Reactive Power in PJM: Clean Energy Caucus Solutions Package

Reactive Power Compensation Task Force
June 6, 2022

PINEGATE RENEWABLES

Basis for Compensation: Cost-of-Service Rate Recovery

- Resources should be compensated based on their costs of investment in reactive power capability.
  - FERC generally permits cost-of-service rate recovery for reliability products.
  - Transmission owners entitled to cost-of-service recovery in transmission rate base for investments in reactive power service on the transmission system.

- *AEP* Method is currently the only method that compensates a generator for the full investment in reactive power capability.
  - Not specific to synchronous generation.
  - The *AEP* Method is a generic means of identifying facility equipment at all types of generation that support the reactive power capability function.

Proposed Compensation Mechanism: *AEP*-Derived Stated Rate By Generation Type For All New Generation

- The Issue Statement in this process began with a need to streamline the time that PJM market constituents are devoting to process *AEP* rate cases at FERC.
- Clean Energy Caucus agrees that case-by-case filings at FERC can be time consuming.
- The *AEP* "formula" is well known.
- Clean Energy Caucus proposes a method to streamline the process by adopting an *AEP*-derived stated rate by generation type (e.g., solar, wind, energy storage, etc.)
- Once the stated rate (per class) is adopted, it would apply to the generation.
- The stated rates would be revisited periodically and adjusted for inflation.
- The stated rate "formula" would be listed in Schedule 2 of PJM's Tariff.
- No FERC filing would be required for each individual generating unit seeking recovery.

AEP Method

- John Simpson explained the *AEP* approach at an earlier stakeholder meeting.
- "The *AEP* methodology generally reflects the costs associated with four groups of plant investments including the generator-exciter, generator step up transformers (GSU), accessory equipment and the remaining production plant investment. Since these groups of production power plant investment involve both reactive and real power, under the *AEP* methodology, an allocation factor is developed to sort the annual revenue requirements of components between real and reactive power production." (*Dynegy*, 121 FERC P 61,025 (2007))
- "The cost of the generator-exciter is generally isolated from the turbine-generator-exciter costs based on a manufacturer's suggested percentage."

AEP Method

- "The allocator used to determine the amount of generator-exciter investment related to reactive power is based on the ratio of $MVAR^2$ to MVA^2 (reactive allocator) where MVAR is megavolt amperes reactive capability and MVA is megavolt amperes capability at a power factor of one."
- "Because GSUs also facilitate the transmission of real and reactive power, GSUs are allocated using the same reactive allocator to determine the portion related to reactive power service."

AEP Method

- “Accessory equipment, including such equipment as auxiliary generators, generator main connections, and station buses are allocated to reactive power production using the product of two allocators.”
- “The first allocator is the ratio of generator-exciter auxiliary load (MW) divided by total production plant auxiliary load (MW).”
- “The second allocator used to determine the portion of accessory equipment that is reactive-related is the same reactive allocator used for generator-exciters and GSUs.”

AEP Method

"The remaining production plant investment is calculated by subtracting the generator-exciter, GSU and accessory equipment from total production plant to avoid double counting. The remaining production plant investment is allocated to reactive power service using the allocator called the remaining power plant investment allocator (RPPIA) or balance of plant (BOP) allocator . . . . ."

"Once the reactive related costs of the generator-exciter, GSUs, accessory equipment and remaining production power plant are identified, the sum of these, known as the total reactive power plant investment, is multiplied by a fixed charge rate . . . ."

AEP-Stated Rate Approach

- Establish Proxy Capital Costs for Plant Components to Determined Fixed Capability Component
- Apply Proxy Reactive Allocator to Fixed Capability Component
- Determine Proxy Balance of Plant Amount
- Apply Proxy Balance of Plant Allocator to Balance of Plant Amount
- Apply Proxy Fixed Charge Rate
- Results in *AEP*-Based Stated Rate

Proxy Reactive Capital Investment - Solar

- Inverters/Power Stations (SMA, Sungrow, Huawei, Power Electronics, TMEIC, ABB, etc.)
- AEE: DC collection system
- AEE: AC collection system
- AEE: LV portion of Substation
- Capacitor and/or reactor banks
- GSU

Proxy Reactive Capital Investment - Wind

- Wind turbines/Transformers (GE, Vestas, Siemens, Clipper, etc.); use average of % allocation usually 10-12%
- AEE: AC collection system
- AEE: LV portion of Substation
- Capacitor and/or reactor banks
- GSU

Proxy To Use For Reactive Allocator

Solar:

- SMA, Sungrow, Huawei = 0.80 Power Factor
- TMEIC = 0.85 Power Factor
- Power Electronics = 0.50 Power Factor

Wind: Ranges from 0.87 to 0.95 Power Factor

Results in Proxy Reactive Capital Investment

- For Solar, if the median 0.80 Power Factor is used, results in 36.00% of Proxy Reactive Capital Investment.
- For Wind, if the median 0.90 Power Factor is used, results in 19.75% of Proxy Reactive Capital Investment.

Proxy To Use For AEE Allocator

- Proxy AEE Allocator = Allocation factor applied to the various categories of AEE costs related to the investment in both real and reactive power.
- The resulting amount from multiplying the AEE costs by the AEE Allocator is then multiplied by the Reactive Allocator to determine the AEE portion of the Proxy Reactive Capital Investment.

Solar AEE:

- DC System
- AC System
- LV substation equipment

Wind AEE:

- AC System
- LV substation equipment

Proxy Balance of Plant

- Proxy Balance of Plant = Proxy Total Capital Costs – Proxy Reactive Capital Investment
- The amount is then applied to a Proxy BOP Allocator, such as 0.15% as used in *AEP*.

Total Proxy Reactive Capital Investment - Solar

Sum of the investment in the following items:

- Inverters/Power Station Investment x Reactive Allocator
- DC collection system x AEE Allocator x Reactive Allocator
- AC collection system x AEE Allocator x Reactive Allocator
- LV portion of Substation x AEE Allocator x Reactive Allocator
- Capacitor and/or reactor banks
- GSU x Reactive Allocator
- Balance of Plant x BOP Allocator

Total Proxy Reactive Capital Investment - Wind

Sum of the investment in the following items:

- Wind turbines/Transformers x Reactive Component Cost Allocator x Reactive Allocator
- AC collection system x AEE Allocator x Reactive Allocator
- LV portion of Substation x AEE Allocator x Reactive Allocator
- Capacitor and/or reactor banks
- GSU x Reactive Allocator
- Balance of Plant x BOP Allocator

Proxy Fixed Charge Rate

- The value that the Total Reactive Capital Investment is multiplied by to calculate the Annual Revenue Requirement.
- Represents the maintenance, depreciation, return, and other components of the rate.

Proxy Fixed Charge Rate

Typical components include:

- O&M / A&G
- Depreciation
- Cost of Capital
- Federal and State Income Tax
- ADIT
- Taxes Other Than income

For Simplicity, could include only

- Proxy O&M / A&G (is often 1.50 to 4.00% of original CapEx)
- Straight line depreciation rate for sinking fund recovery period calculation, such as 4% or 5%
- Proxy Cost of Capital: Wide variety among PJM Transmission Owners; use a weighted average cost of capital such as 50/50 cap structure, 4.0% debt rate, 10.5% equity rate
- No federal or state income tax gross-up or ADIT offset

Determine Stated Rates

- Apply FCR to Proxy Reactive Capital Investment + Proxy Balance of Plant Investment
- The same approach would be applied to classes of synchronous generation to determine rates.
- Established rates would be updated annually to account for inflation

Updates

- As industry component change and cost change, new proxy inputs could be used to determine the stated rates per generation type.

Schedule 2

- Would include the “formula” that is used to derive the rate per generation type
- Would provide that actual rates are published on PJM’s website

Storage

- This same process could be used for storage that has reactive power capability.

Next Steps

- The Clean Energy Caucus would provide “example” data to demonstrate how a wind or solar stated rate would be determined
- The data would be a range with the goal of using median amounts
- Synchronous generation entities would provide “example” data to demonstrate how gas, coal, nuclear, etc. is determined

Benefits

- No more rate cases at FERC
- Would be streamlined just like transmission formula rates are now streamlined
- Transparent
- Certainty and Predictability
- Easy to implement future changes in the industry in terms of cost and technology

Sponsor Companies

- Pine Gate Renewables, LLC
- Solar Energy Industries Association
- GlidePath Power Operations LLC
- NextEra Energy Resources, LLC
- Clearway Energy Group
- Open Road Renewables
- Lightsource BP
- Leeward Renewable Energy
- Invenergy
- Jupiter Power
- TransAlta
- Geenex Solar
- Cypress Creek Renewables

Thank You