Wind, Spill and Chief Joseph Dam

Adam Price
Seattle District
September, 2012

Images from USACE Image database

US Army Corps of Engineers
- Power Market Management
  - Balancing
  - Reserves
- Wind
  - Market Penetration
  - Balancing Reserves
- Wind and Spill
  - Wind Variability
  - Effect at dams
  - Remediation
BPA – a Balancing Authority

- The Balancing Authority provides all services required to interconnect a generating resource.
- Total generation must be equal to total power demand at all times (e.g. maintain load/resource balance and frequency).
- Assure adequate reserves to cover contingencies and balance intermittent generating resources.
Balancing Authority - Reserves

- Contingency Reserves
  - At any instant, 5% of hydro plus 7% of thermal generation must be held in reserve.
  - At least half of the contingency reserve obligation must be physically spinning.
  - Reserve pooling reduces the individual BA’s reserve obligation.
  - Upward reserve only, and only deployed when a qualified contingency occurs.
Balancing Authority - Reserves

- Balancing Reserves
  - Reserve obligation is based on covering 99.5% of the combined load and intermittent generation variability.
    - Amount is a function of the installed intermittent generating resource capacity.
  - Bidirectional Reserves
    - Covers increases [INCs] and decreases [DECs] in generation.
  - Constantly deployed to maintain load/resource balance.
Balancing Authority - Reserves

Reserve Requirements on the Federal Columbia River Power System

Chart: BPA
Current and Expected Installed Wind Capacity within the BPA BA

Forecast of Renewable Projects Connected to BPA Grid based on Existing Queue and Recent Trends

Low Likely High

Renewable Generation Forecast (MW) for Interconnection Projects to BPA Grid (Oct 1 - Sept 30)
(Note: Graph represents MW forecasted for interconnection and commercial operation date, some may not be in BPA BAA)

NOTES:
1. Projections beyond FY12 may be impacted or delayed due to a need for Transmission system expansion.
2. Projected totals based on previous experience and present growth factors including Production Tax Credits and RPS Demand.
3. Generation shown is interconnected to BPA-T; amount within BPA Balancing Authority Area is not estimated.

S. Enyeart As of: 11/0/2011
Wind Turbine Gen Curve

Typical wind turbine power output with steady wind speed.
Wind - Variability

BPA Balancing Authority Load & Total Wind, Hydro, and Thermal Generation, Last 7 days
30Aug2012 - 06Sep2012 (last updated 5Sep2012 12:21:56)

Based on 5-min readings from the BPA SCADA system for points 45583, 79587, 79582, and 79585
Balancing Authority Load in Red, Wind Gen. in Green, Hydro Gen. in Blue, and Thermal Gen. in Brown
Click chart for installed capacity info
BPA Technical Operations (TOT-DpInfo@bpa.gov)
BPA BAA WIND FLEET GENERATION

EXAMPLE OF GENERATION IMBALANCE AFFECTING HYDRAULIC OPERATIONS

Chart: BPA
Hydro as Reserve

[Diagram showing various hydroelectric sites along the Columbia River, including The Dalles, Bonneville, John Day, Priest Rapids, McNary, Wanapum, Chief Joseph, Grand Coulee, and Arrow Lakes.]
Some impacts of increased wind penetration

- Projects must operate to greater hourly minimum discharges
- Projects must operate to lower hourly capacities
- Projects “on response” will see larger fluctuations in actual generation
- Project may need to spill more to provide reserves
- Scheduling of out-of-service periods requires more coordination.
Spill at Chief Joseph

Image from USACE Image database
Gas Abatement: Flow Deflectors

- Since 1995, FCRPS Biological Opinions require gas abatement at GCL/CHJ
- Flow Deflectors and CJD were determined to be the most cost efficient means for gas abatement
- Project construction was completed in 2008
Flow
Deflectors

Image: Adam Price
Gas Abatement: Results

![Graph showing total dissolved gas saturation versus unit spillway discharge for 2009 with deflectors and 1999 without deflectors.](image)
Opportunities for innovation

- BPA

Huge Thanks to Steve Barton, BPA