# Mini ROV plays major role

*Technological advances have made ROVs even greater value in hydro power inspections. Caleb Adams and Richard L Glenn from Glenn Underwater Services highlight the advantage of deploying ROVS into situations deemed to be too dangerous for divers*

IN mid 2008, a large subsurface explosion was heard at a hydro station in the US. The violence of the explosion and its concurrence with the cycling of the wicket and head gates caused the owners grave concern, with many unanswered questions regarding the nature of the event and possible damage that it had caused.

An immediate surface level inspection of the facility offered no visual indications as to what had happened. The owner quickly determined that an emergency underwater inspection was critical to protect power and water supplies.

Glenn Underwater Services (GUS) was selected to quickly assess the situation and deliver a clear report and action plan. The hydro project owner tasked GUS personnel with performing a detailed underwater inspection to ascertain what had occurred during the gate cycle. There were safety concerns connected to sending a diver into an unknown situation within a large gate system, and so the company deployed its LBV200L mini ROV prior to any diver entering the water.

The gate in question was approximately 6m wide by 15m high and operated within a traditional guide system. The bottom seal was located approximately 28m below the surface of the water. GUS was able to almost immediately deploy the LBV200 once on site due to the minimalist setup process and site preparation required. The deployment cycle alone saved a full day that otherwise would have been spent mobilising a dive team and setting up a dive station. Once in the water the LBV200 began what became a lengthy and highly technical inspection of what was soon discovered to be a gate collapse resulting from a guide failure.

## Substantial damage

Glenn Underwater Services has been using ROVs for many years and is very familiar with the benefits of their application. More advanced camera systems, navigation and imaging sonars, position systems and more advanced flight controls with the LBV200 has enabled the company to expand its use of ROVs to a wider range of applications. The main advantages are now at hydro facilities.

Diving environments are quite often cramped, deep, with limited visibility and a high potential for differential pressures. The company also tends to dive into damaged areas frequently that, though manageable with extensive safety protocols, are certainly much less dangerous after a detailed initial inspection with the LBV200.

The modern mini ROV such as the LBV 200 allows field teams to access areas that divers cannot inspect, gather information (such as heading) that is difficult to impossible for a diver to effectively gather, and occupy areas and situations (depth, water temperatures and low visibility) that are too hazardous for divers.

ROVs such as the LBV200L can be effectively launched and managed by one person if need be, immediately reducing labour cost. The size and weight of the system is considerably less than that of previous systems, reducing transportation and deployment costs.

The particular environment that was discovered in the gate system was highly dangerous. Initial ROV dives discovered that the gate had sheared its downstream guides completely away due to failure of the concrete pier structure, and was precariously balanced against the remaining pier wall and scroll case downstream and off angle of its intended position.

Large masses of concrete that originally made up the guide pier were hanging in broken pieces from the mangled and twisted H-beam that served as the sealing surface of the guide.

The pieces of concrete were only held in place by the anchors that originally attached the H-beam to the pier. These were obviously severely stressed and unstable. This area was approximately 12m off of the concrete bottom, limiting the area that a diver could safely search. Inspection of this damage by a diver would have required securing the upper portions of the gate to the remaining (though now questionable) pier sections and slowly working down the face of the gate as the diver progressed to greater depths. The upper portions of the separated concrete and H-beam would have had to be either secured or cut away and allowed to drop to the bottom, contaminating the scroll case further with debris. Simply engineering and implementing the safety plan would have required days of highly dangerous work. However, the ROV with onboard navigation was able to penetrate the gate area and inspect the damage from the top to the bottom without any risk to a diver.

The ROV was deployed under the gate and into the area of hanging concrete and gathered information that drove the dive safety plan forward, with a much better understanding of the complexities of the failure and the resultant situation. Thus, the ROV increased the safety of the job in two ways:

- Limiting the exposure of the diver to an unknown and possibly dangerous situation.
- Gathering detailed and reliable information that would enable the diver to quickly and safely transverse the damaged gate to provide more detailed information for the purpose of removing the gate.

The LBV200L was able to access areas that no responsible safety plan would have allowed a diver to occupy. The dive safety plan therefore could be engineered as a complete system from the beginning, rather than a 'secure a little and go' approach.


The LBV200 ROV

## Advanced technology

The increase in quality due to the use of the LBV200L is multi faceted as well. The LBV200L has advanced onboard technology


**The gate did substantial damage to the concrete base of the scroll case**


**Poor visibility (as above) was overcome with the Tritech Micron Sonar**

contained in a small package that makes gathering the critical information required of such an inspection far easier and more succinct. Due to the destruction of the original guide system and gate, many of the common visual reference points used to position a diver were absent. A diver inspecting such an area would, for example, make numerous references to the guide itself to make measurements. He would also use the gate and guide to hold a steady position in the water. The limited visibility present (0.9m) would make longer measurements difficult and unreliable.

The use of the Tritech Micron Sonar system aboard the LBV200L allowed topside personnel to maintain positional awareness by reference to the entire pier structure. The team was able to ensure that a complete inspection had been performed and that there were no surprises hidden just out of the range of a diver's visibility. Equally, the auto heading and auto depth functions allowed for longer inspection of critical areas. A diver would have, for instance, been required to hold onto material that was structurally questionable, or simply fin in place in an attempt to get a steady, long shot in any one area.

The LBV200L could be 'parked' at that same area without any need for additional support and be kept there until all the topside personnel were satisfied that the appropriate amount of information had been gathered.

The benefits of the LBV200L on this project were its lateral thruster, allowing the operator to move sideways along the area of inspection while keeping the sensors on target. In addition, on-the-fly ten-step thruster gain adjustments and a 32-step precision joystick enabled the operator to precisely tune power output to the minimum required to overcome currents while providing a smooth, stable platform for optimising the quality of the video and sensor data.

## Cost reduction

The cost reduction and safety potential of the mini ROV is perhaps the main reason that it has entered into the market so effectively. The LBV200's combination of cost, advanced onboard technology, speed, stability, accuracy, risk reduction and the ability to deploy the system without any other required assets make it an invaluable tool with obvious price benefits.

In the case of the gate collapse the cost benefits started to accrue immediately following initial contact by the owner. The inspection was conducted and the gate removed without any incidents to the owner or contract personnel.

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**Above and below: Images from the ROV show the substantial damage**


**Below: Rov inspecting an intake guide**