

Hydro Leader

VOLUME 12 ISSUE 9

OCTOBER 2021



**Timothy Welch of the Water
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Funding Research Into the Future
of the U.S. Hydropower Industry**

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Timothy Welch of the Water Power Technologies Office: Funding Research Into the Future of the U.S. Hydropower Industry

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COVER PHOTO:

Timothy Welch, Hydropower Program Manager, Water Power Technologies Office. Photo courtesy of the Water Power Technologies Office.

PHOTO COURTESY OF THE WPTO.

Coming soon in *Hydro Leader*:

November/December: Congresswoman Annie Kuster on the Twenty-First Century Dams Act

Do you have a story idea for an upcoming issue? Contact our editor-in-chief, Kris Polly, at kris.polly@waterstrategies.com.

Promoters of Progress, Public and Private

By Kris Polly

Progress in hydropower is pushed forward by private companies; federal, state, and provincial entities; and even local agencies. All those levels are on view in this month's *Hydro Leader*.

The U.S. Department of Energy's Water Power Technologies Office (WPTO) funds important research into hydropower, marine energy, and freshwater hydrokinetic power. WPTO Hydropower Program Manager Timothy Welch tells us about its new research, including the development of modular hydropower projects in remote locations in Alaska, and the importance of pumped storage for the future of the grid.

We also speak with Nick Lesnikowski of David Evans and Associates, Inc., about the firm's underwater dam monitoring services, which involve bathymetric data, remotely operated vehicles, sonar, and more.

Ontario Power Generation (OPG), the provincially owned entity that generates half the electricity used by the Canadian province of Ontario, is refurbishing older hydro stations as part of its efforts to achieve a net-zero carbon future. Paul Burroughs, OPG's director of project management for renewable generation, tells us more.

CEATI International is a research and advisory firm that provides answers to its members' difficult operational questions by leveraging the expertise and experience of their

peers in the industry. Vice President Chris Hayes and Head of Marketing Lizzie Smith tell us about the benefits CEATI can deliver to hydro utilities.

Russell Berry, the president of Intake Screens, Inc., and John Burnett, its director of technical services, tell us about the company's custom, industrial-grade screen systems and its services for hydro facilities.

Finally, we speak with three water professionals, Rachel Little, Amanda Newell, and Julia Pinnix, about Kids in the Creek, an educational program that helps high schoolers in north-central Washington State learn about the hydrology, biology, and multiple uses of waterways.

From federal agencies in Washington, DC, to local-level initiatives like Kids in the Creek, water resources professionals are always promoting progress. Wherever you may find yourself, I hope that this issue of *Hydro Leader* inspires you to join in. **H**

Kris Polly is the editor-in-chief of Hydro Leader magazine and the president and CEO of Water Strategies LLC, a government relations firm he began in February 2009 for the purpose of representing and guiding water, power, and agricultural entities in their dealings with Congress, the Bureau of Reclamation, and other federal government agencies. He may be contacted at kris.polly@waterstrategies.com.

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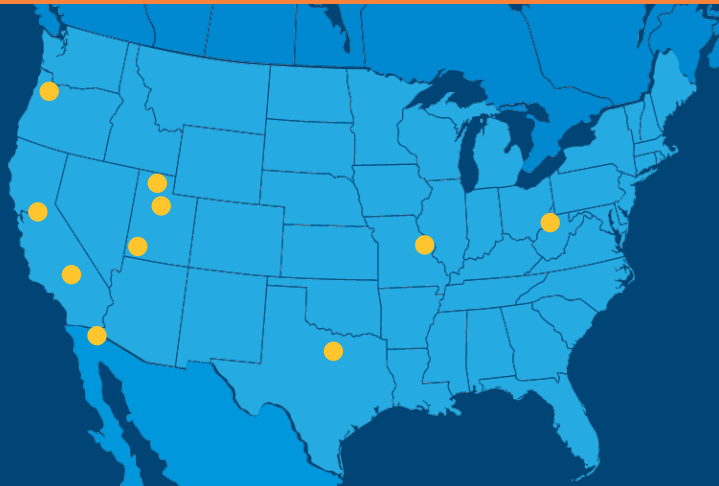
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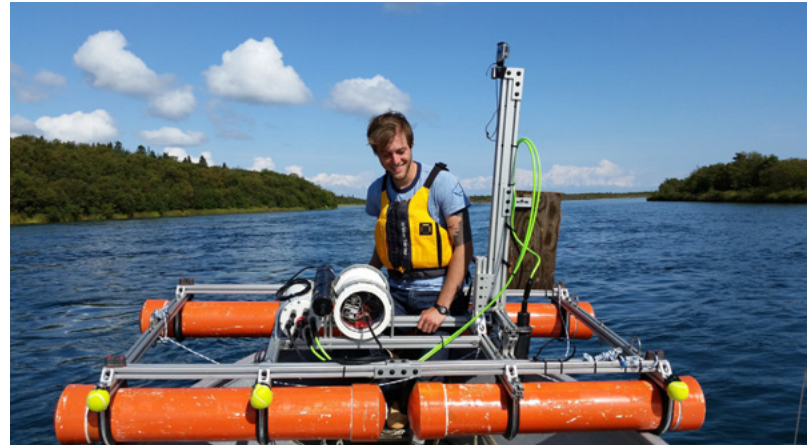
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Timothy Welch of the Water Power Technologies Office: Funding Research Into the Future of the U.S. Hydropower Industry



The Village of Igiugig, Alaska, installed its first RivGen hydrokinetic turbine in 2019 as part of a multiyear effort launched in 2018 via a WPTO award.



The RivRaft drifting hydrophone array, an underwater listening system used to monitor the potential interaction of marine energy technologies with fish, was deployed to monitor the Ocean Renewable Power Company's RivGen hydrokinetic turbine in Igiugig, Alaska.

The U.S. Department of Energy's (DOE) Water Power Technologies Office (WPTO) funds important hydropower, marine energy, and freshwater hydrokinetic research at U.S. national laboratories, private companies, and universities. Its hydropower portfolio covers new technology, hydropower's relationship with the electric grid, fleet modernization, environmental mitigation, and data science. In this interview, WPTO Hydropower Program Manager Timothy Welch tells us about the focuses of the office's research; some of its specific projects, including the development of modular hydropower projects in remote locations in Alaska; and the importance of pumped storage for the future of the grid.

Hydro Leader: Please tell us about your background and how you came to be in your current position.

Timothy Welch: I'm the manager of the hydropower program at WPTO. I oversee the hydropower program research and development portfolio. I'm a fishery biologist by training and have been in the hydropower community for over 30 years. I've worked for the DOE for 6 years and previously worked for the Federal Energy Regulatory Commission in hydropower licensing for 25 years.

Hydro Leader: What is WPTO and what does it do?

Timothy Welch: WPTO covers a few major programming areas: the hydropower program, which is what I'm a part of; the marine energy program, which includes wave and tidal marine projects; and the freshwater hydrokinetic project,

which covers projects that don't need a dam to operate and operate strictly by flow. My part of the portfolio focuses on five major activity areas. The first one is innovation for low-impact hydro, which covers new technology. The second is Water Innovation for a Resilient Electricity System (HydroWIRES), our newest activity area, which focuses on hydropower's relationship to the bigger electric grid and how it facilitates variable renewables like wind and solar. The third area is fleet modernization, which focuses specifically on the existing hydropower fleet and how we can use digitalization to bring it into the 21st century. The fourth area is environmental and hydrologic sciences, which looks at environmental mitigation strategies for hydropower and at fish tags and fish passage systems. In the hydrologic science area, we use new sensors to capture watershed data that enable us to get a handle on what hydrological regimes might look like in the future under different climate scenarios. The fifth area is data access, which covers all the types of data that are collected through the projects we fund. We're in charge of the largest existing comprehensive hydropower database in the country, HydroSource, which is a project through Oak Ridge National Laboratory.

Hydro Leader: Does WPTO do research in house, or do you mainly fund other people and programs?

Timothy Welch: We mainly fund other people and programs. We have two major areas of funding. The first is the national laboratories, including Pacific Northwest National Laboratory, Oak Ridge National Laboratory, the National Renewable

Energy Laboratory (NREL), Idaho National Laboratory, and Argonne National Laboratory. These laboratories do the bulk of the hydropower research. Our other area of funding is the private sector and universities. We provide them funding through a variety of mechanisms. The most noteworthy are our Funding Opportunity Announcements (FOAs), in which we announce specific topic areas in which the private sector can submit proposals for funding. We usually have one highly funded FOA a year. We develop these specific topic areas through our strategic planning. We have a lot of specialists in different research areas, including fish biologists like me and engineers, because we need to be able to approve the methodologies associated with different research projects and review the results and reports. We also develop our strategic plan based on conversations and workshops with the hydropower industry and partnering federal agencies. I currently have a staff of five federal employees and receive support from three contractor employees.

Hydro Leader: What is the current state of hydro in the United States, and where do you see the biggest opportunities for advancement?

Timothy Welch: I always start off by saying that the era of Hoover Dam and Grand Coulee Dam has ended. In the United States, we saw significant growth in the hydropower industry in the 1940s, 1950s, 1960s, and a little bit in the 1970s, but then it started tailing off. Today, we aren't seeing much growth in the area of big dams, and when we talk about growth, most people still think of building new projects. What we're talking about is using the existing fleet in a new and innovative way.

The real growth in hydropower falls into two categories: new stream reach development and, most notably, the development of nonpowered dams. There are 90,000 dams in the United States, of which only 2,500—or less than 3 percent—currently generate electricity. We think there is the potential for at least 6–10 gigawatts (GW) of growth at nonpowered dams in the United States. Our research is focused on coming up with new, innovative ways of powering nonpowered dams.

We're looking at new stream reach development in a way that is totally different from how it has been done historically. Historically, the design paradigm for building a project in a new stream reach area was to build your project and then go through the regulatory process by asking resource agencies and environmental organizations what needed to be done to mitigate its effects. Our new design paradigm, which is called standard modular hydro, takes the approach of using modules, which will hopefully someday be standard, and arranging them in a manner that not only supports but enhances the functionality of the stream. In other words, you move into your design phase by first looking at the environmental attributes of the stream reach and then designing your project to mitigate or enhance those stream functions. It's much

easier to go into a conversation with a resource agency saying that your project is going to provide certain benefits for the stream reach and is going to generate electricity as well. It's a real paradigm shift. We're applying the same principles to nonpowered dam development.

Hydro Leader: Would you tell us about your efforts to promote hydro development in remote communities and why it is important?

Timothy Welch: We think that hydro has a huge role to play in remote communities. Hydropower can act as the foundation for something like a microgrid in remote communities and can help with intermittent outages because of its flexibility. In the city of Cordova, Alaska, we are cofunding a project called the RADIANCE Project with the DOE's Office of Electricity. It is looking at hydropower and pumped storage as the cornerstone of a microgrid.

The multifunctionality of a hydropower project can be key to community health, especially with respect to enhancing water quality, enabling groundwater recharge, creating recreational opportunities, and creating new fish habitats. Small hydropower plays a key role in remote communities, particularly in communities that depend on irrigation. Hydropower can play a huge role in providing a revenue stream for the modernization of irrigation systems in rural communities, including the replacement of open ditches with pressurized piping and the use of more precise and advanced technology in agriculture.



The Monroe low head hydro project in Madras, Oregon, which was developed with the support of grant funding from the WPTO.

Hydro Leader: Would you tell us about the project in Alaska that you are working on with Littoral?

Timothy Welch: The Littoral project is one of our standard modular hydro projects, and it would be a new stream reach development. If there's anywhere in the country where new stream reach development can help bolster real estate, it's probably Alaska. There are many streams and sites without hydropower. Littoral partnered with Oak Ridge National

Laboratory to design a standard modular hydropower facility in Fair Creek, Alaska. They are coming up with two different designs: a conventional design and a modular design that uses a form factor module, which looks something like a shipping container and can be used to put together a dam almost like Legos. Littoral is going to compare the costs of the conventional design and the standard modular design. Right now, we think that using the modular approach might reduce the cost of the facility by 15–30 percent.

Hydro Leader: Is WPTO's role in the project funding that research?

Timothy Welch: Yes. Our role is funding, and Oak Ridge National Laboratory is providing technical assistance.

Hydro Leader: How do you see pumped storage in the United States developing over the coming years?

Timothy Welch: Pumped storage hydropower is the least expensive and the most used method of bulk energy storage in the world. It makes up 95 percent of all bulk energy storage worldwide. Energy storage in general has a huge role to play amid the increase in variable renewables like wind and solar. Pumped storage is reliable when the sun sets, the wind dies down, and demand increases. Pumped storage projects can pump water all day and then release it and generate power as it is needed. We think there's going to be an uptick in pumped storage development. In fact, the hydropower vision report we did in 2016 projected, based on modeling by NREL, that there will be 35 GW of new pumped storage by 2050.

However, there are some significant technical hurdles that we need to overcome, and this is where we're focusing our efforts. The biggest one is the high capital cost of building these projects, which can be in the tens of millions of dollars. Argonne National Laboratory just came out with a guidebook for valuing pumped storage projects that demonstrates how these long-term assets can last for 50–100 years and pay dividends. We've developed a methodology for developers to show the facilities' value and thus to get financing.

We are also working on technical advances to help lower the costs of construction, particularly in new tunneling techniques. We're also looking at a more modular approach to pumped storage that might involve a series of 5–10 megawatt pumped storage projects. We're about ready to release a report drawn up by the Obermeyer Corporation about constructing a small, underground, modular pumped storage project that does not require an underground powerhouse. The pump and turbine facility are in a shaft that can be easily lifted for maintenance. That eliminates the need for tunneling underground or driving vehicles down to a powerhouse. We think there are big cost savings there.

Oak Ridge National Laboratory is also looking at the concept of building a pumped storage project by using an existing lower reservoir and constructing a modular upper

reservoir. To minimize environmental effects, a membrane in the lower reservoir would keep the water for the pumped storage project separate from the natural waters. There would be no mixing and no issues associated with water quality, temperature, or fish entrainment. It would be a closed-loop project in something like an open-loop situation. We're testing different membrane concepts and working to enable the use of this concept on a greater scale. We need to do a lot more work on making pumped storage projects more flexible and able to react more quickly to changes in the grid as well.

Hydro Leader: Are you doing any work that would help address water quantity issues related to climate change and how they might affect power production?

Timothy Welch: DOE is preparing to issue our third 9505 Assessment, which is a technical report to Congress, next year. The 9505 Assessment looks at the effects of climate change on the federal hydropower system. We do a new version every 2 years. We've worked on taking global climate models and downsizing them to a watershed level to look at different climate scenarios and show how they affect hydropower generation in the federal fleet. Since our first report in 2013, we've made those models more granular and are coming up with more accurate answers. What we want to do next is to expand that analysis to the nonfederal fleet.

We're also looking at other areas. NREL is working on water risk with a changing hydrologic table and trying to identify the long-term risks that hydropower operators need to face. How do you model them and how do you predict them? We're also investing in better forecasting techniques, because the key for long-term planning is better short- and long-term forecasts.

Hydro Leader: What do we need to do to meet national emission-free goals?

Timothy Welch: I can't speak for all the energy sectors, but achieving 100 percent decarbonization will require a much greater deployment of wind, solar, and other renewables. We think that hydropower will play a huge role, too, just because it's such a long-lived asset, it already exists, and its flexibility can allow for the variable nature of both wind and solar. We recently issued a report called the North American Renewable Integration Study, which we did in partnership with Canada. It shows that hydropower has a huge role to play with the increasing deployment of variable renewables. [H](#)



Timothy Welch is the hydropower program manager at the U.S. Department of Energy's Water Power Technologies Office. He can be contacted at timothy.welch@ee.doe.gov.

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As industry knowledge and awareness of the resulting human, environmental, and social impacts from dam and levee infrastructure decisions of decades ago are more understood, it has become increasingly important to recognize and consider these long-term impacts from current investment decisions. The conference will be a forum for sharing technical expertise and fostering a healthy dialogue to promote improved decision-making, planning, design, construction, and management of dams and levees today in order to meet the needs of future generations without compromising our natural systems.

With its complex nexus of relationships between coastal and riverine systems, low-lying and mountainous typologies, urban density and suburban sprawl, and rich wildlife and habitat history, San Diego is a great place for dam and levee practitioners to come together and discuss topics related to the conference theme. Up the Interstate-5 freeway in Carlsbad, CA is the famous LEGOLAND theme park, home to the Legos we assembled as kids and perhaps reminding us of our childhood inspiration to become engineers and scientists. Next year's conference theme is also an opportunity to think about the future generation of dam and levee professionals and how we can set them up for success.

WORKSHOPS

Concurrent workshops will be held on Thursday, April 14

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A DEA marine services boom truck on site for an inspection survey at a hydropower dam.

David Evans and Associates Inc. (DEA) is an engineering and professional services consulting firm with 29 offices and more than 850 employees nationwide. DEA serves energy, water, transportation, land development, surveying, and marine services clients. The firm provides numerous services of interest to hydropower facilities, including advanced underwater dam inspections that involve bathymetric data, remotely operated vehicles (ROVs), imaging sonar, 3-D scans, and laser systems. In this interview, Nick Lesnikowski, DEA's senior geophysicist for marine services, tells us about these techniques and their uses.

Hydro Leader: Please tell our readers about your background and how you came to be in your current position.

Nick Lesnikowski: I grew up in New England. I went to the University of Massachusetts and received a geology

degree in 1982. Immediately after graduating, I accepted a job as a geophysicist with Amoco Production Company in New Orleans. Amoco liked to hire geologists and teach them geophysics as they practiced it. I worked in the offshore division, assessing lease holdings that were coming up for bid and things of that nature. I also did a bit of work with shallow hazard analysis and started to get familiar with side scan, high-resolution subbottom profiling, hydrography, and detailed mapping of areas where rigs might be placed.

I left Amoco after about 3 years and was commissioned as an officer in the National Oceanic and Atmospheric Administration (NOAA) Corps. I was assigned to the research vessel *Discoverer*, which was a class 1 vessel, meaning that it was one of the bigger ships that NOAA operated. I spent 2½ years on the *Discoverer*, going in and out of Seattle and all around the Pacific. It was a great experience.

I was lucky enough to be on the *Discoverer* when she became the second NOAA ship to be outfitted with a full-ocean-depth multibeam bathymetric system. It was a SeaBeam system that had 16 beams, which was a lot at the time. I was there during the installation and when everybody was getting up to speed on how it worked.

After my time in NOAA, I found a job in Seattle working for somebody who I met on the *Discoverer*, Mike Williamson. He's a great guy and he had a great team of people with him. They were on the forefront of geophysics and deep-ocean mapping. I worked at Williamson & Associates for 14 years, doing all sorts of transoceanic and deep-ocean survey work. We developed a special kind of interferometric swath bathymetry that was highly innovative at the time.

As my family started growing, I needed to be closer to home in the Northwest, and it was the right time for me to change from worldwide to more regionally oriented work. I was lucky enough to meet Jon Dasler, and in 2001, I joined DEA.

We do high-end, detailed bathymetric and geophysical surveys and a lot of support work for bridges, dams, and construction projects. I had a small hiatus of 5 years when I took a position at BlueView, which is an underwater sonar manufacturer. I assisted in the development, testing, and initial operation of some of its underwater 3-D systems. Then, BlueView moved its operations back to Denmark, and after talking to Jon, I was able to step back over to DEA. I have been here a total of about 14 years. I handle a lot of the geophysical survey work, some profiling, seismic work, the underwater infrastructure mapping, and operations.

Hydro Leader: Please tell us about DEA as a company.

Nick Lesnikowski: It's an absolutely wonderful company. It was founded around 1976 and had its roots in surveying and engineering and things of that nature. When I joined, I actually met David Evans and had a brief interview with him. Jon Dasler, who runs the marine services group, is a land surveyor, civil engineer, and hydrographer. He started DEA's marine services division in 1989. DEA has grown over the years to a company of around 850 people. We've got about 29 offices, mostly on

the West Coast, but also including offices in Colorado, Mississippi, Nevada, New York, South Carolina, Texas, and Utah.

Hydro Leader: Please tell us about your underwater dam inspections. Are those a part of normal scheduled dam inspections, or are they only needed in specific scenarios?

Nick Lesnikowski: Both. There are immense forces involved in dams: the power of the water being held back and the power of the water that's rushing through. What that water can do to the physical structure needs to be monitored. We've been involved with different types of monitoring operations, some of which are critical—meaning there's some risk that needs to be assessed—and some of which are routine annual or biannual surveys to inspect for any obvious damage to the structure and any infilling of sediments or debris that may obstruct intakes.



An ROV prepped for deployment from a DEA survey vessel for underwater video inspections of a hydropower dam.

Hydro Leader: How are those inspections carried out?

Nick Lesnikowski: We offer a wide variety of equipment, and there's a range of things that fall under the term *inspection*. There are remote inspections that involve looking at the infilling of the bathymetry in the bottom of the sediment, and interactive inspections that involve close examination with a variety of sensors. We use high-precision positioning, so all our data are precisely geolocated. When we do a multibeam survey, we get a dense coverage of soundings of the structure and can see it in quite a lot of detail.

However, in some cases, there may be water flowing constantly and a lot of scour or undercut. In these scenarios, sometimes looking from the surface isn't enough, and you have to get underneath the water, so we use ROVs or underwater tripods to inspect the structure from a different vantage point. Often, the water clarity is poor, so we put scanning sonar devices on the vehicles or tripods. There are different types of scanning sonars. One is an imaging sonar, which creates something like an acoustic photograph that allows you to see logs, debris, cables, cracks in concrete, and so on. We can also use a 3-D scanning system, which collects both sounding and intensity data. We place it in a difficult-to-access area and then rotate the scanner 360 degrees to get a detailed point cloud. That's especially useful for dams with an undercutting condition, because they are difficult to assess. The undercutting on footings won't always be big and broad. If a diver goes down, it's sometimes difficult to determine exactly where the diver got a probe measurement, and divers can only make a limited number of measurements. A scanner, by contrast, gets hundreds of thousands of data points, allowing us to see subtle undercuts, deeper undercuts, or narrow cracks that a diver might not be able to find or accurately quantify.

A lot of the time, we work with our clients to determine the best approach. We are also safety aware. We work closely with dam operators to keep safety paramount and make sure our operations are well thought through. We try to avoid putting people below a spillway or something similar if it can be avoided. In our work with the U.S. Army Corps of Engineers, we built a special deployment device that we lowered into a stilling basin, and we used an ROV equipped with video equipment and a 3-D sonar system so that we could safely conduct a complete survey without the use of manned vessels.

Sometimes, we use remotely operated surface vessels, too. Other times, we have two vessels. The second vessel is unmanned but will track our primary survey vessel so that we can increase our coverage and our efficiency without having to increase the number of people involved in the project. That technology is becoming more and more prevalent, as are autonomous underwater vehicles and autonomous survey vessels.

Hydro Leader: Who are your clients?

Nick Lesnikowski: Our clients in the hydro industry include a wide range of commercial and governmental dam operators in the Northwest. A lot of times, we come in on specific operations. An organization will have a unique project that's going to require detailed measurements so that structures can be assessed and anything that will need to be attached to the structure can be prebuilt. It is important that the measurements be precise so that whatever is built fits.

Hydro Leader: What are the most common issues your hydro clients are looking at?

Nick Lesnikowski: We see a lot of work assessing scour and undercut, including undercut inside training walls and sidewalls, undercut in structures, and the undercut of endsills. We also work extensively in upgrading structures. Sometimes, valves or other things that are highly integrated into the dam need to be replaced, which requires a large construction project. The dam itself will need to be assessed in its current condition to compare it with as-builts. We work with as-builts and information we collect from the client, but we have to go out and get current condition surveys so that the engineers have the best data. We also do a lot of work with fish bypasses. We are always trying to improve the functioning of fish transport systems.

Hydro Leader: Aside from these underwater inspections, are there any other services that DEA provides that our hydropower industry readers should know about?

Nick Lesnikowski: DEA has extensive experience in energy development, design, and project delivery. We support clients who provide renewable energy, including wind, solar, and wave power. We also provide consulting services that support traditional power delivery, including submarine transmission line route surveys and substation and transmission line design. We have a water and environment group that can assist with permitting. That team knows all the regulations and can walk clients through the whole process. Our roots are in surveying and geomatics, so we run a lot of land crews and do laser scanning. DEA has been doing laser scanning for more than 20 years. We have developed a lot of in-house techniques and have always kept our group at the forefront of emerging technology. We've integrated laser systems into our hydro vessels, so we can collect dense point clouds above the water as we're collecting dense soundings below the water, providing a full view of a structure. We've been doing that on a lot of our big nautical charting contracts for NOAA. We just completed a large stretch of the lower Mississippi River, where we combined swath bathymetry and mobile LIDAR data into an integrated dataset, which included the heights of transmission lines over commercial shipping lanes. 



Nick Lesnikowski is the senior geophysicist and underwater inspection manager for the marine services division at David Evans and Associates, Inc. He can be contacted at nsl@deainc.com or (206) 419-4595. For more information on DEA's marine services, visit deamarine.com.

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Work on the Little Long Dam safety project.



Another view of work on the Little Long Dam safety project.

Ontario Power Generation (OPG) is a provincially owned entity that uses its diverse fleet to generate half the electricity used by the Canadian province of Ontario. With 66 existing hydropower stations and an ambitious goal of supporting OPG's newly released Climate Change Plan, which aims at achieving a net-zero carbon future through nuclear, hydro, and solar power, OPG has recently taken on major projects refurbishing old hydro stations. This has involved close work with the First Nations communities on whose traditional territory many stations are built. In this interview, Paul Burroughs, OPG's director of project management for renewable generation, tells us about some of the company's recent projects and about how it is working to update its facilities efficiently and safely.

Hydro Leader: Please tell us about your background and how you came to be in your current position.

Paul Burroughs: I'm the director of renewable generation projects in our enterprise projects office. We plan and execute hydroelectric, solar, and other projects across the business in support of renewable generation and our climate change initiatives. We work closely with our business development group to bring many of these projects to life. I started in 1990 in the civil analysis group of what was then Ontario Hydro and slowly worked my way through civil design and analysis, dam safety, and then project management.

Hydro Leader: Please tell us about OPG.

Paul Burroughs: OPG is a power generating entity that is wholly owned by the province of Ontario and primarily operates in Ontario, though we have subsidiaries

elsewhere. We have a portfolio of 66 hydropower stations across the province; a biomass station in northwestern Ontario; a dual fuel oil-gas station in eastern Ontario; the Darlington nuclear facility in Clarington; and the Pickering nuclear facility east of Toronto in Pickering. Recently, OPG installed our first solar farm on the site of our decommissioned coal-fired station at Nanticoke. We produce more than half the electricity used in the province of Ontario, but there are also other generators. OPG has a total capacity of 18,876 megawatts (MW), and its hydropower facilities have a current generating capacity of 7,478 MW. We are a regulated company with a large portion of our generation regulated by the Ontario Energy Board.

Hydro Leader: Would you tell us about how you engage with First Nations on your building and refurbishment projects?

Paul Burroughs: Our hydroelectric facilities are in the traditional territories of indigenous communities. To move projects ahead, we need to consult and engage with the First Nations that may be affected by the project. Where OPG has developed new generating facilities, we have been partnering with the local First Nations. Currently, OPG has partnerships with the Moose Cree Nation at the Lower Mattagami River Hydroelectric Complex, the Taykwa Tagamou Nation at the Peter Sutherland Sr. Generating Station, the Lac Seul First Nation at the Lac Seul Generating Station in northwestern Ontario, and the Six Nations of the Grand River and the Mississaugas of the Credit First Nation at a solar project at Nanticoke.

Hydro Leader: What is the nature of these partnerships?

Paul Burroughs: They are commercially based partnerships. The First Nation invests in a project, which it then owns for the life of the asset. In some cases, partnerships have been derived as part of a past grievance process, which is a process to address the historical effects of our existing stations, which were built from the 1920s to 1960s without consultation with the local First Nations. These partnerships create the opportunity for the First Nations to invest funds back into the projects to earn a long-term revenue stream. That way, they are directly benefiting from what is built in their traditional territories. These partnerships also provide an opportunity to build long-term mutually beneficial relationships, since hydroelectric assets can last more than 100 years if they are maintained and refurbished.

Hydro Leader: Please tell us about the Little Long Dam safety project.

Paul Burroughs: The Lower Mattagami Hydroelectric Complex has four stations: Little Long, Smoky Falls, Harmon, and Kipling. Smoky Falls was built in the 1920s and was substantially smaller than the other stations, which were built in the 1960s. From 2010 to 2014, the old Smoky Falls Generating Station was replaced by a new powerhouse and three new units, while a single unit was added to each of the other stations on the river to increase the total capacity by nearly 500 MW. The Mattagami River goes from being a meandering river in the summer to passing more water than Niagara Falls in the spring, so we have to get water safely around the stations. The most upstream hydropower station is Little Long, where the Adam Creek spillway was constructed in the 1960s to bypass flows above the capacity of the four cascade hydropower stations around the complex. The bypassed water reenters the Mattagami River downstream of Kipling Generating Station. In 2011, the Province of Ontario updated its dam safety requirements, including the criteria for determining the inflow design flood. The Little Long Dam safety project involves bringing the discharge capacity of the Adam Creek spillway up to meet these revised requirements. The current discharge capacity is being increased from approximately 6,100 centimeters to 8,700 centimeters. To put that in perspective, OPG will be increasing the discharge capacity by almost the amount of water you can see cascading over Niagara Falls during tourist season.

Hydro Leader: What are the elements of dam safety?

Paul Burroughs: Our public safety program covers some of the recreational aspects of safety, such as operating our spillway gates in a stepped manner to minimize risks to the public downstream; ensuring we have adequate barriers, signage, fencing, and safety booms in place; and carrying out active media campaigns like “Stay Clear, Stay Safe.” We do a lot of work in that area, because dams are part of communities.

Dam safety requirements are intended to address the extreme events that can cause dams to fail catastrophically. The amount of water a dam must be able to safely pass is known as the inflow design flood (IDF). The IDF is determined by provincial requirements as defined under the Lakes and Rivers Improvement Act. Once we know the IDF, we design the structures and systems to safely pass it. Structural stability is another aspect of dam safety. The



The replacement of a scroll case at the Adam Beck I Generating Station in Niagara Falls.

structures must be stable as they resist the force of water they hold back. We can't have the dam turn over or slide away. There are various seismic load cases, ice load cases, and basic water load cases that are considered in the design; these requirements are also spelled out in the province's standards. Dam safety also involves the ongoing monitoring of dams by trained staff, which involves inspections and instrumentation to measure water pressures and any movements of the structures.

Hydro Leader: What is the status of the Little Long Dam safety project?

Paul Burroughs: The project involves three key pieces of work. The largest component of the project is the

addition of four new sluiceways to the structure—two on each side of the eight existing gates—to address the new IDF requirements. Second, we are upgrading the existing structures to meet stability requirements. This involves rock-anchoring the structure into the ground. Finally, we are replacing the 10 existing gates and the associated equipment, most of which are over 50 years old and near their end of life. There are some new standards for the gates and structures, including some that require us to enclose the hoist houses to protect the equipment from the elements and to improve access for maintenance tasks. With the new market and new renewables, the gates at our stations operate more than they ever have in the past. Historically, we usually wouldn't operate them much in the winter. To support the intermittent nature of some renewable generation facilities, hydroelectric facilities are being asked to be more flexible. That implies an increased need to spill water, including in the winter, which means that these gates are now designed to be able to lift with ice on them. The hoist house is a way to keep the motors warm and operable through the winter.

Hydro Leader: You are also working on a refurbishment project at Niagara Falls. Would you tell us about that?

Paul Burroughs: In Niagara, there are 10 units down at the Sir Adam Beck I Generating Station, which was built in the 1920s with 25-hertz (Hz) power. From 1960 to 1990, all the units were replaced with 60 Hz generators except for two that supplied steel mills that were also still at 25 Hz. Eventually, the demand for 25 Hz power went away, and OPG had two units that were sitting there unused and at the end of life. We made a case to replace them with new 60 Hz units. The infrastructure to support the units is already there; we just have to take the older units out and put the new units in. This project will substantially upgrade the station's capacity, with an increase of 113 MW.

An interesting aspect of this project is that we ended up replacing the 100-year-old cast steel scroll cases on both units. The scroll case is a part of the water passage that distributes the water from the penstock evenly into the turbine. We did an initial assessment of the scroll cases and found that they were among the first cast steel structures of significant size to be built. We found that the builders had improved the quality of the castings as they progressed through the 10 units they built, but that the first 2 scroll cases had quality issues. Once we got more thorough access to the scroll cases and assessed the cracks and voids in more detail, we realized that they would require a significant amount of work to repair and that there was a risk that even after repair, we would find that they needed to be replaced. We analyzed how much it would cost to keep chasing the cracks and welding them versus the option of replacing the scroll cases entirely. Removing the old scroll cases was a little tricky, as they were embedded in mass concrete. However, we did some tests and found that

the concrete poured immediately around the scroll cases was secondary concrete and could be chipped out. During construction, the scroll cases had been placed on the primary concrete and then had had secondary concrete poured around it to fix them in place. We reversed the process; cut out the scroll cases; and chipped out the secondary concrete, which separated nicely at the original primary concrete. Now, we have installed new, modern, steel scroll cases and reembedded them in concrete to provide a solid foundation for the new units. This is the first time we have replaced embedded steel scroll cases, and we are pleased with the results.

Hydro Leader: Do you have any other additional projects coming?

Paul Burroughs: We're building a 10 MW plant in Calabogie on the Madawaska River, northwest of Ottawa. The previous plant there was over 100 years old, and 3 years ago it was destroyed by a tornado that tore the roof off, damaged equipment, and threw some diesel generators around. We always had plans to redevelop it, but the tornado expedited our timeline. Last year, we started construction and are well into the concrete program. We expect to start installing the two turbine generators by Christmas 2021.

Hydro Leader: What is OPG's vision for the future?

Paul Burroughs: We have a lot of value to add as a large electricity producer. Almost all our generation is carbon-free nuclear and hydro. Some of our subsidiaries have gas plants, but OPG's direct generation is around 98 percent carbon neutral. We're continuing to directly support climate change objectives by reinvesting in our hydroelectric units. OPG will refurbish, overhaul, and upgrade 66 plants and around 167 units over the next 10–20 years. We're also looking at advancing small modular reactors. We support Ontario's electrification initiatives because we have expertise in managing electrical projects and connecting to the grid. We're proud of our ability to execute capital projects such as the refurbishment of the 4,000 MW Darlington Nuclear Station, which we are doing on time and on budget.

I'm proud to be a part of OPG, and I am proud of our focus on a net-zero future. I see opportunities to redevelop a lot of our small hydro assets that are at their end of life and, in the longer term, to look for more opportunities to develop new hydroelectric generation in Ontario in partnership with First Nations. 



Paul Burroughs is the director of projects for renewable generation at OPG. He can be contacted at paul.j.burroughs@opg.com.

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How CEATI International Helps Hydro Utilities Benefit From Industry Expertise



The exhibit hall at CEATI's Hydropower Conference, March 2020, Palm Springs, California.

CEATI International is a membership-based research and advisory firm focused on the current and emerging needs of the electrical utilities industry. It facilitates user-driven interest groups that cover topics across the activities of an integrated power utility. Interest group members benefit from the experience and knowledge of their peers, as well as guidance and analysis from CEATI's network of technical advisors. In this interview, CEATI Vice President Chris Hayes and Head of Marketing Lizzie Smith tell us about the company's activities and the benefits it can deliver to hydro utilities.

Hydro Leader: Please tell us about your backgrounds and how you came to be in your current positions.

Lizzie Smith: I've been with CEATI for just over 10 years. I started straight out of university. CEATI runs 20 different interest groups in various areas of the power industry, including generation, transmission, and distribution, and when I first joined CEATI in 2010, I was working on a couple of groups that dealt with emerging tech and thermal generation. In 2012, I moved over to work on our three hydro groups, and for the past 4 years, I served as their program manager. Our three hydro interest groups are dam safety; hydraulic plant life, which looks at power plant equipment;

and hydro operations and planning, which looks at water management and optimization. Just a few months ago, I took a new position as the head of our marketing department.

Chris Hayes: I'm an Anglo-Quebecer, born and raised in Montréal. I went to McGill University, where I obtained a mechanical engineering degree. Although I had strong interests in academics, including math and the sciences, I come from an entrepreneurially spirited family and had a passion for business development. This proved to be a great combination in my professional career. Coming out of school, I spent some time with Bombardier Aerospace as an intern. The opportunity at CEATI came up shortly after my graduation. I started with CEATI in May 2002, and over the past 20 years, I have had the chance to work with and learn from some of the best people in the industry. I'm now a vice president, and I look after key account management and business development.

Hydro Leader: Please tell us about CEATI and its history.

Chris Hayes: CEATI was founded by a gentleman by the name of Jacob Roiz, who, once upon a time, was a director with the research and development group of the Canadian

Electricity Association (CEA). In the mid-1990s, when the department was faced with the possibility of being shut down, he had the opportunity to salvage the situation by spinning off the group. He was then able to completely change the program model and open up the doors to international collaboration. That was the birth of CEA Technologies, which later became the Center for Energy Advancement through Technological Innovation, or CEATI.

Hydro Leader: Would you explain CEATI's business model?

Chris Hayes: Let's start by talking about industry drivers and then CEATI's program model. As you know, the electric grid is rapidly aging, and utilities are working to reinvest to maintain reliability while incorporating new and emerging technologies. Also, baby boomers are retiring with their experience, so there's a gap between that generation and the new guard coming on the scene. There's a big need for succession planning and training that needs to be addressed. Beyond that, you've got grid-edge technologies, distributed energy, and integration to account for. CEATI as an organization is dedicated to addressing all those issues from a programmatic perspective.

We've got 20 interest groups, which are set up like an integrated utility. There are groups covering generation, transmission, and distribution. Each of these 20 groups targets a department or a division. They are all utility only and meet twice a year, usually in person, in addition to collaborating on projects, webinars, and workshops throughout the year as needed. The conventional hydropower program, for instance, has a hydraulic plant life interest group, which is dedicated to electrical and mechanical engineering managers and plant managers; a dam safety group, which is dedicated to chief dam safety engineers, civil engineering managers, and directors; and a hydro operations and planning group, which is dedicated to hydrologists, inflow forecasters, production planners, river schedulers, and those responsible for optimization. We also have an asset management group, which is dedicated to investment planning strategies, including capital and maintenance.

Using these focused platforms, we provide opportunities for interutility exchange, best practices sharing, war stories sharing, knowledge transfer, and knowledge gap identification. The groups serve as excellent training vehicles for new staff and make great benchmarking platforms for seasoned experts.

What makes CEATI unique, in my view, is the benchmarking process, which can identify knowledge gaps, combined with our ability to do something about those gaps. We can scope studies to address those gaps, and as part of that scoping exercise, we can identify the industry participants with the most appropriate expertise, whether they are retired utility subject-matter experts, big firms, or original equipment manufacturers (OEMs). That is the source of the deep inventory of guidance documents we

have completed over the last 20 years. In a lot of the cases, the studies are de facto industry standards that were written by subject-matter experts who have since retired or passed away. That speaks to our ability to capture the knowledge of yesterday for the benefit of today and tomorrow. The reason I think our benchmarking process is highly effective is that we can do it in real time. If an issue comes up in a company's day-to-day operations, we've got the tools and techniques to quickly canvas the group and provide input from several other utilities within a couple days.

Hydro Leader: Would you tell us about the nature, size, and location of your member utilities?

Chris Hayes: Within the hydropower space, our coverage is excellent across the United States and Canada as well as internationally. We have a great mix of municipal utilities; investor-owned utilities; U.S. federal agencies; Canadian crown corporations; and bigger agencies like the U.S. Army Corps of Engineers, Hydro Québec, and BC Hydro, to name a few. There are quite a few smaller utilities with 20–500 megawatts (MW), another big grouping of utilities with 500–1,000 MW, another set with 1,000–2,000 MW, and around 5–10 of the biggest utilities. The bigger utilities benefit from working with us because we give them an opportunity to benchmark. They're advanced from a technical expertise perspective, and they've got plenty of personnel, but they still need to calibrate their practices against the industry. For other utilities, we serve as their technical resource tool. By being a member of one of the groups, a utility with a team of 2 suddenly has 70 hands on deck. CEATI can dramatically augment the technical resource capability of a utility like that by leveraging expertise and costs.

Hydro Leader: Do your activities go beyond the United States and Canada?

Lizzie Smith: Yes. Our roots are in Canada, but we are active in 17 different countries at this point. We've got members from Europe, Australia, New Zealand, Asia, and Africa. About 150 utilities support us in at least 1 of our 20 interest groups. About 50 percent of our members are from the United States, about 30 percent are from Canada, and the other 20 percent are from other countries.

Chris Hayes: Our founder and head office are based in Montréal. Our new owner, Pamlico Capital, is based in Charlotte, North Carolina. Our personnel are pretty much all in North America. I'm in Montréal, Lizzie is in Vancouver, and a number of our technical advisors and contractors are in the United States.

Hydro Leader: Would you give a few examples of the knowledge gaps that your members identify for CEATI to provide studies and guidance documents on?

Chris Hayes: We developed a dam safety program maturity matrix, which is an excellent tool on a number of fronts. If an owner is implementing or building a new dam safety program, this tool serves as a roadmap. If an owner is looking to take an existing program and make it better, this is a great tool to do that with. Over and above that, it's a tremendous vehicle for liaising with both internal and external stakeholders, because it can help an owner demonstrate where they are and where they want to go. It's a great tool for dealing with executives, putting budgets in place, building a business case, and dealing with a regulator outside the company or an insurance company.

Another example related to dam safety is training. We've developed training programs, or more precisely, a source code that a utility can take and make its own by inserting its facility names and pictures. We did both a training for plant operators and nonengineers and also a deeper dive for engineers a few years later.

Another example is quality assurance (QA) and quality control (QC). Equipment is being procured and built all around the world, so we've developed guidance about what to pay attention to. We're adding another layer having to do with specifications and what a utility should consider when drafting its own specs, including the cost associated with adding or removing certain elements. This helps utilities identify key staples that they need to include in their QA/QC programs. This project, like many of our projects, includes both a written guidance document and a few training webinars to help communicate the important content to the members so that they can implement that knowledge right away.

Finally, our mechanical overhaul guide is an example of one of our guidance documents that has become a de facto industry standard. One of our members keeps a copy of the guide in the trunk of his car and has a bunch of copies in each of his plants, but it is also available electronically, as are all the materials we produce.

Hydro Leader: Would you tell us about your conferences, particularly those most pertinent to the hydropower industry?

Lizzie Smith: Two of the six industry conferences that CEATI hosts every year are highly relevant to the hydro industry. The first is coming up in October: our asset management conference, which we hold every fall. We've got two interest groups dedicated to asset management: one focused on generation assets and one dedicated to transmission distribution assets. They get together every fall and talk about asset management and investment planning strategies. Most of the events we host for our utility members are confidential and open to the members only, but these industry open conferences are the only time of year when those groups are open to the industry, and vendors and consultants are invited to present, participate, and network with our members.

Our biggest event of the year is our annual hydropower conference, which is held every March. It is hosted by the other three conventional hydropower programs: the dam safety group, the hydraulic plant life group, and the hydro operations and planning group. About 100 utilities support those three groups, and they are always in attendance because the conference is colocated with their spring general meetings. The utilities come because they want to be there for their semiannual meeting and network with their colleagues in the group, and then they stay for the industry open conference to attend technical presentations and visit with the vendors and consultants in the exhibit hall. We're looking forward to being back in person in March 2022 for the first time in a couple years after a gap caused by the pandemic. The theme of our 2022 hydropower conference is the past, present, and future of hydro, and our call for abstracts is currently open.

Chris Hayes: Part of CEATI's mandate is to keep our utility members apprised of best practices and the latest and greatest technologies, and CEATI's annual hydropower conference is a great vehicle for accomplishing that. The attraction for the vendors is that there is an audience of 100 utilities that are interested in learning about how to improve. It's a good dynamic.

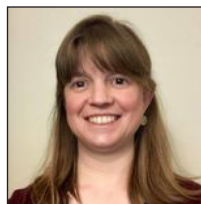
Hydro Leader: Why should utilities that are not current members of CEATI consider joining?

Chris Hayes: It comes down to leverage. We can serve as an excellent technical resource and can help those utilities leverage their time, their resources, and their money. Ultimately, we're going to help to create awareness, build expertise, save them money, and drive down costs.

Lizzie Smith: They stand to join a great network, too. Once a utility becomes a CEATI member, it has a network of many other utilities that it can consider friends and call on to get help from. That kind of network helps build out your staff capabilities. 



Chris Hayes is a vice president at CEATI International. He can be contacted at chris.hayes@ceati.com.



Lizzie Smith is the head of marketing at CEATI International. She can be contacted at lizzie.smith@ceati.com.

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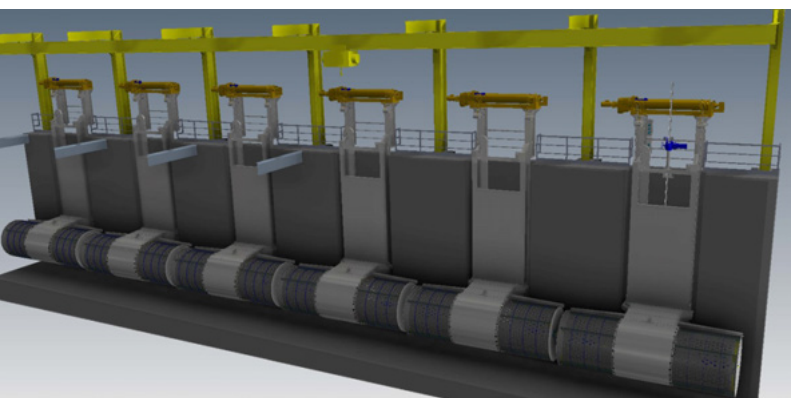
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Intake Screens Inc.'s Hydro Products

ISI's largest hydro facility screen install, a 550 cfs Pacific Gas & Electric structure on the Stanislaus River in California.



A diagram of the Stanislaus River screen.



Another view of the 550 cfs screen ISI manufactured for Pacific Gas & Electric.

Intake Screens Inc. (ISI) was founded in 1996 to manufacture industrial-grade fish protection and debris management screen systems. Today, it designs custom screens for hydro, irrigation, municipal, and industrial facilities around the world. In this interview, ISI President Russell Berry IV and Director of Technical Services John Burnett tell us about the company's history and its services for hydro facilities.

Hydro Leader: Please tell us about your backgrounds and how you came to be in your current positions.

Russell Berry: I grew up working with my dad, who pioneered and patented new screen designs over a decades-long professional career. Starting when I was very young, I went out with my dad and installed screen projects on the weekends. When I was about 18 or 19, I actually started getting paid to work. In those early years, I did the welding, fabrication, and installation work; after gaining some years of experience, I started doing some of the design work as well. Soon after that, I got involved in hiring employees; keeping them lined out every day; and doing all the design, manufacturing, and installation of our screen systems. In 2008, my dad stepped back, and I was named president of the corporation. For the last 5 years, I've been responsible for all aspects of the business, from running meetings to signing contracts and sweeping the floor. In all seriousness, I do make sure that I still put on a wetsuit, run an excavator, and provide thoughtful input on designs, as it is the creation of quality industrial products that fulfills me most.

John Burnett: I'm a fishery biologist by training and hold a master's degree in the subject. I spent 20 years consulting on various fish protection projects and leading small and large teams on biological sampling programs, intake technology feasibility and alternatives analyses, and economic evaluations. I helped clients make informed decisions about how to optimize fish protection and debris management at their water intakes. I came to know all available fish protection and debris management methods and screening options and came to value ISI's technologies over all others in the marketplace. In fact, Russell and I developed some

large projects together over the 10 years before I joined ISI. After leaving consulting and working for 2 years in the fish protection program at the Electric Power Research Institute, I decided to join ISI as a director on the project development side, and that's where I sit today.

Hydro Leader: Please tell us more about the organization's history, focus, and customer base.

Russell Berry: Starting in the 1970s, my dad worked on a ranch in Nebraska where center-pivot irrigation systems were being installed. The ranch was pumping out of a river, and he was getting leaves, pine needles, and other debris in his sprinkler head, so he made some self-cleaning screens to keep his pump and irrigation system operating. In 1980, he quit the ranch and started Plum Creek Manufacturing, a small company in Nebraska that produced self-cleaning screens for irrigation systems. He sold screens across the United States and even sold a few internationally. Ultimately, he sold Plum Creek Manufacturing in 1990, and our family moved to California.

The early 1990s was a period of increasing focus on fish protection screens because of the Endangered Species Act (ESA), state regulations, and the need to develop working screen systems for larger intakes. My father saw that the need for industrial screen applications at larger intakes could not be fulfilled with the technologies being used in irrigation. In 1996, he started ISI, with the sole purpose of designing a more industrial-grade screen system. From 1996 to 1999, we were based in Fresno. There was a group of projects that were diverting water out of shallow, brackish water with no power available, so my father developed the cone screen, which we still build for those conditions today. In 1999, we moved to Sacramento. For 10 years, we worked almost exclusively in Northern California, developing our screen systems and retrofitting existing ones. In 2006, we hired a couple of engineers and started taking on larger projects that involved designing screen systems to meet all the different site conditions you might encounter.

Today, we deliver screens across all industries that convey water: irrigation; municipal water; hydropower; thermal generation; and all types of industrial facilities, including an increasing number of desalination facilities. We've even built screens that are now installed at golf and ski resorts. We have completed more than 300 custom screen design projects, some of which include 10 or even 20 screens. We have projects around the globe, including throughout the United States and in Australia, Canada, New Zealand, Peru, and the UK. Fish protection requirements around the world are becoming increasingly stringent, and that's creating an opportunity for us to deliver screens in even more applications and to become better at what we do.

Hydro Leader: What differentiates ISI fish and debris protection screens from other screens on the market?

Russell Berry: Facilities usually have a bar grate or some kind of trash rack to keep large debris from going into the intake. Any kind of finer filtration is done on the pump discharge. With fish protection, there's a need to screen the water on the suction side, or inlet side, of the pump. There are regulatory criteria for the size of slot openings, which can go down to 1–2 millimeters (mm) and sometimes smaller, and for approach or through-screen velocity. We typically custom design our screens for the site conditions and these specific fish protection requirements.

The screens consist of wedge wire, which is triangle shaped and can be used to create a strong screen structure. We size the screens so that they have low approach and through-screen velocities. For cylindrical screens, we install a drive system—a submersible electric drive, a hydraulic drive, or a turbine drive—that rotates the screen against a fixed external brush. There's also an internal brush that cleans the inside of the screen to prevent algae and fouling organisms, such as barnacles or mussels, from adhering and growing. The internal brush also does a great job of keeping sand or small rocks from getting pinned in the wedge-wire screen openings. Because the cleaning system is so effective, the screens don't have to run all the time. They'll typically be passive or stationary for 6 or 12 hours. Then, the screen will go through a cleaning routine: it will rotate the cylinders slowly against the brushes—1 minute of forward revolution and 1 minute in reverse—and then shut off. The fact that the screens are not running all the time is a key reason why we can put screens out in a lake or river and expect them to operate for 10–15 years with little maintenance.

Hydro Leader: Where are ISI screens typically installed at a hydro facility, and how are they operated?

John Burnett: Roughly 90 percent of our screens are installed in the source water body at the entrance to the facility. We design the screen system to have low approach and through-screen velocities, and they typically have the small slot size that Russell mentioned. That allows us to essentially eliminate potential effects on fish: The small slot size prevents fish from being drawn through the screen and into the facility, and the low velocities prevent fish from being trapped against the screen surface. The screens also keep debris and fish in the source water body with no collection or conveyance, as occurs with other screen systems. These elements are key to reducing potential effects on fish and preventing incidental take under the ESA. The best proof of our ability to minimize potential effects on fish is the hundreds of installations of our technology in designated critical habitat for ESA-protected species, including anadromous salmon and sturgeon.

Some hydro facilities have off-channel diversions and a fish bypass. These facilities use the same elements in designing the screen system that I just mentioned, but have a fish bypass downstream of the screen so that fish can be

returned to the source water without being withdrawn into the turbine flow or impinging on the screens.

Our screens are operated using a control panel with a touchscreen human-machine interface. From that control panel, you can program the frequency and duration of screen cleaning to correspond to the conditions at a particular site. That control panel also receives information on the screens' operational conditions—for example, whether they are rotating—and can receive signals from other onsite instrumentation—for example, a water level sensor system can dictate a screen cleaning cycle. The same control system can also be configured to open or close a knife gate or raise or lower the screens, if those features are part of the system. We can also customize a system to allow for the remote monitoring and control of the screen system. Design of the controls is typically a key point of engagement among ISI, the engineer of record, and the facility owner, and the system is optimized for the end user.

Hydro Leader: You alluded to different screen shapes and drive types. Which screens are typically used for hydro facilities?

John Burnett: Cone screens and cylindrical screens are the two key shapes we use to build screens. We've built flat-panel screens as well, but have found that the conical and cylindrical shapes almost universally result in smaller total project footprints and lower total project costs. Cylindrical screens can be fitted with an internal and external brush cleaning system, which is also a key advantage of that screen shape. For our hydropower projects, we've consistently used cylinder screens in both T-screen and drum-screen configurations.

The drive type is selected based on site conditions. At a hydro facility, we would typically recommend an electric drive to rotate the screen cylinder between the internal and external brushes. We take the submersible motor and couple it to a high-reduction gearbox to build our drive assembly, because we want our screens to rotate twice per minute—a low-speed, high-torque screen rotation. We use the electric drive assembly because it's simple and robust. The motor inside the screen will typically be 1–2 horsepower, so operating the brush cleaning system consumes little power.

We'll use a hydraulic-type drive on screens that might be operating in the mud, on the bottom of the river, or in locations with high siltation. Hydraulics are low-speed, high-torque systems that have more of a tendency to slip. Hydraulic drives can be stalled out, reversed, and often overcome a buried condition, which can happen on some high-bed-load, flood-prone rivers.

Our turbine drive is for sites that do not have any power available. It is basically a propeller inside the inlet. When water flows through the screen, it spins the propeller, which is coupled to a high-reduction gearbox that rotates the

screen. We're using the energy of the water going through the screen to operate the cleaning system.

Hydro Leader: What is the largest installation you have at a hydro facility?

Russell Berry: Our largest screen system is an irrigation diversion that diverts 1,450 cubic feet per second (cfs). There's no reason why it couldn't be applied at a hydro facility. Our largest hydro facility screen install is at a 550 cfs Pacific Gas & Electric structure on the Stanislaus River in California. At a large hydro facility, you might expect to have more than one screen—maybe two, five, or more.

John Burnett: Keep in mind that there's a direct correlation between the flow rate and the size of the screen. For every cfs of screen flow, we typically have around 3 square feet of screen surface. For a 500 cfs intake, we'd have roughly 1,500 square feet or more of screen surface area. This is where the cylinder shape screens come into play and allow us to fit a lot of screen surface area in a small project footprint.

Hydro Leader: Do you have any interesting projects in the pipeline right now?

John Burnett: One interesting project we expect for next year is a deep-water pilot study in Europe in which we plan to deploy our electric drive screens in a lake at a depth of 60 meters, or about 200 feet, and evaluate their operational effectiveness and the water quality produced from a 0.5 mm slot opening. In terms of full-scale projects being built today, we are fabricating a large screen system with four T-screens and retrieval tracks that will be installed in the Hudson River. The screen system will have 0.75 mm slot openings and a 0.5-foot-per-second through-screen velocity. The screen system is being installed to protect river herring, sturgeon, and other species in the Hudson River. 



Russell Berry is the president of Intake Screens Incorporated.



John Burnett is the director of technical services at Intake Screens Incorporated.

For more information about ISI screens and projects, visit www.isi-screens.com.



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Kids in the Creek: A Hands-On Education in Water Resources Management



Students use models to measure the speed of the current.

Kids in the Creek is a north-central Washington State educational program supported by the U.S. Fish and Wildlife Service (USFWS). The program consists of a 3-day educational field experience at Entiat National Fish Hatchery that brings students from local high schools together to interact with local waterways; learn about the environment; and discover the ways in which the various interests on the river, including irrigation, navigation, transportation, wildlife and habitat management, and hydropower generation, must be balanced in water resources management. In this interview, Rachel Little, the information and education coordinator for Benton Conservation District in south-central Washington and

one of the original founders of Kids in the Creek; Amanda Newell, the education and outreach specialist at Cascadia Conservation District; and Julia Pinnix, the visitor services manager at the Leavenworth Fisheries Complex, tell us about the origins, development, and benefits of this important program.

Hydro Leader: Please tell us about your backgrounds and how you came to be in your current positions.

Rachel Little: I am the information and education coordinator for Benton Conservation District in south-central Washington. I am a fishery biologist by training, but I also pursued graduate studies in education. I love to talk to people about fish. Conservation districts are a form of local government agency that are found throughout the nation. The mission of a conservation district is to encourage wise stewardship of natural resources, including water, soil, air, plants, wildlife, and fish. I believe that wise stewardship of rivers includes both the use of hydropower as a clean, reliable, renewable generation source and fisheries management. New technologies, including improvements in turbine design and construction, have led to demonstrated improvements in both juvenile fish passage survival and generation efficiency at Ice Harbor Dam on the lower Snake River. My first professional role after graduating from the University of Washington was at Leavenworth National Fish Hatchery, Washington, where the Kids in the Creek program started.

Amanda Newell: I'm the education and outreach specialist at Cascadia Conservation District and have been there 11 years as of this fall. I have a bachelor's degree in communications from San Diego State University. Right after college, I worked in the travel industry for several years; this is my first real job in the conservation world. However, my mom managed a conservation district on the west side of Washington State for about 10 years while I was in high school and college, and I would work there on breaks, so I was exposed to the work of conservation districts at an early age. Having a biologist for a mother, I have always had a great love for the natural world.

Julia Pinnix: I arrived at Leavenworth in 2015 and started helping out with the Kids in the Creek program. My role was visitor services manager for the Leavenworth Fisheries Complex. The complex includes three fish hatcheries, which are located in Leavenworth, Entiat, and Winthrop, and the Mid-Columbia Fish and Wildlife Conservation Office, which is based in Leavenworth. My dad was a park ranger, and I was born when he was working at Mount

Rainier National Park. I lived across the country in different national parks before he switched to being a congressional aide. He helped to do things like put together the legislation for the Alpine Lakes Wilderness Area next to Leavenworth. I have a degree in environmental education from the Huxley College of Environmental Studies in Bellingham, Washington. I've worked for the National Park Service, the USFWS, the U.S. Forest Service (USFS), and private companies and nonprofits for more than 30 years.

Hydro Leader: How did the program originate?

Rachel Little: I'm proud to have been there in the beginning. I was a young fishery biologist at the USFWS when the Adopt-A-Stream Foundation approached us about doing an adopt-a-stream volunteer training at the Leavenworth Hatchery in 1991. The Adopt-A-Stream Foundation is a nonprofit group that recruits and trains citizen volunteers to monitor waterways, protect water quality, and develop riparian projects. When the foundation came to Leavenworth to develop this training, it already had a training template that included components such as how to do a fish survey; how to take water quality samples; and how to collect, sample, and identify aquatic insects and use them as indicators of water quality. I was glad to help with that volunteer effort, and it was a success with adults, but it struck me that it would work for students, too. That idea was the seed for the Kids in the Creek program.

I reached out to partner agencies, including the USFWS; the USFS; and the Chelan County Conservation District, which became the Cascadia Conservation District in 2007, and we developed a team so that these different modules could be taught by area experts. I taught the fish habitat section, a USFS hydrologist demonstrated how to take stream measurements, and some soil scientists from the Chelan County Conservation District and the Natural Resources Conservation Service took part as well. We decided to hold this field event at the hatchery. The hatchery at Leavenworth has 160 acres to protect its water rights, and there was a bypass channel that had water control at the head and lower ends so that flow could be controlled to keep the students safe. Being a hatchery, we also had lots of chest waders for students to wear. Just pulling on chest waders for the first time was a learning experience for some students. We wrote a curriculum to accompany the field event to make sure it was a really strong learning experience. The curriculum drew upon each of the field segments of fish habitat, stream and flow measurements, and soil types and asked students to use that data to inform the recommendations they made in response to a hypothetical question about land use at the site. This culminating land use simulation for students is a simplified model of what hydropower developers have to do: collect field data and design a defensible project that meets various social and environmental needs.



Judy Neibauer, a USFWS biologist for the Ecological Services Office in Wenatchee, is a long-time instructor for Kids in the Creek. Here, she helps students collect macroinvertebrates from the river.

Hydro Leader: How has the program evolved from those beginnings?

Julia Pinnix: I observed the program in 2015 and started getting involved in 2016. There were a couple of things that I saw that differed from how the program had been run in the past. The biggest change we've seen is that the school day in our area has been reduced by about an hour and a half. The amount of time we had to spend with kids was reduced to the point at which we felt like there were elements of the program that weren't functioning anymore. That was really frustrating.

The other thing is that spring meltwater runoff has been happening earlier and earlier. We were reduced to having kids in the mud instead of kids in the creek because it wasn't safe to get anywhere near the river. Springtime was becoming really problematic. In response, a few years ago, we moved the program from the spring to the fall.

While the weather in the fall season can be trickier, there weren't any dangerous high-water levels like those we were consistently seeing in the spring.

The other change we made was with a summative activity called Watershed Wonders, in which the kids take all the work they have done in the field and think about it. That's a really important part of the program, but we didn't have enough time to do it during the shorter school day. We had been trying to smash it into 20 minutes, and it just wasn't working. Instead, we decided to dedicate the entire day to field activities and then go into the classrooms afterward, sometimes up to 2 months later, and do the summative activity then. We've been impressed by how well kids retain the information they have learned in the field.



Students examine the pebble-studded case of a caddisfly.

Amanda Newell: Some of the partners have stayed the same from the time when Rachel was here, and we have some new ones as well. When I came on in 2011, the core team planning the event included one member each from Cascadia Conservation District, USFWS's Leavenworth National Fish Hatchery, and the USFS. In 2011, the team was in the end stages of creating a standalone website for the program. They also created a round of training videos for each of the stations. We've been able to use those videos and all the great resources on the website since then. In 2020, we produced some virtual materials and videos, since we weren't able to host the in-person event.

Julia Pinnix: Of course, one of the big challenges we faced during the COVID-19 pandemic was that we couldn't do in-field biology. However, there was still a lot of interest from many of our teachers, who wanted to make the program available to their students in some form. We had the idea of creating videos and putting them on the website, but the teachers wanted materials as soon as possible. We thought about what we could put online quickly that would still be meaningful. We didn't want to record a lecture,

because that's not a good educational experience. We wanted it to still be as hands-on as we could make it.

One of the programs we found the easiest to adapt was the one on macroinvertebrates. Identifying the aquatic macroinvertebrates—insects and other organisms—that you can see without a microscope gives you a measure of water quality. It can help you figure out the health of your stream without having to do chemical tests. Our idea was to get some video footage of a number of these different organisms and then have kids use online keys to figure out which organisms they were looking at and what the health of the stream might be. We were able to put that video together with a significant effort. I had to learn how to make videos, for starters. I went out to Entiat National Fish Hatchery and took a lot of footage, using a little magnifying device that clips onto my cell phone. We got good reviews from the teachers, so we know that the product works. Now it can just be used by anyone anywhere, and we've got plans to make more videos.

Amanda Newell: We also created virtual versions of the macroinvertebrate station, habitat station, and riparian station. I've been contacted by people from other parts of our state, neighboring states, and even New Zealand, asking if they can use our online materials. Of course, that's what they're there for. We love that the hard work that went into making these high-quality educational videos is benefiting people in different areas.

Usually, 30–35 resource professionals from over a dozen local agencies and groups help us throughout our 3-day event, so it is a huge partnership effort. Career-connected learning is an important part of the program as well. The kids get to interact with actual resource professionals and use the tools and techniques that they would use in their daily work. That gives students an idea of the types of careers that are out there in conservation and natural resources. About 10 different schools usually participate in the program, including a mix of traditional and alternative high schools. Around 250 students total are involved every year. Students come from Chelan, Douglas, and Okanogan counties.

Hydro Leader: What kind of knowledge base do the student participants come into this program with, and what kind of results do you see?

Julia Pinnix: Some teachers, such as Joyce Block at Wenatchee High School, prepare their students thoroughly. They go over the material in advance of the program. Other students haven't looked at any of this before. It can vary tremendously.

Amanda Newell: We also have pre- and postwork opportunities for teachers on our website.

Rachel Little: The program provides a lot of great field technique information. It's exciting for students who may live in town and may never have waded into a creek before. That

can be an influential experience. It's great for secondary school students to meet natural resource experts in the field. It gives them an element of career education. While we don't expect every student who takes part in this program to become a fish biologist or a stream hydrologist, they will all be natural resource consumers. They all will be using water, electricity, and oil and affecting plants and wildlife. Even if this Kids in the Creek experience doesn't affect their career trajectories, I hope that it helps inform them about how natural resource agencies work and how we base policy on science and that it affects how they choose to live their lives and cast their votes. It's important for students to see the connection between field science data collection and natural resource policy.



Experiments with fish in tanks give students a chance to build and test hypotheses and explore habitat elements that are good (and bad) for fish.

Amanda Newell: It's a great way to expose students who might not spend much time in the natural world or who wouldn't explore a creek with their families. There are always kids who don't want to put on waders or touch the bugs at the beginning of the day. But by the end of the day, they're sometimes the most engaged students. It's rewarding to see that.

Julia Pinnix: A few years ago, we started a great work experience program in which students, in addition to their regular high school classes, also do conservation work. Kids in the Creek lasts for 3 days, and this group of students spent the first day doing all the activities that the regular students did. Over the next 2 days, they assisted at the different stations and helped teach other students what they had just learned the day before. They got a lot out of that program. These are not students who would typically be in honors biology or anything like that, but the experience changed how they viewed the importance of natural resources and the meaning of what they learned.

Hydro Leader: How does Kids in the Creek tie in with the hydropower world?

Rachel Little: The Kids in the Creek program helps students understand the process of collecting and analyzing field data and the importance of using field data to inform natural resource management. There are different stations within Kids in the Creek that have different focuses. I see that as being parallel to modern river management. You've got different silos of particular interest, including irrigation, navigation and barge transport, power generation, and salmon recovery with tribal and sport fisheries. In modern river management, we need to think about all those needs, similar to how students in the program have to assimilate the field data they collect at each station into the culminating activity and make recommendations on how best to manage the creek. Sometimes those river uses seem to be competing, but we're hoping to broaden the students' viewpoints by emphasizing that you have to take multiple factors into account to come up with a sustainable program that preserves the natural resources but also makes them usable by people.

Julia Pinnix: One of the things that has struck me while doing the summative activity for the Watershed Wonders program is what an eye opener it is for students to learn about water rights. They don't know how water rights in the state work, and it's an opportunity for us to teach them. It's important for them to gain an understanding not only of the biological importance and value of the streams and rivers and lakes that we have, but also of how the law around them works.

Amanda Newell: In the Watershed Wonders activity, the kids use the knowledge gained from their field experience at Kids in the Creek to work through a land development proposal in a small group and then present their design to mock commissioners. The exercise gets students thinking about elements to be considered for land development and perspectives of different stakeholders that they wouldn't learn elsewhere. ^H



Rachel Little is the information and education coordinator for Benton Conservation District. She can be contacted at rachel-little@conservewa.net or (509) 736-6000.



Amanda Newell is the education and outreach specialist at Cascadia Conservation District. She can be contacted at amandan@cascadiacd.org or (509) 436-1601.



Julia Pinnix is the visitor services manager at Leavenworth Fisheries Complex. She can be contacted at julia_pinnix@fws.gov or (509) 393-6507.

For more about Kids in the Creek, visit www.kidsinthecreek.com.



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- + Manage project files to ensure they are organized and provide current information.
- + Design project to minimize manufacturing/shipping costs.
- + Review and assess vendor proposals.
- + Coordinate manufacturing and delivery with shop personnel and customer/engineer.
- + Monitor production & customer schedules. Modify schedules or plans as required.

REQUIREMENTS:

College degree in civil engineering, mechanical engineering, or construction management.
Minimum of three years' work related experience in project management or equivalent combination of education and experience.

For more information: contact Nick Hidalgo, talent acquisition, at nhidalgo@nwpipe.com, or go to www.nwpipe.com/careers.

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PROJECT MANAGER

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Salary: Based on qualifications

RESPONSIBILITIES:

- + Design, development, and delivery of effective water transmission applications.
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- + Review and assess vendor proposals.
- + Manage multiple, parallel projects using formal project planning techniques.
- + Manage application design through the various life cycle stages from business needs through design and delivery.

REQUIREMENTS:

- + Demonstrated ability to manage multiple, parallel projects.
- + Must have excellent computer skills including MS Word, Excel, CADs, and other project management programs.
- + Excellent oral and written communication, advanced mathematics, and analytical and problem solving skills.

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Location: Adelanto, CA; Tracy, CA; and Portland, OR (Travel 30%)

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Salary: Based on qualifications

RESPONSIBILITIES:

- + Directs and coordinates activities concerned with manufacturing of Company products by performing the essential job functions personally or through their subordinates.

REQUIREMENTS:

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LABOR COATING TECHNICIAN

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For more information: For Atlanta position, contact Cherry L. Martinez, senior recruiter, at (407) 287-8790 or cmartinez@garney.com; For Denver position, contact Ariana Craft, recruiter, at (407) 287-8808 or abeehler@garney.com.



PROJECT ENGINEER

Location: Denver, CO

Deadline: Open until filled

Salary: TBD based on qualifications

RESPONSIBILITIES:

- + Negotiate and purchase materials
- + Create submittals, RFIs, and change orders
- + Coordinate projects from start to finish: Assist with estimating; Project setup & closeout; Support field operations; Maintain detailed job costs
- + Work professionally with owners and engineers
- + Assist in scheduling projects and crews
- + Be willing to fill in on crew when needed

REQUIREMENTS:

- + Degree in civil engineering, construction management or other related field
- + 0-3 years' experience
- + Must be willing to travel 1-4 weeks at a time to support projects

For more information: contact Josh



PROJECT DEVELOPMENT MANAGER

Location: Remote

Deadline: Until Filled

Salary: Based on qualifications

RESPONSIBILITIES:

- + Execute market, resource, analytical, strategic, transmission and policy assessments for project development.
- + Quantify risk and rewards to prioritize commercial activity and drive development and sales.
- + Proactively manage customer and partner deliverables to

ensure excellence and consistency.

- + Analyze and evaluate data, creating innovative advanced analytics and data visualizations.
- + Communicate value proposition and financial performance to drive site agreements, unit sales, and PPAs.
- + Develop project portfolio through site identification, permitting, and negotiating transactional documents.
- + Work closely with engineering and technical sales team to prepare project proposals in a timely manner.

REQUIREMENTS:

- + BBA/BA/BS in business, finance, accounting, or engineering or equivalent experience.
- + Experience in renewable energy project development, market analysis, transmission interconnection, land acquisition, permitting and system organization & implementation.
- + Intermediate proficiency with Excel and PowerPoint for financial modeling and presentations.
- + Excellent written, analytical, and organizational skills, including the proven ability to manage multiple projects.
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RENEWABLE ENERGY ANALYST

Location: Atlanta, GA

Deadline: Until Filled

Salary: Based on qualifications

RESPONSIBILITIES:

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- + Translate business problems into advanced analytics and research projects
- + Own detailed financial modeling and market research for economic determinations such as cost of energy, breakeven, and project IR
- + Analyze and evaluate data, creating innovative advanced analytics and data visualizations
- + Conduct periodic customer engagements to communicate value proposition, product fit, and financial performance

REQUIREMENTS:

- + BBA/BA/BS in business, finance, accounting, or engineering
- + Involvement in developing creative research and analysis program
- + Intermediate proficiency with Excel and PowerPoint for financial modeling and presentations
- + Excellent written, analytical, and organizational skills, including the proven ability to manage multiple projects
- + Experience in energy, particularly renewable energy, is preferred
- + Ability to travel up 25%

For more information: go to <https://emrgy.com/careers/> or send cover letter and resume to HR@emergy.com

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Upcoming Events

- October 3–6** Edison Electric Institute, Transmission, Distribution, Metering, and Mutual Assistance, Phoenix, AZ
- October 5–7** U.S. Society on Dams, 2021 Fall Workshop Series, Denver, CO
- October 6–7** Northwest Hydroelectric Association, Fall Regional Workshop, Tacoma, WA
- October 6–7** Oregon Water Resources Congress, 2021 Golf Tournament and Water Law Seminar, Sisters, OR
- October 12** Utah Water Users Association, Utah Water Summit, Provo, UT
- October 12–13** Nevada Water Resources Association, Minerals and Mine Water Management Symposium, Sparks, NV
- October 17–20** American Public Power Association, Legal and Regulatory Conference, virtual
- October 20** Texas Water Conservation Association, Fall Conference, San Antonio, TX
- October 20–22** National Hydropower Association, Clean Currents Trade Show and Conference 2021, Atlanta, GA
- October 21** U.S. Society on Dams, Filter and Drain Design and Construction Details, virtual
- October 27** Northwest Hydroelectric Association and National Hydropower Association, Northwest Regional Workshop, virtual
- October 29** Agribusiness & Water Council of Arizona, H2Open Golf Tournament, Casa Grande, AZ
- November 7–9** Edison Electric Institute, Financial Conference, Hollywood, FL
- November 8–10** National Water Resources Association, 90th Annual Conference, Phoenix, AZ
- November 17–18** Kansas Governor's Water Conference, Manhattan, KS
- November 18** U.S. Society on Dams, Reservoir Sedimentation and Sustainable Management, virtual
- November 30–December 3** Association of California Water Agencies, Fall Conference and Exhibition, Pasadena, CA
- December 1–3** U.S. Energy Storage Association, Conference and Expo, Phoenix, AZ
- December 6–8** U.S. Society on Dams, Specialty Geotechnical Workshop for Dam and Levee Investigations and Modifications, Fort Lauderdale, FL
- December 7–10** North Dakota Water Users Association, 58th Annual Joint North Dakota and Upper Missouri Water Convention and Irrigation Workshop, Bismarck, ND
- December 8–9** National Hydropower Association, 2021 California Regional Meeting, San Diego, CA
- December 14–16** Colorado River Water Users Association, Annual Conference, Las Vegas, NV

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