

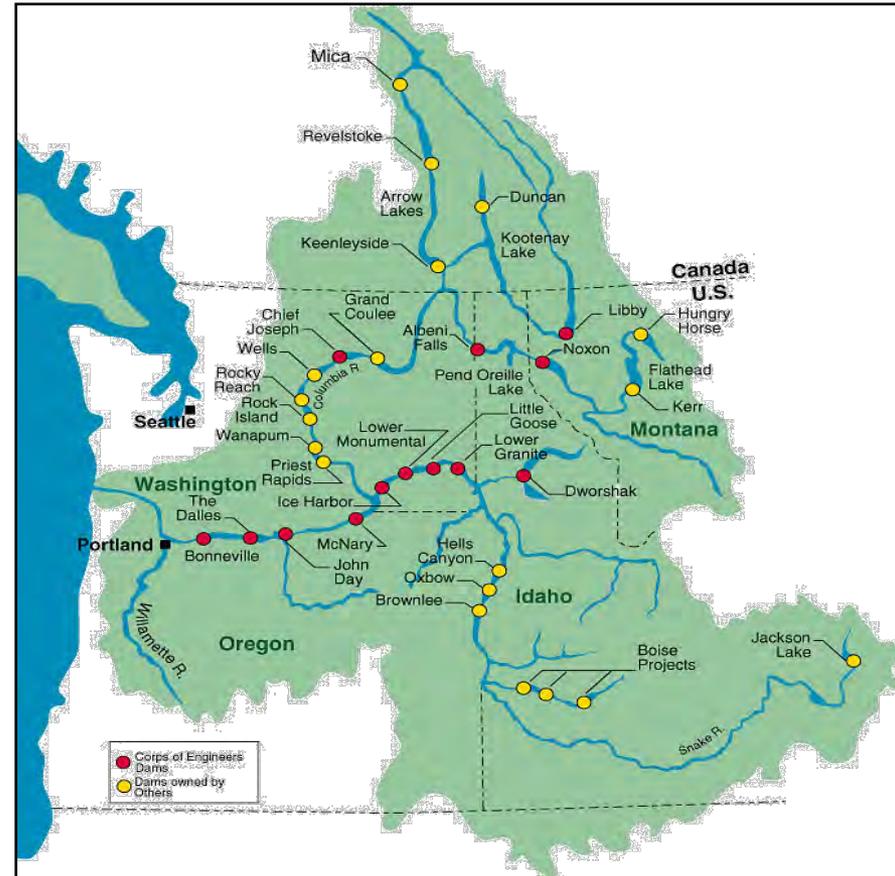
# Pumped Storage Update

May 16, 2012



# Introduction to BPA

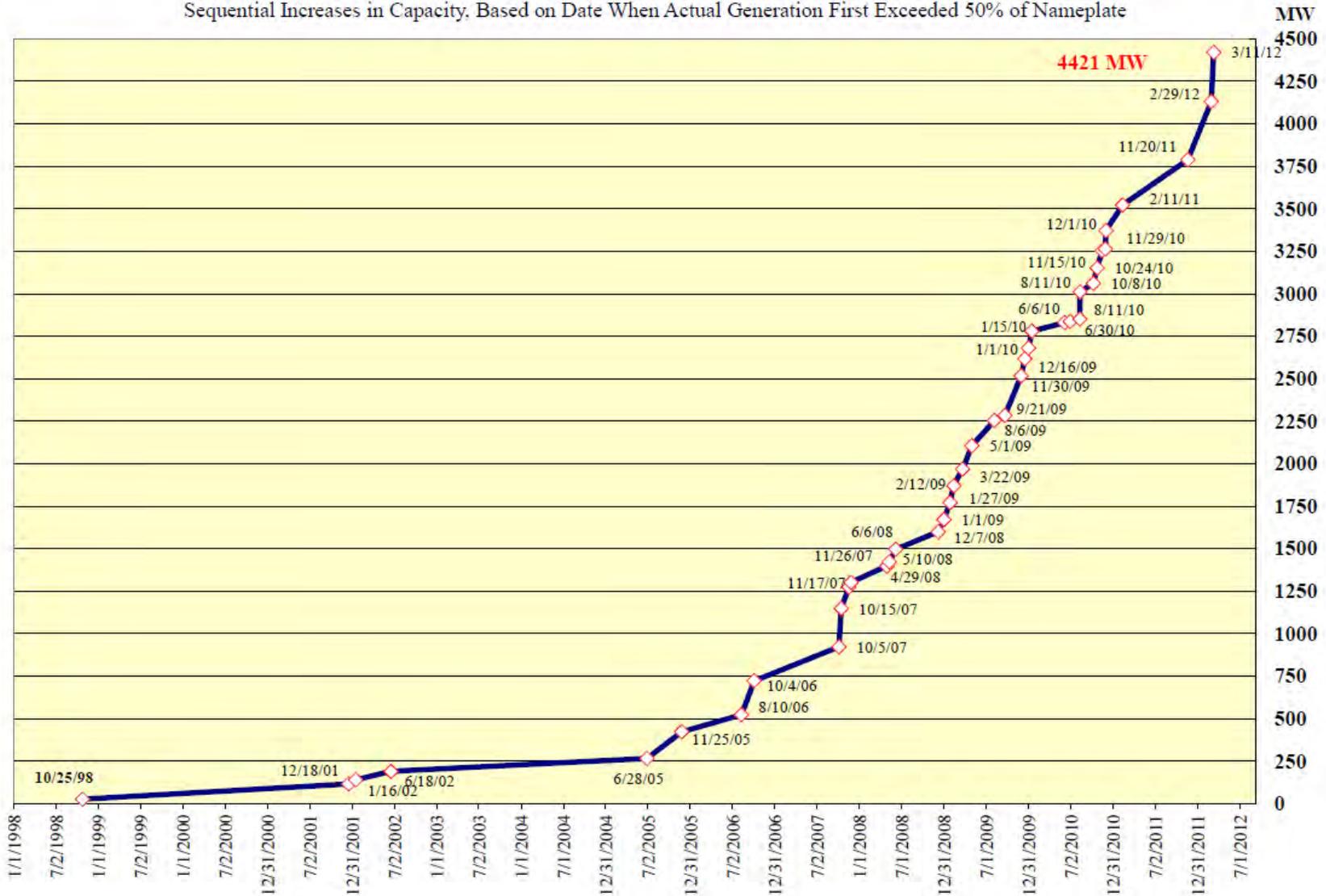
- Federal Columbia River Power System (FCRPS):
  - BPA markets power from 31 Federal Hydropower Plants (21 COE/10 BOR)(6,195 avg. MW; about 22,000 installed MW), Columbia Generating Station Nuclear Plant and some non-Federal hydro and wind.
  - More than 80% of the power BPA sells is hydroelectric.
  - BPA accounts for about 33% of the electric power consumed within the Region.



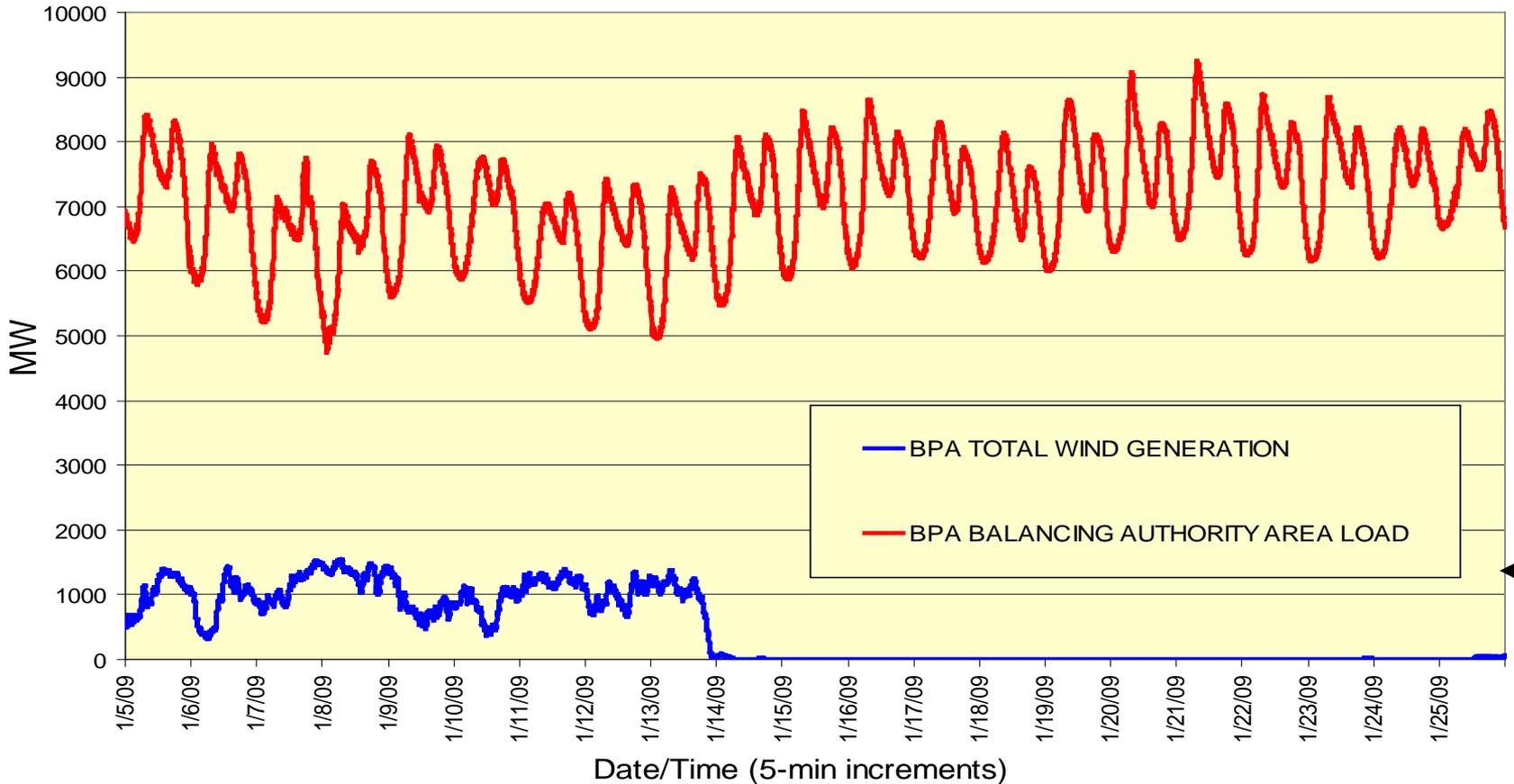
# Renewable Energy Growth

## WIND GENERATION CAPACITY IN THE BPA BALANCING AUTHORITY AREA

Sequential Increases in Capacity, Based on Date When Actual Generation First Exceeded 50% of Nameplate



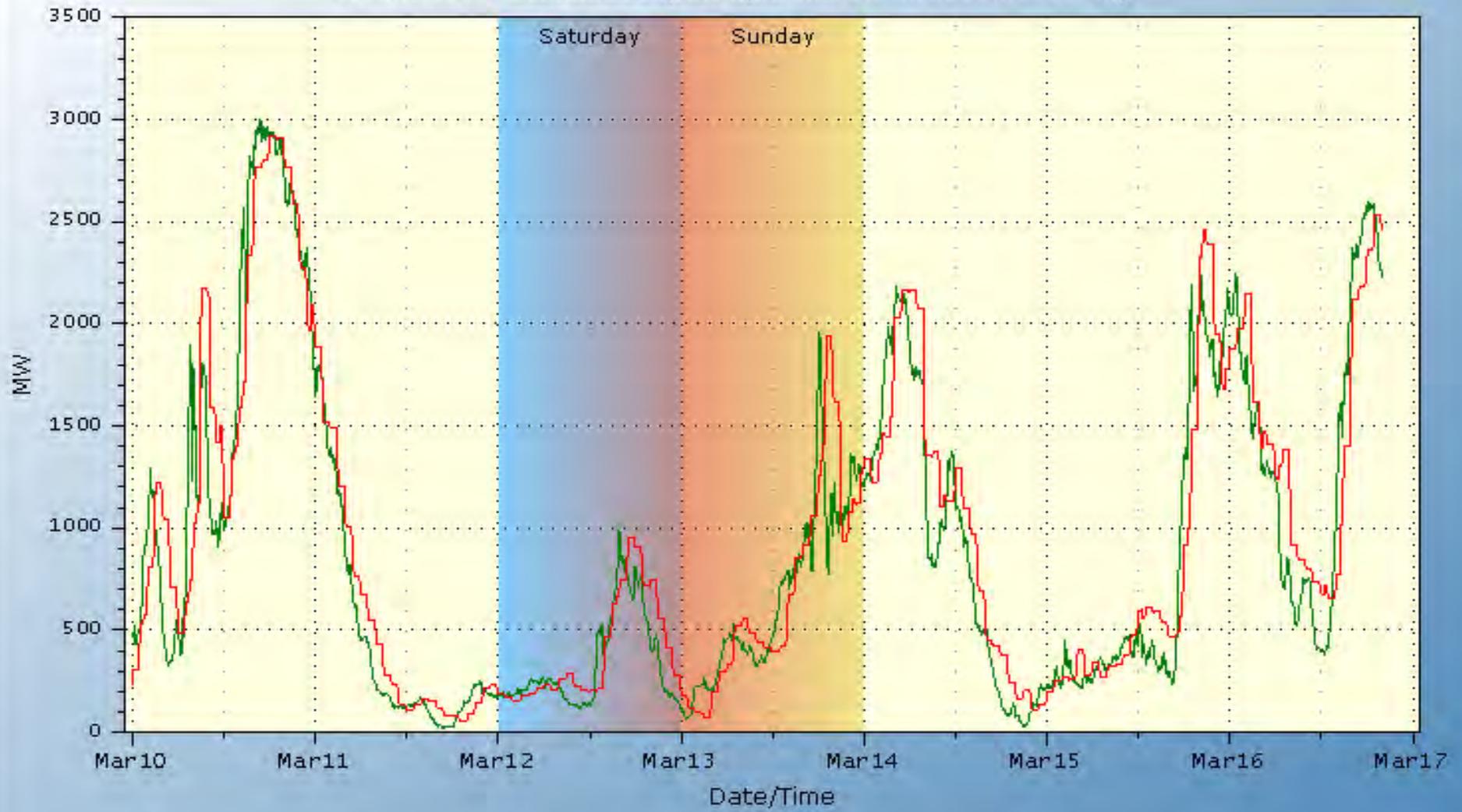
## BPA Balancing Authority Area Load & Total Wind Generation Jan. 5-25, 2009



Wind started coming back on Jan 26 and peaked at nearly 1600MW on Jan 29.



BPA Balancing Authority Total Wind Generation and Wind Basepoint, Last 7 days  
 10Mar2011 - 17Mar2011 (last updated 16Mar2011 20:11:43)

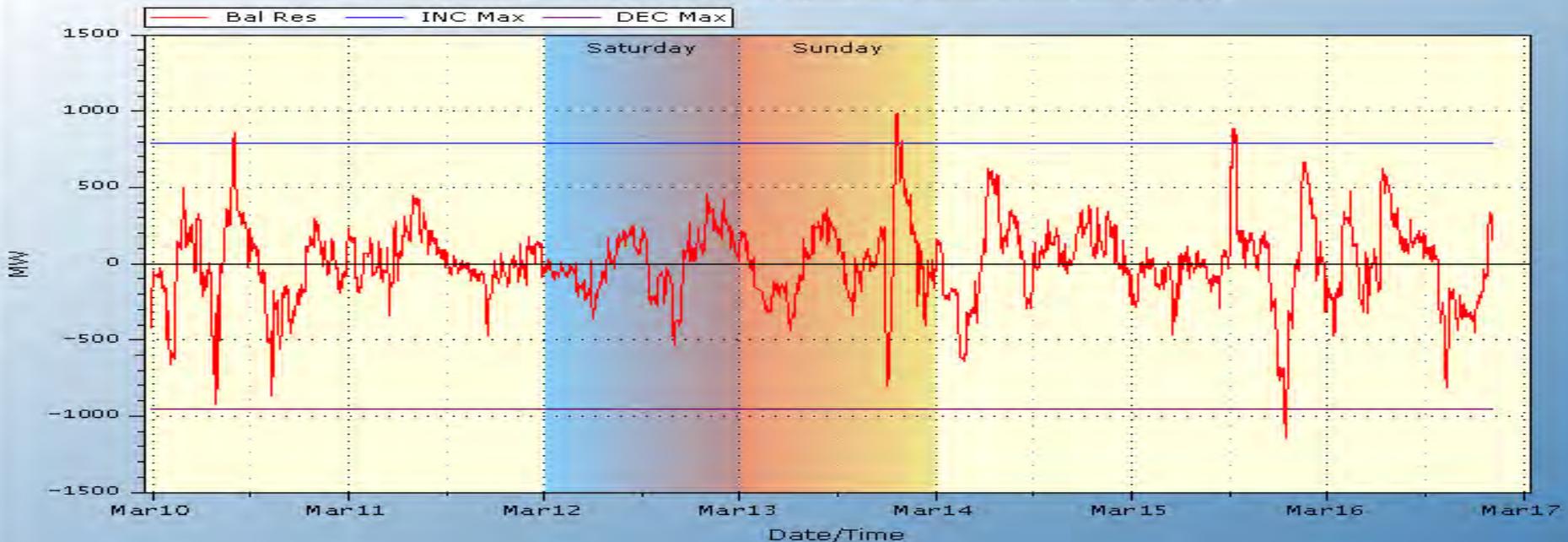


Based on 5-min readings from the BPA SCADA system for points 79687, 103349  
 Balancing Authority Wind Generation in Green, Wind Basepoint in Red; Installed Wind Capacity=3522 MW  
 BPA Technical Operations (TOT-OpInfo@bpa.gov)

BPA Balancing Authority Total Wind Generation and Wind Basepoint, Last 7 days  
 10Mar2011 - 17Mar2011 (last updated 16Mar2011 20:11:43)



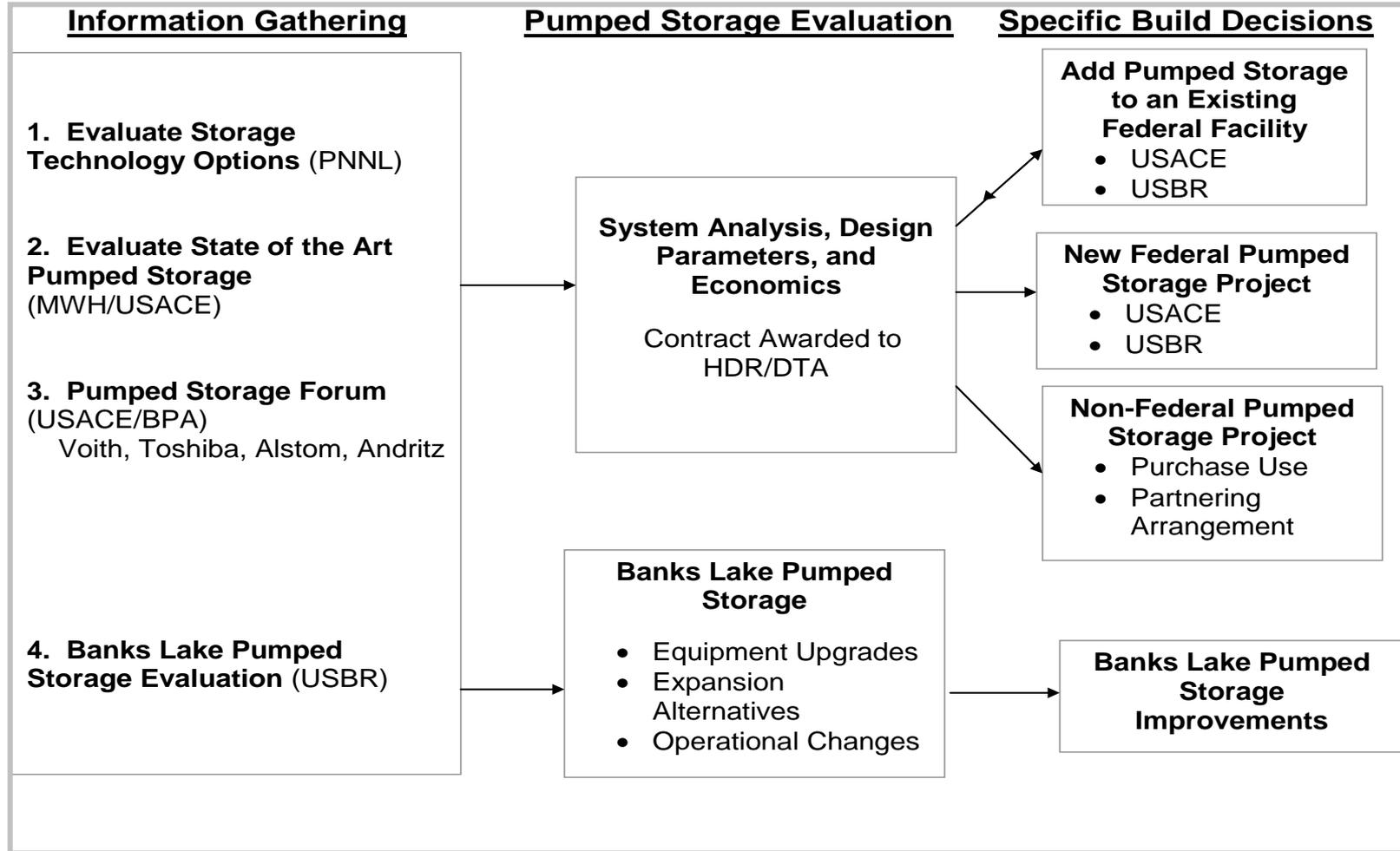
BPA Balancing Reserves Deployed, Last 7 days  
 10Mar2011 - 17Mar2011 (last updated 16Mar2011 20:21:45)



# Pumped Storage Evaluation – Overall Plan

Summer-Fall 2009

Fall 2009 - Present

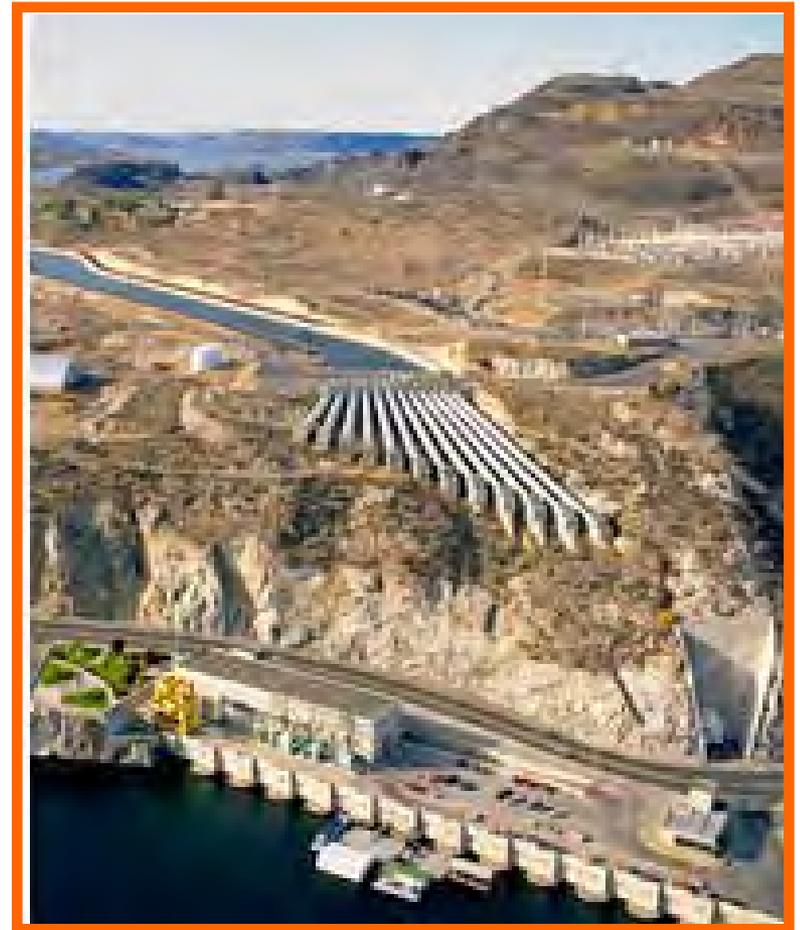
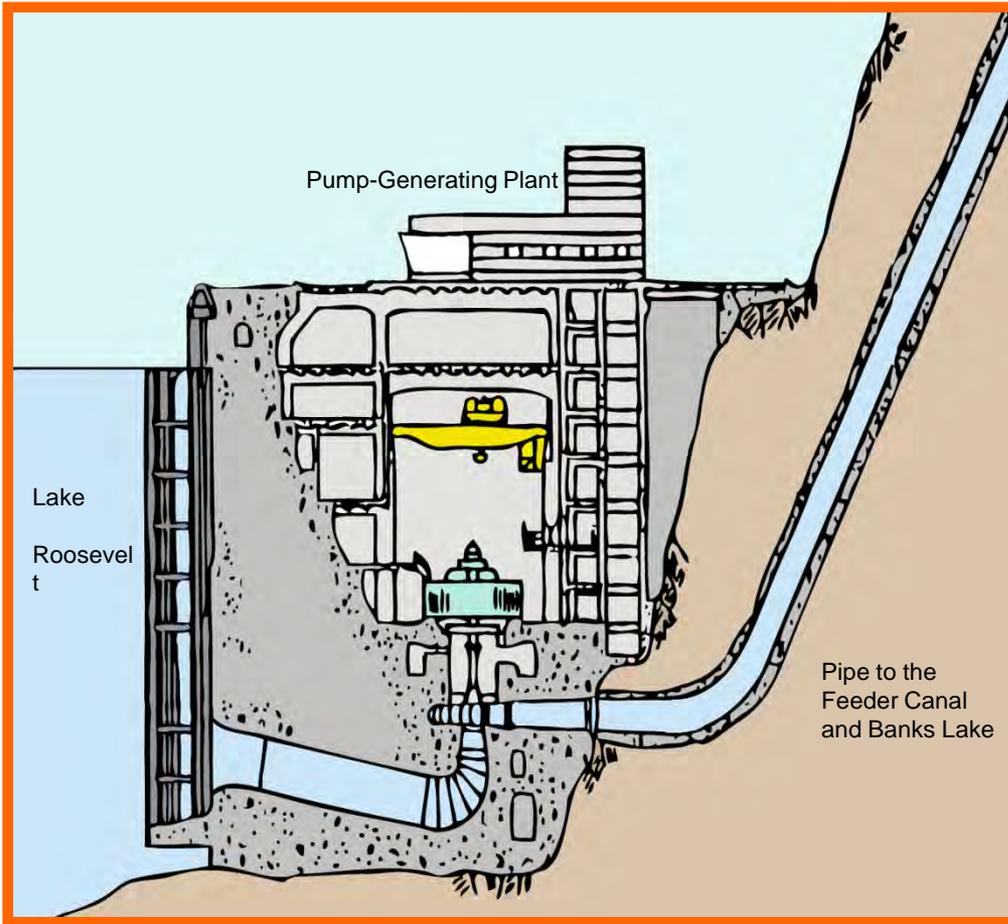


# John W. Keys III Pump Generating Plant

- Original installation in 1951
  - Six 50 MW pumping units
  
- Upgrade in 1973
  - Two 50 MW pump/generators installed
  
- Upgrade in 1983-84
  - Four 53.5 MW pump/generators installed
  
- Current Capacity
  - Pumping – 12 Units 614 MW
  - Generating – 6 Units 314 MW



# Reclamation's John W. Keys III Pump Generating Plant at Grand Coulee



# Keys Pump-Generating Plant Assessment

NEPA/NHPA Studies – Reclamation EA complete March 2012

## Reclamation's TSC and HDR Recommendations Under Evaluation:

- **Modernization**

- Excitation
  - Governors
  - Unit Controls and Protection
  - PG Phase Reversal Switches
  - PG Unit Circuit Breakers
  - Main Step-up Transformer & Transformer Disconnect Switches
  - Station Service Upgrades
  - Miscellaneous Balance-of-Plant refurbishment
- Preparation of the Specifications are 90% complete – January 2012

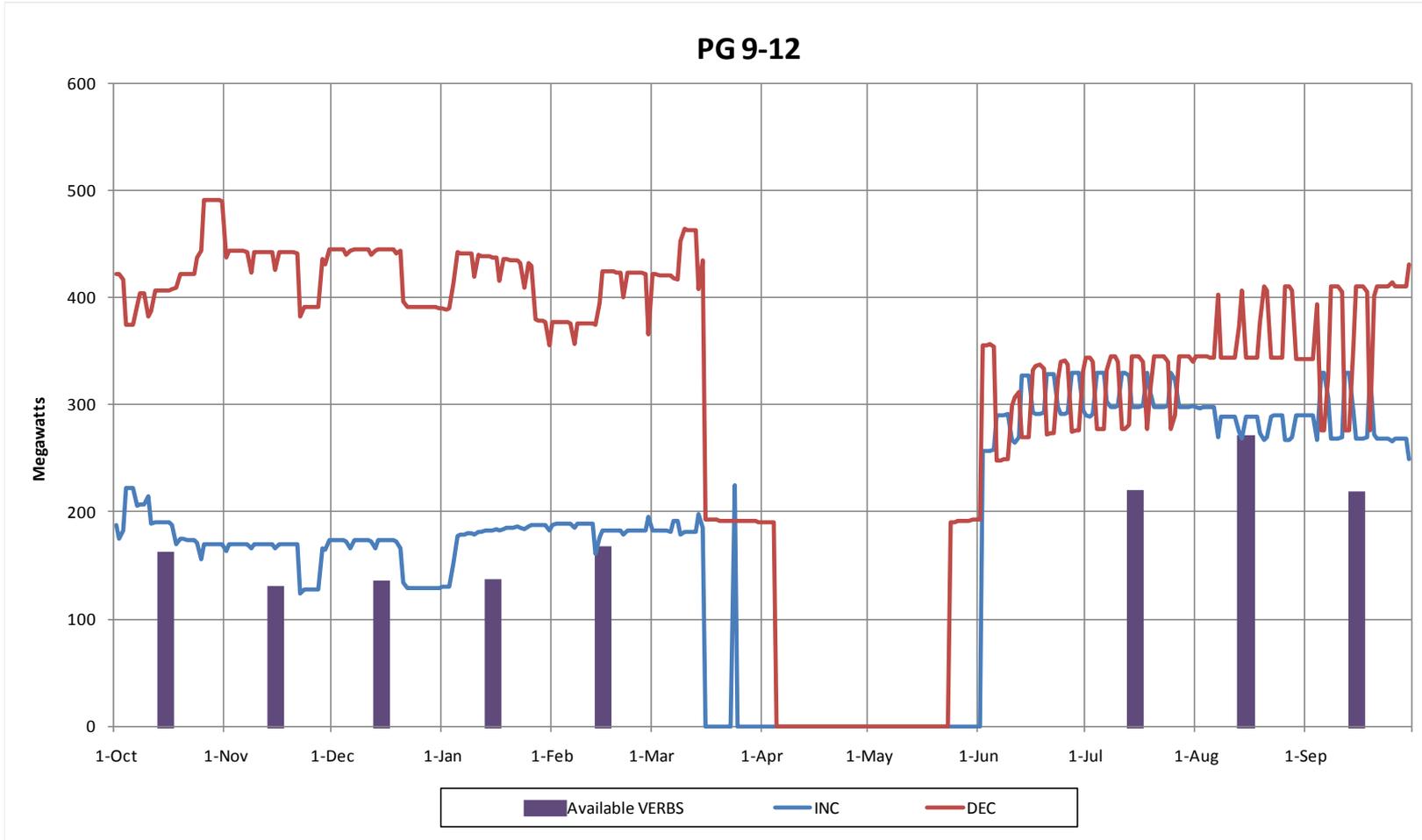
- **Upgrade of Pump-Generator Units 7-12**

- PG7 & 8 Wicket Gate Operating Mechanism Improvements
- Increase the operating head range of PG7-12 to be more consistent with the pump head range
- PG7-12 Rewinds

- **Decouple Pumps from GCL Left Powerhouse**

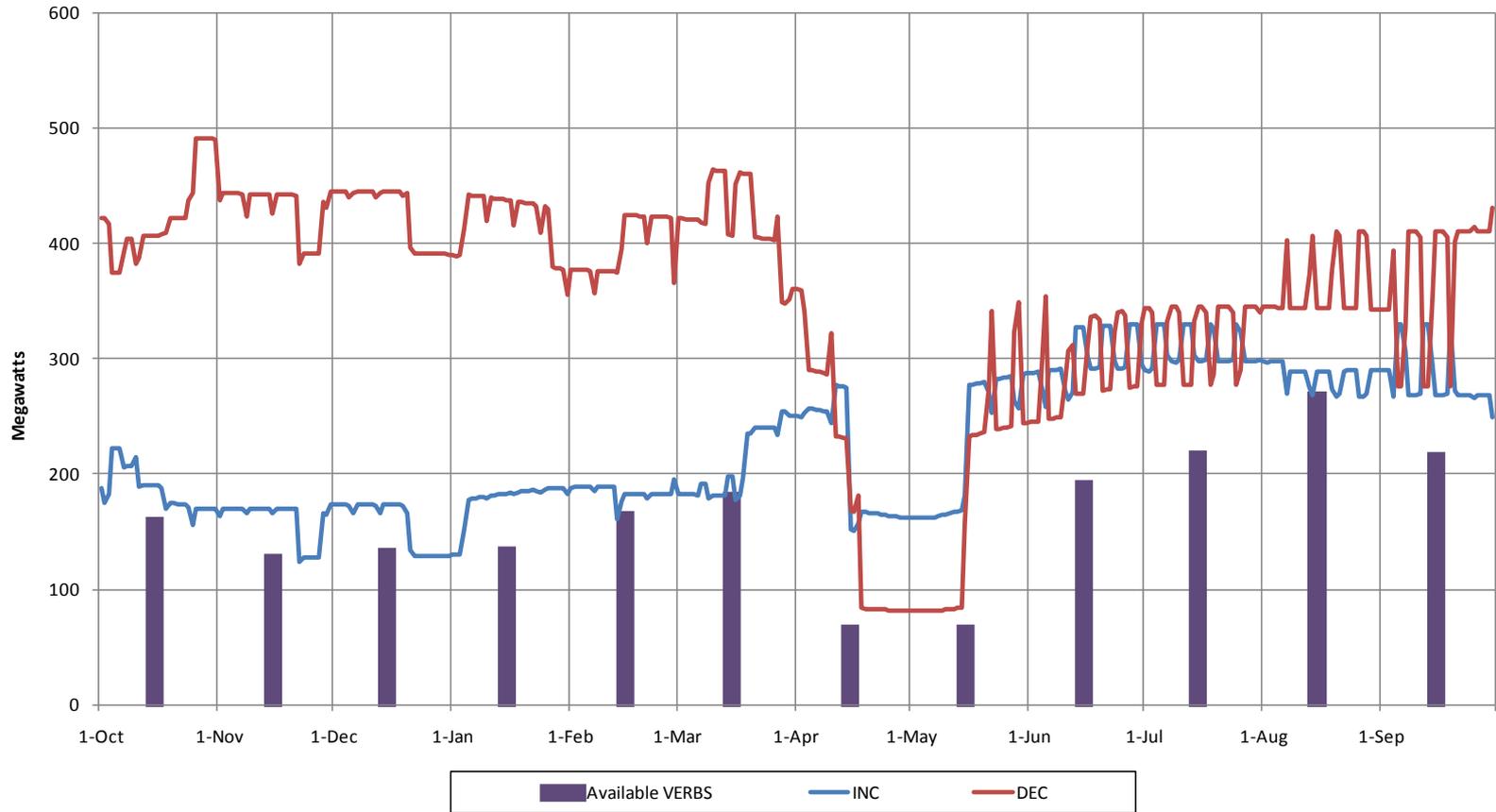
- TSC is studying several options in FY12

# Sample Model Run



# Sample Model Run (Continued)

## Decoupling



# HDR/DTA Report – Greenfield Pumped Storage Examples

Project Feature/Characteristic	Project X1 **	Project X2 **
<b>Upper Reservoir:</b>	<b>New off-channel reservoir</b>	<b>New off-channel reservoir</b>
Storage Volume (ac-ft) ▶	15,000 ▶	1,550,00
Active Surface Area (acre) ▶	282 ▶	11,750
Dam Height (ft.) ▶	150 ▶	780
Max. Water Surface Elev. (msl) ▶	2,436 ▶	2,159
<b>Lower Reservoir:</b>	<b>New off-channel reservoir</b>	<b>Existing Columbia River reservoir</b>
Active Storage Volume (ac. ft.) ▶	15,000 ▶	1,550,00+
Surface Area (acres) ▶	209 ▶	80,000
Max. Water Surface Elevation (msl) ▶	624 ▶	1,290
Approx. Net Head (ft.) ▶	1,700 ▶	870
Conveyance Length (ft.) ▶	4,800 ▶	10,560
Plant Capacity (MW) ▶	1,050 ▶	1,136+
Units Sizes/Number ▶	250/4 ▶	282/4
Est. Annual Generation (GWh) * ▶	1,560 ▶	1,760
Est. Annual Pumping (GWh) * ▶	1,950 ▶	220
Transmission Line Length (ml.) ▶	5.0 ▶	7.5
Est. Capital Cost (Million \$, 2010) ▶	2,733 ▶	2,500
Cost per installed MW (Million \$) ▶	2,603 ▶	2,200



# Questions ?

