4.3 Synchrophasor Communication System

The PJM Synchrophasor Communication system allows PJM to collect and manage data from phasor measurement devices which include the standalone phasor measurement units (PMUs), or Relays and Digital Fault Recorders (DFRs) with phasor measurement capabilities from individual generators or MOC. Synchrophasor measurement devices are required at all new generator interconnections 100MW or larger that entered PJM’s interconnection queue on or after October 1, 2012. It shall also include the communication system capable of carrying the phasor measurement data to a phasor data concentrator (PDC), and then transport the information continuously to PJM; as well as store the data locally for a minimum period of 30 days.

A Phasor Data Concentrator (PDC) shall be located at either the Member’s generation site or MOC, and, after collecting data from the phasor measurement devices, communicate with PJM’s Synchrophasor system using C37.118 data transfer protocol.

4.3.1 Phasor Measurement Device Requirements

A phasor measurement device is a device which measures the electrical wave forms on the electricity grid in real-time, using a common time source for synchronization.

- The performance of phasor measurement device must comply with the current revisions of standards such as IEEE C37.118. The protection (P) performance class PMU is preferred.
- The phasor measurement device shall have the capability to calculate sequence values for voltage and current Phasor data; as well as to provide the sequence synchrophasor values to a PDC at the minimum rate of 30 scans per second. (For all calculation purposes Phase A shall be used as the reference phase.)
- The phasor measurement device shall have GPS (UTC) synchronization function either through an internal or external GPS receiver. All data recorded shall be in the Coordinate Universal Time (UTC)
- The phasor measurement device shall be able to automatically switch to local clock in the event of the loss of GPS signal, and resynchronize automatically when GPS signal is available.
• The phasor measurement device data stream shall indicate whether it is using GPS clock or local clock. NOTE: Default data stream should be synced to the GPS clock, with local clock serving as a backup.

• Accuracy and resolution of time synchronization shall be equal or under 1 micro second to UTC. The phasor measurement device should be able to locally store collected or calculated data at the minimum rate of 30 frames per second.

• The phasor measurement device shall be installed on the Customer Facility side of the generator step-up transformer (low side) unless it is a non-synchronous generation facility, in which case the device shall be installed on the Customer Facility side of the Point of Interconnection (POI).

4.3.2 Phasor Data Concentrator (PDC) Requirements

The PDC at the generation station or the MOC (GO PDC) is the central point of collection, management, storage, and distribution of PMU data for authorized real-time and non real-time uses.

• The performance of the GO PDC should comply with the current revisions of standards such as IEEE C37.118

• The GO PDC shall be able to consolidate and synchronize data from all connected PMUs before sending it to PJM; including unaligned data

• The GO PDC shall have capability of assigning positive sequence reference to any phase (rotate it by 120 or 240 degrees on per signal basis)

• All data streaming from the GO PDC to PJM PDC shall be in compliance with IEEE C37.118 communication standards

• The GO PDC should have the capability to down sample PMU signal before transmitting it to PJM PDC and to configure the down sampling rate

• For packets arriving later than expected time, the GO PDC should flag such packets and store their UTC arrival time.

• The GO PDC should be able to locally store all incoming data at the minimum rate of 30 frames per second for minimum two weeks

• The GO PDC should be able to retrieve and provide locally stored data per PJM’s request
• The GO PDC should have a clock that is synchronized to UTC. It is recommended that this clock be an external GPS clock. Resolution and accuracy of time synchronization at Substation PDC should be equal or under 1 micro second to UTC

4.3.3 Network Requirements

A high-speed real-time data acquisition network is required to simultaneously transfer the PMU data to PJM Valley Forge and Milford control centers. This telecommunications network is independent of the existing SCADA network operated for PJM’s EMS at its control centers. End-to-end (GO PMU to PJM PDC) latency should be less than or equal to 100 milliseconds. The GOs data acquisition, processing and communications systems should be designed to achieve the 100 millisecond Latency limit. PJM will provide redundant T1 connections and dual routers to the GO PDC. A typical connection from the GO PDC to PJM is described in Exhibit 8. In some cases, transmitting phasor data with SCADA data together is permitted.

Exhibit 8: GO-PDC to PJM Network
4.3.4 Data Exchange and Management Requirements

PJM maintains configuration information for each phasor measurement device and PDC connected to the Synchrophasor system. This configuration information is used to accurately interpret the data collected from the generators. The generator should register its phasor measurement device and PDC with PJM by using the registration form in attachment M. The generator should use NERC-assigned 5 Digit ID Codes for phasor measurement devices that are reported to PJM.

Generators interconnected with and synchronized to the transmission system must provide PJM all necessary and requested information through PJM Synchrophasor system, to assure that the electrical system can be operated in a safe and reliable manner. This data includes, but is not limited to:

- Generator gross MW and MVAR outputs measured at the low side of the generator step-up transformer (for wind generating plants, measurements at POI are acceptable)
- Generator terminal voltage
- Generator terminal frequency
- Generator Field voltage and current (preferred)

All data items, regardless of type, are collected and disseminated at a frequency of 30 frames per second and should be sent to PJM with associated data quality codes in compliance with IEEE C37.118 communication standards. (See 4.3.1 Phasor Measurement Device Requirements)

The generation owner will report to PJM the outage of any data communication equipment connecting the facility to PJM system to the following email address (outage@pjm.com). Please reference M01 section 3.3.2 for more details.