INLINE MICRO-HYDRO: PORTLAND WATER BUREAU

Portland, Oregon

Left: Above-ground electrical invertors, drives and control equipment for inline micro-hydro

Right: Below-ground components of micro-hydro facility

PROJECT DESCRIPTION

The Portland Water Bureau (PWB) is a retail and wholesale drinking water utility that serves just under 1 million customers in Portland, Oregon. PWB investigated the potential for on-site renewable energy generation in the late 2000s in response to the City of Portland's energy reduction goals and City Commissioner interest in energy conservation and renewable energy. The utility had been tracking its carbon emissions since 2007 and identified electricity as the largest single source (~75%) of annual operational emissions. Opportunities to mitigate electricity emissions were therefore important to PWB.

Inline hydropower was of interest because Portland's gravity-fed water system has a high flow rate, so installing turbines to capture this head pressure was feasible. PWB evaluated numerous sites with existing vaults and pressure reducing valves that would be necessary for a micro-hydro generator. PWB selected a facility at near a local park as the best facility because of power line access that would enable electricity to be generated on-site and any excess to be net-metered (i.e. sold back) into the grid. At this site, in-town reservoirs create pressure as water is distributed downstream through the water system.

Additionally, the chosen facility had a 16-inch pressure-reducing valve, large pipes, and a large vault in the ground, which made it a good candidate for a micro-hydro turbine. Given these factors, PWB initiated a basis-of-design report for the facility in the late 2000s, with design taking place in 2010. The micro-hydro generator came online in August 2012. The project was designed at 25 kW generating capacity. On an annual basis it generates between 120,000 to 170,000 kWh.

MAKING THE PROJECT HAPPEN

PWB's micro-hydro project was motivated by several factors. In the late 2000s PWB developed an internal Energy Committee to look for energy conservation, efficiency and renewable energy opportunities within the water system in response to the City of Portland's climate and energy policies and interest from elected officials. The utility's Chief Engineer was influential in advocating for the project, and PWB had a Project Manager (PM) who was invested in the project and wanted to see it happen. The PM was engaged during planning, design and construction oversight, which helped streamline the project. These factors enabled organizational buy-in.

WUCA
Water Utility Climate Alliance

INLINE MICRO-HYDRO PROJECT

Portland Water Bureau

IMPLEMENTATION

Several internal and external stakeholders were involved in project implementation. The PM from the Engineering Group worked on the project throughout. Operations staff were involved in project instrumentation conversations. An external vendor developed a project design concept and proposed and installed a specific instrumentation package unit. PWB also hired an electrical contractor to install the electrical equipment. The City of Portland's Energy Coordinator acted as a liaison for the project to help PWB identify energy incentives and funding sources. PWB entered into complex negotiations with Pacific Power to develop the project PPA. PWB also coordinated with the local Neighborhood Association about closing local park and children's playground access during project installation which presented a few challenges in terms of stakeholder buy-in. PWB Maintenance and Construction crews installed the onsite vault and package unit. Permitting was not an issue because PWB owned the land at the site.

FINANCES

The total cost of the micro-hydro project was $418,000. To help cover these costs, the project received $165,000 in incentives. Incentives included $55,000 from the 2009 American Recovery and Reinvestment Act for shovel ready stimulus projects, $65,000 from the Energy Trust of Oregon, and $35,000 from Oregon's Business Environmental Tax Credit (BETC) which was created to incentivize energy efficiency and renewable energy projects. Because PWB does not pay taxes, the utility had to find a third party to buy the BETC, which added an extra layer of complexity to this financial incentive. The project has a 20-year Power Purchase Agreement (PPA) with the electric utility Pacific Power where the price per kWh depends on the year of the project life, increasing from $.06/kWh to just over $.08/kWh. PWB currently owns and operates the micro-hydro facility and sells the excess generated power back to the grid under the finances outlined in the PPA.

The final cost of project after incentives was $253,000. This amount was funded by PWB's Capital Improvement Program, which is financed through bond sales.

INLINE MICRO-HYDRO PROJECT

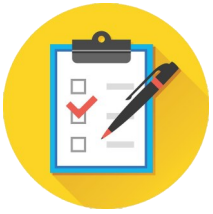
Portland Water Bureau

CHALLENGES

There were a few barriers to this project. One of the biggest challenges was that PWB had to convert power on site from 480 to 277 volts to feed into the electric grid. PWB had to install invertors to make the conversion, increasing project complexity and initial cost. The electric utility was also concerned about the small project size, and PWB had to negotiate a PPA for the wholesale power buyback. There is no guarantee the utility will renew the 20-year PPA. There was also internal dialogue about the feasibility of the project due to the specific package unit of turbines and equipment. Operations staff were not familiar with this equipment, instrumentation, and programming; and the unique design has made it difficult to find replacement parts. The unit began experiencing some failures in year 9 of the project, including issues with the vault lid design which allowed rainwater to drip on the equipment. There have been some other unexpected failures of the components. PWB will replace and repair the vault lid as needed.

If PWB installs future micro-hydro facilities it will evaluate and consider newer designs from near-by peer utilities that use standard generators and equipment with inline hydro turbines that are easier to maintain.

ADVICE AND LESSONS LEARNED



One of the most important lessons PWB learned was that it is important to evaluate your site and know your parameters up front before you jump in (for example, having to install invertors to connect the project to the electric grid was complicated). PWB identified that it would have been much easier to set up the inline micro-hydro unit to only offset power needs onsite at the local park instead of also setting up the system to net meter and sell excess power to the grid. This would have avoided the need to install invertors and negotiate a complicated PPA. PWB also recommends carefully considering whether the project equipment will be easy to operate and maintain and that spare parts will be available in the future.

LEARN MORE

For more information about PWB and this project, contact:

Bryan Robinson, P.E.
Bryan.Robinson@portlandoregon.gov

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET