



# Phase Angle Regulator Task Force Final Proposal Report

September 1, 2015

## Issue Summary

The PJM Planning Committee authorized the formation of the [Phase Angle Regulator Task Force](#) to discuss issues relating to the acceptable classification of Controllable A.C. Merchant Transmission Facilities as defined in the PJM Tariff (Section 1.6B). Previously, PJM has interpreted the definition of Controllable A.C. Merchant Transmission Facilities as including only Variable Frequency Transformer technology and that projects which may employ Phase Angle Regulator (PAR) technology cannot qualify as Controllable A.C. Merchant Transmission Facilities.

### Submittal Deadlines

Problem Statement/Issue Charge: [Problem Statement](#)

Problem Statement brought forward by PSEG Energy Resources & Trade LLC

Problem Statement/Issue Charge approved at November 4, 2014, Planning Committee

Number of Meetings covering this topic: 6

## 1. Recommended Proposal

The recommended proposal developed by the PARTF creates a set of requirements that will allow for Phase Angle Regulator technology such as phase shifting transformers (PARs) to be considered as Controllable A.C. Merchant Transmission Facilities under the PJM Tariff, and to apply for and be awarded Transmission Injection and/or Withdrawal Rights if certain criteria are met. The proposal was developed initially by PJM Staff after PAR flow control analyses were conducted and indicated that the installation of one or more PARs at a given location did not show any significant deviation from other controllable AC or DC type installations. In addition, no issues were identified in the analysis to indicate the degradation of existing rights, assuming reinforcements identified for PAR installations were made. The proposal was then reviewed, modified, and improved with stakeholder input. The following is a summary of the various aspects of the proposal.

### ***PAR Flow Control***

A customer must be able to control flows with a PAR device in a manner consistent with existing requirements in Manual 11 related to allowable deviations for all resources which are self-scheduled. Operating Reserve charges associated with deviations will similarly be governed by existing rules. The controllability of these flows are required to be automatic, but with the ability to manually adjust. The customer must also be able to achieve a zero flow state (stop flow) when directed by PJM. If the customer is unable to achieve a zero flow state, PJM will reserve the right to disconnect the PAR to prevent unscheduled flows. From a zero flow state, initial energization shall not exceed the size (MW) of the step change established through interconnection studies (see below). In addition, a customer must design the facility in such a way that it maintains the ability to control flows across the range of requested megawatts under all required contingency conditions (e.g. all PJM RTEP planning requirements).



### ***Number, Frequency, and Size (MW) of Tap Changes***

The number and frequency of tap changes made by a PAR device is entirely a customer design consideration. PJM will require controllability as stated above and will not regard itself with the number or frequency of tap changes performed by the PAR device to achieve the desired controllability. Regarding the size in megawatts of each tap change, or step change, PJM will determine the acceptable size through required interconnection studies. This will be determined on a case by case basis; however, as guidance, it is expected that steps of 20 MW or less will be acceptable in most applications.

### ***Injection / Withdrawal Rights***

When a customer requests rights, PJM will conduct a number of studies to determine the system impacts based on granting those rights. These studies will, at a minimum, include a load flow analysis (Generation deliverability/Load deliverability/N-1-1), a short circuit analysis, and a stability analysis. The analysis shall demonstrate that rights of existing rights holders are not degraded. If a customer is unable to demonstrate the ability to flow scheduled service across the PAR, this will result in the loss of rights. A customer will be able to obtain interim rights through the existing interim deliverability process currently outlined in PJM Manual 14A.

### ***Implementation***

It is PJM's belief that implementing this proposal will not require changes to the PJM Tariff, as the existing Tariff is currently silent on specific technologies that qualify as Controllable AC Merchant Transmission Facilities. This proposal would instead be implemented through additional language in Manual 14E.

Cost allocation for PAR facilities will be treated consistent with existing methodologies used for HVDC and Variable Frequency Transformers for future baselines.

## **2. Other Items**

During discussions at the PARTF, the task force identified another item that was deemed out of scope for this group but that the PARTF wished to memorialize in this report and bring to the attention of the Planning Committee. This item pertains to the operation of Controllable AC Merchant Transmission Facilities, including but not limited to PARs, in "bypass mode" and the potential for that situation to affect firm capacity quantity and energy pricing interfaces.

## **Appendix I: Supplemental Documents**

- [Phase Shifting Transformer Principles](#)
- [Tariff Rights for New Service Customers](#)
- [Phase Angle Regulator Task Force Charter](#)
- [Solutions Matrix](#)

## **Appendix II: Stakeholder Participation**

Aaron Berner  
Becky Webb  
Bob O'Connell

PJM Interconnection, LLC  
Commonwealth Edison Company  
Main Line Electricity Market Consultants



Brock Ondayko	Appalachian Power Company
Cara Lewis	PSE&G
Carl Johnson	Customized Energy Solutions, Ltd.
Chris Pilon	PJM Interconnection, LLC
Craig Crider (Dominion)	Virginia Electric & Power Company
David Anders	PJM Interconnection, LLC
David Parquet	N/A
David Pratzin	GT Power Group
Deniz Ozkan	Atlantic Grid Operations A, LLC
Derek Hagaman	GT Power Group
Eric Mortenson	Exelon Generation Co., LLC
Esam Khadr	PSE&G
Gary Fuerst	American Transmission Systems, Inc.
George Kogut	NYP&A
Gerry Binder (SESCO)	SESCO Enterprises LLC
Guy Filomena	Customized Energy Solutions, Ltd
Howard Fromer	PSEG Energy Resources and Trade LLC
Janell Fabiano	PJM Interconnection, LLC
Jason Connell	PJM Interconnection, LLC
Jeff Stuchell	FirstEnergy Solutions Corporation
Joel Yu	Rockland Electric Company
John Brodbeck	PHI
John Citrolo	PSEG Energy Resources and Trade LLC
John Dadourian	Monitoring Analytics
John Farber	DE Public Service Commission
John Horstmann	Dayton Power & Light Company
John Kopinski	ITC Mid-Atlantic LLC
Jonathan Sasser	Customized Energy Solutions Ltd.
Julie Mason	Duke Energy Ohio, Inc.
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Vicki Folmar	Monitoring Analytics
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