Release mechanism, if a load multiplier such as a lever, or load splitter, such as a chain loop or strongback is needed;
- Additional command/control/interrogate capabilities in addition to anchor release

Acoustic releases provide the end-user *schedule flexibility* as to when they return to recover their mooring or benthic landers. Weather, personnel issues, or ship malfunction and repairs can force a chief scientist to call a weather-day to straighten things out. The acoustic release will patiently wait until the crew gets back to the deployment site and signal it to operate.

Acoustic releases can be integrated into a single package through which the load of the mooring maybe taken, or segmented, separating the control electronics from the release mechanism.

Fig. 1: An EdgeTech 8242 Acoustic release provides the basic functions of in-line strength, depth, and anchor release.

Figure 2: A dual or tandem release provides greater load capacity than one release, by nature of the second redundant release system. A tandem strong back can be used to hold very large loads.

978-0-692-94690-9/$31.00 ©2017 MTS

Fig. 3. An acoustic release on a strongback leverages its lifting capacity.

Segmented acoustic releases provide additional options for vehicle designers, such as the EdgeTech BART board (Burnwire Acoustic Release Transponder) board inside a 12km rated sphere done during the James Cameron ***DeepSea Challenge*** Expedition. The BRT6000 burnwire actuator is another example of a segmented system.

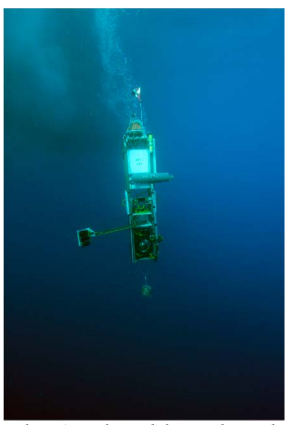

Fig. 4: An EdgeTech BART board housed inside a Nautilus Marine Service Vitrovex 12km rated glass sphere, seen at the top, provided dual release functions and other command/control options to the limits of the Challenger Deep. (Photo by Charlie Arneson, used with permission, Earthship Productions.)

II. HOW AN ACOUSTIC RELEASE WORKS

Acoustic releases use unique command codes and multiple frequencies to negate ambient noise fields, or ignore commands to other releases within transmission range. The acoustic releases mounted in cylinders have either one or sometimes two releases, plus the ability to transpond for ranging. Acoustic release electronics mounted in glass spheres can offer unlimited depth and additional command/control/interrogate functions, plus the advantage of being positively buoyant.

EdgeTech releases utilize a Binary Acoustic Command System (BACS) providing 12,000 unique command sets clearly identifiable by the seafloor receiver. This makes the intended transmitted command resistant to environmental noise and false triggering.

Commercially available release mechanisms function in one of four principle ways:

1. rotation of a collar or retraction of a pin that frees a pelican hook arm;
2. application of electrical power to a sacrificial "burnwire,"
3. a "Push-off" release that uses a rotating threaded shaft to back off a captured threaded release link that supports the load through the threads, and
4. a thermally-activated release mechanism where a DC voltage heats up a thermoplastic material and releases a Stainless Steel hook (EdgeTech's ORCA). This can be reset at sea.

Fig. 5. EdgeTech's thermally-activated release mechanism, ORCA.

In rare cases, subsea engineers have found specialized utility in gas-generating squibs, exploding bolts, and solenoid activators. These are not in the mainstream.

Burnwires are dimensionally small and can be placed away from the control electronics. They are only useful in seawater, and take longer to operate in oxygen depleted zones. The other three work well in seawater, freshwater, and oxygen depleted zones.

Fig. 6: A WHOI OBS incorporates a burnwire release mechanism, seen on the vertical white HDPE face, right side.

III. Some Application Examples

A. Scenario 1: Deploy a single line mooring with multiple in-line sensors in 5000-6000 meters of seawater for 1 to 2 years.

The recommended approach would be a deepwater acoustic release with full transponder capability that can handle a large anchor of 1000kg or more. Using a dual or tandem release set-up for redundancy would also be desirable because of the cost of the mooring instruments and the value of the data.

The transponding capability, (tilt, release status and ranging) is very useful for deepwater operations to locate the mooring before releasing, receive release status and to track the mooring as it rises to the surface.

Depending on depth and how much buoyancy and drag the mooring has it could take up to an hour for the equipment to reach the surface. If there are subsea currents in the area the mooring could be a couple of miles away when it finally reaches the surface.

B. Scenario 2: Deploy an in-line mooring in shallow water in the High Arctic for 1 year

Because of the remote location and harsh environment, The PORT MFE (Push-Off Release Transponder) is ideal for deployments in coastal environments. The mechanical drive off system is the best choice for deployments where normal release mechanisms can experience growth or sediment build up. Unlike traditional releases that use a metallic lever mechanism for their release function, the PORT uses a non-corrosive link that is physically pushed off of the unit when commanded. This eliminates the troublesome issues of biofouling and corrosion that causes failures in other units.

An example from the real world: Twenty moorings were deployed to log fish tracking information in a very remote area in the High Arctic.

The scientific team planned to recover the moorings in 12 months, but due to weather conditions and the inability to schedule ship time, the moorings were left in place for 4 years. When the research team finally returned to the deployment site they were very happy to recover all 20 of the releases. The Push-off release mechanism easily overcame the heavy marine growth that had built up over 4 years.

The releases were covered with so much marine growth they can barely be seen in the photo below.

Fig. 7: Biofouling can cover and encrust critical release mechanisms and prevent them from moving. In this example, a push-off release was unaffected by the marine growth. (Photo courtesy of Dalhousie University.)

C. Scenario 3: Deploy and recover an instrument package including the anchor leaving nothing behind on the seafloor

Occasionally regulations require all equipment, including anchors, to be removed from the seafloor when the job is completed.

The solution for this application would be to use a Pop-up system. A Pop-up system combines the acoustic release, flotation and line in one package. When acoustically commanded by a deck unit the acoustic release and the top portion of the pop-up package will float to the surface. The release and surface flotation remains connected to the bottom section by a high strength synthetic line for easy retrieval leaving nothing behind on the seafloor.

A TRBM (Trawl Resistant Bottom Mount) with integrated flotation and an acoustic release could also be used in areas where there is fishing activity. In this design, all the instruments and an acoustic release are integrated into a low profile TRBM. When commanded, the release will release a flotation module that will carry a line attached to the TRBM and sensors to the surface where everything can be recovered.

Fig. 8. Pop-up float recovery system is shown attached to a Trawl resistant Bottom Mount (TRBM). Upon activation, the acoustic release allows the

yellow float to rise to the surface, pulling a non-hockling single braid nylon line to the surface.

D. Scenario 4: Deploy a hadal-class benthic lander carrying an instrument package, drop arm, water sampler, amphipod traps, sediment sampler, and multiple camera/light systems. Range to unit on descent. Deploy the drop arm with a baited fish trap. Close a water bottle. Close an amphipod trap. Release the anchor. Range on lander during ascent.

Fig. 9. James Cameron's ***DeepSea Challenger*** *submersible approaches the DSC AlphaLander, "Mike". The droparm is seen deployed. An EdgeTech BART board is contained in the top sphere. Wires from the sphere run to two burnwires through a junction bottle. A single cathode is used for both burnwires. The BART circuitry prohibits more than one burn being conducted at the same time. (Photo used with permission, Earthship Productions.)*

The command/control sphere housed an Edgetech BART Board acoustic transceiver circuitry, recovery beacons, and alkaline batteries. The Edgetech BART Board was selected for its two release commands, and an optional daughter board providing four more. These proved invaluable at-sea. The BART system was successfully tested in August 2011 in the Mariana Trench Sirena Deep at 10,800m using a topside Edgetech Model 8011M Acoustic Transceiver deck unit. The basic BART board has five Molex connectors including transducer, burnwire releases, and system power. The other two Molex provide some very intriguing application options: system sense (1 and 2), and Aux I/O (7 pins). There is a lot packed onto this board.

An 85-lb cast iron clump weight is held by two custom pelican hook releases. Both pelican hook releases are held closed by an Edgetech Inconel burnwire (AM200). One Edgetech burnwire is connected to the BART Board in the command/control sphere, and is the primary anchor release method. An acoustic command begins the erosion and release of its anchor chain. The second anchor Edgetech burnwire is connected to an independent, stand-alone countdown timer as a back-up release method. An assortment of Galvanic Time Releases (GTRs) and pocket countdown timers actuated additional mechanisms.

E. Scenario 5: Benthic Landers are free vehicles that sit on the seafloor, generally unattended, for extended periods of time. Placing the acoustic release electronics inside one of the spheres reduces the water weight, making the overall package smaller, lighter and cheaper.

Fig. 10. A WHOI OBS Lander with side-mounted burnwire release mechanism.

IV. Other Applications of Acoustic Releases

Besides dropping an anchor or releasing a float, acoustic releases can also be used to:

- Deploy and recover mine shapes for practice mine fields;
- To create **L**ong **B**ase**L**ine acoustic positioning networks for accurate positioning during survey operations and to create submarine maneuvering and sonar test areas;
- To create **L**ong **B**ase**L**ine positioning networks for surface vessel **D**ynamic **P**ositioning;
- To track underwater vehicles;
- To lower anchors or other bottom mounted platforms or systems that require placement in a precise location;
- To lower and locate Pipes and cables. The acoustic release transponder can be used with a USBL system to first precisely place the cable or pipeline and then release it;
- To mark a location that needs inspection on a regular schedule;
- In cable deployments for lowering and placement;
- Acoustic releases are used in-line with drop weights on buoyant towed systems. The weights bring the system down to depth. If the system loses additional buoyancy and sinks to a critical depth, the release can be activated to drop a weight and bring the system back to a buoyant condition;
- Acoustic releases can be installed in-line with ship or surface platform anchors so that the anchor can be

dropped in an emergency situation, such as weather, so that the platform can be safely moved in a hurry.

- Acoustic releases are used with surface buoys (weather, navigation, etc.) when it is safer and more efficient to use a new anchor than it is to recover the old one.
- Benthic landers

V. Other Considerations

A. Topside transceiver units: Various topside command systems exist, with greater or lesser features. Some can communicate with other manufacturers command codes, some can only speak to their own release units. Some can take green water, some cannot. Take a close look at the spec sheets. The full function EdgeTech Model 8011M and the PACS (Portable Acoustic Command System) are two examples.

Fig. 11. A full-function topside Deck Command Box, the EdgeTech 8011M.-

B. Atmospheric moisture: Acoustic release electronics, like any sophisticated undersea instrument, must be protected from condensation of moisture due to cold temperatures at depth. Desiccant bags alone are passive devices that remove moisture based on water molecules incidentally striking the desiccant and being bound to those crystals. Indicating desiccant visually tells the operator if the material is still active or saturated and no good. As water vapor is depleted in the region of the desiccant, diffusion brings more in. This process takes time. Desiccant manufacturers recommend a minimum of 24 – 48 hours for the dew point to be dropped sufficiently to prevent fogging. EdgeTech provides a purge port in its release endcaps to allow the use of vacuum/desiccant drying systems, such as the Deck Purge Box (Global Ocean Design). The DPB forces interior air over a desiccant to dynamically scrub it of moisture. Thus, no time is lost before deployment. No HazMat makes it easy to ship, and the desiccant can be refreshed in a galley oven.

Fig. 12. A vacuum/desiccant system removes moisture from entrained air in a release, preventing condensation on electronics at colder depths.

VI. Future developments

EdgeTech is presently extending the scope of its BART board by developing a mid-frequency version of the unit. Its circular BART Board already fits in a sphere as small as 10" Diameter. The higher frequency means a smaller transducer that matches the scale of smaller benthic landers and AUVs. The loss in transmission range is unimportant for work in the upper 1000m of ocean. Because of its unique and expanded capability, Global Ocean Design has selected the BART board as the acoustic release for its full line of Benthic Nanolanders.

VII. Conclusion

Acoustic releases provide underwater system designers a command/control link without wire or cable. While acoustic releases do not have the data rate of an acoustic modem, one ping from an acoustic release means a lot to the topside operator. Choosing the optimal acoustic release is a fundamentally important decision for any project. System designers can learn a lot from the prior experience of others, and a call to the applications engineers at release manufacturers, such as EdgeTech, will put you in touch with a river of experience.