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

Markets & Reliability Committee
August 20, 2020

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Issue Timeline

March OC / PC

PJM provides Synchrophasor Informational Update.

OC asks PC to investigate adding PMU placement into the RTEP Process.

May 12 PC

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

May 26 PC

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

June 2 & July 7 PC

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

July 9 OC

OC First Read of PC's recommended M01 language.

August 6 OC

OC Second Read. M01 language endorsed by the OC.

Goal and Vision

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

Benefits:

- Ability to detect high-speed grid disturbances (oscillations, equipment failures)
- Expanded Linear State Estimation
- Assist PJM in meeting its NERC reliability obligations:
  - BAL-003-1.1
  - IRO-008-2
  - TOP-001-4
  - MOD-032-1/033-1

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.

Identified benefits and enhanced observability outweigh incremental costs.

Problem Statement / Issue Charge

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.

Problem Statement / Issue Charge

- 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.

Solution Proposal – Manual 14B

The Planning Committee (PC) endorsed the following modification to M14B Appendix B, Section B.3:

RTEP Deliverables

- A 5-year plan, which includes recommended regional transmission enhancements, including alternatives if applicable, that address the transmission needs for which commitments need to be made in the near term in order to meet scheduled in-service dates
- The 5-year plan will include planning level cost estimates and construction schedules.
- The 5-year plan will specify the level of budget commitments which must be made in order to meet scheduled in-service dates. The commitment may include facility engineering and design, siting and permitting of facilities, installation or modification of metering system(s) required by Manual 01, or arrangements to construct transmission enhancements or expansions.
- The 15-year plan will identify new transmission construction and right-of-way acquisition requirements to support load growth.

Solution Proposal – Manual 01

The Operating Committee endorsed the following additional language to M01 Section 3.6:

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. Supporting equipment (PDC, GPS clock, etc.) installed per this requirement shall include necessary design and configuration to make the device 'CIP ready'.

Solution Summary

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

Additional Control and Support

- PJM will review the costs and effectiveness 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.

RTEP PMU Placement Issue: Stakeholder Process Plan

- 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 – MRC First Read:
  - PC M14B Language
  - OC M01 Language
- September MRC - MRC Second Read and Endorsement

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

Q & A

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Manual 01 and 14B - RTEP PMU Placement

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