Northwest **Power** and **Conservation** Council

August 6, 2019

MEMORANDUM

TO: **Power Committee Members**

FROM: **John Fazio, Senior System Analyst**

SUBJECT: **Estimating System Adequacy Requirements**

BACKGROUND:

Presenter: John Fazio

Summary: In preparation for the 2021 Power Plan, staff will be providing the Power Committee a series of presentations on different aspects to developing the Plan. This presentation describes how the Council's resource adequacy standard will be incorporated into the development of the 2021 plan. First, the associated system capacity contribution (ASCC) for all resources is assessed. The ASCC is the net capacity provided by a resource when added to a power supply with storage. Next, the Council's five percent loss of load probability adequacy standard is translated into and adequacy reserve margin (ARM). The ARM is the amount of surplus (both peak and average) over expected load required to ensure that a power supply is adequate (i.e. that its LOLP is not greater than five percent). Staff will present examples of how the ASCC and ARM values work.

Relevance: For the Council to develop a power plan that assures the Pacific Northwest an adequate, efficient, economical and reliable power supply, analytical tools used must incorporate the Council's resource adequacy standard. The goal is to ensure that any manifestation of the power plan's resource strategy (that is, any resulting future resource acquisitions) will yield adequate but not overbuilt power supplies.

Workplan: A.5.2 Update models to get ready for 2021 power plan modeling

More Info: None

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Estimating System Adequacy Requirements

Power Committee Meeting

August 13, 2019

John Fazio

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Adequacy Requirements
(ARM and ASCC)

- The Adequacy Reserve Margin (ARM) is the amount of surplus capacity (or energy) needed, over the expected weather-normalized peak load (or average load), to ensure adequacy, in units of percent of expected load.
- The ARM is used in the Regional Portfolio Model as the adequacy test for resource buildouts.

- The Associated System Capacity Contribution (ASCC) is the net firm capacity gained when a resource is added to a power supply with storage, in units of percent of nameplate capacity.
- ASCC values are used to calculate ARMs and to assess if a power supply meets the ARM standard.

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Associated System Capacity Contribution

- ASCC is the net firm capacity gained when a resource is added to a power supply with storage (e.g. hydroelectric system).
- During off-peak hours (conditions allowing), the added resource can be operated to replace hydro generation, which saves water
- Saved water translates into added hydro capacity
- ASCC = Resource's stand-alone capacity + Added hydro capacity

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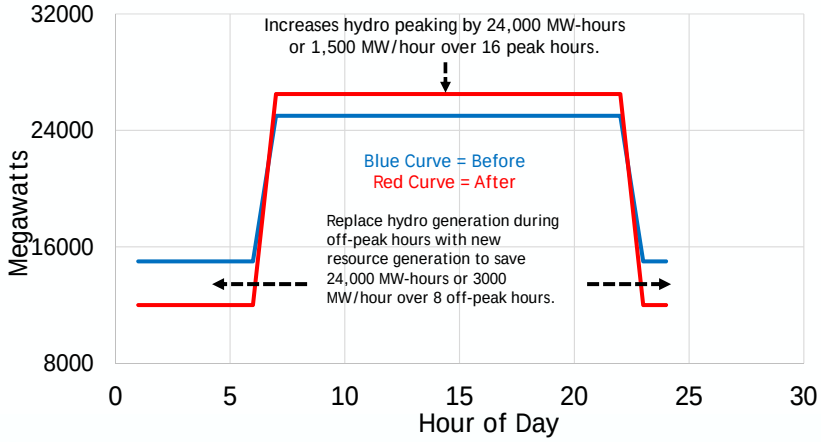
Hydro Capacity Gained with New Resource

Using Hydro Storage to Increase Capacity



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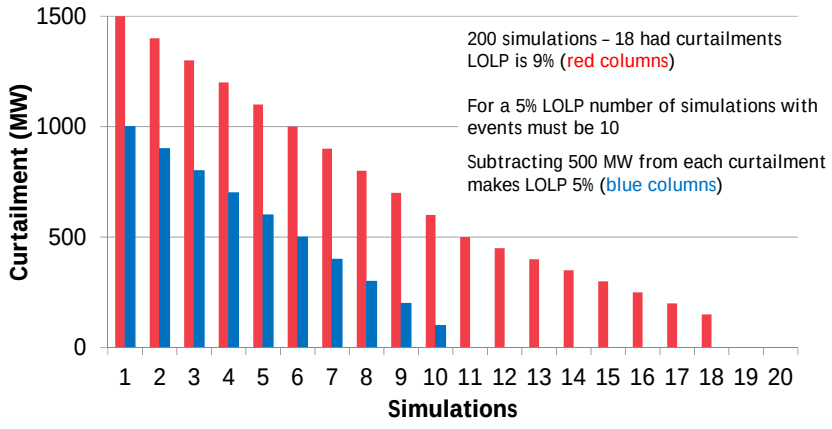
Calculating ASCC

1. Begin with an inadequate supply (i.e. LOLP >> 5%)
2. Using a simulation model, create the peak-hour curtailment duration curve (see next slide)
3. Add a new resource
4. Create the revised duration curve – it will be shifted downward, i.e. curtailments should be smaller
5. Practically speaking, the ASCC is the amount of curtailment reduction per unit of new resource capacity added
6. ASCC = reduced peak-hour curtailment / nameplate capacity

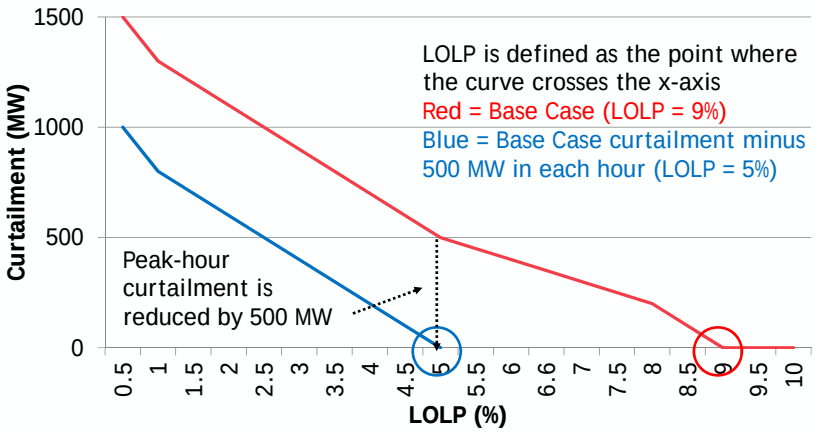
Peak-Hour Curtailment Duration Curve

(Largest hour curtailment per game, sorted highest to lowest)



Peak-Hour Curtailment Duration Curve

(Same as before but LOLP on x-axis)



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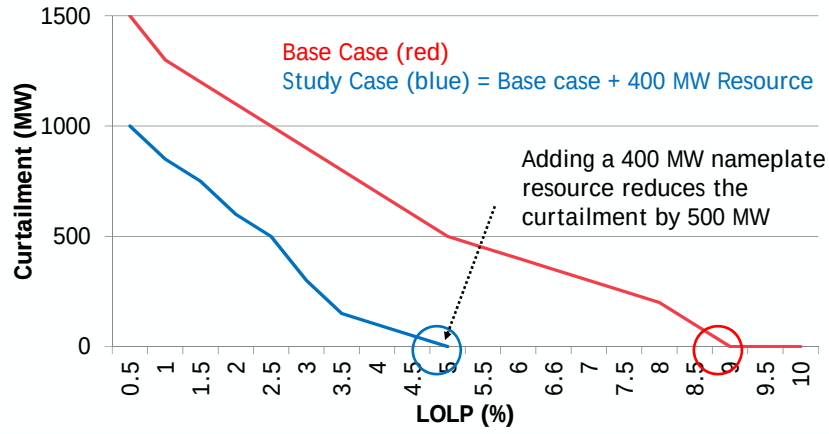
Peak-Hour Curtailment Duration Curve

(Same as before but LOLP on x-axis)



Adding a 400 MW resource reduces peak-hour curtailment by 500 MW so,

ASCC = 500/400 = 125%

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ASCC Values (%) from the 7th PLan[1,2]

Resource	Fall	Winer	Spring	Summer
Solar PV	26	81	81	42
Energy Efficiency	124	101	114	116
Wind	3	11	11	8
Gas-Fired Turbine	128	100	102	120
Geothermal	128	100	102	120

[1]The net gain in peaking capability should be attributed to the hydro system.
[2]Incremental capacity gains diminish as more resource is added.

Adequacy Reserve Margin

- The Adequacy Reserve Margin (ARM) is the amount of surplus capacity (or energy) needed, over the expected weather-normalized peak load (or average load), to ensure adequacy.
- The Council's 5% Loss-of-Load-Probability (LOLP) standard is translated into an Adequacy Reserve Margin (ARM).
- Seasonal (quarterly) ARM's are used in the Council's Regional Portfolio Model to ensure that resulting resource strategies yield adequate future power supplies.

Calculating ARMs

- The capacity ARM is calculated by subtracting the expected peak load from the aggregate capacity of a system whose LOLP is exactly 5%, divided by the load.
- The energy ARM is calculated by subtracting the expected average load from the aggregate average generating capability of a system whose LOLP is 5%, divided by the load.

- Aggregate capacity takes ASCC values into account, which include forced outage rates and maintenance.
- Expected peak and average loads are weather-normalized

- ARM_E (energy) = (average capability – average load)/average load
- ARM_C (capacity) = (peaking capacity – peak load)/peak load

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ARM_C (Capacity)

(Based on a power supply just at a 5% LOLP)

Resource Type	Adequacy Reserve Calc	Value (MW)
Thermal	Nameplate	15,000
Wind	ASCC value of 5%	250
Hydro	Lowest 10-hr sustained peak	20,625
Solar	ASCC value of 25%	125
Imports	Max per hour	2,500
Total Resource		**38,500**
Load	Peak-hour Load	35,000
ARM Capacity	**(Resource - Load)/Load**	**10%**

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Example of How the ARM_C Works

For a Future Operating Year	
Peaking capability	41,000 MW
Peak load	39,000 MW
Implied adequacy reserve	(41,000 – 39,000)/39,000 = 5%
ARM Capacity Requirement	10%
Assessment:	System is inadequate
Action:	More resource needed
Resource need = (ARM * Load) + Load	(0.1 * 39,000) + 39,000 = 42,900 MW
Incremental resource need = Resource need – peaking capability	42,900 – 41,000 = 1,900 MW

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Validating ASCC and ARMs

- From the 7th power plan, several future year resource buildouts were selected to test for adequacy
- Goal: LOLP should be between about 2% and 5% (i.e. to ensure an adequate but not overbuilt supply)
- For all tested years from the 7th plan output, the LOLP fell within the desired range.
- Without using the ASCC values, future resource mixes were always overbuilt (i.e. LOLP = 0%)

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