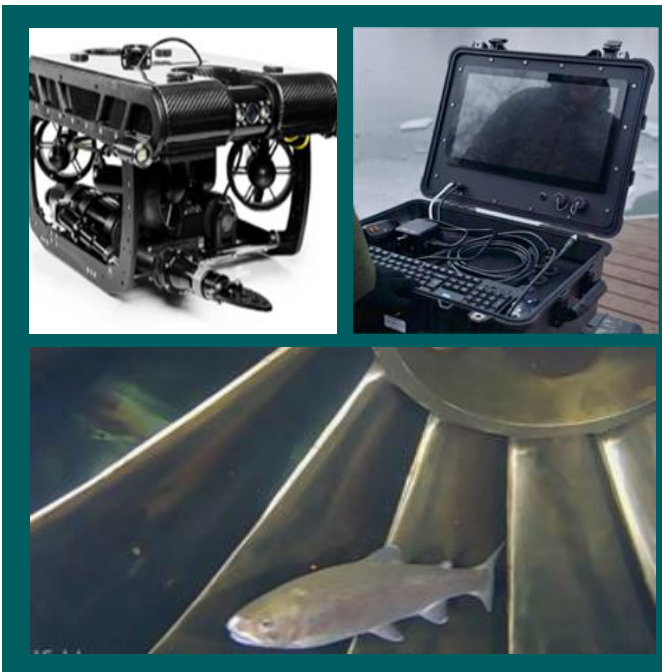


ROV UNDERWATER TURBINE INSPECTION

GE Vernova's pioneering underwater inspection technology achieves results comparable to dry visual inspection without confined space work and dewatering. The remotely operated vehicle (ROV) deploys sensors to previously inaccessible areas. Experts review the information in real-time to ensure proper inspection of all critical surfaces. Inspection is performed with reduced risk, resources and outage time requirements.



DEPLOYMENT AND ACCESS

Light ROVs can be quickly deployed and operated by a single operator. The solution is specifically designed to access hard to reach areas (e.g. between the blades of Francis runners) and can easily inspect civil structures and hydromechanical equipment.

SYSTEM

- The inspection system is based on 3 main components:
 - A software to synchronize, display and record inspection videos, pictures and annotations.
 - An industrial ROV to carry general inspection and transport the patented inspection probe.
 - A small inspection probe including 36 LEDs, 2 lasers and a 360-degree camera.

REPORT

The inspection report includes numbered pictures with identification, localization, and dimensions of defects. Additionally, internal and external experts can review inspection video and images remotely (live or recorded), optimizing resource allocation. The user interface allows simultaneous viewing of multiple cameras and annotation by the inspector.

ADVANTAGE

ROV inspection eliminates risk, effort and delay of unit dewatering and platform installation. It eliminates confined space, work at height and diving operations. This approach significantly reduces outage duration and cost.

VERSATILITY

Turbine, trash racks, gates and penstocks can be inspected on most Hydro turbines: Vertical and horizontal Francis, Kaplan, Propeller, bulb and pump turbines.

INNOVATION

Our compact inspection probe can be inserted between runner blades and record 360 degrees images in 4K, Ultra High Definition.

DETECT, LOCATE, QUANTIFY

Erosion, cavitation, corrosion, impact marks and foreign bodies.

DEPTH RATING

305 meters (1000ft)

TETHER LENGTH

Standard 150m (500 ft). Up to 800 meters (2600 ft)

LIGHTING

The cameras and dimmable lights are designed specifically for underwater use. If water turbidity is low, the image quality is comparable to a digital camera in daylight.

DIVER SUPPORT

Complex underwater tasks can require divers. A pre-dive ROV environment survey and current validation increase diver's safety and efficiency.

ACCESSORIES

Grabber, cutter, samplers, pressure washer, caviblaster, DVL, sonar, water quality and dissolved oxygen sensors can be added to meet your needs.



QUESTIONS & ANSWERS

Q1:WHAT IS THE IMPACT OF WATER TURBIDITY?

Water turbidity affects visibility. Clear water allows better and faster inspections. GE Vernova's solution has dimmable lighting configurations adapting to most situations. Water turbidity of 20 NTU is required, 10 NTU is recommended and 2NTU is ideal. If needed, GE Vernova can measure water turbidity from a 500ml water sample and confirm inspection feasibility.

Q2:WHAT IS THE OUTAGE REQUIREMENT?

Unit to be inspected must be stopped. Runner must be submerged. Flow must be minimized by closing the wicket gates and water inlet. No dewatering necessary.

Q3 :WHAT IS THE RUNNER INSPECTION DURATION?

The time is dependent on water clarity and level of detail required. In most circumstances, the runner inspection lasts 4 hours. GE Vernova recommends planning a 2-day outage to cover unforeseen and in-depth inspection.

Q5:WHEN IS THE BEST TIME OF THE YEAR TO PERFORM ROV INSPECTION?

Inspection is possible in all weather. GE Vernova recommends low flow season when water is typically clearer.

Q6:WHAT EQUIPMENT IS NEEDED TO LAUNCH/RETRIEVE THE ROV?

Our ROVs respectively weigh 4 and 18Kg (9 and 40lbs). The ROVs are launched using their tethers and a portable pulley system.

Q7:HOW DOES THE ROV ACCESS THE RUNNER?

Generally, the ROV is lowered in the tail race then navigates to the runner.

Q8:WHAT IF THE ROV GET STUCK BETWEEN THE TURBINE BLADES?

The GE Vernova inspection ROV is designed to remain under the runner while the compact inspection probe is inserted between the runner blades. Should there be a problem, the probe is detachable from the ROV. The probe is made of plastic and would not damage any part of the turbine. The ROV would sink in the draft tube and be retrieved by the operator pulling on the tether.

Q9:WHAT ARE THE PROBE DIMENSIONS?

The probe is 105mm (4.125") diameter and 225mm (8.875") long. It can be inserted in a 150mm (6") opening.

Q10:CAN YOU INSPECT THE ENTIRE RUNNER?

The ROV inspection uses the same protocol as dewatered inspection. A qualified engineer ensures all the critical surfaces are inspected and defects identified. Should an area require additional inspection, it is possible to vary camera distance, angle and lighting to gather more information about the defect. Draft tube, runner and wicket gates can be inspected.

Q11:HOW DO YOU KEEP TRACK OF LOCATION UNDERWATER?

GE Vernova has adapted inspection software developed in the aviation and wind industries to display multiple cameras, facilitate localization, defect tagging and reporting.

Q12: HOW DO YOU MEASURE DEFECTS?

The ROV and probes have laser scalers allowing to measure defect with a precision of +/-3mm (1/8")

Q13: WHAT IS THE BATTERY LIFE DURATION?

Our direct power configuration allows continuous operation. The inspection has no time limitation. This eliminates the time consuming ROV retrieval and battery replacement.

