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The National Irrigation Initiative: Panel Discussion Low-Cost Technologies for Improving Existing Water Delivery Systems

by

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Low-Cost Technologies For Improving Existing Water Delivery Systems

by Clifford A. Pugh[1] and Roger D. Hansen[2]

Introduction

The approach described in this paper, to bring new automated monitoring and control technologies to existing water delivery systems for optimal water management, clearly complements the vision of the National Water and Land Irrigation Initiative. The vision for the Initiative is to: "Create a setting for the use of water and land for irrigation, in harmony with other demands for water resources, in the most efficient and environmentally acceptable manner possible."

Automated control results in highly effective water management, including more timely deliveries to improve crop yields, reduced operation and maintenance costs, and significant conservation through reduced spillage and seepage. Water conserved through optimizing system deliveries becomes available to enhance instream flows, extend water supplies, and improve recreational opportunities.

Need for Improved Water Distribution Systems

Most of the agricultural water distribution systems in the western United States are aging and largely in need of upgrade and repair. Many water managers now recognize that improvements are necessary and are striving to find cost-effective solutions. Financial pressures on small irrigation districts are increasing, making major rehabilitation projects prohibitive. Often operators of small projects are not aware that distribution system automation is a practical solution to their problems. This misconception stems from the fact that many of the well publicized automation efforts are used in large-scale systems, such as the Central Arizona and Central Utah Projects. However, our research indicates that the vast majority of western canal systems, most of which are relatively old and usually small-scale, could similarly benefit from automation technologies. The elaborate and expensive automation equipment used on larger projects is not required. Further, the recent appearance of low-cost technology has made small-scale systems affordable and effective.

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Case Studies in Small Scale Automation

Reclamation's Provo Area Office, in conjunction with the Water Resources Research Laboratory (WRRL) in the Technical Service Center in Denver, Colorado, has implemented several small-scale monitoring and control enhancements recently on Utah projects. Many projects evolve from installing instruments and radio telemetry to monitor gate positions, flows, and water levels, then to remote control of gates for making changes, and finally to automated systems with control algorithms that automatically control the canal system. As water users become more familiar and comfortable with the equipment and methods, they develop an interest in further enhancements. Other key aspects of generating a sustainable technology transfer include standardizing equipment, utilizing modular designs, providing a user friendly equipment interface, and more importantly involving water users closely with the process. Involving system operators in the conception and design of the system greatly improves the likelihood of a successful application. Technical assistance is also facilitated by a relationship built on trust and communication with the operators as the system evolves.

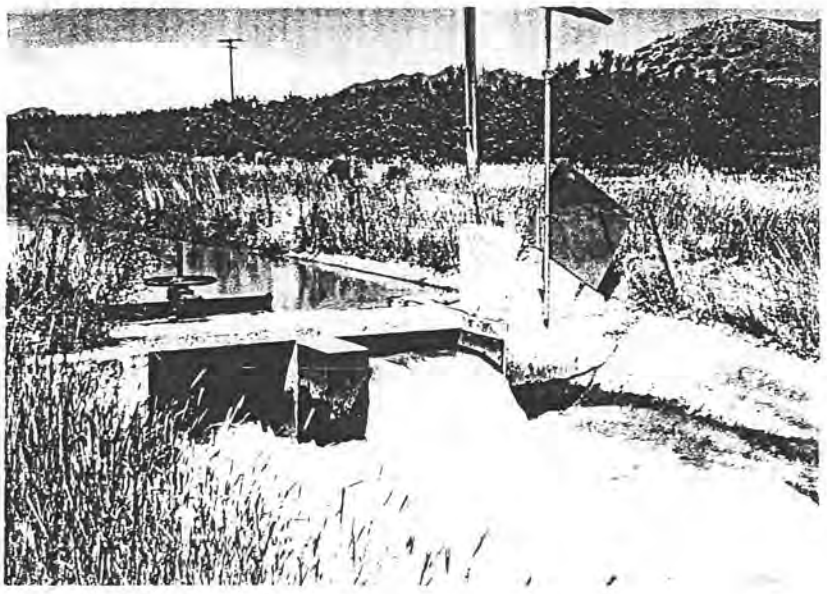

Figure 1 - Solar powered, inflatable gate check structure, Strawberry Highline Canal, Utah

Strawberry Highline Canal

The Strawberry Highline Canal completed during the 1920's, was one of the earliest projects constructed by Reclamation. To enhance operation along the 17-mile-long antiquated canal system, real-time monitoring and control has been retrofitted on existing structures.

This case study illustrates the equipment and methods used, and the evolution of the process. The first year, managers of the Strawberry High Line Canal, working with Reclamation, installed instrumentation to monitor canal conditions at two small storage ponds. The next year, a check structure in the canal was modified by installing a pneumatically-operated, solar-powered overshot gate to automatically control upstream water levels. This check structure was remotely monitored and radio controlled from the Highline Canal Company Office. The third year, 1995, a long-throated flume and real-time equipment were added to monitor flows at the headworks of the canal. In addition, a major lateral near the end of the canal was upgraded with remote control. For this latter application, 12-volt motors were used to adjust the gates. The remote sites along the canal are now controlled with low-cost remote terminal units (RTU's) which communicate with a central site, i.e., a personal computer located in the canal office, through a radio-telephone connection. Control algorithms are now being developed to execute flow changes based on data transmitted from the real-time equipment.

The Strawberry Highline Canal example illustrates that low-cost real-time systems can easily evolve over time. Both the number of field sites and system complexity increase with added components. It also demonstrates that older systems can be retrofitted with real-time technologies. However, the ultimate operation method suitable for the canal must be taken into account as the canal is upgraded.

Sevier Valley-Piute Canal System

The Sevier Valley-Piute Canal system stretches for over 65 miles through central Utah. Because of its length, the system has historically been complicated to operate. Directing water to the end of the canal is frequently a challenging task. It is also difficult to maintain a steady flow at the head of the canal because of fluctuations in Sevier River flow.

To correct these problems, two initial actions were taken. First, five low-cost flow monitoring sites were installed along the canal. These real-time stations allowed the water manager to survey system-wide conditions from his home. He could then compare how the system was working with how it should be working, and take corrective action as necessary.

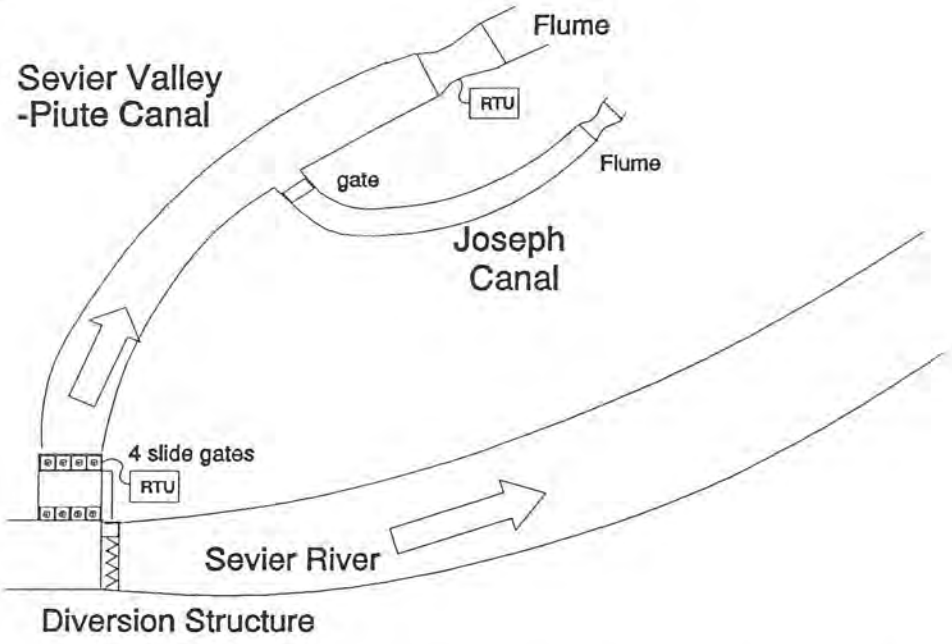

Figure 2 - Solar Powered, low powered gate operator layout at Sevier-Piute turnout on the Sevier River, Utah.

Second, at the diversion structure, the gates were motorized using fractional-horsepower, 12-volt solar-powered motors. The movement of these gates is controlled by a low-cost RTU. The gate position targets are directed by the water manager through the telemetry system. By 1996, the manager will be able to set flow targets so that the gates will adjust automatically to maintain the required flow.

A simple algorithm is planned to communicate with an RTU located about 1 mile down the canal at a Parshall flume. The RTU at the headworks will estimate the gate movement required to effect the flow change needed at the flume. After a time delay, the same cycle will be repeated to fine-tune the desired flow within a specified deadband. Plans are also underway to remotely control the releases from Piute Dam to optimize the timing of deliveries to the Sevier Valley-Piute Canal.

Similar case studies involving the automation of canals in the Emery Water Conservancy District, Ogden River Water Users' Association, and Bear River Migratory Bird Refuge will be also be discussed during the panel discussion.

Conclusion

The low-cost automation technologies described here provide opportunities for partnering with Federal, State (University), and local organizations. The solutions are cost-effective and have already been proven to conserve water, provide more dependable water deliveries to irrigators, and provide reliable sources for augmenting instream flows. The demonstration sites in Utah have convinced a skeptical audience of the benefits. Irrigators who thought they would never adopt an automated system now state they have no intention of reverting to manual operation because they recognize that the technology provides effective water management.

The close relationship between Reclamation and the system operators has been one of the keys to success. Irrigation groups have sought and appreciated technical assistance. In addition, training programs and workshops are being conducted locally and on a regional basis for all levels of expertise.

SUNDAY, JANUARY 07

10E
The National Irrigation Initiative: Panel Discussion

10:30 1. The National Irrigation Initiative
Terry P. Lynott

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2. 75-WORD BIOGRAPHY FOR SPEAKER INTRODUCTION AT THE CONFERENCE:
(Please include previous employment, colleges attended, degrees held, offices and committee memberships held in AWWA, memberships in professional organizations, awards and honors received. Do not send resumes.)

Clifford A. Pugh, P.E., Technical Specialist, Hydraulics - B.S. degree from Colorado State University; graduate studies in hydraulics at CSU Mississippi State University.

He is the leader of the Water Conservation Team in Reclamation's Water Resources Research Laboratory and a technical specialist and consultant for the WRRL.

He is the author of over 30 reports, guidelines, and articles on a variety of technical subjects.

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Mr. Pugh has 23 years of experience in hydraulics with the Corps of Engineers and Reclamation.