Proposal for Capacity Credits for Variable Output Electric Power Generators in Michigan

Michigan Wind Working Group
Subcommittee on Capacity Credits
Michigan Renewable Energy Program

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Outline of Presentation

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Intro: What is a Capacity Credit?

- Definition: A capacity credit is a measure of an electric power generator's expected or actual contribution to meeting system reliability goals.
- One commonly used and well accepted measure of capacity credit is effective load carrying capability (ELCC).

Intro: How is a Capacity Credit used?

- In planning process, to evaluate likely contribution generator can be expected to make to help meet system reliability goals
- In setting reserve margins, to correctly recognize contributions from variable-output generators
- In contracting for power and energy, to set prices that reflect costs and benefits of each generator's contributions towards meeting system reliability goals.

Intro: Why are Capacity Credits Important?

- No generator is guaranteed to be available at the precise times when it might be most needed.
- Every generator has some risk of failure; some are more likely to fail than others.
- An appropriate capacity credit measures the relative contribution to reliability that each generator provides to the utility system, in the context of overall system reliability.

Qualities of Good Approaches to Capacity Credit Modeling

- Simple & straightforward, yet accurate
- Data-driven, based on empirical data that reflects actual performance
- Transparent, consistent, not speculative
- Independent of the order in which generators are evaluated

Measuring Capacity Credit

- Capacity credit based on reliability analysis
- Large and established literature
- Capacity credit is also called effective load carrying capability (ELCC)
- ELCC is data-driven, empirical approach based on
  - Hourly load profile (year)
  - Actual generating unit data
  - Units with large forced outage rates have lower ELCC
  - Small units have smaller ELCC
- Other definitions of "capacity credit" have emerged, but often don't recognize differential contributions to reliability among alternative power plants

Capacity Credit Calculations

- Can be applied to wind generators
- Wind capacity credit depends on output profile:
  - Low when wind contributes small amount to reliability
  - High when wind contributes large amount to reliability
  - Varies depending on both system and wind characteristics
  - Values can range from approximately 10%-40%, depending on system and wind characteristics
  - Capacity credit values outside this range are possible
  - Use multiple years of data if available

How Does ELCC Work?

- Holds the system at constant annual risk level with/without wind
- Can be measured relative to a “perfect unit” or selected benchmark unit (preferred)
- Utilizes reliability/production simulation model
  - Hourly loads
  - Generator characteristics
  - Wind generation pattern (hourly)
  - Calculates hourly LOLP (loss of load probability)

The MREP/WWG Recommendation to Michigan's Capacity Needs Forum

- Use Effective Load Carrying Capacity (ELCC) modeling and calculation methods

1. Begin with meteorological data, at least 3-year running average. Gradually replace with actual performance data, again using at least 3-year running average.

MREP/WWG Recommendation (2)

2. Calculate estimated ELCC value using CNF production model, during the 10% of the hours of the year that have the greatest system risk.

3. Run production model first without and then with the estimated contribution from the variable output generation.

MREP/WWG Recommendation (3)

4. Remove variable output generation from model, and rerun with *benchmark unit*, adding capacity from benchmark unit until risk with benchmark unit is equal to risk modeled with variable output unit.

5. The capacity added from benchmark unit = ELCC for variable output generation.

Next steps: Performance-Based Capacity Credits for Variable Output Generators in Michigan

- Gradually replace meteorological data with actual performance data for each wind farm (or other variable output generation resource), while continuing to use 3-year running average performance

- Recalculate ELCC based on actual performance, using same method as before

Performance-Based Capacity Credits (2)

- Base capacity payments on actual performance, paying only for actual deliveries

- Basic Formula: Capacity Cost of Benchmark Unit ($/kW-year) * kW output of variable generator * ELCC % of variable output generator = Total Annual Payment. Total Annual Payment / Annual kWh Production = Capacity Payment / kWh.

Next steps

- WWG endorses method
- MREP Recommends to CNF
- CNF accepts model
- WWG provides meteorological data
- CNF models ELCC based on proposed methods
- CNF reports back to WWG with ELCC calculations