Meeting Agenda

- Welcome and Ground Rules
- Quick Review – Where We Are Today
- Grid Services Review
- Next Steps
Ground Rules

- Chatham House Rule will apply – no personal or organizational attribution will be made to any comments/feedback provided during the meeting by any participant nor in written documentation.

- Working group meetings, and other information exchanges are intended solely to provide an open forum or means for the expression of various points of view in compliance with antitrust laws.

- Under no circumstances shall engagement activities be used as a means for competing companies to reach any understanding, expressed or implied, which tends to restrict competition, or in any way, to impair the ability of participating organizations to exercise independent business judgment regarding matters affecting competition or regulatory positions.

- Proprietary information shall not be disclosed by any participant during any industry engagement meeting or information exchange. In addition, no information of a secret or proprietary nature shall be made available to industry engagement participants.

- All proprietary information which may nonetheless be publicly disclosed by any participant during any industry engagement meeting or information exchange shall be deemed to have been disclosed on a non-confidential basis, without any restrictions on use by anyone, except that no valid copyright or patent right shall be deemed to have been waived by such disclosure.
Objectives for Today’s Meeting

- Summarize progress made to date
- Introduce the Energy Reserve Margin Grid Service
- Review methodology for Load Build and Load Reduce Grid Services
- Review relationship between resources and grid services
Review of SEOWG Discussions

- Needs Assessment and Solution Sourcing Process (Sept 20, Nov 13)
- Fuel and Resource Costs (Jan 23, Apr 20)
- Modeling Sensitivities (Dec 9, Jan 23, Feb 12, Mar 16)
- Grid Services/Grid Needs Assessment (Dec 9, Jan 23, Apr 20, May 22)
  - Regulating Reserve Rule (Jan 23)
  - Load Build/Load Reduce (May 22)
  - Energy & Capacity-ERM (May 22)
- Solution Evaluation Methodology (Jan 23, Feb 12, Apr 20)
- Transmission Needs (Dec. 9, Jan 23, TBD)
Capacity Planning Criteria: Energy Reserve Margin
Objectives

• Introduce a resource planning criteria that analyzes contributions from diverse generating portfolio for planning purposes.

• Illustrate the concept and use of an Energy Reserve Margin criteria for capacity planning purposes.
Regulatory Background

• “The generation capacity of the utility’s plant, supplemented by electric power regularly available from other sources, must be sufficiently large to meet all reasonably expected demands for service and provide a reasonable reserve for emergencies”

Hawaii Department of Regulatory Agencies
  – Title VII – Public Utilities Commission
  – Standards for Electric Utility Service in the State of Hawaii – General Order No. 7
Capacity Planning Criteria: A Metric of Reliability

- The capacity planning criteria is a metric to evaluate if a system has the appropriate amount of electrical generating capability needed to serve consumer demand and provide a reasonable reserve for emergencies.
- All generation sources are not created equal, diversity is key.
Current Capacity Planning Criteria Issues

<table>
<thead>
<tr>
<th>Island</th>
<th>Capacity Criteria</th>
<th>Planning Consideration</th>
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</thead>
<tbody>
<tr>
<td>Oahu</td>
<td>Loss of largest unit</td>
<td>4.5 yrs/day LOLP</td>
</tr>
<tr>
<td>Hawai‘i</td>
<td>Loss of largest unit</td>
<td>20% reserve margin</td>
</tr>
<tr>
<td>Maui</td>
<td>Loss of largest unit</td>
<td>20% Reserve margin</td>
</tr>
<tr>
<td>Moloka‘i</td>
<td>Loss of largest unit</td>
<td></td>
</tr>
<tr>
<td>Lana‘i</td>
<td>Loss of largest unit</td>
<td></td>
</tr>
</tbody>
</table>

- Studies the ability to meet instantaneous peak demand.
- Challenging to properly evaluate the contributions to capacity planning from variable renewable energy resources and energy storage.
- As variable renewable and storage resources become more abundant, a reliability criteria with focus on energy rather than capacity becomes more important.
Capacity Planning Criteria Issues (continued)

Due to increasing amounts of variable generation and storage resource additions, a planning criteria must:

- Consider dynamic nature of variable resources
- Consider impacts from load shifting storage

These considerations can be achieved if evaluation and application of capacity criteria are applied to smaller periods (e.g., hourly time slices instead of one annual system peak value).
<table>
<thead>
<tr>
<th>Company</th>
<th>Planning Criterion</th>
<th>PRM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound Energy</td>
<td>LOLP: 5%</td>
<td>16% (2023 - 2024)</td>
</tr>
<tr>
<td>Avista Summer: 1,700 MW;</td>
<td>LOLP: 5%</td>
<td>22% (14% + operating reserves)</td>
</tr>
<tr>
<td>PacifiCorp</td>
<td>LOLE: 2.4 hrs/yr</td>
<td>13%</td>
</tr>
<tr>
<td>Arizona Public Service</td>
<td>One event in 10 years</td>
<td>15%</td>
</tr>
<tr>
<td>Tuscon Electric Power</td>
<td>PRM</td>
<td>15%</td>
</tr>
<tr>
<td>Public Service Co. of New Mexico</td>
<td>LOLE: 2.4 hrs/yr</td>
<td>Greater of 13% or 250MW</td>
</tr>
<tr>
<td>El Paso Electric</td>
<td>PRM</td>
<td>15%</td>
</tr>
<tr>
<td>Cleco</td>
<td>LOLE: 1 day in 10 years</td>
<td>14.8%</td>
</tr>
<tr>
<td>Kansas City Power &amp; Light</td>
<td>1 day in 10 Years</td>
<td>12%</td>
</tr>
<tr>
<td>Oklahoma Gas &amp; Electric</td>
<td>1 day in 10 Years</td>
<td>12%</td>
</tr>
<tr>
<td>South Carolina Electric &amp; Gas</td>
<td>24 to 2.4 days/10 years</td>
<td>14-20%</td>
</tr>
<tr>
<td>Tampa Electric</td>
<td>PRM</td>
<td>20%</td>
</tr>
<tr>
<td>Interstate Power &amp; Light</td>
<td>PRM</td>
<td>7.30%</td>
</tr>
<tr>
<td>Florida Power and Light</td>
<td>PRM</td>
<td>20%</td>
</tr>
<tr>
<td>California ISO</td>
<td>LOLE: 0.6 hours/month</td>
<td>15-17%</td>
</tr>
</tbody>
</table>
Criteria Selection

- Any criteria will be predicated on a set of assumptions to plan for reliable operation and provide a reasonable reserve for emergencies.
- The planning criteria should be flexible enough to maintain reliability, regardless of portfolio composition.
Energy Reserve Margin (ERM)

- Energy Reserve Margin is a planning criteria to satisfy load and plan for a reasonable reserve for emergencies.
- Energy Reserve Margin plans for reserves to mitigate impacts from contingency conditions such as:
  - Conventional resources
    - Unit derates
    - Forced outages
  - Variability from Interruptible load contribution
  - Variable resources
    - Fluctuations in generation capability
    - Prolonged poor weather patterns or atypical weather events
  - Storage
    - Battery degradation or failures
    - Paired renewable resource limitations
  - Forecast error, especially higher than forecasted load conditions
Energy Reserve Margin (continued)

(Firm Capability – Maintenance Units + Hourly Dependable Capacity + Shifted Load + Interruptible Load) ≥ Load Demand * (1+ERM)

- Available energy is compared to the load on an hourly basis.
- An hour in which the energy reserve margin is not satisfied is considered at-risk and may result in unserved energy.
Energy Reserve Margin (continued)

Hourly Available Energy

- Firm Capability
  - Maintenance
  + Hourly Dependable Capacity
  + Shifted Load
  + Interruptible Load

≥

Hourly Demand with Energy Reserve Margin

Load Demand ×

(1+ Energy Reserve Margin%)
Hourly Dependable Capacity (HDC) Definition

- Hourly Dependable Capacity is a statistically dependable output from a variable generation resource based on empirical data that can be reasonably counted on for capacity purposes.

- Hourly Dependable Capacity (in MW) could be calculated as follows:

  \[
  \text{Hourly Dependable Capacity} = \chi - N \times \sigma,
  \]

  Where \( \chi \) = the hourly mean of a variable generation resource,
  \( \sigma \) = a standard deviation,
  \( N \) = the number of standard deviations

- An hour that is two standard deviations less than the mean has an approximately 97.7% probability of availability
Energy Reserve Margin Target

- Plans to meet forecasted energy demands and provide a reasonable reserve for emergencies
- The Energy Reserve Margin plans for reserves to mitigate:
  - Loss of largest unit in any given hour
  - Multiple forced outages
  - Unplanned Maintenance
  - Fluctuations in generation capability from variable resources
  - Prolonged poor weather patterns or atypical weather events
  - Battery failures
  - Forecast error, especially higher than forecasted load conditions
- Target values selected to meet or exceed current capacity planning criteria
## Energy Reserve Margin Target (continued)

<table>
<thead>
<tr>
<th>Island</th>
<th>Energy Reserve Margin Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oahu</td>
<td>30%</td>
</tr>
<tr>
<td>Hawaii</td>
<td>30%</td>
</tr>
<tr>
<td>Maui</td>
<td>30%</td>
</tr>
<tr>
<td>Molokai</td>
<td>60%</td>
</tr>
<tr>
<td>Lanai</td>
<td>60%</td>
</tr>
</tbody>
</table>
Long Term Plan Process

Inputs, Assumptions, Annual Forecast

Capacity, Energy & AS Needs

Load ↓
Load + ERM Target

Variable Renewable Energy ↓
HDC

Resource Optimization
• Energy
• Fast Frequency Response
• Regulating Ramp Reserve
  • Energy Reserve Margin
• RPS
• T&D Deferral

RESOLVE Modeling

PLEXOS Modeling

Portfolio Verification

Yes
No

Down Select RESOLVE cases to one portfolio

Portfolio Shortfalls?

...
Conclusion

- The ERM captures the same aspects of reliability as a traditional reserve margin, with increased granularity and flexibility to include energy availability accounting.
- An Energy Reserve Margin can be utilized for capacity planning purposes.
- Energy Reserve Margin targets plan to meet forecasted energy demands and provide a reasonable reserve for emergencies.
Load Build and Load Reduce
Grid Service Definitions

- Load build: Capacity that can be provided by storage or controlled load to increase system load in the required timeframes and durations in response to a remote dispatch signal.

- Load reduce: Capacity that can be provided by a generator, storage or controlled load to reduce system load in the required timeframes and durations in response to a remote dispatch signal.

The intent of these two services is to encourage more load resources to participate economically in the provision of grid services, aligned with marginal energy cost.
Purpose

- In tandem, load build and load reduce grid needs would identify a potential for energy arbitrage although the capacity for and timing of these needs may not be identical.

**Load reduce**

- Aligned with high marginal cost hours
- Subset of the energy service for resources that can’t participate in the regular provision of energy or are constrained on the number of calls for service

**Load build**

- Aligned with negative or low marginal cost hours
- Reduce hours of overgeneration or to serve unmet downward regulating reserves
Methodology

- A subset of hours and their marginal avoided costs for the energy service will be used to identify the need for load build / reduce.
- A production simulation will be used to evaluate marginal avoided costs for energy across all hours.
- Avoided costs will be calculated every 5 years, consistent with the planning horizon used in RESOLVE.
Proposed Grid Services for IGP
# Proposed Grid Services for IGP

<table>
<thead>
<tr>
<th>Grid Service</th>
<th>Description</th>
<th>Represented in RESOLVE &amp; PLEXOS</th>
<th>Represented in PSSE/PSCAD/ASPEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>A continuous, controllable, and predictable supply of megawatt-hours to serve system load needs in response to an AGC signal</td>
<td>✓</td>
<td>Not Represented</td>
</tr>
<tr>
<td>Energy Reserve</td>
<td>A guideline to minimize risk of insufficient generation capability from a diverse mix of generating resources available to the system in long-range generation expansion studies</td>
<td>✓</td>
<td>Not Represented</td>
</tr>
<tr>
<td>Margin Load Reduce</td>
<td>Capacity that can be provided by a generator, storage or controlled load to reduce system load in the required timeframes and durations in response to a remote dispatch signal</td>
<td>✓</td>
<td>Not Represented</td>
</tr>
<tr>
<td>Load Build</td>
<td>Capacity that can be provided by storage or controlled load to increase system load in the required timeframes and durations in response to a remote dispatch signal</td>
<td>✓</td>
<td>Not Represented</td>
</tr>
<tr>
<td>Regulating Reserves</td>
<td>A reserve capacity provided by generating and load resources to allow continuous energy balance over the next 1 minute and 20 to 30-minute time interval due to the variability in renewable resources and load that can be called upon in response to an AGC signal</td>
<td>✓</td>
<td>Not Represented</td>
</tr>
</tbody>
</table>
# Proposed Grid Services for IGP

<table>
<thead>
<tr>
<th>Grid Service</th>
<th>Description</th>
<th>Represented in RESOLVE &amp; PLEXOS</th>
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</thead>
<tbody>
<tr>
<td>Inertia*</td>
<td>Contribution to the capability of the power system to resist changes in frequency by means of an inertial response from a generating unit, network element or other equipment that is electromagnetically coupled with the power system and synchronized to the frequency of the power system.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Primary Frequency Response (PFR)*</td>
<td>Automatic and autonomous response to frequency variations through a generator’s droop parameter and governor response</td>
<td>◀</td>
<td>✓</td>
</tr>
<tr>
<td>Fast Frequency Response (FFR1)</td>
<td>An autonomous and predictable capacity to limit the frequency drop resulting from a frequency disturbance.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Voltage Support*</td>
<td>Ability of generators or other equipment to produce or absorb reactive power to maintain the system voltages within specified limits.</td>
<td>Not Represented</td>
<td>✓</td>
</tr>
<tr>
<td>Short-Circuit Current*</td>
<td>Available current under fault conditions at a given location. A minimum value is required for proper coordination of protective devices and a safe and reliable operation of protection system.</td>
<td>Not Represented</td>
<td>✓</td>
</tr>
</tbody>
</table>

*Work in progress descriptions*
# Proposed Grid Services for IGP

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<thead>
<tr>
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<th>Description</th>
<th>Represented in RESOLVE &amp; PLEXOS</th>
<th>Represented in PSSE/PSCAD/ASPEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPS</td>
<td>% of annual retail sales forecast</td>
<td>✓</td>
<td>Not Represented</td>
</tr>
<tr>
<td>Transmission Capacity*</td>
<td>A supply and/or a load modifying service that DERs and grid-scale resources provide as required via the dispatch of power output for generators and electric storage, and/or reduction in load that is capable of reliably and consistently reducing net loading on desired transmission infrastructure</td>
<td>◐</td>
<td>✓</td>
</tr>
<tr>
<td>Distribution Capacity</td>
<td>A supply and/or a load modifying service that DERs provide as required via the dispatch of power output for generators and electric storage, and/or reduction in load that is capable of reliably and consistently reducing net loading on desired distribution infrastructure</td>
<td>◐</td>
<td>Not Represented</td>
</tr>
<tr>
<td>Distribution Reliability</td>
<td>A load modifying or supply service capable of improving local distribution reliability under abnormal conditions</td>
<td>◐</td>
<td>Not Represented</td>
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</tbody>
</table>

*Work in progress descriptions
### Grid Service Capability by Technology

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</thead>
<tbody>
<tr>
<td>GS PV</td>
<td>1</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>1. Requires grid forming inverter capability; 3-5 years away (Technology in transition)</td>
<td>2</td>
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<td></td>
<td>2. Contribution to ERM limited by hourly dependable capacity</td>
<td>2</td>
<td></td>
<td></td>
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<tr>
<td>GS BESS</td>
<td>1</td>
<td></td>
<td></td>
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<td></td>
<td>3. Contribution to ERM subject to change as resource portfolio changes</td>
<td>2</td>
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<td>4. Requires controllability/communications for frequent dispatch signals</td>
<td>3</td>
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<tr>
<td>Sync. Cond.</td>
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Solution Sourcing Process
Next Steps
Next Steps

- Release next draft of SEOWG Week of May 25
- Schedule June meeting to discuss transmission needs and stakeholder questions and comments
- Finalize SEOWG deliverable by end of June