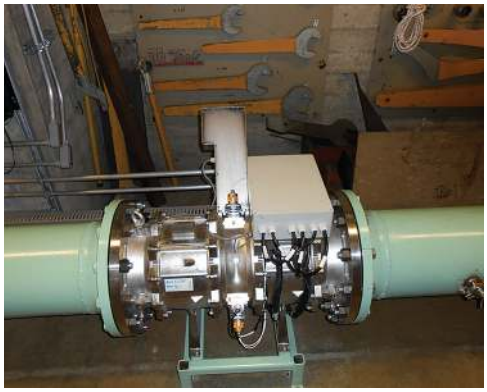
Atlantium
Illuminating Water Technologies

APPLICATION BRIEF

Hydro-Optic™ Technology
MACRO/MICRO BIOFOULING CONTROL

FirstLight Power Resources Installs Hydro-Optic™ UV System for Mussel Control at Shepaug Hydroelectric Station

The Shepaug Hydroelectric Station located in Connecticut has a nameplate capacity of approximately 42 megawatts. The facility is managed by FirstLight Power Resources (FirstLight), a subsidiary of H20 Power. Following the invasion of zebra mussels in the Housatonic and Shepaug Rivers and Lake Lillinonah Reservoir, FirstLight inquired about control options to protect their facilities while having little to no environmental or ecological impact. The Hydro-Optic™ (HOD) UV treatment system was selected for non-chemical control of invasive mussels in cooling water circuits in the Housatonic River Project hydroelectric system at the Shepaug.



Shepaug has one turbine, with six heat exchangers, requiring protection from invasive mussels. In May 2015 one HOD UV system (Model RZB300-11 with DPM) accommodating a flow rate of 375 m^3/hr (1,650 gpm) for water quality conditions with percent UV transmittance as low as 89.5 %UVT was installed. The proprietary medium pressure UV system was supplied with a deposit control mechanism, %UVT monitor, UV dose monitor, and flow switch. To confirm water was flowing a flow meter was installed by the facility on the inlet side of the HOD system. This feature provided full control of all features of the HOD UV system to flow pace and control real-time operator selected dose.

The HOD UV system was installed immediately after the strainer on the 8" cooling water line supplied from Lake Lillinonah via a 24" intake in the power house. The UV system was placed horizontally with adequate spacing for maintenance (30" on each side for ease of UV bulb removal and located 2-3' above the floor). Additionally, a bypass was installed so the unit could be taken out of service for annual maintenance while ensuring adequate flow to the cooling water for the generators. The slightly longer length of the inlet pipe as compared to the outlet pipe allows for laminar flow so that air bubbles are not created inside the UV chamber. The flow meter is used to detect when to signal the UV bulbs to shut down when no flow exists or fluid has drained out of the UV chamber. All electrical components (480V – 3 Phase) are located in a weather-proof room, dry area, that does not exceed 100˚F. The system's communication is accomplished by MODBUS and signals are taken to a central location for monitoring the system alarms and operating parameters.

Following the full-scale installation and independent validation of the HOD UV system at Shepaug, the technology has proven to be an environmentally friendly, non-chemical disinfection method to minimize the risk of mussel fouling by preventing invasion and infestation.

Hydro-Optic™ UV Technology: Principles of Operation

Unlike chemical treatment approaches, UV systems employ a physical process for disinfection. When bacteria, viruses and protozoa are exposed to the germicidal wavelengths of UV light, they are rendered incapable of reproducing.

Medium pressure (MP) UV lamps provide polychromatic UV light (200–415nm), while low pressure (LP) lamps provide monochromatic light (254nm). MP lamps produce a high-density broad-spectrum UV light inclusive of wavelengths responsible for disinfecting certain resistant viruses.

Since different microorganisms are sensitive to different UV wavelengths, MP lamps can easily inactivate more microorganisms, such as algae, adenovirus, and IPN, through their broad UV germicidal spectrum.

When a microorganism has been inactivated by a LP UV system, it can still repair using its own cell-repair mechanism or by summoning host repair mechanisms. In a MP UV system, the various wavelengths work together to disable cell repair mechanisms. MP lamps disable the proteins and enzymes needed to trigger repair, achieving permanent microbial inactivation at a lower dose than LP systems.

The Hydro-Optic UV technology measures four critical parameters including %UVT, flow rate, UV lamp intensity (kW) and UV apparatus (consisting of Total Internal Reflection and Dose Pacing) in real time to maintain the minimum required UV dose.

The system uses a proprietary Total Internal Reflection (TIR) based design that when coupled with the comprehensive monitoring of critical parameters allows the system to achieve and maintain the specified UV dose.

The system's patented TIR technology, which is similar to fiber optic science, recycles UV light energy within the HOD UV chamber. The core of the technology is its water disinfection chamber made of high-quality quartz surrounded by an air block instead of traditional stainless steel (Figure 1). This is especially important given that in traditional UV systems metal adsorbs or "detracts" the UV dose the closer it gets to metal, whereas the TIR enhances the UV dose.

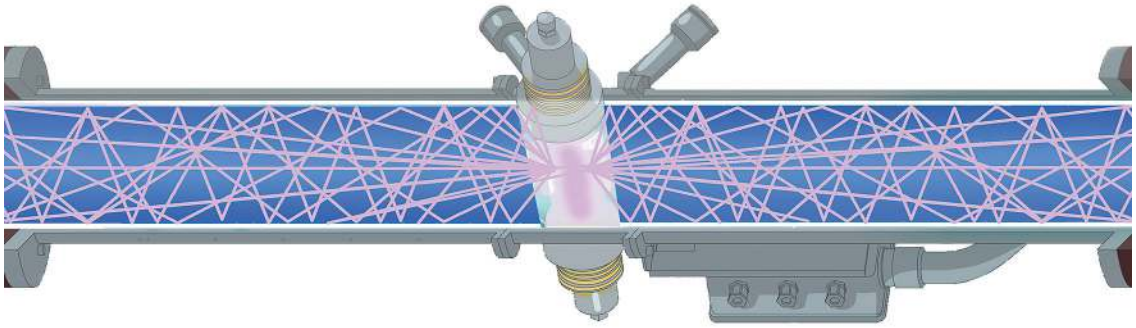


Figure 1: Atlantium Hydro-Optic™ UV Lamp and Chamber

This configuration uses fiber optic principles to trap the UV light photons and recycle their light energy. The photons repeatedly bounce through the quartz surface back into the chamber, effectively increasing their paths and their opportunities to inactivate microbes.

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