ERCOT PSCAD Study Experiences

ERCOT Transmission Planning

ESIG Fall Workshop

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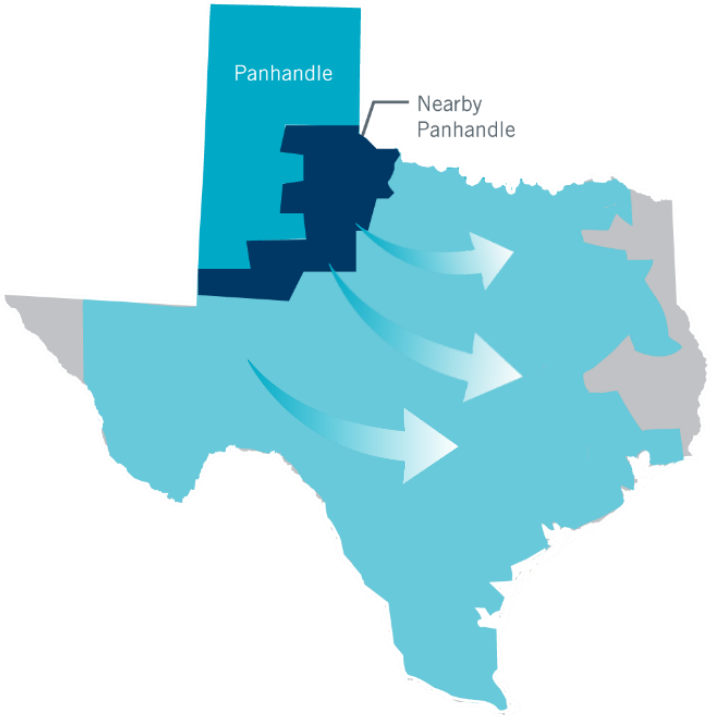
Outline

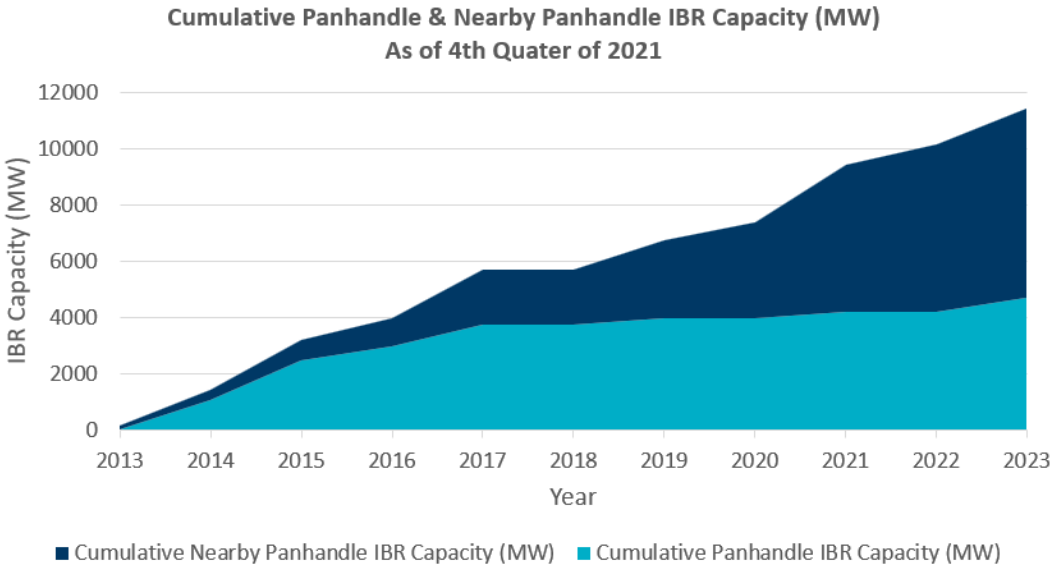
- The IBRs in Panhandle Region
- 2020 Panhandle Stability Study
- PSCAD Model Quality test requirements
- PCAR Tool Development
- Sample Model Quality test results
- Next steps

Renewable Generation in Panhandle

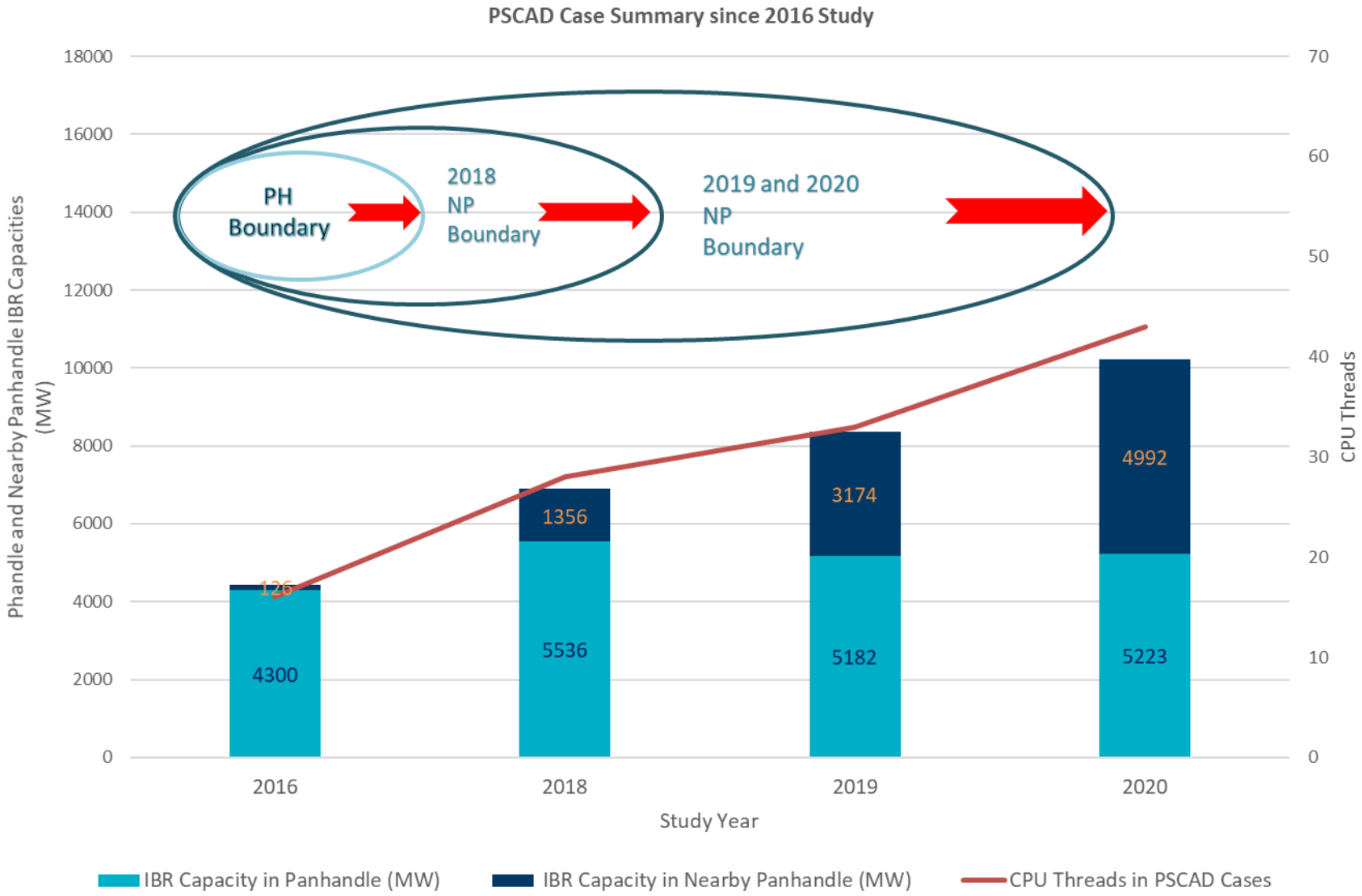
- Remote from synchronous generators and load centers
- GWs of power export
- All inverter-based resources (IBR)
- IBR capacities keep growing



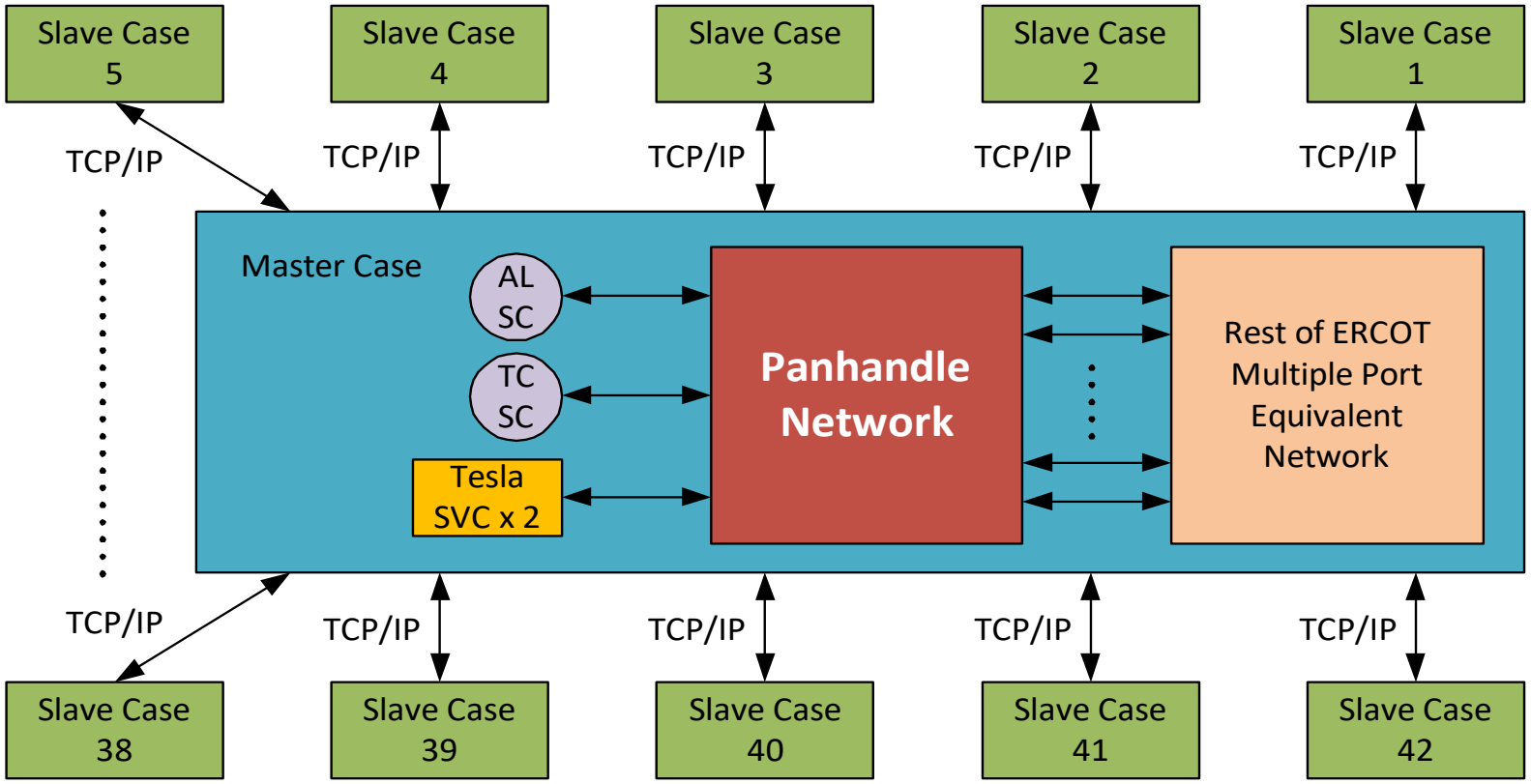
- Challenges and Needs
  - Voltage stability (RMS tools)
  - Control stability (EMT tools)
    - Two synchronous condensers were identified and installed in 2017



PSCAD Case Expansion since 2016 Study



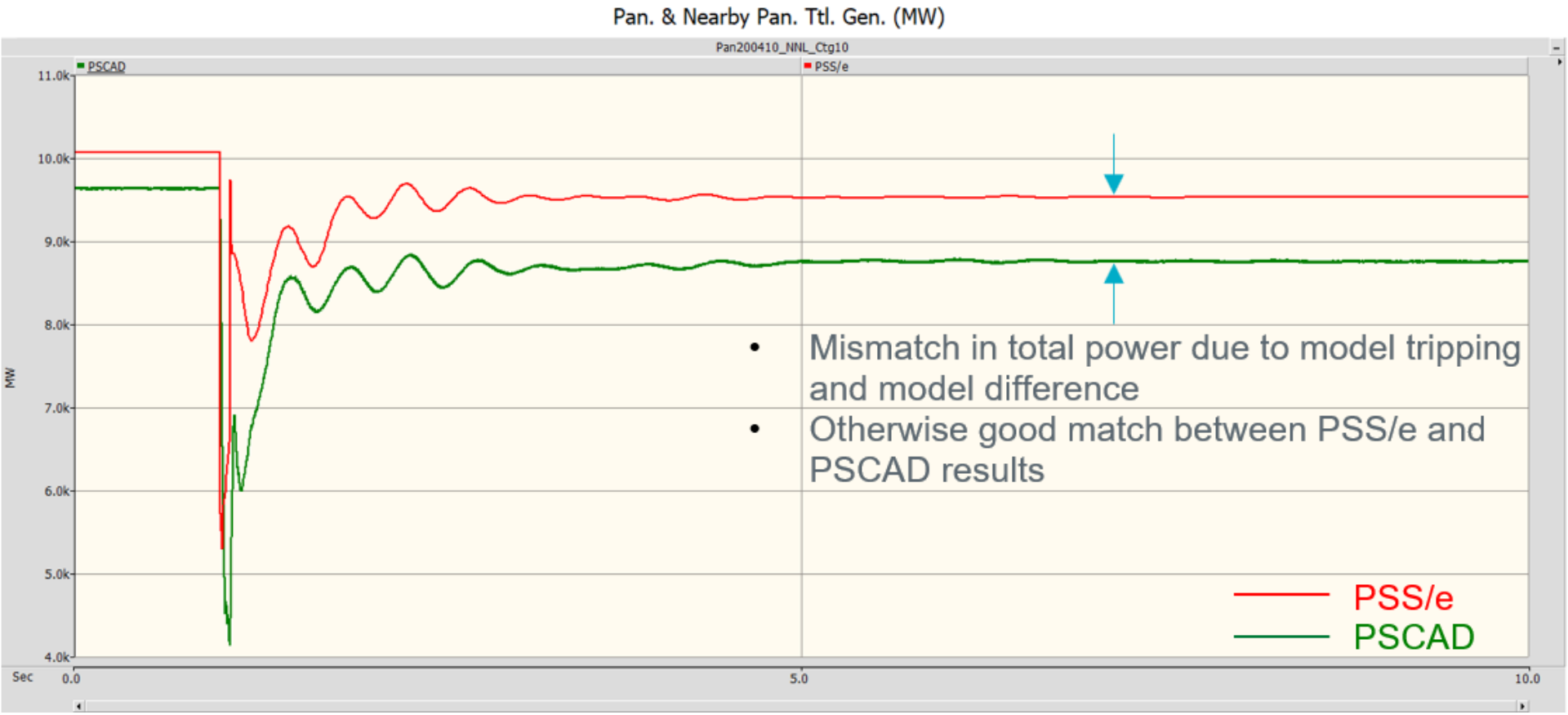
PSCAD Parallel Case setup



1. Total of 46 IBR Projects
2. Represented by 62 PSCAD models
3. 43 threads are used to perform PSCAD simulation

1. Efforts in preparing the base case
2. For each contingency, took 2.5 hours, and created 3.4 GB data
3. Took time for individual model update and quality improvement

Results comparison between PSS/e and PSCAD



PSCAD Model Review necessity and challenges

- In general, PSCAD models are expected to better reflect the IBRs under weak grid conditions.
- PSCAD model quality and accuracy need to be validated and verified to 1) improve the fidelity of the system level study and 2) be used as a reference to benchmark positive sequence models.
- The model review and update process often requires support from Resource Entities (REs), developers, manufacturers, consultants, and Transmission Service Providers (TSPs).
- Large scale PSCAD study is time consuming.

Current Dynamic Model Requirements

Generation Interconnection

- Provide PSS/e model
- PSS/e model quality tests
- PSCAD model and tests request may be triggered at this stage*

QSA**

- PSCAD model and quality tests
- PSCAD model validation
- Benchmark PSS/e↔PSCAD using model quality tests onwards

Commissioning

- Verification of key settings of PSCAD models
- Model quality tests (PSS/e and PSCAD) are required for any model or setting changes during Commissioning

Operations

- Keep dynamic models up to date
- Verification of key settings within two years and every ten years thereafter or if there is a settings change
- Model quality tests and verification are required for any model or setting changes during Operation

* If SSR or others EMT studies are deemed necessary in the interconnection process
** QSA: Quarterly Stability Assessment

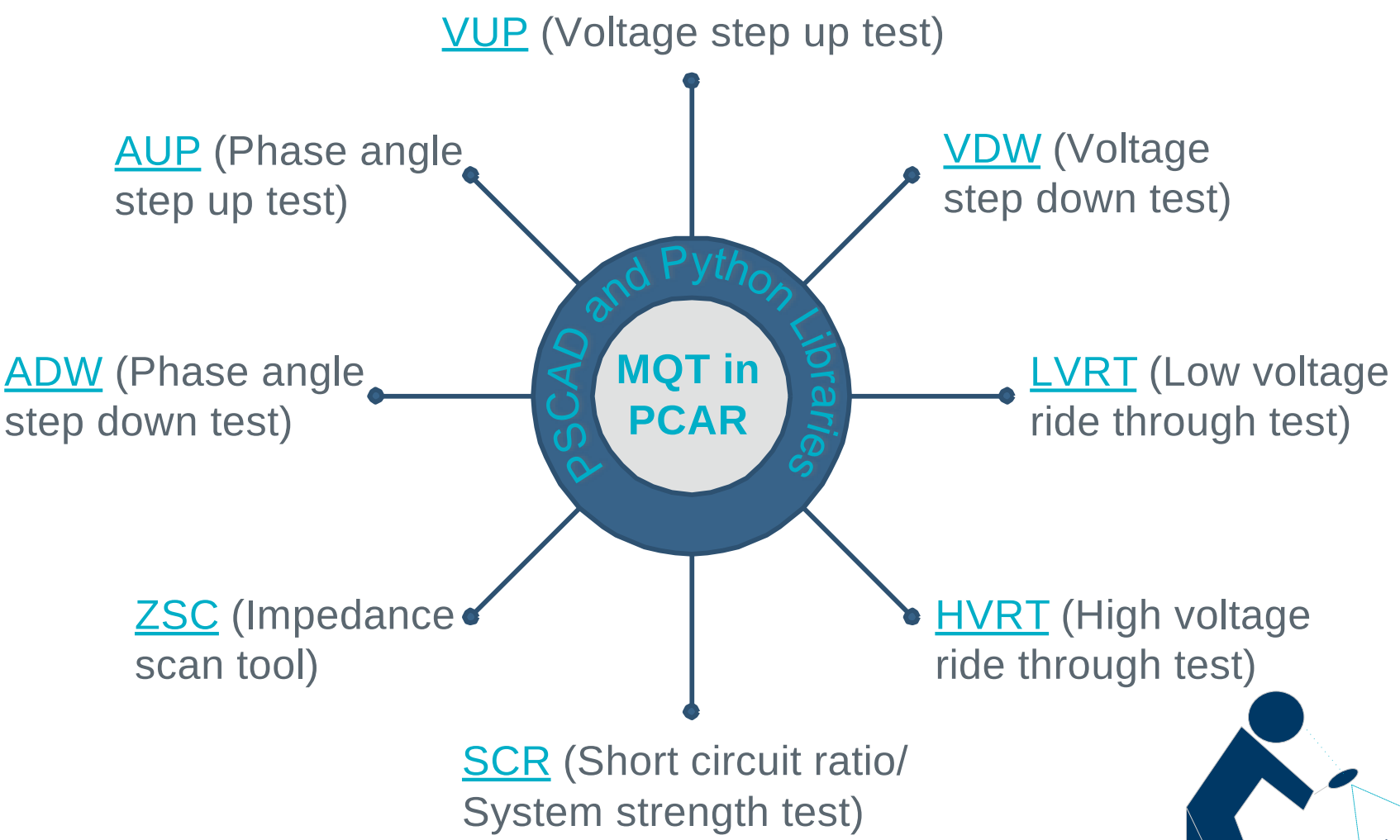
Resource Entities are responsible for all these requirements, from model validation, model quality tests, to model verification

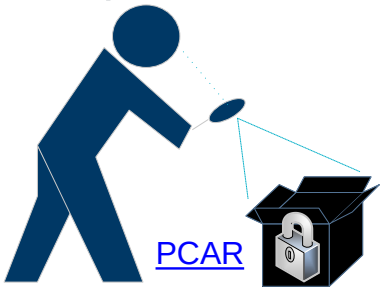
- **Planning Guide** sections 5.7.1 and 6.2
- Dynamics Working Group DWG Procedure Manual section 3.1
- **Model Quality Guide** published on the Resource Integration webpage
- **Dynamic Model Templates** published on the Resource Integration webpage

PCAR Tool for PSCAD Studies

- ERCOT developed PCAR (PsCad Auto Run), a python-based tool for large scale system wide PSCAD study. Notable features include:
  - Use of automation libraries in PSCAD => flexible for update and expansion
  - Include functions for PSCAD model quality test => facilitate model performance review
  - Automatically create and consolidate the simulation plots, including adding both PSS/e and PSCAD plots in a single platform
  - Support multiple runs and parallel computations => reduce user manual processes
  - Reduce case building time to focus on studies and result analysis

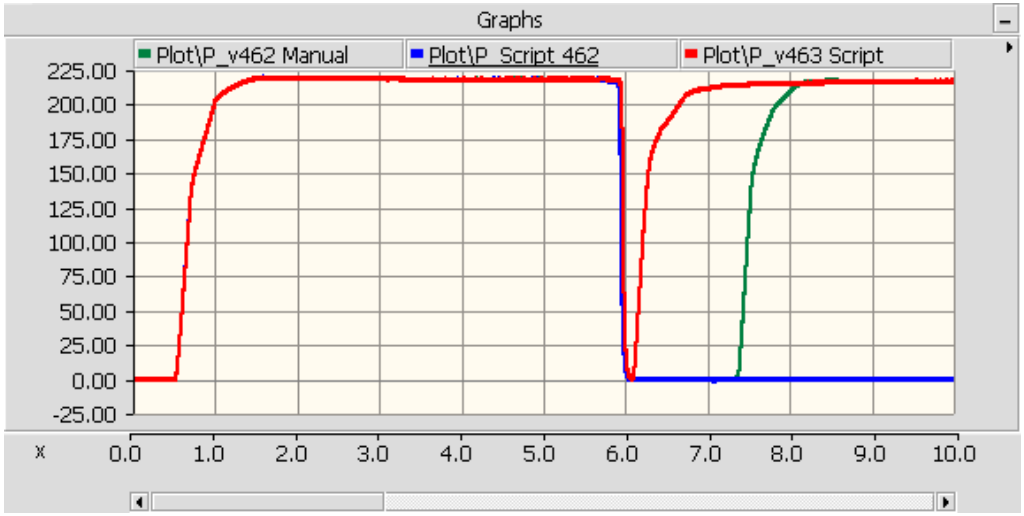
PCAR Tool for PSCAD Model quality tests



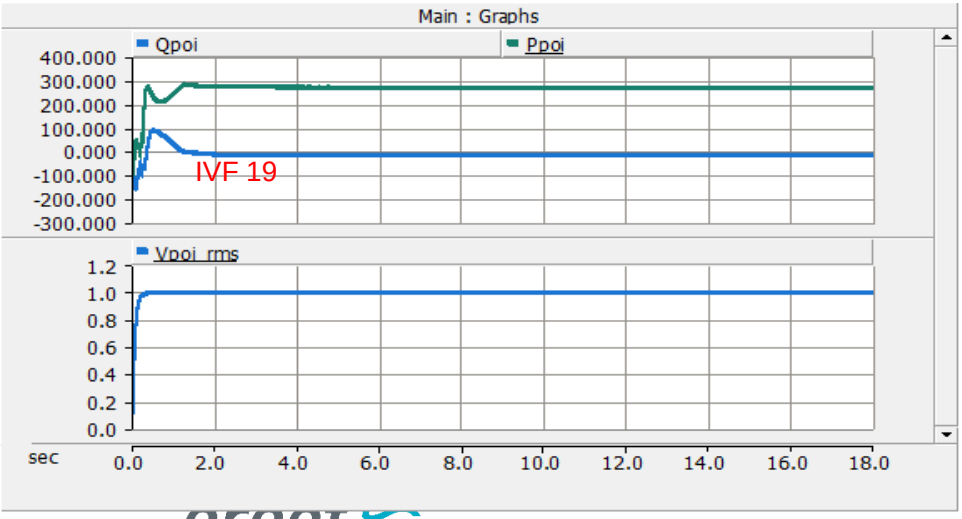


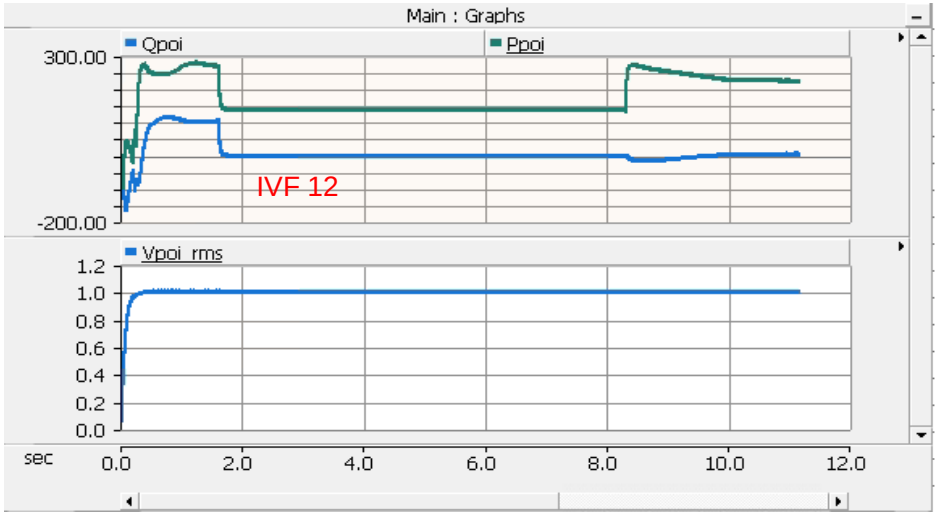
https://github.com/toolsite/PCAR

Examples in PSCAD Model quality tests



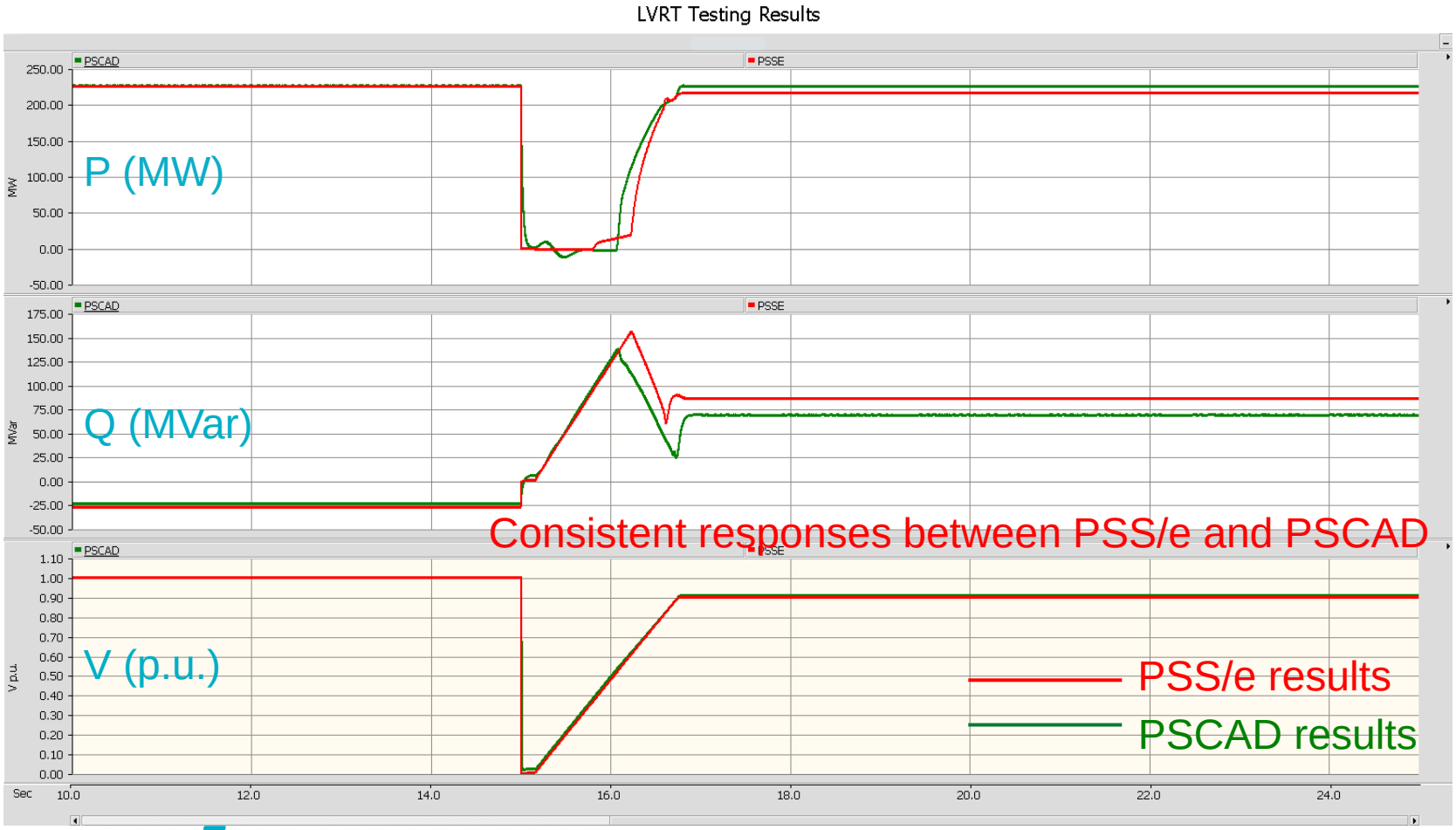
- Inconsistent response between different PSCAD software versions and Fortran compilers (PSCAD v4.6.3 and IVF v12)
- Suspicious trip during simulation
- Incorrect rated capacity in the model





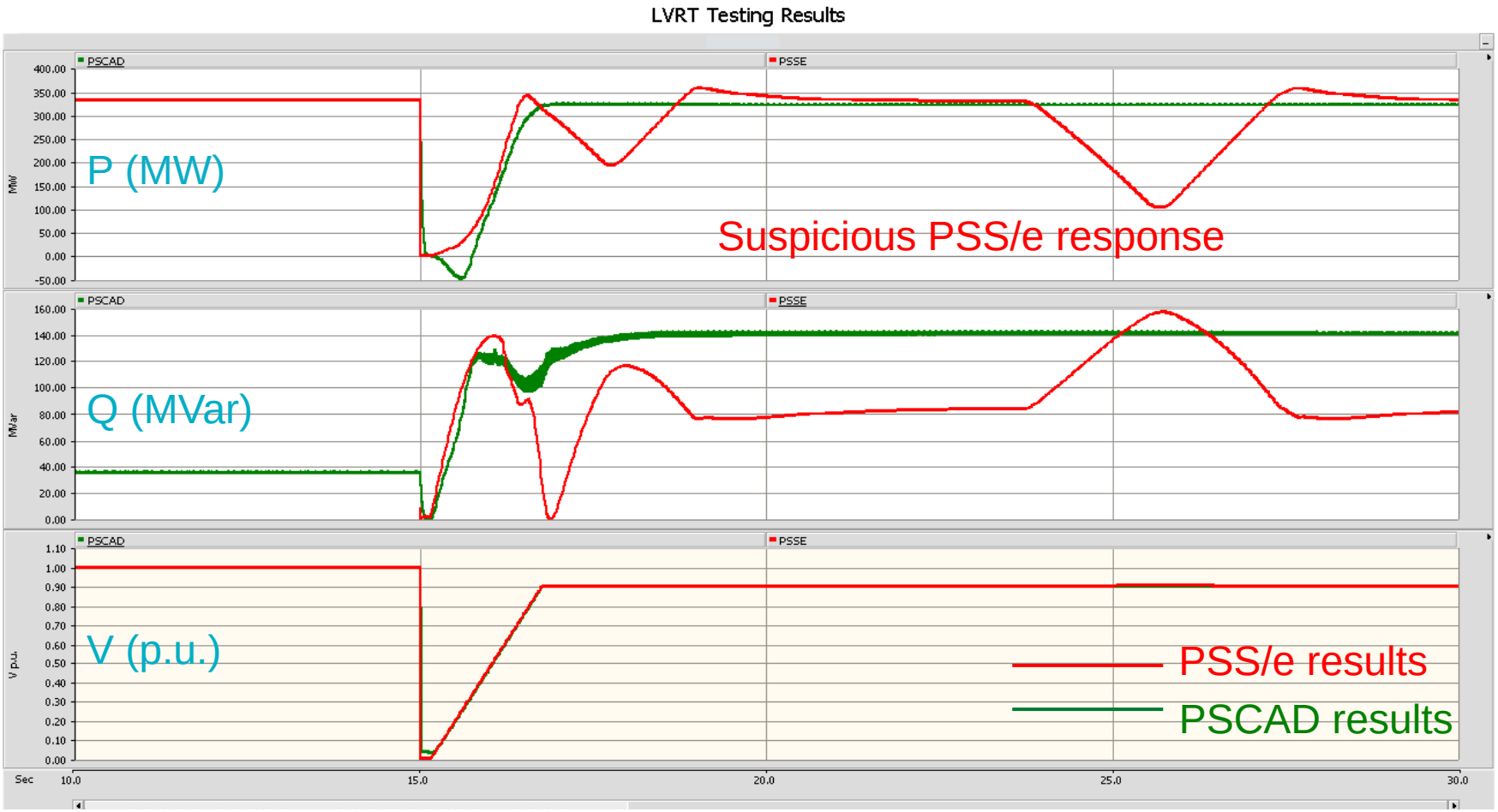
LVRT test sample 1

- Performances match between PSS/e and PSCAD



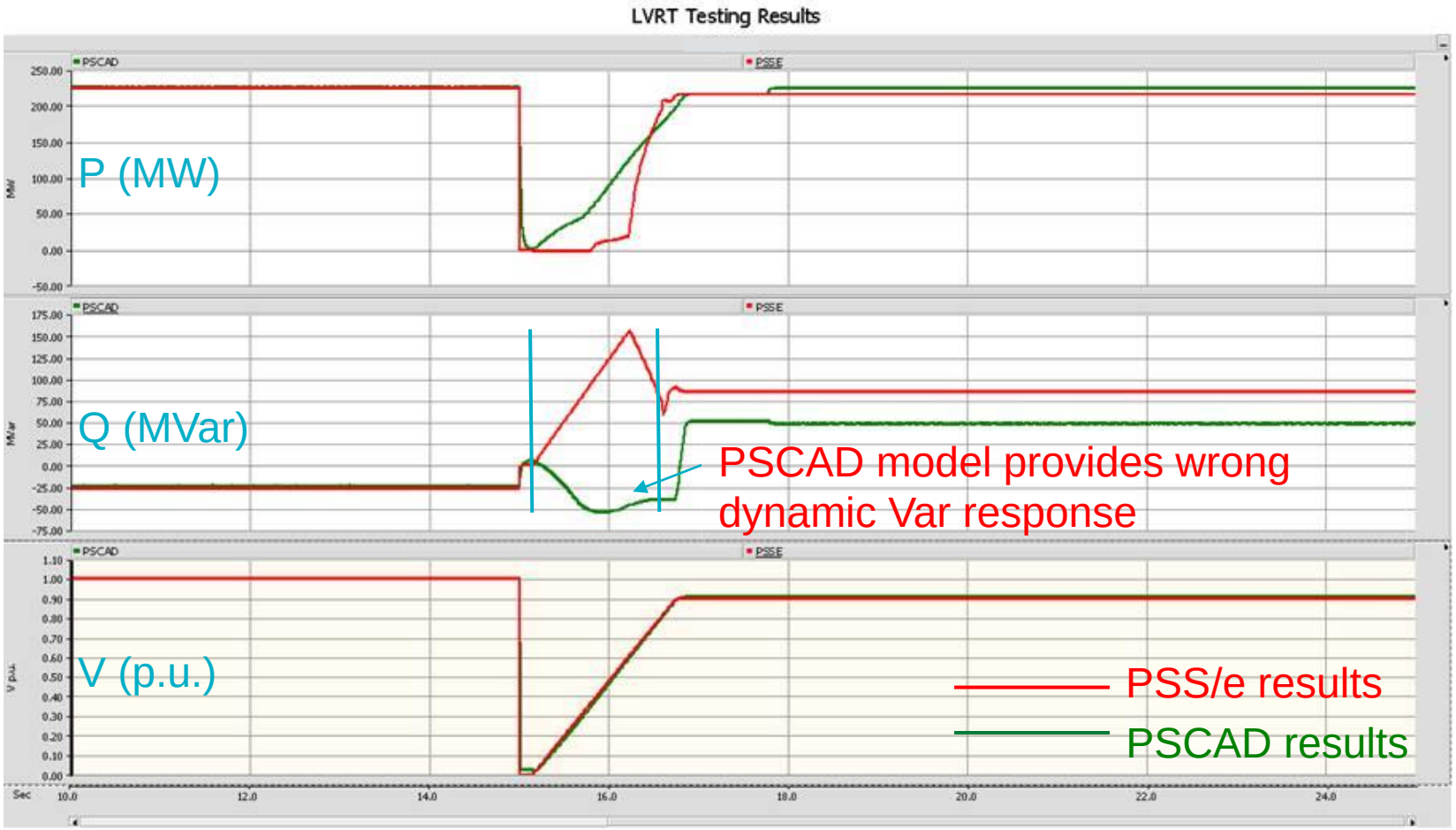
LVRT test sample 2

- Mismatch observed between PSS/e and PSCAD



LVRT test sample 3

- Mismatch observed between PSS/e and PSCAD



Ongoing and next steps

- The PCAR tool has been successfully applied to the ERCOT PSCAD studies, including PSCAD model quality tests and parallel simulation.
- The tool has been shared with stakeholders to facilitate the PSCAD model quality tests.
- With increasing penetration level of IBRs in the system, large scale EMT studies are becoming more necessary but still challenging to the industry.
- Identify ways to improve the EMT simulation efficiency.
- Explore ways to develop adequate screening approaches to evaluate system strength and determine when and where the EMT studies would be required.

Appendix

- http://www.ercot.com/content/wcm/lists/197392/2020_PanhandleStudy_public_final__004_.pdf
- http://www.ercot.com/content/wcm/lists/197392/2019_PanhandleStudy_public_V1_final.pdf
- http://www.ercot.com/content/wcm/lists/144927/Panhandle_and_South_Texas_Stability_and_System_Strength_Assessment_March....pdf
- http://www.ercot.com/content/news/presentations/2016/Panhandle%20System%20Strength%20Study%20Feb%2023%202016%20(Public).pdf.

Thanks!
Questions?

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