Pumped Hydro
Lost Opportunity

Pumped Hydro Lost Opportunity

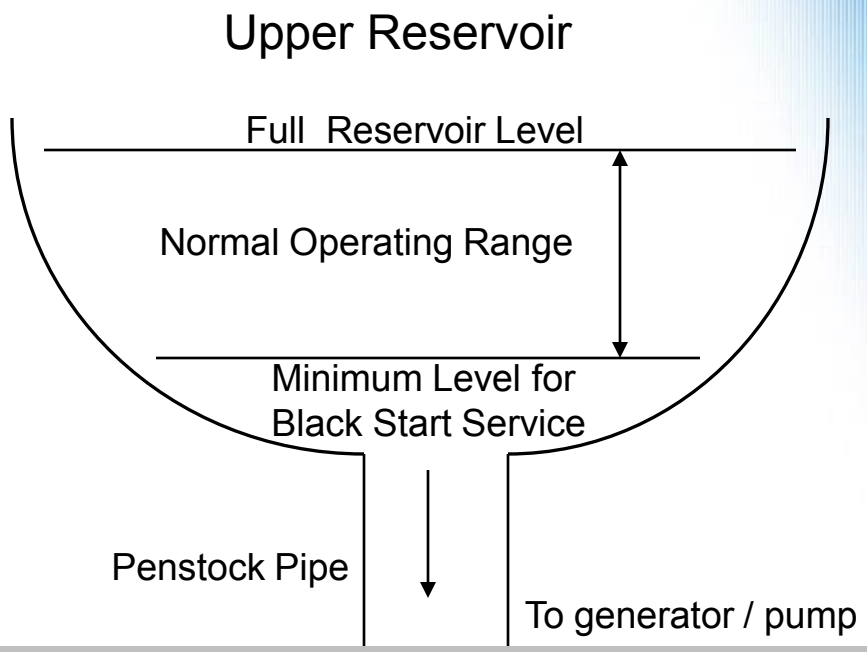
A Pumped Hydro unit which maintains a minimum water level for Black Start Service is basically being required to withhold MWH from the market without compensation

The water level maintained for Black Start Service can be equated to a specific quantity of MWH that could be injected into the market

These MWH would produce revenue and margin for the generation owner

Pumped Hydro unit

- A minimum Reservoir Level is maintained on a daily basis to provide Black Start Service to PJM



Model Assumptions

- Optimize plant generation and pumping to maximize financial margin
  - Analysis of reservoir with current limitations
  - Analysis of reservoir with an added water capacity in feet
  - LMP values were historical from Nov. 2009 to Oct. 2010 for Seneca Plant

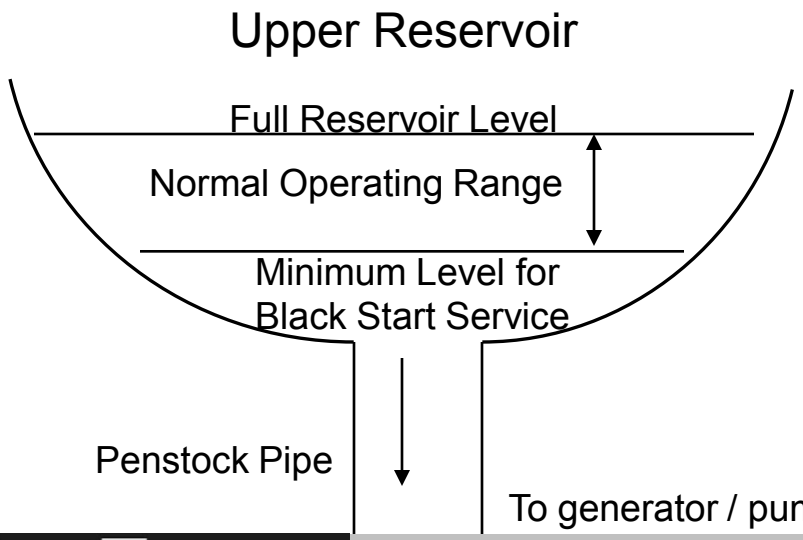
Model Assumptions

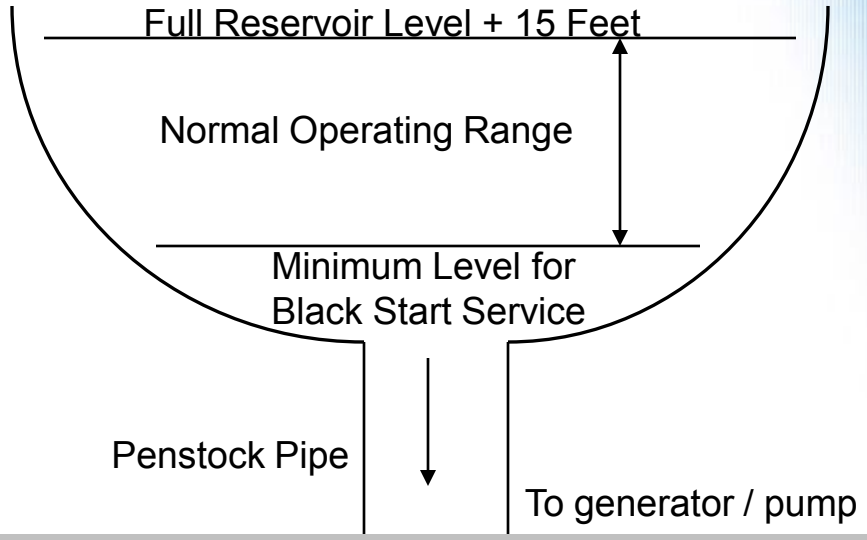
Base Case

- The unit is dispatched based on the cost and quantity of the MWH available in the reservoir for the Normal Operating Range
- The cost is defined as the average of the off-peak LMP price divided by the pump efficiency
- Units stop generating when the water level reaches the minimum level

Base Case + 15 Feet

- Simulate the 15 feet of water retained for Black Start Service by adding the equivalent MWH that correspond to 15 ft of water
- Units stop generating when the water level reaches the minimum level

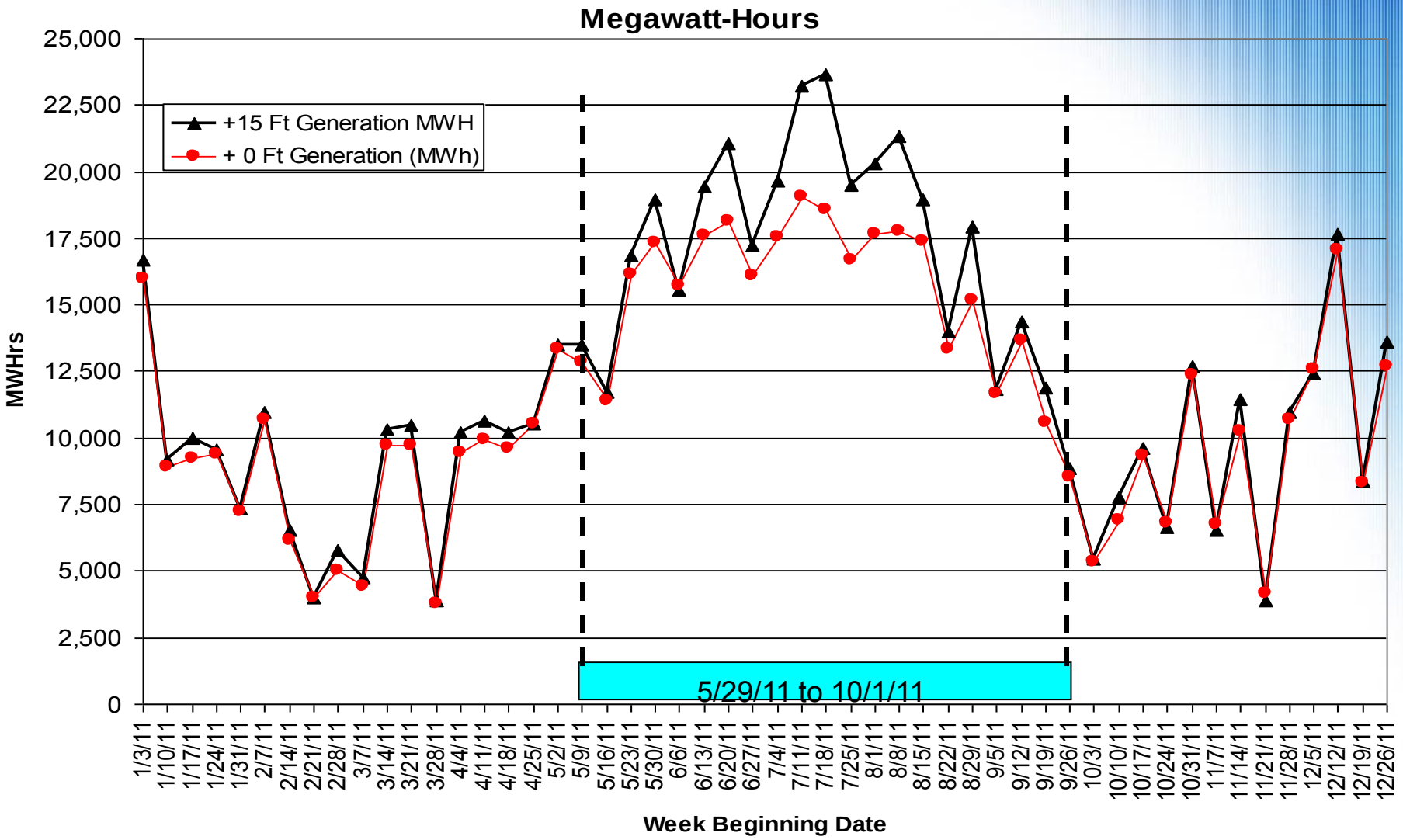




Model Output

- Difference between cases
  - MWH about 50,000
  - Margin/Lost Opportunity was positive and will be shown later in the presentation
  - A $/MWH margin value was calculated and was used later in the analysis

Megawatt-hour (weekly)



Model Development

- Appears to be site characteristic specific
  - Reservoir volume
  - Generating capacity
  - Pumping capability
  - Pump efficiency
- One model/equation may not represent all pumped hydro units

Pumped Hydro Characteristics

- Water capacity in feet
- Generating rate in MWH per foot of water
- Daily generating capacity in MWH
- Generating capacity of installed units
- Hours/time available to run at full load
- Pumping capacity in feet per hour per pump
- Hours/time required to fill the Reservoir

LMP determination

- The average Off Peak LMP value was calculated based on standard off peak hours (8) plus Saturdays and Sundays
- The Average Off Peak LMP was divided by the pump efficiency to establish the cost to pump water back to the upper reservoir
- Next the $/MWH margin value was added to the cost to pump LMP to determine the LMP value to use for establishing the number of days the reservoir could be drained
- The average On Peak LMP value was based on the highest 8 hours of LMP (for each day the reservoir could be drained) since the reservoir can be drained in just under 8 hours at full load

Days available to drain the reservoir, Base case + 15 Ft

- Using the cost to pump plus the Margin LMP the number of days the reservoir could be emptied was determined to be 50 days when looking at the entire year
- For the time frame of May 29 to Oct 1 a total of 40 days were identified where the reservoir could be emptied based on the cost to pump plus the Margin LMP

Results

- Using the equation:

$/Year = Lost MWH * (On peak LMP – Off peak LMP/pump efficiency)

Where Lost MWH are defined as:

Lost MWH = # of days/year * Water rate in MWH/ft * Number of feet

The values shown below are representative values but are for example use only.

Using this equation for the annual and summer cases the following results are achieved:

Annual ➔ 50 days/yr * 50 MWH/ft * 15 ft * (80.00 – 40.00/.7)$/MWH = $857,143

Summer ➔ 40 days/yr * 50 MWH/ft * 15 ft * (81.00 – 38.00/.7)$/MWH = $801,429

Recommendation

- It is recommended that a new section be added to the Black Start Service formulaic rate (Schedule 6A) to include the Lost Opportunity associated with pumped hydro units retaining water for Black Start Service

- This new section would contain a decision point to use this Lost Opportunity methodology or the Fuel Cost Storage methodology. The generation owner can pick which methodology to use but it is an exclusive decision. Both methods can not be claimed for the same period.