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LucidEnergy

Case Study

Regenerative drive power goes underground

Unique below-ground system at Portland Water Bureau utilizes Lucid Energy power generation, Siemens motors and regenerative drives with natural water flow to create energy; will produce 1.1MW of electricity per year, enough to power 150 homes.

Recently, the use of regenerative energy has ramped up quickly in American industry due largely to the advancements in drives technology. Through various mechanical components coupled with regenerative drives, energy can be captured or created and used in three ways. Namely, it can be battery-stored for subsequent use, redirected immediately to other electrical power requirements or fed back to the power company in a contract arrangement, all done without loss of host system performance, mechanical component integrity or safety issues.



Siemens motors are powered by the turbulent flow of the water through the municipal water line. The energy is captured and transmitted to the PGE grid for powering the local community.

usa.siemens.com/lv-drives

Typically, regenerative power is produced by, for example, a motor turning during braking or stopping. What if the motor turned as the result of something other than an electrical power supply?

At the City of Portland (Oregon) Water Bureau, they partnered with a local firm, Lucid Energy, who provided a very unique method of power generation. The renewable energy and smart water management solution used is the supplier's patented LucidPipe™ Power System, which enables industrial, municipal and agricultural water facilities to generate clean, reliable and low-cost energy from gravity-fed water pipeline and stream flow.



The installation of the system at SW 147th Avenue and Powell in Portland, Oregon.

For a recent installation under the road at SW 147th Avenue and Powell Boulevard in Portland, Lucid Energy provided their system, which comprises four 42" lift-based turbines spun by the gravity-fed water flow inside the Portland Water Bureau pipeline. These turbines turn four Siemens torque motors as 50kW generators for a 200kW nameplate capacity project. The electricity generated by this system is captured and fed to the Portland General Electric (PGE) grid by four Siemens regenerative drives. In a 20-year power purchase agreement, this project will generate approximately \$2 million in renewable energy capacity, to be used for development, installation and operational maintenance costs.

The project investor, Harbourton Alternative Energy, will share the revenue with the City of Portland and Portland Water Bureau to reduce the cost of water operations. Upon completion of the agreement, Portland Water Bureau has the right to purchase the system and the power produced. Since the pipeline is expected to have a lifespan of over 50 years, this project represents a mutually beneficial arrangement for the investor and the city alike.

Known as the Conduit 3 Hydroelectric Project, this system represents the first venture in the U.S. to secure a 20-year Power Purchase Agreement for renewable energy produced by in-pipe hydropower in a municipal water pipeline.

"For the execution of this project, we reached out to Siemens, in tandem with their solution partner in our area, Applied Motion Systems, who wrote the software for the regenerative operational protocols, connecting the hardware to the grid," according to Lucid Energy's director of operations, Susan Priddy. In addition to the drives and motors on this project, Siemens also provided the motion controller, transformers, circuit breakers and all power supplies. The master control cabinet is installed underground, in close proximity to the pipeline and the four LucidPipe turbines (shown in photo).



The LucidPipe™ Power System uses a unique lift-based, vertical axis spherical turbine technology to smoothly transfer the kinetic energy of the water flow to rotate the motor shaft without impeding the water flow to any great degree.

Functionally, the water being fed from reservoirs flows downhill to turn the torque motors into generators, which supply power back onto the Siemens Sinamics S120 drive system, which in turn feeds it to the electrical grid of PGE. The electricity is generated by the water flow with no other power source. The pipeline performance is unaffected and there is no environmental impact. The Lucid Energy system has been tested and certified by NSF International to meet the NSF/ANSI Standard 61 for potable water systems. The LucidPipe system extracts very little head pressure, typically 1-5 PSI, so the turbine units can be installed in sequence without disruption of the water flow. The system does not require installation in a pressure-transient zone or where extreme differential pressures are required.

Lucid Energy developed its patented lift-based, vertical axis spherical turbine technology (shown in photo) at the end of the generator's flange to maximize the use of the water's gravitational flow to put work back onto the motor. Units can be installed in 24"-96" diameter pipes. For this project, Lucid Energy was able to use standard motor and drive components that would typically require external power supply to control the motion of a machine, as part of its LucidPipe™ power generation system.

Aesthetically, as a collateral benefit, the entire system detailed here is located underground.

The system was final tested in February 2015 and is producing power to full expectations today. Based on subsequent performance metrics analysis, Portland Water Bureau is considering additional installations of the LucidPipe system.

How regenerative drives work

Power regeneration is the process of recovering kinetic energy created by a motor turning during stopping or braking or, as in the situation described in this story, by the natural gravitational motion of water flow, and converting that energy to electricity, then feeding it back onto the grid.

Siemens regenerative active infeed drives, as demonstrated in this story, efficiently return the energy created back into the supply system, rather than losing the energy in the form of heat or inertial load losses. The regenerative operation is combined with power quality management, improving the overall operational system efficiency. By virtually eliminating harmonics and optionally providing power factor control to compensate for poor power factor from other loads, active infeed drives provide more stable operation on the load in weak supply systems with voltage and frequency fluctuations and can actually help stabilize the supply system. Motor performance is also improved significantly with active infeed (also called active front end) regenerative drives technology.

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Video of Lucid system in action...

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