RECLAMATION Managing Water in the West

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The Knowledge Stream
Research Update

Hydrokinetic Demonstration Results to Date and Path Forward

Can hydrokinetic projects work in canals while still maintaining efficient water and power deliveries?

Bottom Line

Develop and calibrate a model (HEC-RAS) to determine if a HK project could work in a particular canal while maintaining efficient water and power deliveries. This tool will use canal geometry and operating information to predict impacts on water delivery systems and associated powerplants from HK turbines.

Better, Faster, Cheaper

This model will be a useful tool for both private developers and water system owners to help determine if and where an HK device could be deployed without impacting existing water or power operations, before any installations are made.

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Problem

Unlike traditional hydropower or low-head hydropower, hydrokinetic (HK) devices do not require a reservoir or head drop to operate. HK devices use flowing water to turn the turbine rotor and produce energy. In general, Reclamation's canals were designed so that water flows slowly and efficiently to deliver water with the least amount of wasted energy possible. Thus, adding a new component such as an HK device could impact canal hydraulics. Moreover, powerplants or other existing hydraulic structures and facilities in the system could be affected, lowering their efficiency. Therefore, these HK devices should only be installed in systems and at strategic locations where they can operate without causing negative impacts to existing canal operations. Careful consideration should be given to determine if and where this could be possible.

Since 2011, Reclamation has received requests from private HK developers to install their technology in Reclamation canal systems for demonstration testing. This is a relatively new field and, while many new technologies are being developed, their impact on the performance of the overall system is still largely unexplored.

Solution and Application

As the impacts of this technology on existing systems are unknown, Reclamation partnered with a private developer to install an HK device and to determine the hydraulic effects of these devices on existing water delivery and hydropower operations.

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The HK device is attached to a spanning structure that is secured to both sides of the Roza Canal on concrete foundations. The spans prevent contact with the existing canal structure to preserve the physical integrity of the canal lining, as well as ongoing operations. Visitors to the site (left to right): Jane Shaw, Canadian Consulate Seattle; Shannon Halliday, IES; Sid Ottem, Reclamation; Brett Hawse, IES; Ken Miller, IES; Phil Georgariou, BAE Systems; Ali Grovue, IES; Jim Hawse, IES; Shane Grovue, IES; and Congressman Doc Hastings.

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In August 2013, Instream Energy Systems Corporation (IES) deployed their newly designed 25 kilowatt (kW) BAE Systems rotor and generation system in the Roza Main Canal near Yakima, Washington, about 5 miles upstream from the existing Roza Powerplant.

This Reclamation Science and Technology Program research project will use the data from this installation to develop a computer modeling tool to predict the devices' impacts on canal systems. Water surface elevations and canal velocities were measured, which if changed, could alter the canal operations (e.g., raising the canal's water levels or impeding the waterflow). Physical data from this installation is currently being used to calibrate the numerical model under a range of canal and HK turbine operating conditions. By using this model, private developers and water system owners can evaluate if an HK device could be deployed without impacting existing water delivery operations.

To ascertain the effects of the HK device on existing hydropower operations, a performance test on the downstream Roza Powerplant was also conducted. As the device did not impact hydropower performance at the Roza Powerplant, it was determined that there was no need for further testing for existing hydropower impacts at the powerplant. However, as each hydropower plant has varying circumstances and factors that need site-specific consideration, further analysis will be needed for each potential site to determine the hydraulic impacts to any existing hydropower operations.

Future Plans

It is anticipated that testing at the Roza Canal will continue through 2015, with various configurations of turbine scenarios. Field results will help calibrate the numerical model to better predict impacts within the range of conditions that have been tested. For example, Reclamation or an irrigation district could provide canal geometry and operational information and the model could then predict what impacts would occur, determine whether HK devices are appropriate and, if so, then identify potential places for effective HK use.

Tagline and Rio Grande Acoustic Doppler Current Profiler (ADCP) at a section upstream from the HK turbine. Canal velocities were measured at the same cross-sections as water surface elevations with and without the HK device operating for comparison.

Reclamation recognizes the valuable opportunity to provide field testing and help further understand the operational criteria and limitations of HK devices. As with other renewable energy technologies, the market and economics will help define the niche that these devices can play in the future of the electrical power grid.

More information

www.usbr.gov/research/projects/detail.cfm?id=7973

http://instreamenergy.com/projects/yakima-washington/

"A well-developed numerical model will be a useful tool for both private developers and water system owners to help determine if and where a hydrokinetic device could be deployed without impacting existing water delivery operation, before any installations are made."

Josh Mortensen
Hydraulic Engineer, Reclamation's Technical Service Center

Collaborators

- **Reclamation's Power Resources Office**
- **Instream Energy Systems Corporation**
- **Sandia National Laboratories**