



Performance Based Reactive Power Compensation – PJM Package

Glen Boyle

Sr. Manager, Performance Compliance Dept.

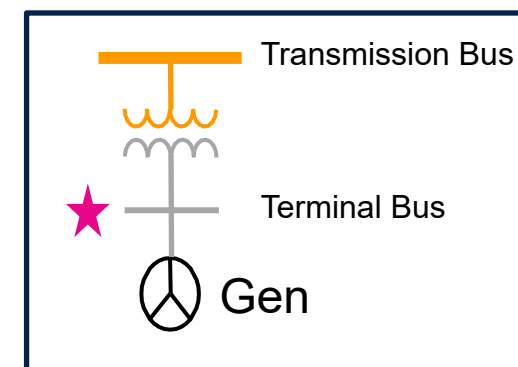
Market Implementation Committee

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- Focus on PJM operational needs
 - Reactive Power is an essential reliability service
- Provide incentive for full, usable reactive capability
- Encourage and reward resource performance for real time transmission voltage control
- Reduce administrative and legal burden of existing process

- Eligibility criteria to support transmission level voltage control
- Flat rate design
 - Equal compensation for reactive capability regardless of technology type
- Compensation based on demonstrated or tested reactive capability
- Robust performance evaluation to encourage voltage control
 - “Pay for performance”
- Elimination of administrative burden of FERC filed rates

- Physically connected directly (through unit step-up transformer) to PJM Transmission Facilities
 - Modeled and necessary telemetry
- Must have Automatic Voltage Regulation (AVR) set to control transmission level voltage based on PJM approved voltage schedule
 - Units operating on fixed power factor mode not eligible
- AVR must be operating at all times except planned outages
 - Automatic response
- Requirement to be dispatched by PJM for reactive power as needed
- Must be PJM Member or have executed full responsibility DOA



- Flat Rate = PJM Total Reactive Compensation as of 1/1/23
Total System MVAR Capability*
- Flat Rate = \$384 m / 130,048 MVAR = **\$2952/MVAR/year**
- Monthly Compensation = (Flat Rate/12)(Unit MVAR Capability)(Availability Factor)
 - Availability Factor (between 0 and 1) reflects resources ability to provide reactive power
 - Synchronous resources/"Wind-free"/"Q at night" based on full eDART outages
 - Inverter based resources based on when resource is generating

*Total System MVAR Capability based on 95% power factor at Pmax and rectangular D-curve

Monthly pass/fail lookback evaluation to determine eligibility for monthly credit

1. Determine if any regulated bus voltages are outside voltage schedules for 5 consecutive minutes

- Tighter of PJM default or bus specific
- For example, 230 kV voltage goes above 239 kV or below 231 kV for 5 consecutive minutes

	PJM Default Generator Voltage Schedules								
Voltage Level (kV)	765	500	345	230	161	138	115	69	66
Schedule (kV)	760.0	525.0	350.0	235.0	164.0	139.5	117.0	70.0	67.0
Bandwidth (+/- kV)	+/-10.0	+/- 8.0	+/- 7.0	+/- 4.0	+/- 4.0	+/- 3.5	+/- 3.0	+/- 2.0	+/- 1.5

2. Determine MVAR supplied or absorbed by generator (at measured point consistent with tested capability)
3. Compare actual MVAR delivered to eligible capability (within 10%)
4. If generator provides less than capability, ineligible for monthly credit
 - Update D-curve and MVAR eligibility to delivered amount
 - Capability could go up if generator provided more MVAR than expected

- If regulated voltage is within voltage schedule limits for entire month, resource is eligible for credit
- If resource was offline during voltage excursion, it is assumed to have passed performance test and remains eligible for credit
- If resource fails performance test due to AVR outage, it is ineligible for credit
- Must pass each voltage excursion check each month to be eligible for month

- Actual MVAR delivered \geq (.9)Eligible capability \rightarrow Eligible for that month
 - Actual MVAR delivered $<$ (.9)Eligible capability \rightarrow Not eligible for that month
- Update D-curve

- Synchronous and non-synchronous resources eligible for uplift if MW output is reduced at PJM direction to provide increased reactive
- Voltage schedules (including AVR mode) set by PJM with TO input
- Capacitors at generator sites can be included in plant MVAR capability if they meet technical conditions
 - Fast enough autonomous response to be useful post-contingency

- Transition issues from current Schedule 2
 - New generators and existing generators rolling off legacy Schedule 2 rates would be eligible for new flat rate
 - 18-24 month implementation
 - Smooth transition from status quo
 - Allow time for generators to adjust performance
 - Allow time to develop supporting tools and automation

- Proxy formulas for all technology types yet to be developed
 - Cost impact unknown
 - Needed in order to file OATT rates
- Vague and limited performance evaluation process
- MVARs being compensated at different rates based on technology type
- Based on nameplate MVAR capability
 - May not be needed or deliverable
- Distribution connected resources eligible for compensation regardless of impact on transmission voltage
- Mechanism to compensate inverter-based resources for providing reactive power when not providing real power
 - Mechanism required by package but not provided

- Applies to capacity units only
- Performance incentives – unclear what penalty would be for non-performance
- No incentive for resources to increase MVAR capability beyond what is required by ISA
- Same concerns with IMM-2 package following 5 year transition period

Chair:
Foluso Afelumo,
Foluso.Afelumo@pjm.com

Secretary:
Amanda Martin,
Amanda.Martin@pjm.com

SME/Presenter:
Glen Boyle, Glen.Boyle@pjm.com



Member Hotline

(610) 666 – 8980

(866) 400 – 8980

custsvc@pjm.com