Pumped Storage

Mark Jones, Manager of Federal Hydro Projects at the Bonneville Power Administration (BPA), provided an overview of their evaluation of pumped storage potential for the region. BPA and the region have experienced a significant increase in energy production from wind. There was 250 MW of installed capacity from wind in 2006; today, there is nearly 4,500 MW. As this amount continues to increase, pumped storage has been considered as one of the technologies that would assist with the integration challenges. BPA contracted with HDR, Inc. to assess the characteristics and costs of potential Greenfield (new) projects. This assessment suggested that new storage capacity would cost between $2.5 and $2.7 billion, which is not considered cost effective in current regional market structures. In addition, BPA has been working with the Bureau of Reclamation and the Columbia Basin Irrigation Districts to assess the potential benefits of modernizing or upgrading the existing Keys Pump Generating Plant at Grand Coulee. Hopeful next steps are for national groups to address R & D technologies and/or help develop markets for multipurpose uses of the facility that would help bring costs down.

CRPAG members and the audience had numerous questions:

- Are you getting better at predicting available wind? [Yes; however there are still significant challenges in being able to accurately predict wind.]
- What is pumped storage? [From an energy standpoint, it’s using two reservoirs at different elevations to move water between them for the purpose of either creating load through pumping or producing energy through generation when moving the water back down hill. There are three main technologies; conventional, variable speed, and ternary (hydraulic short circuit). The conventional is the most affordable but offers the least flexibility. As for the reservoirs, the power only design typically allows for about a 12 hour cycle time. If the reservoir was needed for multiple purposes, they would have to be sized significantly larger.]
- How do you fill in the holes shown in the model runs? [The reservoirs must be designed and allowed to operate to fulfill their respective purposes. You cannot have a time when the reservoirs are unable to be operated in a way that fully supports power, irrigation, or any other authorized use.]
- What percentage of need would the modeled projects pick up? [That’s a difficult question, but assuming the 1,000 MW modeled facilities would be able to support something close to our current wind load, if it would remain in our balancing area, would not be unreasonable.]
- Since the cost of the two projects that you modeled is similar, is it logical to think if you had a broader system, you could spread the cost to other groups? [Yes, but you need to be attentive to the values of the other groups as well. At the current time, our ability to recover costs for the power benefit would only cover a small percentage of the overall cost.]
- How does the $2.5 billion compare to alternatives? [It still has the potential to be a least cost alternative.]
- Are you at capacity in terms of integrating the amount of wind coming into the system? [We are close to that place. At times we have too much generation and not enough load.]
- Do you put a stop sign on more wind? [If there is further development, there will need to be resources provided to be able to support the integration.]
- Where do we go from here on pumped storage? [The biggest stumbling block is in valuing the product pumped storage creates, and developing the appropriate cost recovery mechanisms.]
- How much has BPA looked at spilling more water, thereby incurring less harm to fish? [I am aware of the discussion around this issue. We currently comply with the Biological Opinion and state water quality standards. But in any case, if you were looking at significant additional wind such that pumped storage, or some other form of grid level storage would be needed, additional spill would have very little effect.]
- Is there greater potential to utilize more wind power? [From a national perspective, I believe the answer is yes.]
- Are there other technologies for managing storage? [Yes, there is research in battery technologies, flywheels, hydrogen, and compressed air. Some people think that a system of batteries is just around the corner. From a grid scale energy perspective, I believe that pumped storage is the most proven and most practical of the technologies. And there may be some demand side management options that will be effective also.]
- Does expanding the grid address any of these issues? [Yes, especially if we have greater national integration and can truly take advantage of geographic diversity; however this is a very costly option and has significant challenges if we were looking at direct current.]
- Are there European projects the size of those modeled by HDR? [I am not aware of any on the scale of HDR’s modeled multi-purpose X2 project, but I’m not certain.]
- What efficiency rate do you use? [Moving water is a net loss of electricity, which is also the case for pumped storage. The Keys facility at Banks Lake is estimated to operate at about 70% efficiency. A new facility could get into the low 80s.]
- Does Europe use different turbines for generation and pumping? [There is only one hydraulic short circuit (ternary) project in operation where a separate runner and impeller are used. This design is extremely expensive.]
- Wouldn’t a better option to the integration problem be expanding the grid, since no matter what the cost, you could recover it more so than pumped storage? [Not necessarily, you would still need to evaluate the costs, and if you went with a direct current design, overcome the challenges.]
- What about power from biomass digesters; is it level or variable? [I assume it would be a nonintermittent source of power.]
- Are efficiency curves dependent on weather and temperature? [To some degree in some applications like nuclear.]
- What are the particulars of the proposed Klickitat County project? [It would be a closed loop system, with over 1,200 feet of head, and about 1,000 MW of capacity on a 12-hour cycle.]
- Under the Project X2, when discharging back to the river, does the power cascade back through the system? [No, you are effectively borrowing it for some period of time, and then returning it later, minus some small leakage and evaporative losses.]
- What is the percentage of wind compared to hydropower? [The capacity of the Federal hydro power system is almost 22,000 MW; the average generation is about 8,700 MW; and the current capacity of wind generation in our balancing area is about 4,400 MW.]
- Can you describe the two proposed Banks Lake projects? [The North Dam would be able to use about 300 foot of head; the South Dam would have about 1,000 foot. The North Dam would have an advantage with flexibility since it’s using two very large reservoirs, but would be disadvantaged due to the relatively low head and higher unit costs. The
South Dam would be more in line with what is believed to be an optimal design with higher head, and would likely be more cost effective.]

- Is it better to build a project higher and dump the water quicker? [From a slope stability standpoint, it is better to draft slower.]

Andrew Grassell of Chelan County PUD then reviewed the PUD’s pre-feasibility pumped storage assessment funded by the Columbia River account. The projected costs varied from $1.1b to $3.9b, or $25k to $107k per acre-foot. The net present value varied from a negative $2.8b to a positive $758m. The PUD believes that pumped storage was a good technology but the price of the project was simply prohibitive and the uncertainty was too high.

The CRPAG members and audience had the following additional questions, which Mark and Andrew addressed:

- Did the initial capital cost sink this project? [Yes. The capital cost associated with a reservoir, transmission, and delivery is high; long term O & M pencils out much better.]
- Could there be other sources of recovery of other values in terms of water supply? [Chelan County looked at social values, but these values are small, against the cost.]
- Is pumped storage a solution in support of a problem; that is, do we have an abundance of power? [The problem is not quantities of power. Instead, the value of pumped storage is how to provide grid stability, insofar as wind and solar are non-firm sources of power. The ability of hydro to integrate these intermittent supplies is diminishing.]
- Has the PUD looked at a No Action Alternative for a non-balanced load? [There would be damage to the system, which FERC would not ignore. The No Action alternative is not an option.]
- Isn’t the problem that the peak of wind capacity occurs at the same time as the peak of hydro generation that also coincides with fish migration and ESA issues? [That is certainly a challenge for us, but it’s not the only one. And depending on the amount of additional development, further challenges will need to be addressed.]
- Is this really a seasonal problem, or are there both seasonal and year-round problems? [The potential wear and tear on the existing system from cycling units is not just a seasonal issue.]
- Are incentives for wind power a burden for hydro to carry? [No comment.]

**Odessa Aquifer Depletion**

Paul Stoker, Executive Director of the Columbia River Ground Water Management Area (GWMA), presented the results of a recent study that the GWMA had conducted by GSI Water Solution on the depletion of the Odessa Aquifer. Previous studies reviewed thousands of well logs to characterize hydrogeological data including: aquifer units, groundwater flow direction, and groundwater recharge and discharge areas. In addition, well water sampling was also conducted in previous studies to assess water quality and age of water (ancient vs. modern) by aquifer. Most of the water that has been withdrawn is ancient and receives very little natural recharge. The deeper the wells, the more isolated the pockets are and the less recharge that occurs. Groundwater is the principal source of water for municipal and industrial use in the region. 23 of the 25 cities evaluated are primarily pumping older water that is not being recharged. The study looked at the worst-case scenario of catastrophic failure of the well system. The capital costs of converting to new wells, either deep or shallow, is in the tens of millions of dollars, and annual maintenance costs would also be significant. If municipalities shift to
shallower (and typically younger) water, they may need to construct treatment systems, which would also be expensive. About 93% of current agriculture and municipal wells in the GWMA are not sustainable; about 20-25% of the original water remains. Under some scenarios, wells will begin to fail in the summer of 2016 or 2017.

Mike Dexel of the Department of Health reminded the CRPAG that Health is responsible for assuring a safe and reliable water supply for each community. Health is currently reviewing a set of questions that have emerged from the GWMA report: How seriously is each community taking this study? What is their emergency or water shortage response plan? Are there potential regional or partnership solutions? Is surface water a possible solution and what considerations have been made for treatment costs? Are there options for reclaimed water? How far can each community get by being more efficient? The Department will consider offering an open house in the near term to help affected communities discuss their options.

The newest report, which addresses potential impacts to municipalities, will be unveiled in June 2012. The report encompasses 25 cities and will provide city specific information on a) age of water withdrawn, b) specific flow zone (aquifer) city wells are tapping and c) future planning options and costs to address catastrophic failure. An overview of options include:

- Deep conversion of wells – encounter older water, hot water, sulfur and high pH.
- Shallow conversion of wells – encounter younger water, a need for more wells to get desire production, nitrates
- Surface water conversion – encounter bacteria, high treatment and infrastructure.

CRPAG and audience members then offered these questions and comments:

- Are there some positive actions in terms of conservation that are possible? [Yes. (1) The Odessa Special Study suggested some “low hanging fruit” for getting irrigators off of groundwater. (2) There are shallow groundwater possibilities that may be possible without treatment. (3) Many cities have high volume users, such as fruit processors, that could help to mitigate, e.g., through reuse of water.][We can think of a sustainable source for each community, although cost will be an issue.]
- It appears that the big problems facing the region require significant amounts of money. Given the choice, I suggest that we should make an investment in water supply rather than power supply.
- It may be that the best way to handle efficiencies is to work with the industrial users rather than the residential users, as the industrial parties will have more capacity and flexibility to manage their water use.
- Is this problem driven by restrictions imposed by the Department of Ecology? [No.]
- Would the surface water scenario allow a shared use between irrigators and municipalities? [Such a shared use would require a new distribution system.]
- The Odessa SubArea is a bright spot. Ecology and the Bureau of Reclamation initiated action to get irrigators off of deep wells. This has moved about 80,000 acres of usage from the aquifer, and optimized the use of existing project facilities.
- What will be in the final GWMA report; will it only have these worst-case scenarios, or will it show a range of options? [Each city will receive a scientific report of its circumstances and a list of options that respond to those circumstances.]
- Just to be clear: the East Low Canal is not a sieve; the video is incorrect in suggesting that it is.
- Is the anti-degradation restriction a major roadblock for shallow aquifer recharge? [No, not in the Odessa, insofar as the problem is in the delivery system.]
Retiming of Irrigation Return Flows

Mark Nielson, District Manager of the Franklin County Conservation District, discussed a study funded by Ecology and others that the District had commissioned to assess the benefits of retiming of irrigation return flows. The District has been interested to learn if irrigators can use water conservation to increase flows in the Columbia River in July and August, while also providing for an increase in irrigated land. In effect, the retiming is intended to use the ground as a storage option.

Three areas were selected for study: South Franklin County, the Horse Heaven Hills and Walla Walla. The principal author, Peter Schwartzman of the Pacific Groundwater Group, described the theory of retiming and reviewed a set of model runs to show how irrigated water management could be optimized. A primary tool was a dampening of the re-turn waters to the river. The study concluded that the benefits of retiming can be significant where surface waters are used for irrigation and conservation is applied at multiple sites. Through conservation, the goal is to reduce deep percolation by implementing irrigation water management (IWM), Low energy precision application (LEPA) which reduces crop requirements by 17% and real time diversion reductions. The deep percolation contributes to return flows. By eliminating deep percolation, water becomes available. The return flow is “retimed” and has an effect on the river at a different time period than prior to the conservation. The District commissioned a separate legal review evaluating legal issues related to IWM feasibility that concluded the concept was sound legally. The retiming report and legal analysis are available on Ecology’s website.

CRPAG and audience members asked these questions:

- What assumptions were being used regarding the crops being grown and the level of Irrigation Water Management being employed prior to engaging in a program of retiming? [We looked at different crop types.]
- When you say that you are going to move forward, what does this mean? [We will be filing seasonal change transfer applications.][The water made available is non-consumptive in nature and the new uses will be consumptive in nature. The retiming is where we need to focus.]

2013-15 Capital Budget

Derek Sandison previewed Ecology’s development of a capital budget request. Ecology is required to submit a budget to the Office of Financial Management by the end of August. Ecology will review its recommended budget at the July CRPAG meeting, but currently it is considering these projects:

- Completion of the KID Red Mountain project
- Contingency planning for municipalities with problematic wells
- Implementation of the Yakima River Basin Integrated Plan. The Office of Columbia River will fund some of the early action items.
- A long-standing flow problem on Icicle Creek
- Leakage in the Gardena Irrigation District near Walla Walla
- Significant improvement of the Odessa project including east/low canal expansion.

CRPAG and audience members posed these questions and comments:
• What can we do to help prioritize these projects? [Keep communicating directly with Ecology and through the CRPAG. Ecology will distribute information on the projects under consideration. The legislature is particularly interested in on-the-ground work rather than studies and in projects that produce jobs and economic value.]
• These projects will get terrific screening in the House in particular. Ecology will need to prove their worth in a very competitive environment.
• How much of the Columbia River account is available from the initial $200m? [About $80m]
• The capital budget will be tight statewide for the 2013-15 biennium.
• We need to be attentive to the one-third/two-third split in the account. The next request will receive a great deal of scrutiny. We need to focus on results on the ground, such as at the East Low Canal and the municipal well problem.
• We definitely need to provide significant funding to the Odessa project.

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The next meeting of the CRPAG will be July 26 from 9:30 to 1:00 at the Hal Holmes Center in Ellensburg.

Attendees:

CRPAG members and alternates:

Wendy Christensen, Bureau of Reclamation
Jon Culp, Washington State Conservation Commission
Michael Garrity, American Rivers
Mike Leita, Yakima County Commission
Joe Lukas, Grant County PUD
Gary Passmore, Confederated Tribes of the Colville Reservation
Lisa Pelly, Trout Unlimited
Rudy Plager, Adams County Commission
Tom Ring, Yakama Nation
Dave Sauter, Klickitat County
Mike Schwisow, Columbia Basin Development League/WA Irrigation Districts
Teresa Scott, Washington Department of Fish and Wildlife
Ted Knight, Spokane Tribe
Craig Simpson, East Columbia Basin Irrigation District
Leo Stewart, Confederated Tribes of the Umatilla Reservation
John Stuhlmiller, Washington Farm Bureau
Rob Swedo, Bonneville Power Administration
Matt Watkins, City of Pasco

Others in attendance:

Neil Aaland, Washington State Association of Counties
Sally Carpenter, Citizen
Carolyn Comeau, Department of Ecology
Marie Cobb, Intera
Sara Cornell, Columbia Basin Development League
Stuart Crane, Yakama Indian Nation
Jim Davenport, Davenport LLC
Shannon Dininney, Associated Press
Charity Davidson, WA Department of Fish and Wildlife
Mike Dexel, WA Department of Health
Melissa Downes, Department of Ecology
Carl Einberger, Golder Associates
Tim Flynn, Aspect Consulting
Stephanie Flowers, RH2 Engineering
Adam Fyall, Benton County
Joel Freudenthal, Yakima County
Bill Gilmour, J.R. Simplot
Bob Hall, Yakima Basin Storage Alliance
Dan Haller, Aspect Consulting
Tom Helgeson, CH2M Hill
Paul Jewell, Kittitas County
Al Josephy, Department of Ecology
Mike Kaputa, Chelan County Natural Resource Dept.
Linda Kiefer, Avista Corp.
Chuck Klarich, Yakima Basin Storage Alliance
Paul La Riviere, Washington Department of Fish and Wildlife
Carl Merkle, Confederated Tribes of the Umatilla Reservation
Jack Myrick, WA State Conservation Commission
Leigh Nelson, Natural Resources Conservation Service
Mark Nielson, Franklin County Conservation District
Mike Poulson, Office of Congresswoman McMorris-Rodgers
Jeremy Pratt, Cardno-Entrix
Joye Redfield-Wilder, Department of Ecology
Rick Roeder, Department of Natural Resources
Pete Rogalsky, City of Richland
Pat Ryan, Department of Natural Resources
Dan Seligman, Columbia Research Corp.
Derek Sandison, Department of Ecology
Vicky Scharlau, Columbia Basin Development League
Dan Silver, facilitator
Paul Stoker, Groundwater Management Area
Tom Tebb, Department of Ecology
Steve Thurin, HDR Inc.
Patrick Verhey, Department of Fish and Wildlife
Chris Voigt, WA State Potato Commission
Bill Wagoner, National Frozen Foods Coop
Rich Walpole, CNW Engineer