



# Phasor Measurement Unit (PMU) Placement Plan in RTEP Planning Process

System Operations Subcommittee  
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## March OC / PC

PJM provides Synchrophasor Informational Update. OC asks PC to investigate adding PMU placement into the RTEP Process.

## May 26 PC

PC Special Session - Phasor Measurement Unit (PMU) Education.

## July 9 OC

OC First Read of PC's recommended M01 language.

## May 12 PC

PJM provides: Issue Charge, Problem Statement, Solution Proposal First Read under the M34 Quick Fix Process.

## June 2 & July 7 PC

Issue Charge, Problem Statement, Solution Proposal provided as Second Read and endorsed by the PC.

## August 6 OC

OC Second Read. PJM will ask for Endorsement of M01 language.

**Vision:** Full Synchrophasor observability of all EHV equipment 100 kV and above

## Benefits:

- Ability to detect high-speed grid disturbances (oscillations, equipment failures)
- Innovative post-event analysis including dynamic model validation

## Risk of unobservable grid events:

- Widespread installation of Synchrophasors was a recommendation following the 2003 blackout, which lasted 4 days, affected 50 Million people, with an estimated cost of \$6 billion.

PJM feels that the identified benefits and added observability well outweigh the additional installation costs.

Recognizing the history and lessons learned from the Department of Energy's 2009 Smart Grid Investment Grant (SGIG) PMU deployment project, a formalized process is needed to expand deployment beyond the existing research-grade PMU devices on the PJM transmission system. This placement process is needed to:

1. Ensure that PJM's real-time, post-event, and planning applications have the proper quantity and quality of PMU measurements required by these applications.
2. Expand the coverage of high-speed Synchrophasor devices in the PJM footprint to meet the dynamic monitoring needs of the future grid.

This plan would establish a minimum standard of PMU placement and would target the backbone transmission system in PJM.

- PJM has identified the [reliability and resilience benefits](#) of PMU data observability across the PJM footprint. To achieve and maintain these benefits, a minimum coverage of Synchrophasor devices are needed.
- A PMU placement provision is needed in the RTEP planning process to ‘opportunistically’ install Synchrophasor devices at minimal cost. Targeted (retrofit) PMU placement projects may be needed to ensure near-term PMU coverage needed by key Synchrophasor applications.
- PJM sees an opportunity to incorporate PMU Placement as a prospective requirement in the RTEP planning process to establish a growth-cycle of new and replacement PMU devices. Adding such a requirement for an identified category of RTEP projects will be a low-cost, high-benefit implementation.
- Such a requirement would require a long-lead notice for newly approved projects to include PMU devices in project costs and design documents.

Prospective RTEP requirement to include the installation of Synchrophasor devices. The requirement will be carried out by new M14B and M01 language.

## Costs:

- Substation Costs - costs to make a substation “PMU Ready”
  - Estimated total: ~120k
- Project Costs - costs to install a single PMU
  - Estimated total: ~10k

## Yearly Installations:

- Estimated yearly installation: ~75 PMUs
- Estimated yearly cost: ~\$8M

## 1. Additional M01 Section 3.6.2:

For substations with three or more non-radial transmission lines at 100 kV or above, Synchrophasor measurements are required for the following equipment types (see the applicability of requirements below). All measurement points must be in the form of positive sequence values.

- Voltages for busses at 100 kV and above
- Line-terminal voltages and currents (both ends) for transmission lines at 100 kV and above
- High-side/low-side voltage and current values for transformers with a rated low side voltage of 100 kV or greater
- Dynamic reactive device power output (SVCs, STATCOMs, Synchronous condensers, etc.)

Note: These Synchrophasor data requirements shall only apply to new baseline and supplemental projects presented to the Transmission Expansion Advisory Committee (TEAC) and/or the Sub Regional RTEP Committees (SRRTEP) for inclusion in the Regional Transmission Expansion Plan (RTEP) on or after June 1, 2021. In situations where the installation of a Synchrophasor device causes technical challenges resulting in unusually high installation costs, PJM may, on a case-by-case basis, approve an alternative Synchrophasor device installation plan proposed by the Transmission Owner or Designated Entity. **PMU Devices Supporting equipment (PDC, GPS clock, etc.)** installed per this requirement shall include necessary design and configuration to make the device 'CIP ready'.

- PJM will review the costs and efficacy of M14B and M01 PMU placement language on a 5-year basis.
- PJM will update the [Synchrophasor Technical Guidelines Document](#) to include guidance for new transmission-level Synchrophasor devices.



- Synchrophasors are a form of metering, implementing a placement requirement should follow the same documented process used by traditional SCADA.
- Because synchrophasors are a form of metering, the following CTOA section applies to both traditional SCADA and Phasor Measurement Units.

**CTOA Section 4.9: Data, Information and Metering:** The Parties shall comply with the data, information and metering requirements established by PJM, as reflected in the PJM Manuals including but not limited to posting notices as required by Section 4.8.

- PJM feels that the manual language in the solution proposal is sufficient to implement the PMU placement requirement, and that no additional language is needed in the Tariff or Operating Agreement.

- Informational update in March OC/PC
- May PC – First Read: Problem Statement & Solution
- June/July PC – Second Read & Endorsement: M14B Language
- July OC – First Read: M01 Language
- August OC – Second Read & Endorsement: M01 Language
- August MRC – PC M14B Language & OC M01 Language brought to MRC as First Read
- September MRC - PC M14B Language & OC M01 Language brought to MRC as Second Read and Endorsement

Supplemental information: [ISO New England Operating Procedure No. 22 – Disturbance Monitoring Requirements \(OP-22\)](#)

