Project Name: St. Croix Underwater Tracking Range Repair/Upgrade

Author: Don Wells

Organizations/People Involved:

FPO-1: LCDR. Don Wells, Jimmy Martin, Al Sutherland, Fred Agdern, Bill Gardner, George Phillips, Bill Sherwood, D. Scally, Dan Pullen

UCT-1: LCDR. John Wood, Construction Personnel: EQCM Warjonan, EMCM Master Diver T. King, EO-2 Hager, BU-1 Mills, BU-1 Reynolds, BU-1 Heirholzer, EO-1 Sutton, BU-1 Pronin, EO-1 Aylesworth, CM-2 Ossont, EO-2 Caballero, EO-2 Bingham, EA-3 Howardell, EOCN Kolazyk; SEACON Crew: BU-1 Butler, EO-1 Ehly, SW-2 Newberry, UT-2 Wallace, BU-3 Taylor, BUCN Fortner

Atlantic Fleet Weapons Training Center, Roosevelt Road, PR; Lt Tom Ballew

Naval Torpedo Station, Keyport, WA; J Kozak, G Newmeyer, K. Brown, F. Griese

Naval Surface Warfare Center, Fort Lauderdale, FL; Camera Sled Team

Navy Underwater Tracking Range, St. Croix, VI, RCA Contractor staff Ron Kirkpatrick

Project Date: 1973-1976

Project Summary:

Many of the Navy's Ocean facilities support fleet readiness training and weapon system performance assessment. Categorically, these types of facilities represent a large portion of Navy Ocean facility assets. By their nature, they are also the most difficult to plan, design, and to construct to meet facility performance and life cycle cost requirements.

The Navy Underwater Tracking Range at St. Croix, VI is just one of these facilities. Built by a Navy contractor in the 1960's, the underwater tracking facilities had suffered some damages upon installation and further damages due to a lightning strike at the range facility that managed to get into the undersea cables and seriously damaged the hydrophone tracking arrays installed at 3,000 feet deep. The first lighting damage occurred in 1968. Repairs were made to some of the tracking arrays and to the lightning protection system on shore. The lightning protection system was repaired in 1972-3. The second lightning damage occurred on September 1973 and damaged five of the eleven tracking arrays. Further a submarine operating on the range in May 1973 caused damage to several installed systems. FPO-1 was tasked in November 1973 with assessing the damages and planning a repair operation for all underwater arrays and for protection of the range buildings from further lighting strikes.

Lightning Protection System

The cause of the damage to the Undersea Tracking Range from the second lightning strike in 1973 resulted from improper design changes to the system made by the contractor in 1972-3 which

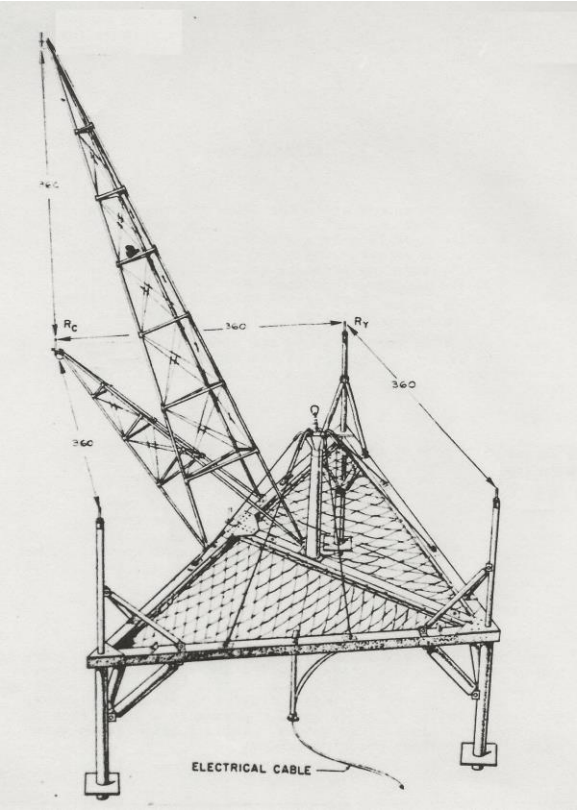
resulted in further unnecessary damages and degradation of the tracking system. Performance of its mission was seriously impacted from the 1973 damages.

Bill Gardner, a electrical engineer from FPO-1 and Lcdr Don Wells did the on-site assessment of the lightning protection system at the range and developed a design to fix this problem permanently. FPO-1 recommended a permanent fix in 1974 and installed those fixes in 1975 with the assistance of Seabees from the MCB stationed at the Naval Station Roosevelt Roads, Puerto Rico. The range has not been damaged by lightning since then.

Underwater Tracking System

The tracking arrays installed at St. Croix weighed 12,000 lbs. and had four hydrophones installed in a 30-foot horizontal plane and another hydrophone installed on a tower structure 30 feet above the horizontal plane of the other hydrophones to create a 30-foot cube. Signals received from these five hydrophones could then be resolved into a location for the ship, submarine, torpedo other object with a cooperative pinger. These arrays function similar to the Global Positioning System (GPS) except on a smaller scale. When damages occur to the array to cause one or more hydrophones to not function, then the positional accuracy provided by the array is seriously degraded as a function of the number of phones lost.

The Underwater Tracking Range had eleven tracking arrays installed to cover about a hundred square mile area for tracking operations. Also installed were underwater voice transmission hydrophones for communication with the submarines, and Fleet Operational Readiness Accuracy Check Site (FORACS) arrays used in special ship performance measurements.



12,000 lb. Installed St. Croix Array

The repair project was to design a repair operation wherein the project team could reach down 3,000 feet and hook into the damaged array. They had to be able to guide the hook within a few feet of the center of the damaged array and then pull the array to the surface and replace the structure with a new one with new electronics and hydrophones. This is equivalent to threading a needle from 3000 feet away with a long rod to steady the thread. This had not been done before so it was a challenge to finding a solution.

Secondly, FPO-1 had to design a new foldable array structure that could be safely handled at sea and opened to its 30-foot cube dimension before lowering it to the bottom. The new array structure would also include newly designed electronics that were more reliable than the

ones currently installed. Lastly, FPO-1 designed new communication arrays and a way to repair some of the FORACS structures currently installed.

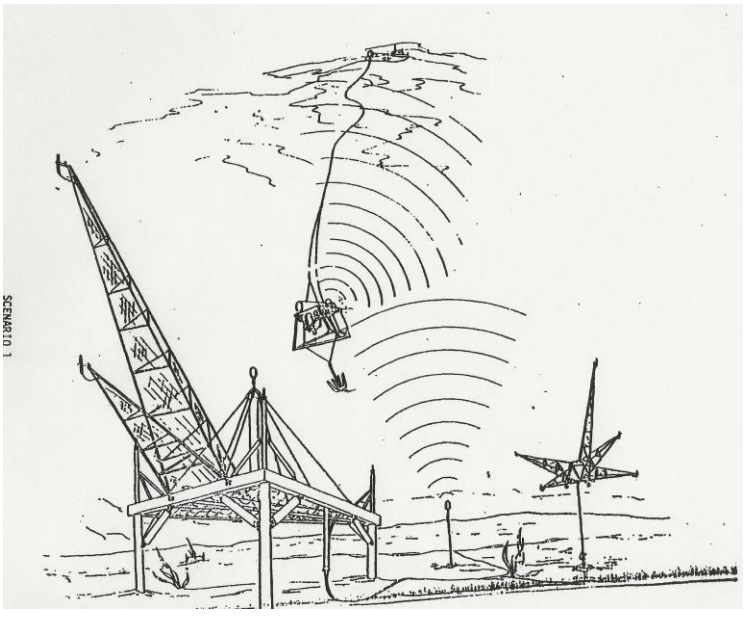
Submersible ALVIN Operations

Submersible ALVIN

As part of the planning for the repair of the St. Croix arrays, FPO-1 needed to know if the array to be lifted was still in good enough shape to be lifted off the bottom and secondly, that the cable from the array to shore was not caught on something on the seafloor which would cause problems during lifting. ALVIN, a Navy submersible, is operated by Woods Hole Oceanographic Institute in Woods Hole, MA. FPO-1 contracted with them to bring ALVIN to St. Croix and the Project Office made dives to check out each array to be lifted to be sure conditions were OK.

FPO-1 made seven dives with ALVIN on the five array sites and two other locations that needed to be checked out. On each dive, FPO-1 had two people on board to record observations of the array and cable track back to shore. Lcdr Don Wells and project engineers from FPO-1 were the observers on each dive.

The experience in diving in the ALVIN was quite different from anything FPO-1 had ever done before. The pressure hull is about 7 feet in diameter of which half of that volume is filled with electronics and operating systems. In the remaining space, there has to be room for the pilot who sits in the center to see all the instrumentation and the two observers of about six feet each who lay on a small mattress against the skin of the hull and observe from the small portholes. It is very cramped quarters to get use to. Plus, you're in the submersible for about 8 hours so your better not have drunk any coffee because there is no bathroom. When you start out at the surface, you only are wearing a t-shirt because it is hot in the submersible. When you get to the bottom it is cold so you bring along layers of clothing to keep you comfortable. To go down, the pilot opens the ballast tanks to take on water to make the submersible slightly negative and you begin your decent to the bottom. Near the bottom, water is pumped out of the tank to make the submersible neutrally buoyant and you cruise



Retrieval of the St. Croix Hydrophone Arrays

along the bottom using the propulsion motors adjusting the submersible up or down to conform to the bottom contour. When you finish the dive, the tanks are pumped with air and you begin your ascent. Once back on the surface, the submersible is steered to its support ship and retrieved back on board the ship.

The Repair Operations 26 August – 11 November 1976

Critical to getting this project accomplished was the availability of SEACON. The ship departed the shipyard on 20 July 1976 and underwent ship trials for 10 days. During the month of August, with the entire operations crew on board, FPO-1 tested out their planned deployment of the new St. Croix arrays and other operations that would be done in St. Croix. On 28 August, SEACON departed Norfolk for St. Croix under tow. The ship arrived in St. Croix on 7 September and all of the arrays and other equipment were offloaded on the pier to get ready for the repair operations.

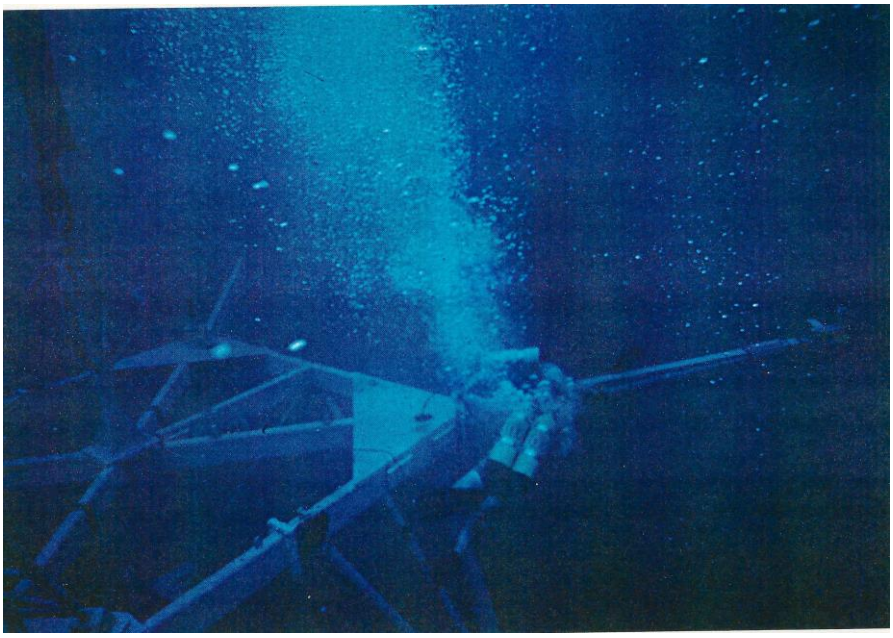
New Hydrophone Array Loaded on SEACON Ready to be Offloaded

The operational plan to retrieve the existing damaged hydrophone arrays, was to position SEACON above the array site, and then lower a camera sled with a multiple arm hook suspended below the camera sled. The camera sled had several motors on it that would allow the sled to be moved where we could see the lift place on the array. The object was to fly the hook into the array and as soon as the hook is in position, the operator on the winch controlling the lift line and camera sled would quickly begin to lift and snag the array. This was done for both the floating arrays and the rigid ones as shown in the diagram above. Like threading a needle, FPO-1 successfully retrieved the five damaged arrays and replaced them with new ones. The sequence for accomplishing this is included in the Project Operations Manual. Essentially, but the old array was retrieved and loaded on a barge and towed to shore. The cable to the array was brought on board and installed to the new array which was then offloaded and connected to the lift line to lower it back to the seafloor.

When the new array was offloaded, it was lowered to a depth of about 30 feet where the divers went down and unfolded the hydrophone arms to form the 30-foot dimensional requirement of the array. The vertical hydrophone structure was unfolded before placing the array in the water. The array was then lowered to the seafloor moving SEACON along the cable route to relay the cable back on the seafloor. When the array was on the seafloor, an explosive release mechanism would be fired to release the lowering line and the array was back in its intended position.

From 18 September until 31 October, the project team recovered and reinstalled the five new arrays with electronics. They also repaired two of the rigid arrays that were retrieved, installed new electronics and added those two additional arrays to expand the coverage of the underwater range. Additionally, the team installed four underwater communications systems and laid the cables to shore; installed two new FORACS arrays and retrieved, repaired and reinstalled two other FORACS arrays. During the operations, the team laid 206,692 feet of undersea cable on the seafloor connecting the arrays to the shore facility.

Typical array replacement operations began with deployment of SEACON around midnight so the array was recovered and back to the surface by early morning so the team could work in daylight and reinstalled by early evening.



Unfolding the Array to its 30-Foot Dimension

Overall, this was one of the largest repair operations ever done for an Underwater Tracking Range and it was done successfully to not only meet the repair objectives but also to install additional operational systems that were not in the original scope. This was also a first for being able to retrieve a 12,000 lb. array structure from over 3,000 feet deep.

Project Report Link: FPO-1: 77(16) St. Croix Underwater Tracking Range Repair/Upgrade Project Construction Report