

McKay's Operating Parameters and Collierville Economics Overview



**Portfolio and Pool
Administration
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Presentation Overview

- 1) McKay's Operational Parameters and Constraints - Historic
- 2) The Market Problem
- 3) McKay's Operational Parameters and Constraints - Updates
- 4) Economics of Flexible Reservoir Storage
- 5) Spilling Economically

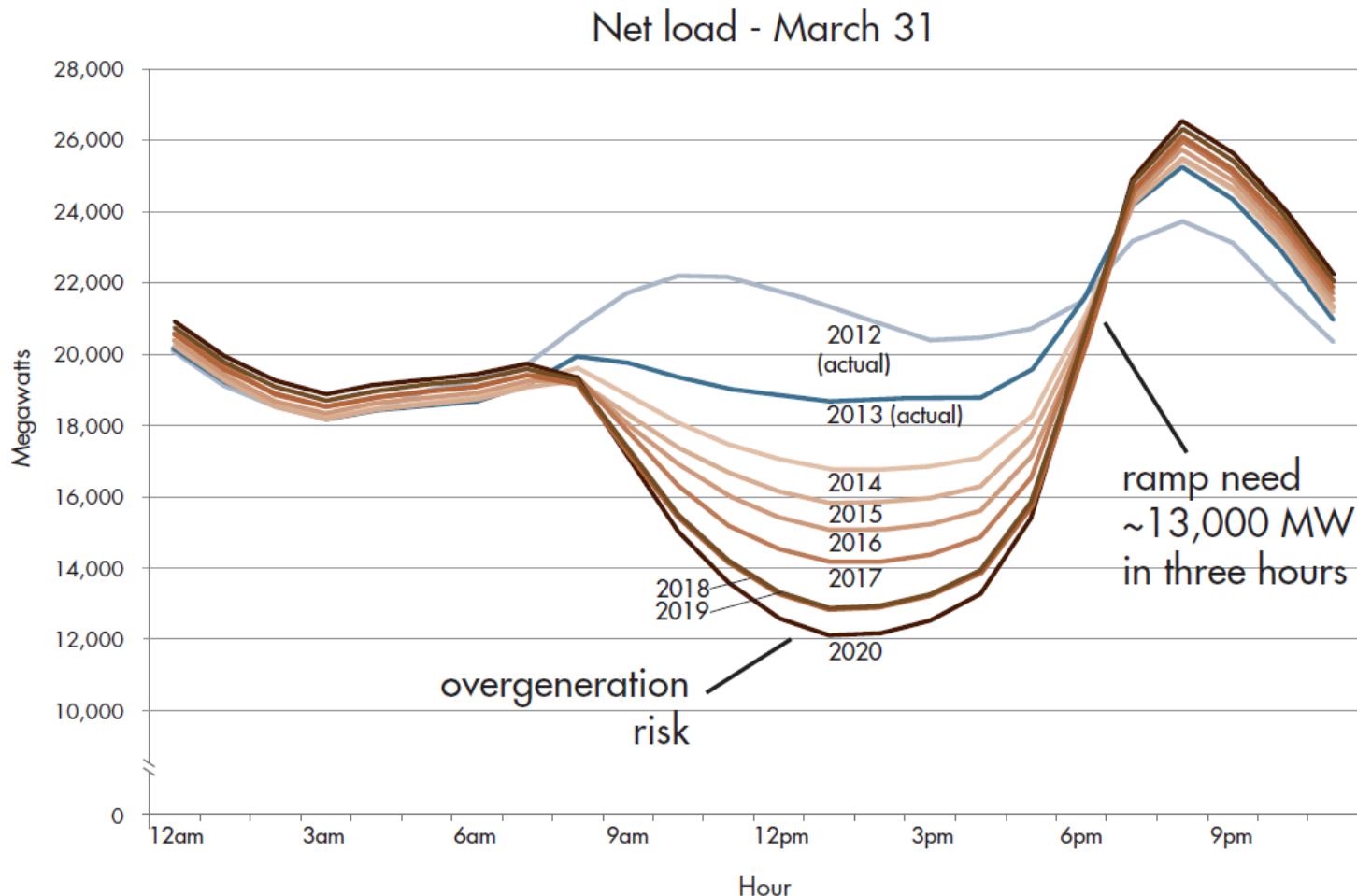
Historic Operational Parameters

Historical Elevation Operational Parameters

- Maintain McKays' elevation between ~3350-3360 feet.
- Traditional dispatching of Collierville limited to Day-Ahead market generation and A/S opportunities (Co-Optimization within the Day-ahead Market)
- Preserve the 2% efficiency premium when operating above 3,360 feet
- Prevention of spilling at McKays



The Market Problem



Operational Parameters and Constraints – Updates

| <u>McKay's Elevation Ranges</u> | <u>Incremental Acre-ft</u> | <u>Incremental MWH</u> | <u>Operational Constraints</u> |
|---|--------------------------------|----------------------------|--|
| 3370' + | | | Spill Point <ul style="list-style-type: none"> - @ or above 3370' |
| 3369' – 3360' | 327 | 643 | High Elevation Operating Range <ul style="list-style-type: none"> - Optimal range for efficiency - ~2% efficiency increase over lower elevations |
| 3359' – 3345' | 456 | 897 | Normal Elevation Operating Range <ul style="list-style-type: none"> - decreasing efficiency at lower elevations |
| 3344' – 3340' | 140 | 275 | Low Elevation Operating Range <ul style="list-style-type: none"> - @ 3340' NCPA Dispatch emails notification to NCPA Hydro of operation at low elevation |
| 3339' – 3330' | 241 | 474 | Minimum Elevation Operating Range <ul style="list-style-type: none"> - Lowest elevation levels for use in economics - @ 3330' NCPA Dispatch calls NCPA Hydro for permission to proceed to a lower elevation. - Before granting permission NCPA Hydro staff will assess risk of intake obstructions and all other operational constraints. |
| 3329' – 3319' | 234 | 460 | Emergency Operating Range <ul style="list-style-type: none"> - Only during extreme events approved by Management can lower elevation to this range - @ 3319' NCPA Dispatch calls NCPA Hydro for clearance to proceed to a lower elevation |
| 3318' – 3311' | 156 | 307 | Operations Dept Normal Low Elevation for Operating Reserve <ul style="list-style-type: none"> - @ or below 3318' - Consider as operational hard limit |
| 3310' – 3306' | 97 | 191 | CCWD no longer able to take from tap <ul style="list-style-type: none"> - @ or below 3310' |
| 3305' – | 133 | 262 | Min Pool Level to obtain 2hr full load operating reserve <ul style="list-style-type: none"> - @ or below 3305' |

McKay's Operating Ranges and Strategies

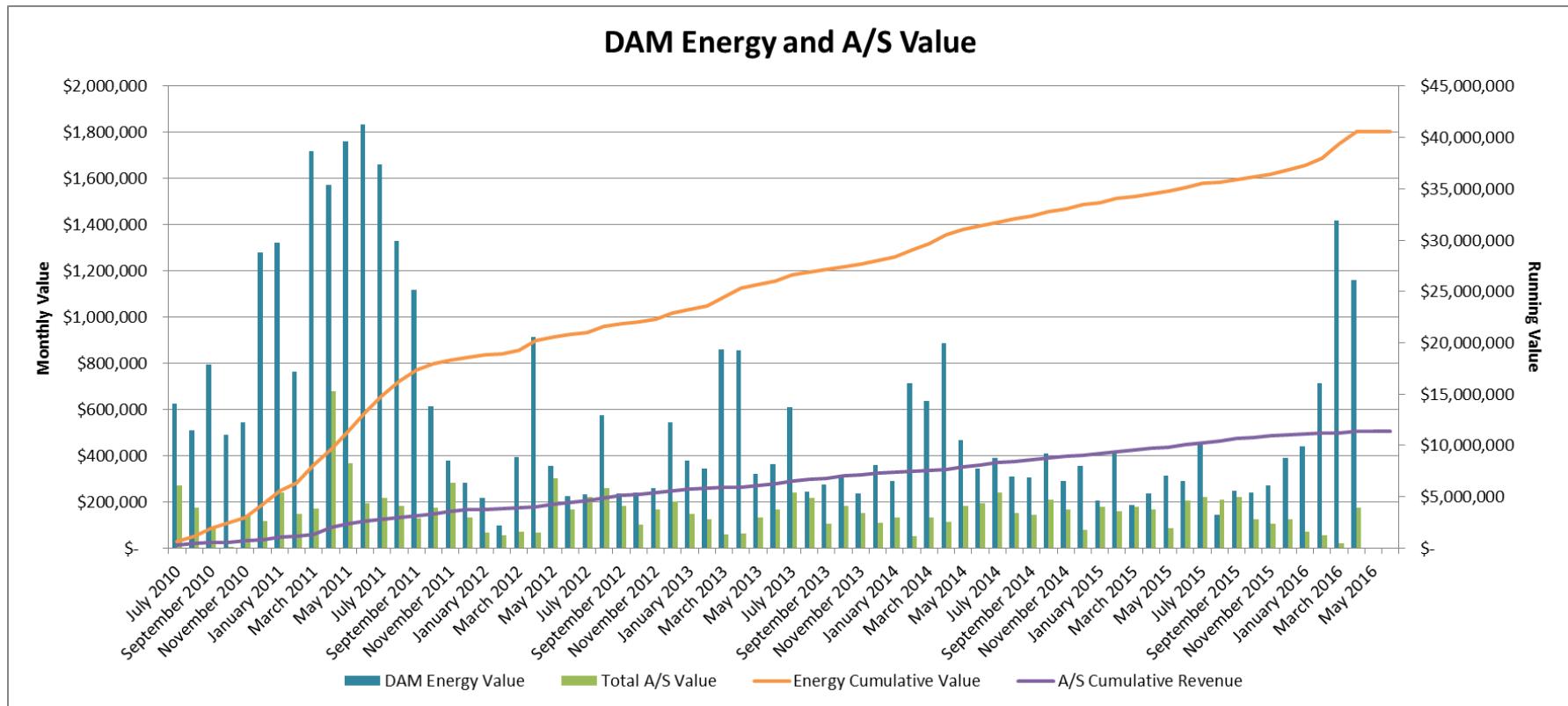
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High Elevation
Operating Range
(need increased generation)

Normal Elevation
Operating Range
(generate for economics)

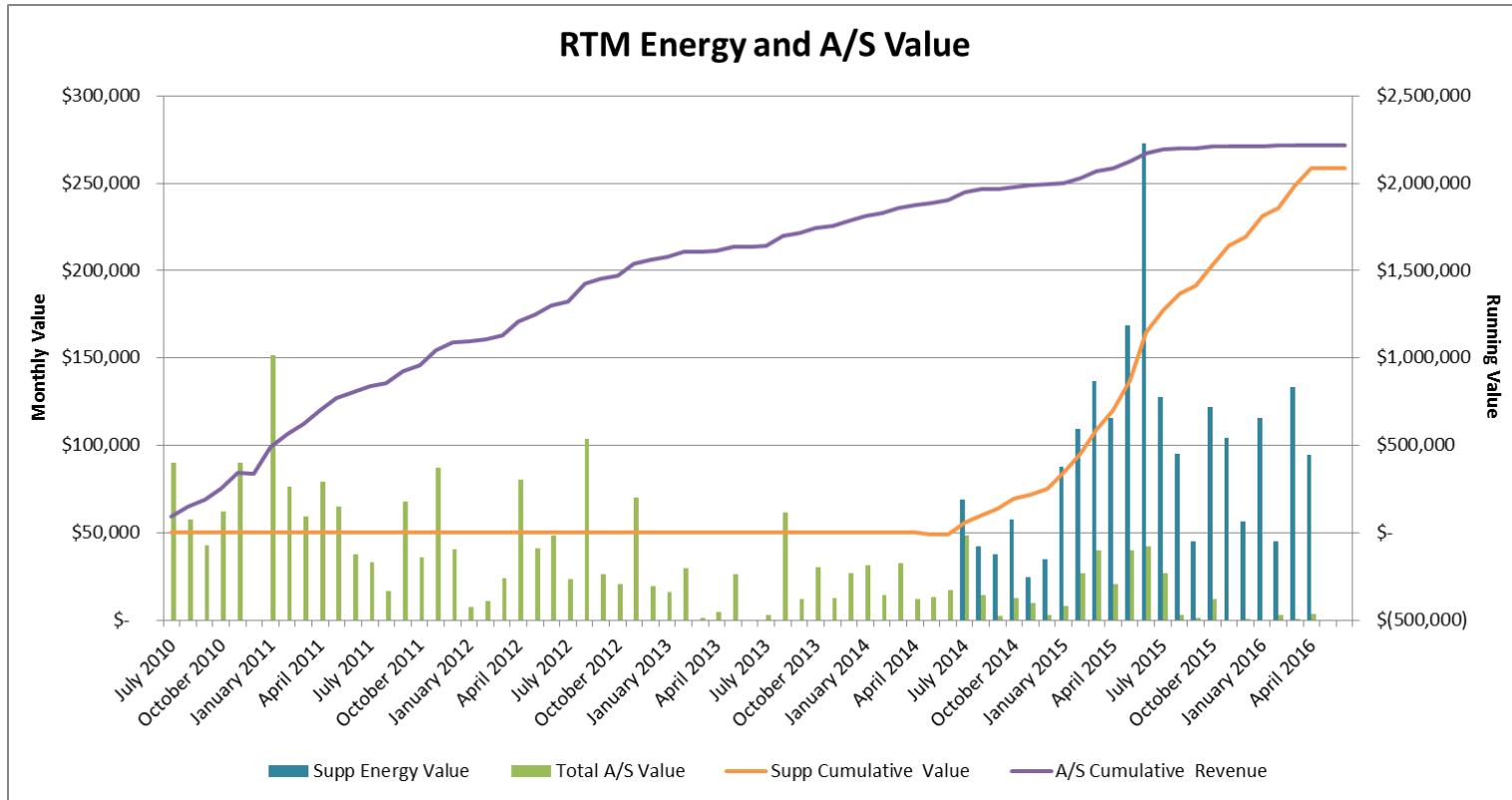
Low Elevation
Operating Range
(need reduced generation)

Economics of Flexible Reservoir Storage



| DAM Awards (\$) | | |
|--------------------|-------------------------|------------------------|
| Row Labels | Sum of DAM Energy Value | Sum of Total A/S Value |
| 2011 | \$ 13,213,301 | \$ 2,596,834 |
| 2012 | \$ 7,581,121 | \$ 1,842,596 |
| 2013 | \$ 5,213,673 | \$ 1,821,962 |
| 2014 | \$ 5,368,786 | \$ 1,810,649 |
| 2015 | \$ 3,707,594 | \$ 1,964,389 |
| 2016 | \$ 5,471,243 | \$ 1,322,883 |
| Grand Total | \$ 40,555,719 | \$ 11,359,313 |

Economics of Flexible Reservoir Storage



| RTM Awards (\$) | | | |
|--------------------|--------------------------|------------------------|--|
| Row Labels | Sum of Supp Energy Value | Sum of Total A/S Value | |
| 2011 | \$ - | \$ 805,743 | |
| 2012 | \$ - | \$ 492,991 | |
| 2013 | \$ - | \$ 337,871 | |
| 2014 | \$ (11,143) | \$ 266,688 | |
| 2015 | \$ 1,155,580 | \$ 266,813 | |
| 2016 | \$ 939,773 | \$ 47,661 | |
| Grand Total | \$ 2,084,211 | \$ 2,217,767 | |

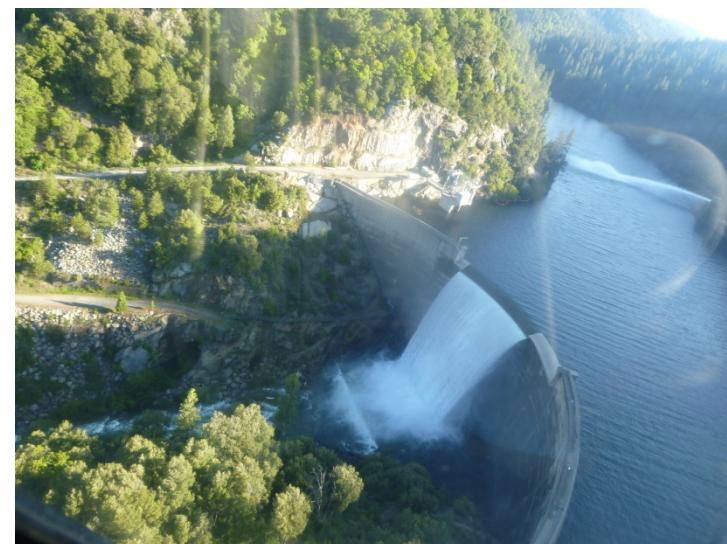
Spilling at McKays

Spilling Economically

- Spilling due to A/S Prices greater than energy prices
- Spilling because energy prices are \$0 or less

Spilling for Maintenance

- Debris removal reducing maintenance costs



Questions and Comments?