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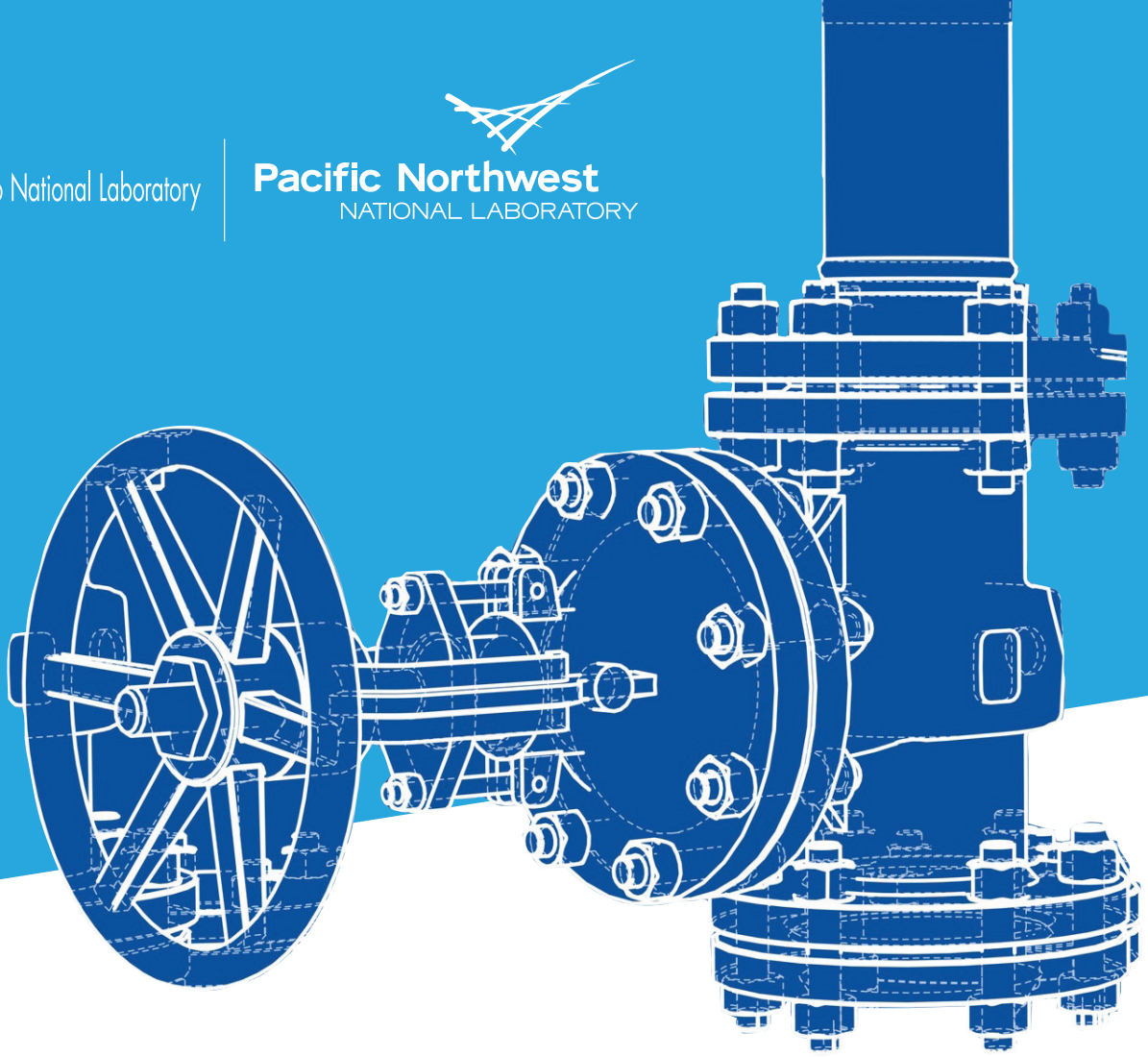


Hydropower Production within Water Supply and Treatment Systems

If your piped water system has significant surplus pressure, you may have the opportunity to integrate conduit hydropower.

Conduit hydropower uses existing water conveyances to generate power. Adding conduit hydropower may be a cost-effective option for on-site renewable energy generation, reducing electricity costs or adding a new revenue stream, with the potential to provide protection to your system from grid outages.

THIS GUIDE WILL HELP YOU UNDERSTAND:

- **How it works** – System overview and common equipment for water conveyance hydropower
- **Whether your site is suitable** – See the flow chart to determine whether your site merits further review
- **What success can look like** – A case study with the East Bay Municipal Utility District in California

HOW IT WORKS

Public water supply and treatment systems often use pressure reduction valves (PRVs) to maintain appropriate system pressures. Hydropower turbines can provide the same pressure reduction in a water system, converting the surplus pressure into electricity for onsite use or sale to a utility. If your water system uses pressure reduction valves (PRVs), you may want to investigate those sites for hydropower potential.

TYPICAL SYSTEM COMPONENTS

The design of water supply hydropower systems can differ, but adding hydropower requires common features.

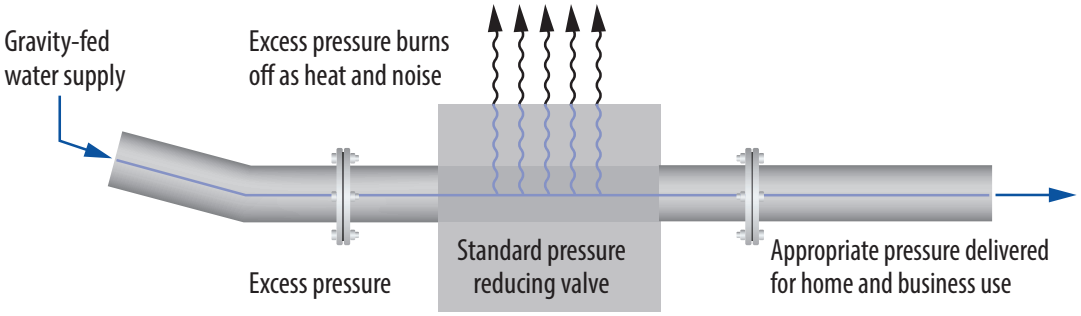
Hydropower Turbines

Depending on the pressure (also known as head) and flow conditions at a site, either a conventional hydropower turbine (*Pelton, Francis, Kaplan, etc.*) or a pump-as-turbine (PAT) can be installed in parallel with an existing PRV to generate electricity while maintaining system pressures. Conventional turbines can operate at broad head and flow ranges while a PAT may be a more cost effective choice for sites with relatively consistent head and flow conditions.

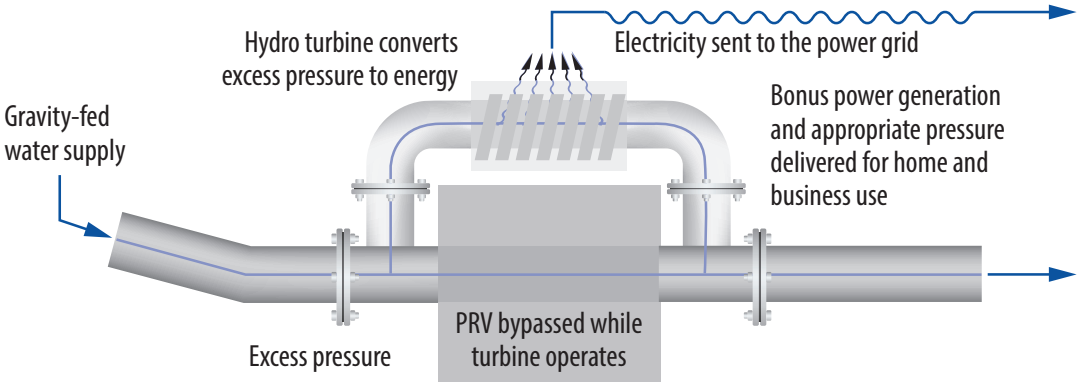
Turbine Control Equipment

Programmable Logic Controllers (PLCs) and turbine control valves are common components used to ensure a hydropower system operates safely while maintaining the water system's delivery integrity. Similar to pumps and other water system controls, hydropower controls can manage valves, safety shutdowns, and other processes that require close monitoring or automation. Turbine control valves are often installed for flow and pressure regulation, as well as for safety, maintenance, and shut-off requirements.

Standard Pressure Reduction



Energy Recovery and Pressure Reduction Solution



Hydropower equipment has been successfully integrated into many water systems, using FOOD SAFE EQUIPMENT (NSF-61) and maintaining the ability to DELIVER WATER 24/7.

SITE SUITABILITY

Is more than ~18' of head / ~8 psi of surplus pressure available?

NO → Hydropower may not be financially feasible at less than 8 psi

YES

Is there space for new piping, valving, turbine, and control equipment at the site?

NO → Building a bigger structure or vault may challenge a project's financial feasibility. **Proceed with caution**

YES

Does this site have existing energy use with three phase power available or is the site less than a quarter mile from the nearest three-phase utility pole?

NO → Connecting to power more than a quarter mile away may challenge a project's financial viability. Work with your engineer to investigate cost considerations.

YES

Does the site have relatively consistent head (pressure) and flow conditions?

NO → The site may be a good fit for a conventional hydropower turbine. Work with your engineer to investigate feasibility.

YES

The site may be a good fit for a pump operating as a turbine (PAT). Work with your engineer to investigate feasibility.

POWER POTENTIAL

Existing conduit hydropower projects in the United States produce 530 MW of power. Even more potential is available.

Oak Ridge National Laboratory has estimated that there is as much as 1.41 GW of new, untapped conduit hydropower capacity (Kao et al., 2022, Figure 2). The largest opportunity is in the agricultural sector (662 MW), followed by the industrial sector (378 MW), and the municipal sector at (374 MW). This resource potential presents a significant opportunity to expand clean and renewable energy throughout the country.

Pressurized water supply systems represent 90% of the total potential for municipal conduit hydropower, in contrast to wastewater systems which, largely being unpressurized, account for just 10%. The Western states hold the greatest potential for conduit hydropower resources, with California leading at 243 MW. Colorado follows with 204 MW, Washington with 119 MW, Nebraska with 99 MW and Oregon with 77 MW.

CASE STUDY – EAST BAY MUNICIPAL UTILITY DISTRICT

In 2023, the East Bay Municipal Utility District (EBMUD) installed a conduit hydropower facility to take advantage of the difference in pressure between pressure zones in their water distribution system. EBMUD is California's second-largest water retail utility, with 1.4 million customers in Alameda and Contra Costa counties.

EBMUD executed an agreement for InPipe Energy's HydroXS patented energy recovery system to reduce operational costs. Generating renewable energy and functioning like a traditional Pressure Reducing Valve (PRV), the HydroXS controls downstream pressure in EBMUD's Piedmont Pressure Zone and converts pressure into clean energy. The HydroXS unit is installed in a bypass, parallel with the utility's existing Piedmont Regulator for continuous service when maintenance is performed.

The HydroXS site operates with average flows of approximately 2.5 cubic feet per second and an average pressure differential of approximately 55 psi. The system has a nameplate capacity of 30 kW and is expected to generate 150,000 kWh annually, supporting the utility's goal to reach carbon neutrality by 2030.

InPipe Energy owns, operates, and maintains the HydroXS system for EBMUD. The HydroXS has its own power panel which ensures safe net metering of electricity on site or to the electric grid similarly to a PV system. The HydroXS meets NSF 61 standards and the standards established by the electric utility industry for safe interconnection to the electric grid. Carbon free electricity generated from the HydroXS is used to offset electricity costs in EBMUD's distribution system.

"EBMUD is always looking for innovative opportunities to meet our goal to become a carbon-neutral enterprise and contribute to fighting climate change," said EBMUD Board Member Marguerite Young. "This project generates clean energy while accomplishing our mission of providing clean, safe water to our customers. I'm looking forward to seeing more projects like this in our service area and around the country."

HydroXS system installed at one of the East Bay Municipal Utility District's pumping stations. (Photo Credit: InPipe Energy)

DID YOU KNOW?

Oak Ridge National Laboratory reported that, as of October 2022, 358 CONDUIT PROJECTS received a FERC exemption. Out of these, 56% (203) of them are located on municipal conduits (Kao et al., 2022).

HYDROPOWER BENEFITS

- Renewable source of energy
- Affordable
- New revenue streams
- Improved energy reliability
- Opportunities to mitigate outages
- Lower carbon footprint

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WATER + POWER RESILIENCE

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