



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

May 26, 2020

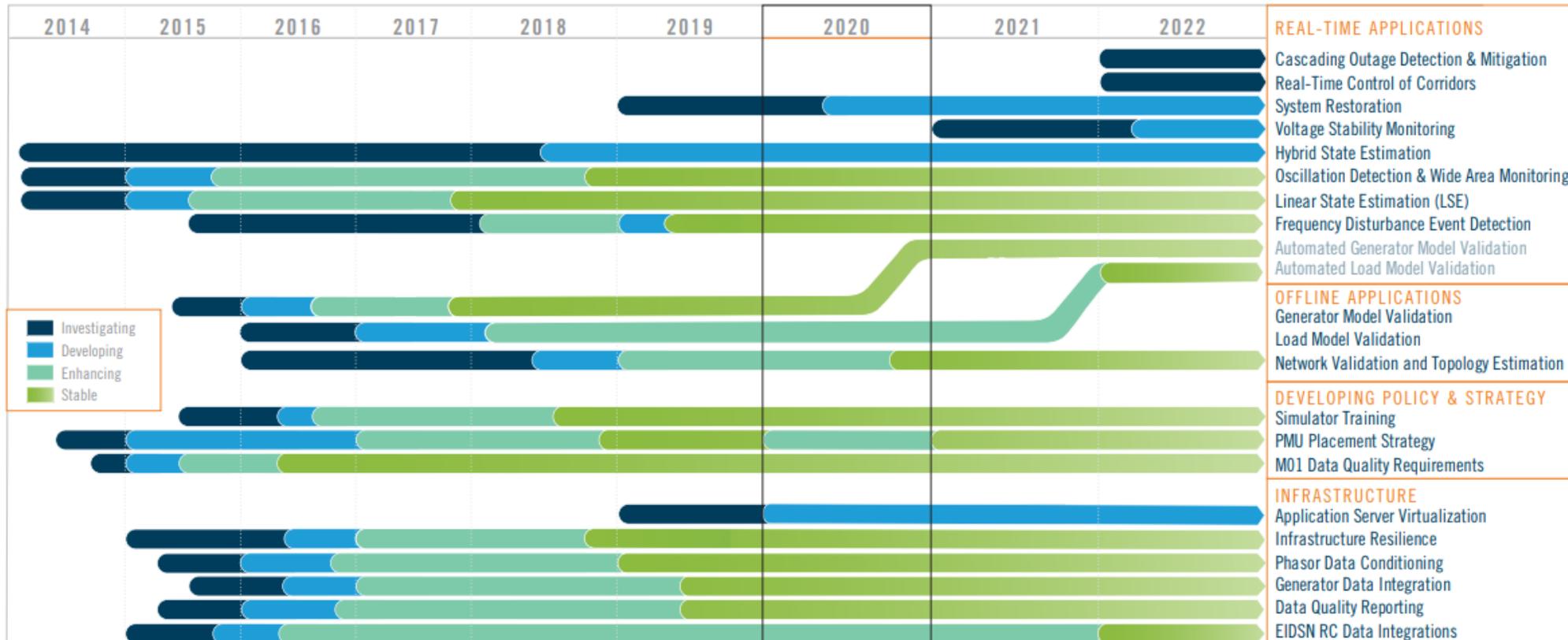
- Today's education session will focus on:
  - Synchrophasor applications ready for regular use
    - Real-time applications
    - Offline applications
  - Benefits to PJM

Please ask questions!

- Introduction
- Linear State Estimation (LSE)
- Oscillation Detection & ESAMS
- Dynamic Model Validation
- Redundant IROL Monitoring
- Solution Proposal
- Q & A

## PJM SYNCHROPHASOR TECHNOLOGY ROADMAP

USED & USEFUL	Year Started	Year Stable
Phasor Data Concentrator	2013	2015
TO DOE Project Data Integration	2013	2016
Post-Event Analysis	2014	2016



## Substation Costs

- Costs to make a substation “PMU Ready”
  - Updating drawings
  - Cabinet / rack space
  - Substation PDC
  - GPS Clock
  - Network infrastructure

Estimated total: ~120k

## Project Costs

- Costs to install a single PMU
  - Updating drawings
  - PMU device (relay) configuration

Estimated total: ~10k

The Planning Committee (PC) will **approve** the following modifications to M14B:

- **Additional language to M14B Appendix B as follows:**

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.

- **Additional language to M14B Section 1.4.1.3:**

Maintaining a safe and reliable Transmission System also requires keeping the transmission system equipment in safe, reliable operating condition as well as addressing actual operational needs. On an ongoing basis, PJM operating and planning personnel assess the PJM transmission development needs based on recent actual operations. This may lead to special studies or programs to address actual system conditions that may not be evident through projections and system modeling.

To ensure that system facilities are maintained and operated to acceptable reliability performance levels, PJM has implemented an Aging Infrastructure Initiative to evaluate appropriate spare transformer levels and optimum equipment replacement or upgrade requirements. This initiative, based on a Probability Risk Assessment (PRA) process, is intended to result in a proactive, PJM-wide approach to assess the risk of facility failures and to mitigate operational and market impacts. Section 2 of this manual provides further discussion of the PRA process.

**Additionally, ensuring adequate Synchrophasor device coverage is needed to support PJM's real-time applications. The PMU Placement Strategy (PPS) identifies the Synchrophasor device coverage needed to support PJM's real-time Synchrophasor applications. The PPS will include placement targets and required operational dates to guide installation plans. The PPS will be periodically reviewed and updated by PJM Operations and will be included in the Operational Performance assessment process.**

Refer **recommended** M01 language to Operating Committee to set placement requirements.

1. Prospective requirement
2. Integrate PMU Placement Strategy into M01 and Operational Performance process

## 1. Additional language to M01 Section 3.6:

### Required Synchrophasor Data\*:

Synchrophasor measurement signals are required for the following equipment locations:

- Bus voltages at 100 kV and above
- Line-terminal voltage and current values for transmission lines at 100 kV and above
- High-side / low-side voltage and current values for transformers at 100kV and above
- Dynamic reactive device power output (SVC, STATCOM, Synchronous Condenser, etc.)

\* ~~These requirements do not apply to existing transmission facilities placed in service prior to June 1, 2021~~ shall only apply to new baseline and supplemental projects presented to the TEAC for inclusion in the RTEP after June 1, 2021. In situations where the installation of a Synchrophasor device would incur an unusually high installation cost, PJM may approve an alternative Synchrophasor device installation plan proposed by the Transmission Owner.

## 2. Review the [PMU Placement Strategy](#) & Incorporate into M01 as Attachment F

