RECLAMATION July-Sep. 2008
Managing Water in the West

Science & Technology Highlights

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Improving Infrastructure Reliability

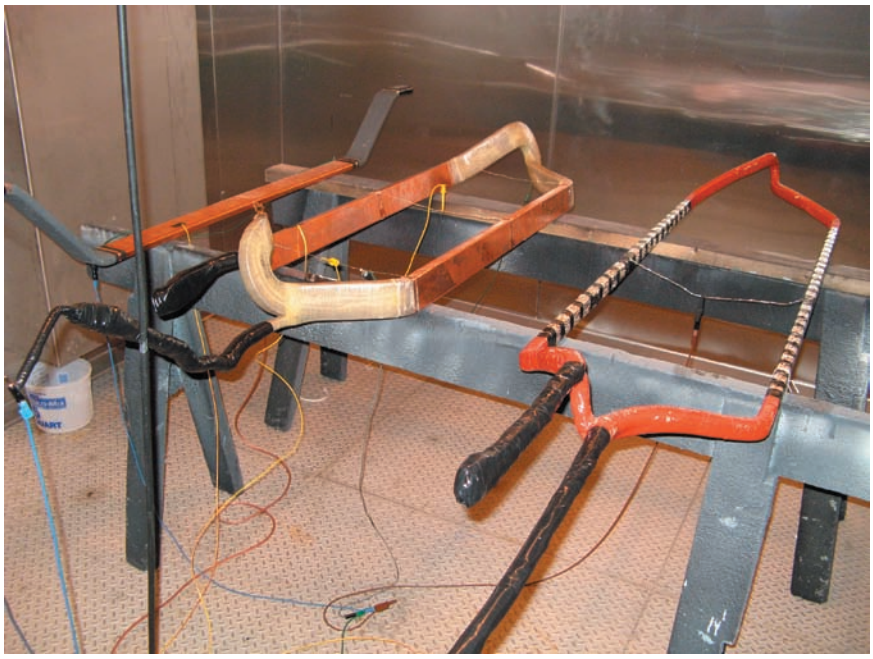
Improving the accuracy of generator insulation condition assessment.—The weakest link in the power generation chain is the insulating components (systems) on high-voltage apparatus. In Reclamation's infrastructure, this is typically the generator stator winding insulation in a powerplant. When insulation components fail, significant outage time and severe damage to the generator may result. Failed insulation components are expensive to repair or replace and can cause collateral damage to other generator components. Thus, Reclamation assesses the condition

of insulation regularly in order to optimize replacement timing before failure occurs. However, assessing the condition of insulation is difficult and requires multiple tests for an accurate assessment. The Science and Technology Program is supporting research on several of these tests. One focus is to improve the standard Polarization Index (PI) test, and find ways to extract PI information from the DC ramp test, and then use the information in combination. The ability to extract PI data from the DC ramp reduces the number of tests required.

While the PI test has been used for many years to assess the condition of insulation in motor and generator stator windings, the insulation components in these systems have advanced significantly. Many of the standards that the PI test data are judged against are from older obsolete types of insulation. An important focus of the research is to understand and apply this test to newer types of insulation systems commonly found in updated or "rewound" Reclamation motors and generators. The reaction of these new insulation components can vary with different temperatures and with different insulation types. Understanding these effects from the new insulation types and temperature on the PI test results helps us more accurately assess the condition of the insulation being tested.

Currently, three different types of stator coils used in Reclamation's generator/motor inventory are being tested. Tests are being done with two different lab test sets. One of these tests also has a "guard" function, which helps to pinpoint the area of insulation being tested and reduce unwanted effects from other areas of noninterest. The test set with the guard function developed through Reclamation's Science and Technology Program and is now in a commercially available product less the guard function. We are comparing the commercially available test set with our more sensitive measuring test set. With the help of an environmentally controlled chamber, we are running tests on these coils at various temperatures (20 °C, 30 °C, 40 °C, and 50 °C). Data are collected, graphed, and then compared and analyzed. Once the results of the testing are fully analyzed and understood field tests results from motor or generator stator windings will be analyzed with higher accuracy and consistency.

This research results could provide more accurate condition assessments. Moreover, if the PI can also be successfully extracted from the ramp DC test data, then we will be able to obtain two types of insulation diagnostic test results with a single test. This will save time and effort for testing. (Eric P. Eastment 303-445-2324)



Test setup of the three stator coils/bars in the environmental chamber.

Protecting powerplant workers from arc-flashes.—The direct current (DC) electrical system is one of the most important systems in a hydroelectric power plant. It is used for plant control and protection during normal operations and provides backup power during an outage or emergency. Consequently, the DC system must be very reliable and available at all times.

To perform work on a high-energy electrical system, the Occupational Safety and Health Administration (OSHA) normally requires that the system be de-energized. However, since the DC system is critical to the plant's operation and protection, work is usually performed while the system is energized. Such work could potentially expose a worker to high levels of arc-flash energy if the technician were to accidentally short-out (short circuit) the battery, making work on DC systems a dangerous job.

To help reduce these hazards, the Hydropower Technical Services group has designed a prototype device which limits the amount of available DC arc flash energy without decreasing the availability of the DC system. The device is designed to be put in service while work is being performed in order to create a safer working environment. We are continuing fundamental research in FY 2009. (Jim DeHaan 303-445-2305)

Testing the new arc flash protection device

Improving Decision Support

Managing Reservoir Sediments During Dam Operations or Removal.—As Reclamation's reservoirs get older, the accumulation of sediment in the reservoir becomes an increasingly important issue. Reservoir sedimentation can reduce reservoir storage capacitythus reducing the delivery of water and generation of power. In some cases, sediment storage can be reduced by sluicing sediment through the dam outlet works. Release of sediment is also an issue if the dam is proposed for removal. However, sediment that is delivered from upstream sources can contain contaminants that pose a risk to water quality if they are released downstream. In addition, release of sediment can impact downstream water supplies and habitat.

Developing guidelines for assessing these impacts from reservoir sedimentation is a national and international issue. Once these guidelines are developed, Reclamation and other agencies will be better able to make decisions about managing reservoir sediment impacts from actions such as dam removals and reservoir sluicing operations. These guidelines will help us become more efficient at determining the level of analyses needed—doing enough to address uncertainties but not performing unnecessary analyses. Reclamation is working on this issue with the Subcommittee on Sedimentation (SOS). Fifty-five technical experts from many agencies and academia are working to establish a decision tool to determine the type of sediment analysis needed for decisions on reservoir sediment management.

Sampling and analyzing sediments under a reservoir can be costly and complicated. This decision framework will not recommend whether or not a dam should be removed or specify which mitigations or sediment management strategy should be used. Rather, the decision framework will help resource managers and stakeholders determine the appropriate sediment management strategy and mitigations for a particular dam removal project. The tool can serve as a reference and guideline when working with local agencies, permitting agencies, and stakeholders

The Subcommittee on Sedimentation held a workshop in Portland, Oregon in October 2008 with about 50 technical experts from a wide range of agencies from across the United States, all working with projects where reservoir sediment is an issue of concern. Workshop participants developed a draft decision tree for these components of the larger framework:

- Reservoir sediment erosion and redistribution
- Downstream river sediment transport and deposition
- Water quality changes and impacts on biologic resources

The next step will be to integrate the products and for participants to "test drive" the framework on real projects being analyzed for reservoir sediment impacts over fiscal year 2009. (Timothy Randle, 303 445-2557 and Jennifer Bountry, 303-445-3614)

Improving Water Delivery Reliability

Evaluating Potential Impacts of the Red Bluff Diversion Dam on Green Sturgeon.— Monitoring the movements and habitat preferences of acoustically-tagged green sturgeon (*Acipenser medirostris*) using strategically placed stationary receivers and by mobile tracking, the information gained will help benefit Reclamation's operation and management of the Red Bluff Diversion Dam (RBDD) and the continued delivery of water to the water users of Northern California.

In May and June of 2008, Reclamation and UC-Davis biologists captured, tagged, and released ten adult green sturgeons about 13 kilometers downstream of the RBDD. Since releasing, researchers found that that pre-spawned sturgeon move from specific holding areas to potential spawning habitats. Monitoring the sturgeons' post-spawning movements have indicated two distinct behaviors—some individuals move immediately downstream and out of the river system while other individuals hold in specific areas for long periods of time prior to emigrating downstream. These two distinct post-spawning behaviors could have implications for the operation of the RBDD, depending on where spawning takes place either downstream or upstream of the RBDD. (Richard Corwin, 530-528-0512)

Reclamation biologist tracking green sturgeon using a directional hydrophone attached to mobile tracking receiver. Photo taken by Richard Corwin, USBR.

An adult green sturgeon breaching at the downstream base of the Red Bluff Diversion Dam. Photo taken from the top of the Red Bluff Diversion Dam by Richard Corwin, USBR, May 2008.

Protecting Heritage Assets with Light Detection and Ranging (LiDAR) Technology.—Reclamation has many historic properties. But the names and dates carved by pioneers into limestone cliffs in Threshing Machine Canyon at Cedar Bluff Reservoir in central Kansas stand out as a unique monument to our country's westward expansion. The inscriptions document the settlers, military expeditions, and itinerant explorers who passed through this country beginning as early as 1849. Unfortunately, the rock carvings are subject to natural erosion, vandalism, and theft even though the site is under Reclamation's ownership and managed as a Kansas State Wildlife Area. Because of these natural and human-caused impacts, some of the carvings have been lost, or are no longer decipherable. This degradation, destruction, and theft significantly harm the historic value of the site.

To help address the problem, the Nebraska-Kansas Area Office (NKAO) is partnering with the Remote Sensing and Survey Group of the Mid-Pacific Region, and the Land Resources Office - Policy and Program Services to document the historic era inscriptions. The project helps Reclamation comply with its management responsibilities required by section 110 of the National Historic Preservation Act.

Using LiDAR technology, the team created highly detailed 3-dimensional imagery of the inscriptions to document the condition of the inscriptions at a very fine scale and pinpoint specific panels that require intervention and treatment to retard erosion or reduce vandalism. Over the next two years, the inscription panels will be recorded again, creating an extensive database that NKAO can use to track natural and human-caused effects to the inscriptions. Reclamation will thus have comparative data that will be used to assess the nature, periodicity, and extent of negative effects on the inscriptions. These data will provide Reclamation with an important management tool to better protect and preserve the site and the inscriptions. Moreover, the LiDAR technology is expected to provide significant cost savings over tradition archaeological in-field recording techniques. (Thomas Lincoln 303-445-3311)

Using LiDAR technology to document historic inscriptions.

Historic inscriptions on limestone bluffs.

Improving Water Supply Technologies

Measuring wetland water needs in Klamath Basin.—To balance water needs in the Klamath Basin, managers need to understand how much water is needed for natural wetlands, restored wetlands, and irrigated land. Yet data on rates of water use for these land covers is extremely limited. Without specific local data on evapotranspiration (ET) rates, experts are forced to rely on data based on experiments in the southwest, which is drier and at a lower altitude. These results do not provide the accuracy and the specificity managers need in the Klamath Basin.

The Klamath ET/Evap Research Project, a three-year effort started in FY08, seeks to more accurately measure measure ET in the Upper Klamath Lake Wildlife Refuge. ET parameters are being measured at two micrometeorological stations deployed at marsh sites. These are state-of-the art, solar powered, eddy covariance type measuring stations, one station measuring bulrush (tule) ET, another cattails, tules,wocus (a local lily), and some open water. Evaporation parameters are also being measured with a bowen ratio station at an open water site on Upper Klamath Lake. These three stations thus provide data a diverse range of conditions. Thirty-minute frequency data transmission is by cell telephone telemetry and maintenance and cleaning of the stations occurs at monthly intervals. The stations will collect data continuously through fall 2009 and findings will be published by fall 2010.

More precise quantification of wetland ET and open water evaporation demands will allow for improved water operations planning and more efficient evaluation of proposed wetland reclamation projects. The findings will be transferable to other similar projects and ecosystems. Staff from Reclamation's TSC and Klamath Basin Area Office are working closely with USGS and FWS staff on this project. (Mark Spears, 303-445-2514).

Eddy Covariance Type Micrometeorological Station at Marsh Site in Upper Klamath Lake Wildlife Refuge