

## Manual 14 A Language

Manual 14A: Generation and Transmission Interconnection Process Section 5: Additional Generator Requirements PJM © 2009 34 Revision 8, Effective Date: 05/01/2009

### Generator Power Factor Requirements

Except as PJM may determine otherwise for small generation resources of less than 20 MW, all generators interconnected with the PJM System shall be designed to maintain a composite power delivery at continuous rated power output and reactive capability, at the generator terminal, corresponding to the power factor requirements stated in the PJM Tariff. **(OATT at Part VI, Att. O, App. 2, Section 4.7.1 – formerly 54.7.1 in Part IV)**

### Application of Power Factor Requirements to Increases of Existing Generation

PJM Tariff provisions require existing generators to be designed to operate at a specified leading and lagging power factor as measured at the generator terminals.

- Power Factor requirements also apply to capacity or energy increases to existing generation. (OATT at Part VI, Att. O, App. 2, Section 4.7.1.2)
- Increases to existing generators must be designed to maintain the grandfathered Mvar capability for the existing and pre-upgraded gross generator output capability and the Section 4.7.1.2 power factor requirement for all incremental MW increases.

Grandfathered Mvar capability will be determined using the following methodology and considerations.

- If an agreement exists and contains a reference to required Mvar capability, the methodology in the agreement will determine the grandfathered Mvar capability.
  - Consideration will be given to the potential interpretations of the language in the agreement. Non-standard or vague terms and conditions will be discussed by PJM and the parties named in the agreement.
- If no agreement exists or there is no reference to required Mvar capability in an existing agreement, PJM will use alternate methods to determine the grandfathered Mvar capability of the machine.
  - Examples of potential alternate methods that may be used at PJM's discretion.
    - Use of the D-Curve provided by the manufacturer and is on file with PJM.
    - Review of the data with the GO and provide an opportunity for the GO provide additional analytical evidence as to the actual Mvar capability, if different from the manufacturer design data.
    - Consideration of available test data with acknowledgement that tests are not always performed under ideal conditions and the system may limit the capability during testing. Input from the GO will also be considered as part of the evaluation by PJM.
    - Consideration of historical operational data.

Attachment H to this Manual 14A details a process, adhering to the requirements of the PJM OATT, to mitigate the reactive deficiency arising when an increase of capacity or energy to an existing generator results in the generator not being able to meet the PJM power factor requirements for the existing and/or incremental capacity or energy. Note that Attachment H is not applicable to capacity or energy increases of 20MW or less of which the power factor is measured at the Point of Interconnection (POI). Requirements to such increases will be addressed in future tariff revision.

## **Wind-Powered Generation Projects**

Because of the intermittent nature of wind-power generation, a specific procedure is required to determine an appropriate capacity value for wind generator output. Further, the use of induction-type generators for wind-powered projects requires the application of specific reactive power requirements.

### **Wind Generation Capacity Credit Rules**

PJM business rules allow for wind-powered generation projects to qualify for Capacity Resource status. Refer to PJM Manual M-21 —Rules and Procedures for Determination Generating Capability for details of PJM procedures for calculating Capacity Credits for Wind Farms.

**Wind Generation—Specific Technical Requirements** Without exception, all Customer Facilities will be subject to the provisions of the PJM OATT at **Part VI, in Section 4.7.2 and Section 4.7.3 in Att. O, App. 2 – formerly 54.7.2 and 54.7.3 in Part IV**, which describes real-time obligations to supply reactive power and the consequences of deviations from voltage schedules and/or reactive power schedules.

Wind projects connected to lower voltage systems must be designed to operate to a voltage schedule, reactive schedule or power factor schedule designed to meet local transmission owner criteria. When applicable, non-standard terms and conditions will be included in a project's Interconnection Service Agreement to address individual power factor requirements.

## **ATTACHMENT H: GENERATOR REACTIVE DEFICIENCY MITIGATION PROCESS**

### **Scope**

The mitigation process is to address a reactive deficiency of an existing synchronous generator caused by an increase of its output resulting in that the generator reactive capability cannot meet the existing PJM power factor requirements as stated in the PJM Tariff. The mitigation process and the associated business rules will be applied to all new interconnection requests regarding an increase of capacity or energy to an existing generator.

They are not intended for:

- wind or non-synchronous generators,
- existing generators not requesting an increase of capacity or energy,
- previous requests for capacity or energy increases, or
- increases of 20MW or less of which the power factor is measured at the POI.

The process is in compliance with the existing PJM tariff requirements and the associated business rules and does not require a change in the existing PJM tariff.

### **Reactive Deficiency Definition**

A Reactive Deficiency is defined as the difference between the Mvar capability of a generator after the upgrade for meeting the PJM power factor requirements and the actual Mvar capability of a generator after the requested increase in capacity or energy.

For existing generators that do not have a signed FERC Proforma Interconnection Service Agreement (ISA), the Mvar capability before the upgrade is the grandfathered Mvar capability determined by PJM. For generators that have a signed ISA, the Mvar capability before the upgrade is determined by the Mvar for meeting the power factor requirements as stated at Part VI, Att. O, App. 2, Section 4.7.1 of the PJM Tariff.

For the incremental MW increase, the corresponding power factor requirements can be calculated according to the requirements stated at Part VI, Att. O, App. 2, Section 4.7.1.2 of the Tariff. Hence, the Mvar capability of a generator after the upgrade for meeting the PJM power factor requirements is defined as the sum of the grandfathered Mvar capability or the Mvar requirements stated in the Tariff and the Mvar requirement corresponding to the incremental MW increase.

Finally, after the upgrade, the actual Mvar capability of the generator is the Mvar, defined by the generator's reactive capability curve, corresponding to the gross generator output (i.e. Winter rating) of the generator before the upgrade plus the incremental MW increase.

The reactive deficiency, if any, is determined during the Feasibility and the System Impact Study phases of an interconnection request regarding an increase of capacity or energy to an existing generator. The Interconnection Customer will be notified of the deficiency and the proposed mitigation before the execution of the Construction or Interconnection Service Agreement.

### **Mitigation Process**

Currently, the PJM Tariff allows the Interconnection Customer, at its expense, to install power factor correction or other equipment at the generation plant to mitigate the reactive deficiency and to enable the generator to meet the PJM reactive power design criteria during operation. (OATT at Part VI, Att. O, App. 2, Section 4.7.3) If the Interconnection Customer fails to mitigate the reactive deficiency, PJM can request the affected Transmission Owner to install Static Var Compensator (SVC) or similar dynamic reactive devices, at the Interconnection Customer's expense in the form of a Reactive Deficiency Charge, to mitigate the identified reactive deficiency. A shunt capacitor application could be considered but its application will require PJM review on a case by case basis.

For a generator reactive deficiency less than 50 Mvar, the Reactive Deficiency Charge will be equal to the reactive deficiency (in Mvar) multiplied by the most recent average cost estimates (in \$/Mvar) for installing SVCs on the PJM system. There will be two SVC cost estimates to be developed and updated annually by PJM – one for installations at or above 230kV and one for installations below 230kV. The applicable deficiency charge is based on the voltage at the high side of the generator step up transformer. In the event that a shunt capacitor application is allowed, the charge will be based on the most recent cost of similar shunt capacitor installation.

For a generator reactive deficiency greater than or equal to 50 Mvar, the affected Transmission Owner will be responsible to provide either the cost estimate (in \$/Mvar) for installing a SVC in its system which will be used to calculate the Reactive Deficiency Charge or the cost estimate (in \$) of a specific SVC or SVCs necessary to mitigate the reactive deficiency as determined by PJM and the affected Transmission Owner in the System Impact Study.

### **Reactive Deficiency Charge Payments**

The Reactive Deficiency Charges can be paid in cash or via a letter of credit. The collected charges will be used to fund reactive projects in the Transmission Owner's zone in which the Interconnection Customer's generator is located. The Transmission Owners shall be responsible to construct, own and maintain these reactive projects.

If the Reactive Deficiency Charge for an individual Interconnection Request is less than \$2M and is insufficient to fund a planned reactive project, PJM can choose to use the collected charge to provide partial funding to this project. Alternatively, PJM can hold the collected charges in an account until sufficient funds have been collected to fund the entire project.

If the Reactive Deficiency Charge for an individual Interconnection Request is more than the cost of a planned reactive project, PJM can choose to use the collected charge to fund this project and hold the remaining fund in cash (not to exceed \$2M) or in a letter of credit as a security for use to fund future reactive projects. These funds will be used as soon as a reactive upgrade has been identified. Alternatively, PJM can develop a different reactive project to be funded entirely by the collected charge.

If the Reactive Deficiency Charge is more than \$2M and a reactive project has not been developed, PJM will require the Interconnection Customer to provide a letter of credit for use to fund a reactive upgrade as soon as it has been identified.

### **Review of and Modification to the Mitigation Process**

NERC standards require that PJM, as the Transmission Operator, shall acquire sufficient reactive resources within its area to protect the voltage levels under normal and contingency conditions. PJM will continue to assess the reactive capability of the system and serve as the backstop to recommend modifications to the mitigation process and the associated business rules when and if there are insufficient reactive resources on the system to maintain system reliability.