SeaCat Inspects 24km Long Water Tunnel

By Jörg Kalwa

In a mission lasting almost 7hr, the autonomous underwater vehicle SeaCat made by Atlas Elektronik dived through a water supply tunnel 24km long in the vicinity of Stuttgart, successfully investigating the tube for damage. With this survey on 6 March 2012, it at last became possible to inspect the tunnel known as “Albstollen” in the State of Baden-Württemberg for the first time in 40 years.

The “Albstollen,” with a length of 24km and a diameter of 2.25m, forms part of the water supply system operated by Bodensee-Wasserversorgung (BWV) with headquarters in Stuttgart. As the largest German long-distance water distribution system, it provides fresh water from Lake Constance to four million people in 320 communities. As one of two main lines, the Albstollen passes through the Swabian Jura range to supply Stuttgart and the northern part of Baden-Württemberg.

Although the concrete duct had been checked regularly in the course of its over 40-year lifetime through measurements of the hydraulic friction losses and the leakage rate, a visual inspection of its condition over the entire length had not been technically possible until now. As a leading German manufacturer of unmanned underwater vehicles, Atlas Elektronik was, therefore, asked to inspect the water tunnel by means of an autonomous diving robot. For the challenging task, the “SeaCat” autonomous underwater vehicle had been selected due to its advantageous size and the ability to operate either remotely controlled or fully autonomously.

The SeaCat Team of Atlas designed a specific inspection head that allows recording high-resolution video data over the total length of the tunnel, while moving continuously through the tube at a speed of about 2kts and remaining centered with the aid of optical distance sensors.

After a thorough disinfection, the vehicle was lowered into the inflow reservoir at Büttnau on the morning of 6 March. The AUV was connected to its laptop-based control station using a fiber-optic Ethernet cable. As a full hybrid vehicle, the SeaCat was guided manually through the first 40m of the tube. Obstacles like a butterfly valve and narrow turns prevented a full automatic operation. After passing these, the autonomous guidance system was activated but still under observation of the operator. All systems worked as expected, so the cable was cut after 300m. The inspection head took over the control for the next 7hr and 24km without any external supervision. Merely the registration of motor noise when the vehicle passed three maintenance caverns on its way indicated the progress of the mission.

The exit point of the trip was the shaft surge chamber at Talheim, a concrete structure comprising a shaft 38m deep and about 8m in diameter. This pressure-balancing well is normally half-filled with water. The water tunnel is routed through the well, forming a semi-circular channel at the bottom. A diver’s lamp was positioned at this point to provide a light, indicating that the AUV had reached its final destination. This visual signal was detected by the vehicle, causing the autonomous guidance system to stop the vehicle and let it rise to the surface.

This pioneering accomplishment was made possible by outstanding teamwork between the staff of BWV and Atlas Elektronik. While the mission demonstrated the technical reliability of the SeaCat, it also showed that the water tunnel was still in good condition after 40 years of continuous use.

The SeaCat AUV is a torpedo-shaped underwater vehicle about 2.5m in length and 30cm in diameter. As a hybrid vehicle, it can be operated either remotely controlled or fully autonomously with an endurance of up to 8hr and a range of 40km. Navigation is achieved by exploiting an aided inertial navigation system. Video cameras and a variety of sonars can be carried as payload sensors. Typical areas of application include the inspection and mapping of inshore lakes, coastal sea areas, harbours, and marine structures such as dams or the foundations of wind turbines.

For more information, visit www.atlas-elektronik.com.