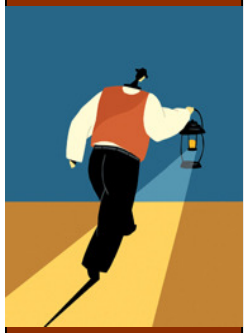

Valuing Capacity of Intermittent Generation – Summary of Potential Methodologies

REGWG Briefing

24 June 2010

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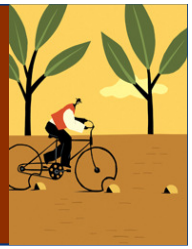
in alliance with NAVIGANT CONSULTING

Work Package 2 Study Objectives



The selected methodology should:

- be operationally simple and minimize associated cost, complexity, volatility and uncertainty;
- enable the calculation of capacity contribution values by plant owners using simple mathematical methods;
- derive values of capacity contribution from computations based on plant output rather than through power system reliability modelling
- provide credits consistent with the contribution to reliability relative to scheduled plant and at penetration levels that might reasonably be expected over the coming decade;
- provide sufficiently reliable results when applied to all anticipated intermittent generator types including wind, solar thermal, solar photovoltaic, wave and tidal power; and
- adequately discriminate between individual plants based on reliability contribution and provide appropriate incentives for the appropriate design and location of new plant.

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Key Implementation Issues

- System reliability concerns.
- Commercial viability of capacity valuation process.
- Differentiation of plant on merit
  - Location, (alignment to need & diversity) &
  - Design

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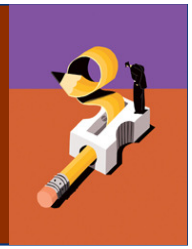
Proposal 1 – Fleet Apportioned; LSG 12 Intervals Average



Key Focus: ***Ensure system reliability is safeguarded by focusing on high confidence, average performance, over a small number of critical intervals to determine overall intermittent capacity value then allocate to individual plant on merit.***

- Assign a capacity value to the intermittent generator fleet based on 95% confidence level of fleet output averages of the top 12 intervals in all previous years selected on Load for Scheduled Generation (LSG).
- Differentiate plant on merit and manage volatility of individual plants by apportioning the fleet capacity value, based on plant averages over a moderate number of critical demand intervals.
  - Rate individual plants to achieve the overall fleet capacity value by weighting on plant size and the average plant output for the 750 intervals comprising the top 250 intervals (from LSG) in each of the 3 most recent years.

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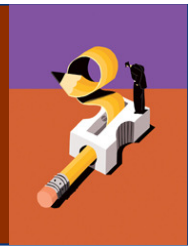
Proposal 1 – Fleet Apportioned; LSG 12 Intervals Average



Process – for <u>existing</u> plants (all plants with Capacity Credits):

- Determine the LSG and rank the highest intervals for each of the previous years from Oct 2001 using actual, modelled or default values.
- Establish the fleet capacity value by determining the 95% confidence level of all the 12 interval average fleet output values for all previous years from Oct 2001
- Determine the 3 year rolling average of the top 250 (LSG) interval performance for each plant using actual, calculated or default values.
- Assign capacity value to each plant such that the sum of assigned values weighted by 3 year rolling average performance and plant size equals total fleet capacity.

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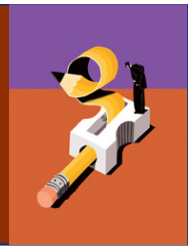
Proposal 1 – Fleet Apportioned; LSG 12 Intervals Average



Process – for <u>proposed</u> plants (assessed individually with existing plant):

- For each of previous 3 years: subtract modelled plant output from LSG (for existing fleet) and rank highest intervals; determine modelled output for plant in each of 250 highest intervals.
- Determine 3 year average of modelled values of output over 750 intervals comprising the top 250 intervals each year.
- Assign capacity value such that the sum of the assigned value together with those of all plants with Capacity Credits, weighted by 3 year rolling averages and plant size equals fleet capacity value.

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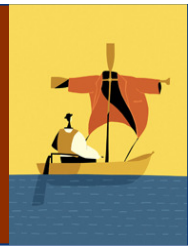
Proposal 2 – Individual Assessment; LSG 750 Intervals Average



Key Focus: ***Ensure system reliability is safeguarded, differentiate plant on merit and manage volatility through a rolling average assessment of individual plant.***

- Assign capacity values based on a 3 year rolling average of plant's average performance over the most critical 750 trading intervals selected on LSG.
- LSG based on 3 historical load profiles scaled to forecast demand in relevant years. (Alternatively could use most recent three years)

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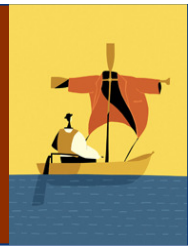
Proposal 2 – Individual Assessment; LSG 750 Intervals Average



Process – for existing plants (all plants with Capacity Credits):

Select 3 representative historical load profiles based on capacity years. Initially these are 02/03, 03/04 and 04/05 which represent 50%, 10% and 30% POE summer peak years, respectively.

- Scale the historical load profile to reflect the forecast demand for the relevant capacity year for each of the historical load profiles for the corresponding level of peak demand.
- Determine the LSG by subtracting the sum of all existing intermittent generation from the scaled load profile. (The intermittent gen profiles must be those for the corresponding historical load profile year to ensure consistency between intermittent gen output and system demand).
- Determine the 750 intervals with highest LSG for each historical load profile.
- Assign capacity value to plant equal to the average of plant output for the 750 intervals for each of the 3 years, weighted appropriately for POE. (Average each new value with the 2 previously assigned values.

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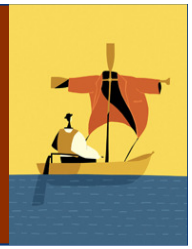
Proposal 2 – Individual Assessment; LSG 750 Intervals Average



Process – for <u>proposed</u> plants (assessed individually with existing plant):

Determine the LSG by subtracting the sum of all existing and proposed intermittent generation from the scaled load profiles. (The intermittent gen profiles must be matched to the weather conditions for each).

- Determine the 750 intervals with highest LSG for each historical load profile.
- Average the plant output for the 750 intervals for each of the 3 years.
- Assign capacity value to the plant equal to the average of the 3 averages calculated above.

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Proposal 3 – Fleet Apportioned; Peak Load Percentile

Key Focus: ***Ensure system reliability is safeguarded by focusing on high percentile performance over peak hours in peak season to determine overall intermittent capacity value then allocate to individual plant on merit.***

- Assign capacity value to the intermittent generator fleet at the 90th percentile level of output during the top 1% of thirty minute intervals for the most recent three years.
- Differentiate plant on merit and manage the volatility by apportioning the fleet capacity value based on individual plant average performance over a moderate number of critical demand intervals.
  - Rate plants to achieve the fleet capacity value, weighted on plant size and the average of individual plant output during the 750 intervals comprising the top 250 intervals (selected on load for scheduled generation) in each of the most recent three years.

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Proposal 3 – Fleet Apportioned; Peak Load Percentile

Process – for existing plants (all plants with Capacity Credits)

- Determine the output of the intermittent generator fleet based on actual data (or available modelled data where actual data is not available) at the 90th percentile level of output during the top 1% of thirty minute intervals for the most recent three years.
- Assign capacity value to the intermittent generator fleet at the 90th percentile level of interval fleet output for the selected periods.
- For each of the previous 3 years including all plants with Capacity Credits determine the LSG and rank the highest intervals.
- Determine the 3-year rolling average of the top 250 interval (LSG) performance for each plant, using actual, calculated or default values as available.
- Assign a capacity value to each plant such that the combination of the assigned values, weighted by 3-year rolling average performance and plant size equals the fleet capacity value.

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Proposal 3 – Fleet Apportioned; Peak Load Percentile

Process – for <u>proposed</u> plants (assessed individually with existing plant)

- For each of the previous three years: subtract the modelled plant output from the LSG (previously determined for the existing fleet) and rank the highest intervals, then determine the modelled output for the plant in each of the 250 highest intervals.
- Determine the three-year average of modelled or assigned values of output over the 750 intervals comprising the top 250 intervals each year for the plant.
- Assign a capacity value to the plant such that the sum of the assigned value of the plant together with those of all plants with Capacity Credits, weighted by 3-year rolling averages and plant size, equals the fleet capacity value.

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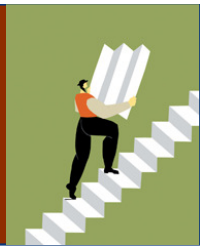
Comparison of Proposals



Method	LSG 12 Interval Fleet	LSG 750 Interval Individual	Peak 90 Percentile Fleet
Method Type	Allocated Fleet Assessment	Individual Assessment	Allocated Fleet Assessment
Fleet Data	95% confidence level of fleet output averages of the top 12 intervals in all years from 2001	Not Applicable	Fleet output at the 90th percentile level of output during the top 1% of trading intervals for the most recent three years.
Fleet Data Type	LSG	Not Applicable	Peak
Individual Data Individual assessment / Capacity allocation	Average plant output for 750 intervals comprising top 250 intervals in each of the 3 most recent years.	3 year rolling average of plant's average performance over the most critical 750 trading intervals	Average plant output for 750 intervals comprising top 250 intervals in each of the 3 most recent years.
Individual Data type	LSG	LSG	LSG

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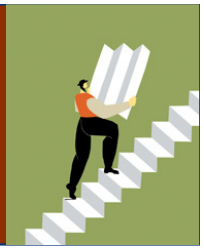
Possible Next steps



- Model each method with consistent data for the various plants that have been considered in the MMA study
- Determine likely magnitude and volatility of ratings
- REGWG review and recommendation to MAC on way forward.

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