Verification highlights

The importance of maintenance: inspecting hydroacoustic station HA01 at Cape Leeuwin, Australia

by Dr Andrea Wurm

With more than 200 monitoring facilities certified and plans to have 90% of the International Monitoring System (IMS) installed by the end of 2008, the focus has increasingly begun to shift from station installation to maintenance and network sustainability. Strategies are being developed on how to best support operation and maintenance of the stations in order to ensure an uninterrupted flow of data.

There are two types of maintenance activities: preventive maintenance includes regular inspection and service of station equipment; corrective maintenance is required whenever a station fails to perform, either due to equipment failure or to infrastructure damage. Whenever a problem at a station cannot be resolved at the operational level, the problem is re-assigned to the Maintenance Unit which then evaluates it and ensures that adequate measures are taken with support from the station operator.

With 11 stations, the hydroacoustic network is the smallest of the four sub-networks that form the IMS; the other networks are seismic, infrasound and radionuclide. Due to the efficient propagation of sound through water, six hydrophone stations and five T-phase stations are sufficient to cover the world's oceans.

IMS hydrophone stations are composed of triplets of hydrophones which are floated off the sea floor up to the depth of about 1000 metres where the sound propagates most efficiently. T-phase stations on small islands employ seismometers, which detect acoustic waves in the ocean after they are converted to seismic energy at the island's shore.

The highly sensitive hydrophones pick up acoustic signals, which are sent via an underwater fibre-optic cable to a shore station. The length of a cable to an IMS hydrophone station varies considerably, from 30 to 135 kilometres. The cable section nearest to the shore is usually the most vulnerable to damage from anchoring, fishing or strong waves and currents. To deploy or repair such a cable is a very costly operation, so the CTBTO Preparatory Commission has a vested interest in maintaining the cables in the best possible condition. Periodically, the Provisional Technical Secretariat (PTS) conducts preventive maintenance inspections to determine signs of instability or movement of IMS hydroacoustic cables, such as loops, kinks, bends, wear or abrasion that could lead to a malfunction.

CAPE LEEUWIN, THE SOUTHWESTERNMOST POINT OF AUSTRALIA WHERE THE SOUTHERN AND THE INDIAN OCEAN MEET

Hydroacoustic station HA01 at Cape Leeuwin, located at the most south-westerly point of Australia, was installed in 2001. The hydrophones are deployed about 100 kilometres from the shore at a depth of 1000 metres. A cable inspection was conducted immediately after installation and key areas for periodic surveys were identified along a stretch of about 20 kilometres near the shore where the cable was lying in shallow water. The first post-lay inspection took place in early 2003.

In early March 2007, José Pereira, PTS Hydroacoustic Officer, supervised the most recent inspection mission to HA01. The team consisted of two engineers from the installation contractor and a survey vessel. Despite having been classified as a routine maintenance trip, the inspection survey encountered several challenges.

The cable was covered by sand or overgrown by algae and other marine organisms and was, to a large extent, perfectly camouflaged. The first challenge was to identify the cable in the open sea at a depth of up to 50 meters on the ocean floor. This was done with the help of GPS navigation and a remotely operated vehicle (ROV). The ROV is an underwater robot equipped with a video camera linked to

PREPARING FOR THE CABLE INSPECTION

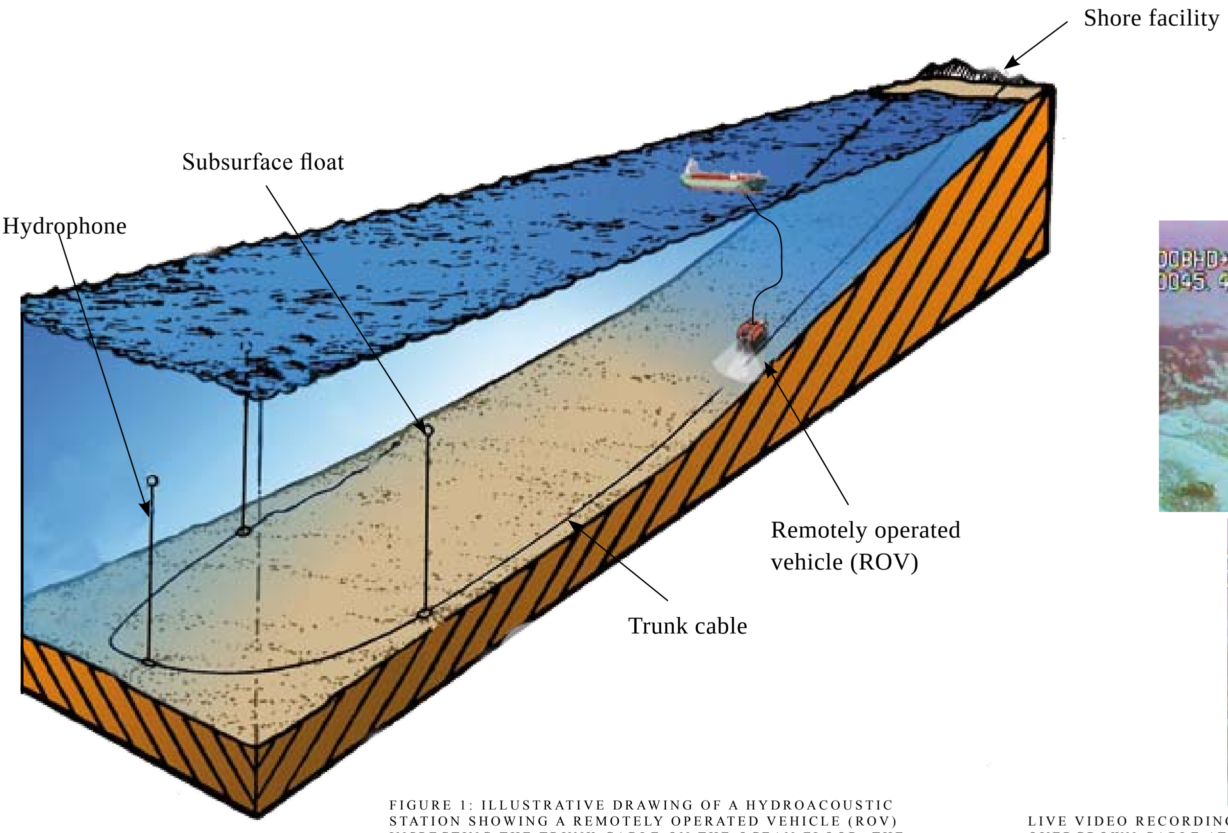

FIGURE 1: ILLUSTRATIVE DRAWING OF A HYDROACOUSTIC STATION SHOWING A REMOTELY OPERATED VEHICLE (ROV) INSPECTING THE TRUNK CABLE ON THE OCEAN FLOOR. THE OPERATION IS STEERED BY ENGINEERS ON BOARD THE VESSEL.

LIVE VIDEO RECORDINGS SHOWING PARTIALLY OVERGROWN CABLE AT HYDROACOUSTIC STATION HA01, CAPE LEEUWIN, AUSTRALIA.

REMOTELY OPERATED UNDERWATER ROBOT

UNDERWATER ROBOT WITH 'UMBILICAL' CABLE, READY FOR INSPECTION DIVE

a monitor by an 'umbilical' cable. This enables real-time inspection and recording for later image analysis. A GPS antenna was connected to a laptop computer for logging geographic co-ordinates. Utilizing the digital map created at the last inspection, the vessel needed to navigate to its correct position. The next challenge was to manoeuvre the ROV along previously defined sections of the cable. Losing track of the cable can happen easily when it is buried in sand or when the rolling of the vessel prevents the skipper from holding the position. To follow the cable required perfect coordination between the skipper, who had to continuously adjust the vessel's position, the engineer, who controlled the 'umbilical' cord that connected the computer with the ROV, and the engineer who checked the live images for signs of cable movement or damage.

Since the 20 kilometre stretch of the cable surveyed at Cape Leeuwin was partitioned into several sections, a new section had to be located every few hours. The heat wave that hit Western Australia in early March 2007 also made the work, which demanded a high degree of concentration for long periods of time, even more challenging for the inspection team. Temperatures of more than 45°C and an increasingly strong ocean current on the second day added to the challenge.

Altogether, the inspection team recorded nearly 20 hours of video material, spending roughly ten hours per day on the boat tracking the cable and analyzing the video recordings. No additional kinks or loops were found. Thus, the near-shore section of the cable of HA01 has remained stable since 2003. If any irregularity or damage, which could have led to a future cable break, had been identified during the inspection, an early repair would have minimized interruption to continuous data flow and would have saved the CTBTO considerable costs of a later major repair. ■

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