Banks Lake Pumped Storage Project
(North Dam Site)
FERC Project No. 14329

PNUCC
Portland, OR
September 4, 2015

Presented By:
Tim Culbertson and Larry Thomas
Columbia Basin Hydropower
“Generation from Irrigation”

• Columbia Basin Hydropower (CBHP) provides administration, operations, and maintenance functions for hydroelectric generation facilities owned by the 3 Irrigation Districts that make up the Columbia Basin Irrigation Project, approximately 700,000 acres.

• The Districts currently own seven projects, ranging in size from 2-94 MW with total generation capacity of all projects = approx. 150 MW.

• The power from the five projects that CBHP operates and maintains goes to the cities of Seattle and Tacoma.

• Two other hydroelectric facilities are operated and maintained under contract by Grant County PUD.

• All of the existing projects are FERC licensed projects.

• CBHP has a number of FERC preliminary permits for new development. Projects range from 600 kw small hydro, up to 1000 MW pumped storage.
A pre-feasibility study of the Banks Lake Pumped Storage Project was jointly conducted earlier this year by the following organizations:

- Columbia Basin Hydropower
- Kleinschmidt and Associates
- Reed Consulting
- Muchlinski Consulting
- Lands Energy
PRESENTATION OUTLINE

- Overview of the Banks Lake North Dam Pumped Storage Project:
  - Purpose of the Project, current status and major stakeholders
  - Capacity, expected energy output
  - Preliminary Project costs and benefits
  - Barriers/challenges to development
  - Next steps
PUMPED STORAGE PLANTS IN THE US

- 40 Pumped Storage Plants in US
- 14 Pumped Storage Plants in Western US
- 1 Pumped Storage Plant in Washington (Keys Plant)
- 4 Pumped Storage Plants actively under consideration in the PNW:
  - JD Pool: Washington – 1,200 MW
  - Swan Lake: Oregon – 1,000 MW
  - Gordon Butte: Montana – 400 MW
  - Coffin Butte: Montana – 250 MW
TYPICAL PUMPED STORAGE PROJECT LAYOUT
BANKS LAKE PUMPED STORAGE PROJECT
FACTS & FIGURES

- The Project is located at the North Dam of Banks Lake in central Washington State near Grand Coulee Dam.
- The Project is a separate project from the Bureau of Reclamation’s existing Keys pump-generation plant (which is sometimes referred to as the Banks Lake pumped storage plant).
- Generating Capacity: Up to 1,000 MW.
- Turbine Type: 2 to 6 adjustable speed pump-generating units.
- Maximum Project design flow: 50,000 CFS.
- Head: 280 to 360 feet (average = approx. 300 feet).
BANKS LAKE PUMPED STORAGE PROJECT
FACTS & FIGURES (cont.)

- Powerhouse: Located on the west side of Lake Roosevelt just upstream of Grand Coulee Dam and near the BOR’s existing Keys pump-generation plant.
- Estimated average annual generation: 1,430,000 Mwh.
- Upper Intake/Reservoir: Banks Lake.
- Lower intake/Reservoir: Lake Roosevelt.
- Transmission Interconnection: Grand Coulee Dam 230 kV or 500 kV switchyards.
BANKS LAKE PUMPED STORAGE PROJECT

NEED FOR THE PROJECT

- Construction of base load power plants has slowed
- Increase of non-dispatchable intermittent generation resources (Wind Plants, Solar Panels) are stressing the grid
- Utilities need to meet State imposed renewable portfolio standards
- Early retirement of two large coal-fired power plants in the region due to environmental reasons and potential retirement of others in the near future.
- Installation and operation of gas fired combustion turbines may be limited due to greenhouse gas emission restrictions
- Additional electrical capacity needed in 2019 - 2021
UNIQUE CHARACTERISTICS OF THE BANKS LAKE PUMPED STORAGE PROJECT

- The Project would not require the construction of any new dams/reservoirs.
- Both of the Project’s upper and lower reservoirs have very large storage capabilities relative to other proposed PNW pumped storage facilities.
  - Banks Lake active storage = 715,000 acre-feet.
  - Lake Roosevelt active storage = 4,200,000 acre-feet.
- The Project would utilize adjustable-speed pump/generators which would allow the plant’s pumping load to be varied in real-time (in addition to being able to vary generation output in real-time).
- The Project might have the capability to provide back-up pumping services to the BOR’s existing Keys pump-generation plant.
- The Project would be used in coordination with Keys, Grand Coulee, and may be integrated into Mid-Columbia Hourly Coordination.
The Project would have the ability to conduct energy shifting/arbitrage operations across a weekly timeframe.

- Under normal operations the Project would only shift water (on a short-term basis) between FDR reservoir and Banks Lake.

The Project would have a very long (for a hydro pumped storage plant) sustained peaking capability due to the large size of the upper reservoir (Banks Lake).

- The Project could generate at its maximum capacity of 1,000 MW for approximately 35 continuous hours assuming a maximum five foot drawdown at Banks Lake.

The Project would have the capability of rapidly releasing water into Lake Roosevelt that could in turn be utilized to supplement discharges thru Grand Coulee Dam.
Supplemental Flow operations could occur during periods when Grand Coulee Dam is approaching or at its daily draft limit.

Supplemental Flow operations could be utilized to increase the energy and sustained peaking capability of the PNW hydro system from Grand Coulee Dam and downstream dams during regional power system stress events (i.e. high loads, generation/transmission outages, etc.)

Overall observation: Due to the above noted characteristics, the Banks Lake Pumped Storage Project can likely provide a greater level of overall value as compared to similarly sized pumped storage plants.
POWER MARKET ASSESSMENT
FOR THE PACIFIC NORTHWEST REGION

- Current Status of the Wholesale Power Markets
- Near-Term Wholesale Power Market Assessment
- Long-Term Market Assessment
- Potential WECC/PNW Energy Imbalance Market Formation
- Management of Variable Intermittent Resources/Need for Additional Grid Flexibility Services
- Potential Role of New Hydro Pumped Storage Plants in the PNW
POWER PRICE FORECASTS

Energy Price Forecasts
- Energy price forecasts at the Mid-Columbia were used to value the energy-shifting capabilities of the Project.
- 2025 average energy prices:
  - Off-peak/nighttime - $39.43/Megawatt hour
  - On-peak/daytime - $49.61/Megawatt hour

Capacity and Ancillary Services Price Forecasts
- Capacity price forecasts for the PNW region were used to value capacity-for-load, ancillary services, and Grand Coulee supplemental flow operations.
- 2025 average capacity prices:
  - Low scenario - $9.43/Kilowatt-month
  - High scenario - $10.55/Kilowatt-month
PROJECT REVENUE FORECASTS

- Four categories of forecasted Project revenues:
  - Energy Shifting/Price Arbitrage
  - Firm Capacity for Meeting Peak Loads
  - Ancillary Services (i.e. transmission grid flexibility services)
  - Grand Coulee Supplemental Flow Benefits

- Overall Forecasted Power Revenue Summary for 2025:
  - Energy Shifting $15.8 M - $20.2 M
  - Firm Capacity for Load $113.2 M - $126.6 M
  - Ancillary Services $34.0 M - $38.0 M
  - Grand Coulee Supplemental Flows $8.5 M - $9.5 M
  - Total Project Revenues $171.5 M - $194.3 M
PROJECT COST ESTIMATES

- Preliminary cost estimates for the Banks Lake Pumped Storage Project: $3–4 billion.

- Relatively high tunneling costs may partially offset the advantage of not having to construct any new dams or reservoirs.

- Additional cost of having to construct full intake structures (including fish screens and trash racks) at both the upper and lower reservoirs.

- The cost of adjustable speed pump/generators is approximately 20-25% higher than the cost of comparably sized single-speed units.
## PRELIMINARY PROJECT COST/BENEFIT ANALYSIS

### 40 YEAR NET PRESENT VALUES

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Conditions</th>
<th>Net Present Value ($M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low Revenue/Low Costs</td>
<td>+1,169.66</td>
</tr>
<tr>
<td>2</td>
<td>Low Revenue/High Costs</td>
<td>+132.15</td>
</tr>
<tr>
<td>3</td>
<td>High Revenue/Low Costs</td>
<td>+1,815.94</td>
</tr>
<tr>
<td>4</td>
<td>High Revenue/High Costs</td>
<td>+778.43</td>
</tr>
</tbody>
</table>
### GENERIC COSTS AND ASSUMPTIONS
FOR THE COST BENEFIT ANALYSIS

<table>
<thead>
<tr>
<th>Cost Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax Free Financing Rate (%)</td>
<td>4.25</td>
</tr>
<tr>
<td>Financing Period (years)</td>
<td>40</td>
</tr>
<tr>
<td>Annual Plant Cost Escalation Factor (%)</td>
<td>2.00</td>
</tr>
<tr>
<td>NPV Discount Rate (%)</td>
<td>4.00</td>
</tr>
<tr>
<td>Project Capital Cost – Low Case ($M)</td>
<td>3,000</td>
</tr>
<tr>
<td>Project Capital Cost – High Case ($M)</td>
<td>4,000</td>
</tr>
<tr>
<td>2010 Project Fixed + Variable O&amp;M Costs ($/Mwh)</td>
<td>4.37</td>
</tr>
<tr>
<td>2010 Project A&amp;G as a Percent of O&amp;M (%)</td>
<td>35</td>
</tr>
<tr>
<td>2010 Project Capital Replacement Costs ($M)</td>
<td>10.00</td>
</tr>
<tr>
<td>Annual Project Generation (Mwh)</td>
<td>1,430,153</td>
</tr>
</tbody>
</table>

Note: Capital replacement costs are forecasted to occur in Project Years 19-22 only.
POTENTIAL PURCHASERS OF CAPACITY, ENERGY AND ANCILLARY SERVICES FROM THE PROJECT

- Investor Owned Utilities
- Public Power Entities
- Power Marketers
- Independent Power Producers
- California Independent System Operator
PROJECT TRANSMISSION INTERCONNECTION

- Proposed Project Transmission Interconnection Point(s)
- Project Interconnection Studies
- BPA Transmission Service
- BPA Generator Interconnection Service
- BPA Line and Load Interconnection Service
PROJECT CONTRACTS AND AGREEMENTS

- Long Term Power Purchase Agreements
- Transmission Interconnection Agreement
- BPA/BOR Operational Coordination Agreements
- Grand Coulee Supplemental Flow Operations
- Mid-Columbia Hourly Coordination
ENVIRONMENTAL AND REGULATORY CONSIDERATIONS

**Environmental**
- Resource concerns by agencies
- Studies to be performed: fisheries, habitat, RT&E, water quality, recreation, cultural resources, other...
- Water availability/allocation analysis (irrigation)

**Regulatory**
- FERC/BOR regulatory coordination & MOA
- Preliminary Permit – Extension Request in 2016
- Advancement of licensing is necessary to meet deadlines
- Begin consultation with agencies, tribes, and stakeholders
GRANT, TAX AND LOAN OPPORTUNITIES

- No apparent Grants available for Pumped Storage Projects at this time, but will continue to seek them out.
- Due to the size and technology (Hydro) of the Project, it is not eligible for Production Tax and Investment Tax Credits.
- DOE Loan Programs Office (LPO) – Financial Terms
  - $4 Billion In Remaining Loan Authority
  - LOAN GUARANTEE: A loan guarantee can support debt from a commercial lender or the U.S. Treasury
  - LOAN TENOR: Long-term financing is available based on the useful life of the asset – up to 30 years
  - INTEREST RATES: Interest rates set based on equivalent U.S. Treasury rate plus a credit-based spread (~0.5-1.5%)
  - EQUITY: LPO can only guarantee up to 80% of the total project cost. Most projects have at least 35% equity
  - CO-LENDING: Co-lending with commercial lenders is encouraged but not required
GRANT, TAX AND LOAN OPPORTUNITIES (cont.)

- DOE Loan Programs Office (LPO) – Eligibility
  - INNOVATIVE TECHNOLOGY
    - Eligible projects must utilize new or significantly improved technology or systems
  - GREENHOUSE GAS BENEFITS
    - Eligible projects must reduce, avoid, or sequester greenhouse gases
  - LOCATED IN THE U.S.
    - Eligible projects must be located in the United States but may be foreign-owned
  - REASONABLE PROSPECT OF REPAYMENT
BARRIERS/CHALLENGES TO THE BANKS LAKE PUMPED STORAGE PROJECT DEVELOPMENT

- High initial capital cost.

- Relative long development timeline (approx. 7-10 years).

- Relatively large up-front investments needed to proceed from the pre-feasibility stage to feasibility to design stage.

- The Project’s overall cost will be highly dependent upon site-specific conditions (especially geological) that have not yet been fully evaluated.

- Existing operational and/or environmental constraints at Lake Roosevelt and Banks Lake.
BARRIERS/CHALLENGES TO THE BANKS LAKE PUMPED STORAGE PROJECT DEVELOPMENT (cont.)

- CBHP must secure the cooperation of the BOR, BPA, the Upper Columbia River Tribes and other partners/stakeholders.

- Pumped storage plants in general are very complex to analyze from both an operational and economic perspective.

- Valuation of the capacity and ancillary service products that the Project can provide is challenging due to the lack of liquid spot and forward markets for these products in the PNW region.

- The Project will need to enter into one or more long-term contracts with off-takers in order to secure bond financing.
NEXT STEPS:

- Based on the results of the pre-feasibility study:
  - Continue to meet with the BOR and BPA to discuss operational issues, transmission interconnection, and Lease of Power Privilege Agreement.
  - Meet with regional utilities to gauge level of interest.
  - Perform more detailed valuation studies that include potential regional benefits.
  - Begin preliminary engineering evaluation.
  - Refine Project costs.
  - Initiate stakeholder consultation/begin environmental scoping for project licensing and permitting.
  - Submit applicable filings to the FERC.
  - Continue discussions with FERC regarding project jurisdiction and possible license requirements.
THANK YOU

Tim Culbertson – Secretary Manager
Larry Thomas – Assistant Manager

P.O. Box 219
457 1st Avenue NW
Ephrata, WA 98823

(509) 754-2227