Inspection of underground intake conduits at Niagara power Project: Operational insights and future monitoring strategies

Ketan Ragalwar, P.E., Ph.D., New York Power Authority

New York Power Authority conducted a remotely operated vehicle (ROV) inspection in 2019 for the general condition assessment of the two underground conduits that extend from the Niagara Power Project's river intakes (located on the upper Niagara River) northerly to the eastern end of an open forebay, adjacent to the Lewiston Pump Generating Plant. The objective of these inspections was to obtain detailed visual and sonar imagery data to assess the internal condition and structural integrity of the conduits. These conduits, critical to the project's water system, are located below grade and are not accessible through conventional inspection methods, necessitating the use of advanced underwater robotic technology. The ROV-based survey enabled comprehensive documentation of the conduits' geometry, alignment, and internal surface conditions. High-resolution sonar and optical cameras were used to capture continuous imagery at 0.5-foot intervals, allowing for the creation of a complete 3D cloud imagery dataset. This data set provides a permanent digital record of the conduit interiors, which can be used as a baseline for future condition assessments and structural change detection. We will present an overview of the conduit system's construction and structural configuration, including the design layout, access constraints, and hydraulic operating conditions that influenced the inspection approach. It will also describe the logistical and technical planning required to deploy the ROV in a confined, submerged environment—covering equipment selection, navigation methods, data acquisition parameters, and safety considerations. The results from the 2019 inspection revealed several noteworthy features, including minor surface irregularities, sediment deposition zones, and joint interface conditions. The discussion will highlight how the integration of sonar and optical data enhanced the accuracy of defect identification in water conditions. We will conclude by outlining recommended next steps for long-term monitoring and asset management. In particular, it will discuss the potential for integrating above-ground drone-based photogrammetry and thermal imaging to complement future subsurface inspections. Such an integrated approach—combining aerial and underwater imaging—can provide early indicators of structural movement or seepage patterns visible at the surface that may correlate with subsurface changes detected in the conduits. This case study demonstrates how ROV technology can be effectively applied to inspect critical, inaccessible hydraulic structures and how combining it with emerging drone technologies can significantly enhance monitoring and maintenance strategies for underground infrastructure systems.