Model Testing for NOGRR245
Initial Discussion

John Schmall/Jonathan Rose/Scott Zuloaga
ERCOT Transmission Planning

IBRWG Meeting
April 12, 2024

Objectives

- Focus on performance evaluation for VRT test profiles presented last month
  - Not a final proposal – ERCOT is open to considering additions or subtractions
  - Assumes that there will be requirements aligned with the IEEE 2800-2022 curves (but NOGRR 245 is not finalized)
- Get stakeholder feedback and input

List of Applicable Tests (MQT)

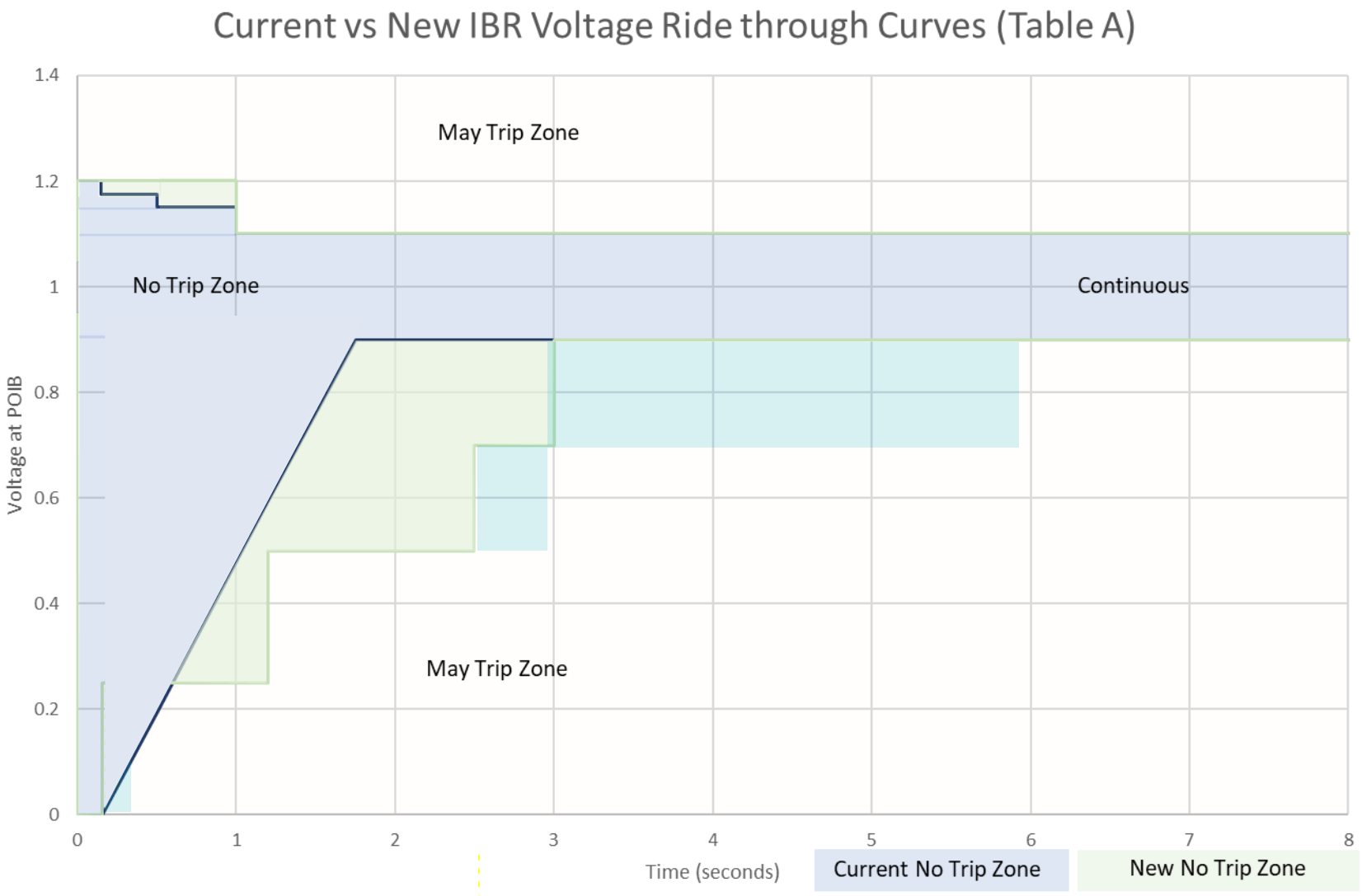
- This presentation will focus on the highlighted items below

Test	Applicable Models	Applicable Technologies	Notes
Flat Start	PSCAD PSS/E TSAT	ALL	
Small Voltage Disturbance			
Small Frequency Disturbance			
LVRT		IBRs WGRs	For LVRT, test both the new NOGRR245 "Preferred" curves and the "Legacy" curves. Of the "Preferred" curves, select the one corresponding to the technology. The "HVRT w/ Transient" can be run with the HVRT simulation (no need for two simulations when testing the PSCAD model).
HVRT			
HVRT w/Transient	PSCAD	IBRs	
Phase Angle Jump			
System Strength	PSCAD PSS/E TSAT	IBRs WGRs	
Large Disturbance (Fault Test)	PSS/E TSAT	Synchronous Machines	

Initial Conditions for VRT Tests

- Full real power output
  - ESR shall also run all tests at full charging condition
- 1.0 pu voltage at POI
- Run all tests for two initial power factor conditions
  - 0.95 leading power factor
  - 0.95 lagging power factor

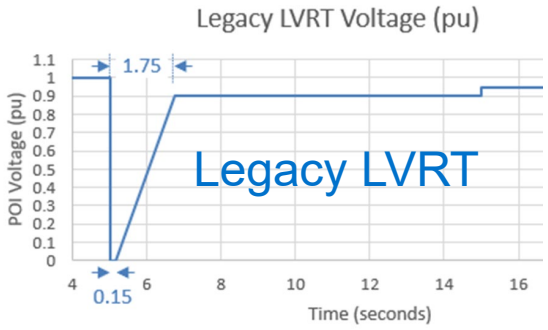
NOGRR245: New IBR Voltage Ride-Through Curves

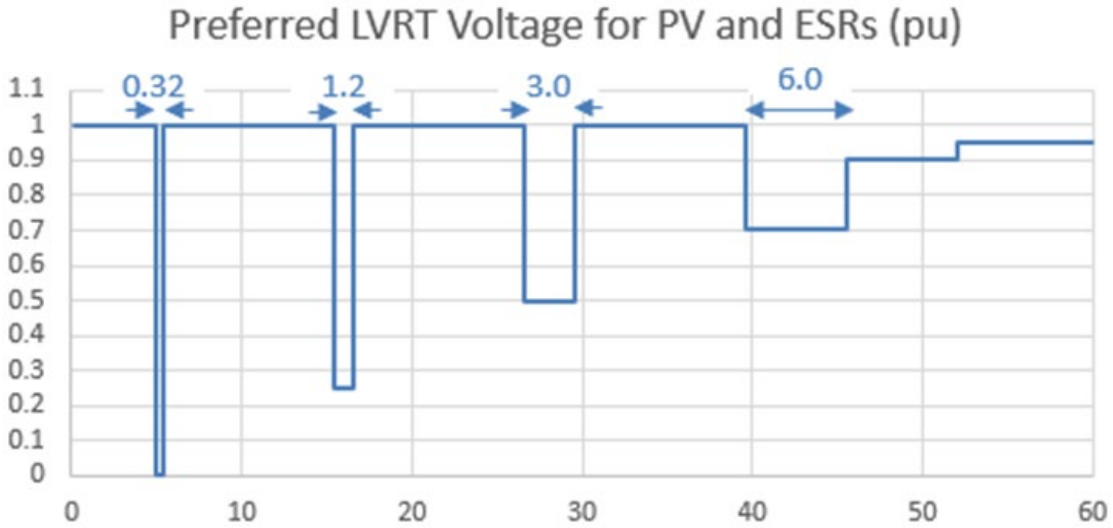


Preferred LVRT Curve for IBR

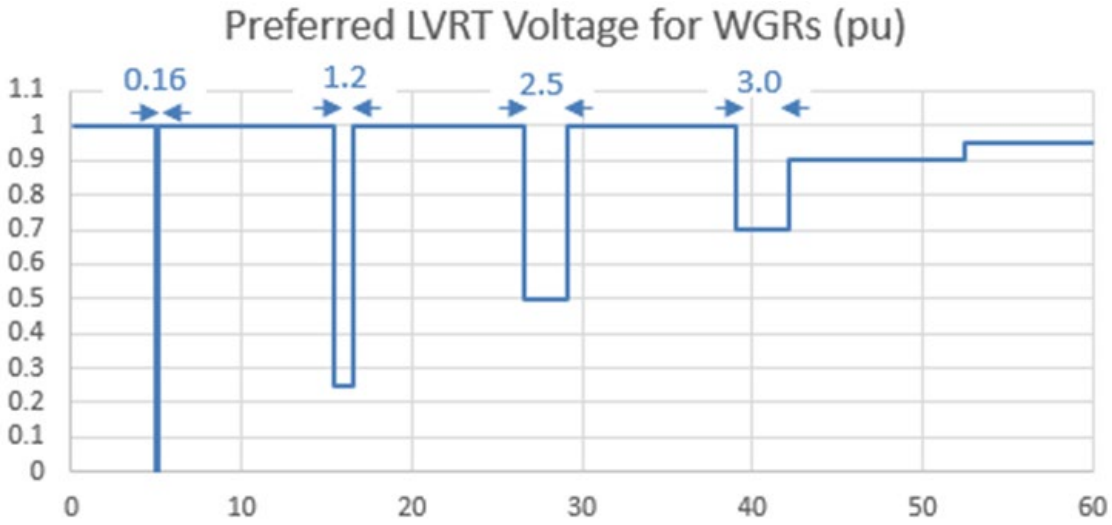
Proposal:

- Test the preferred LVRT curve as a series of voltage dips rather than single stair-step function.
- Test both the Legacy curve AND the appropriate new Preferred curve for leading and lagging pf.
- Per NOGRR245, some plants only required to ride thru the Legacy curve.



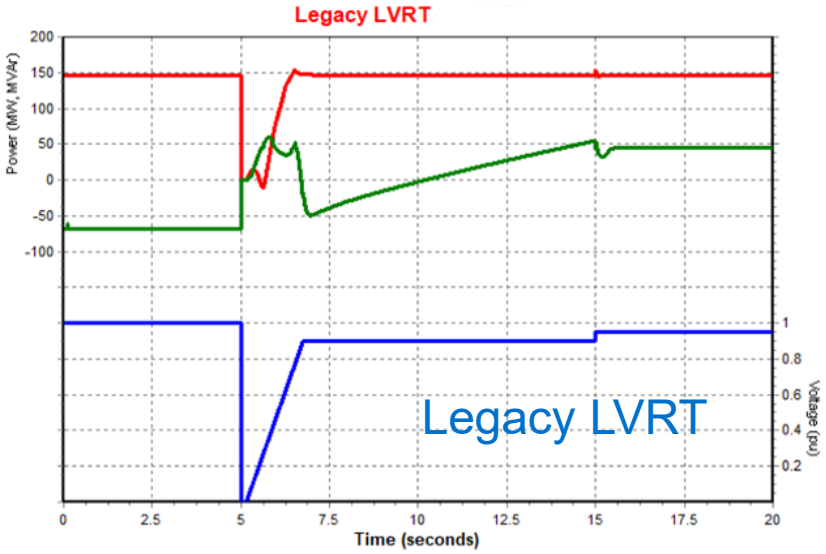


OR



Example Passing Model Test: Legacy LVRT

- Same model tested under new preferred (“P2800”) curve and old Legacy curve.

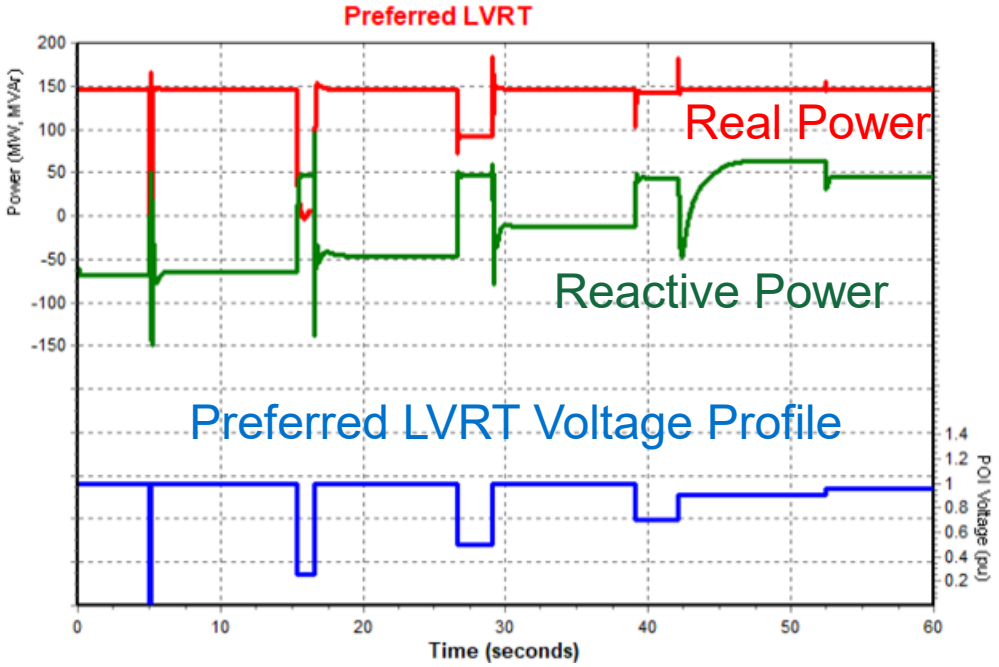


Proposed DWG criteria (unchanged from current):

- *P and Q are necessarily zero during zero voltage. Q injection at the POI should be observable immediately or very shortly after voltage begins ramp up from zero.*
- *Real power recovery within 1 second of voltage recovering to 0.9 (unchanged)*

Example Passing Model Test: Preferred LVRT

- Same model tested under new preferred (“P2800”) curve and old Legacy curve.



Proposed DWG criteria:

- *The model shall inject active current unless reduction is needed to accommodate reactive current injection. Active current injection is required for POI voltage dip of 0.5 pu and higher.*
- *Reactive injection shall be observable immediately or very shortly after voltage dip is applied (should there be a voltage threshold/duration specified?).*
- *Real power recovery within 1 second of voltage recovering to 0.9 (unchanged)*

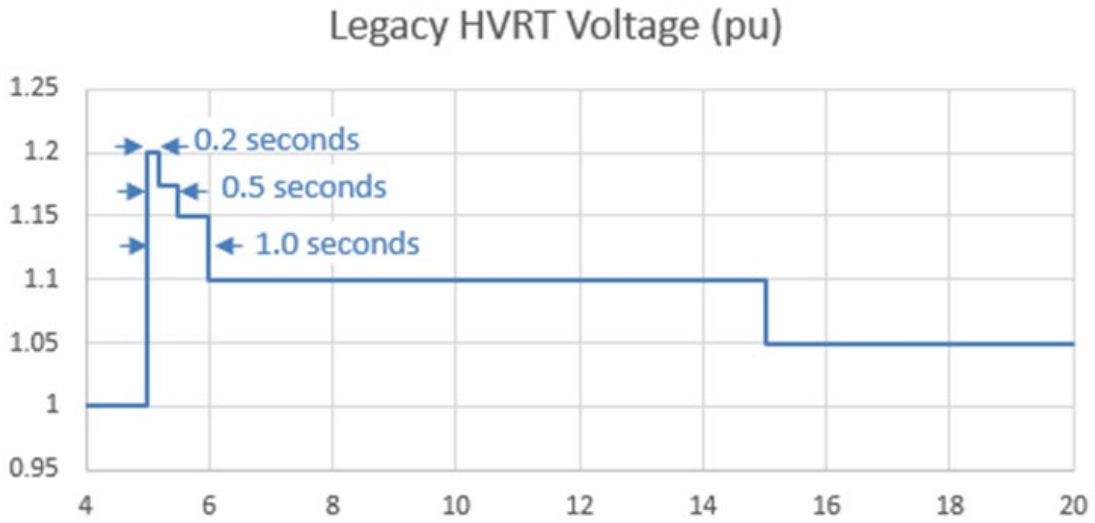
HVRT Curve

Proposal:

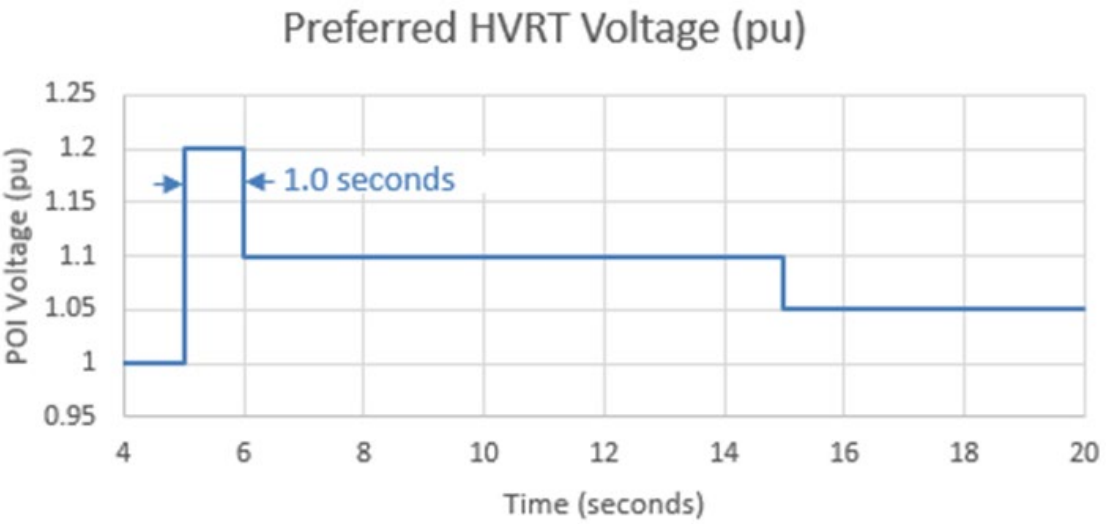
- Test the curve required by NOGRR245.
- Existing plants should try to ride through the new Preferred curve if possible, or at least maximize their trip settings.

Proposed DWG criteria (unchanged from current):

- *Plant shall quickly absorb reactive power, ideally within 0.5 seconds of the transient inception.*
- *Real power should be sustained during the high voltage condition. A modest reduction (typically <5%) may be acceptable to accommodate greater reactive absorption.*



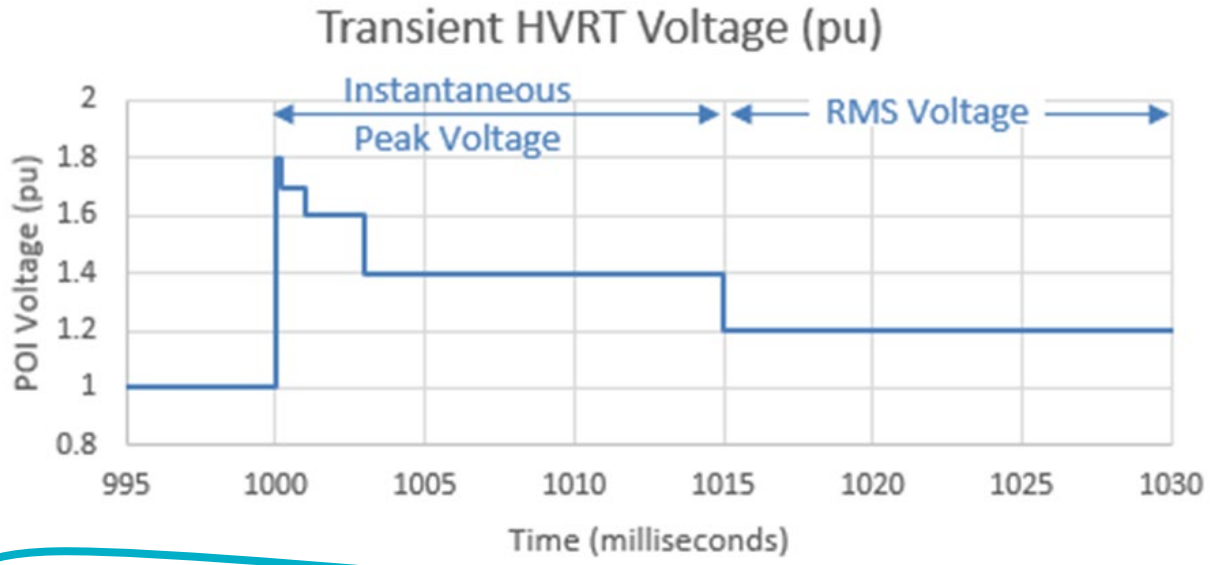
OR

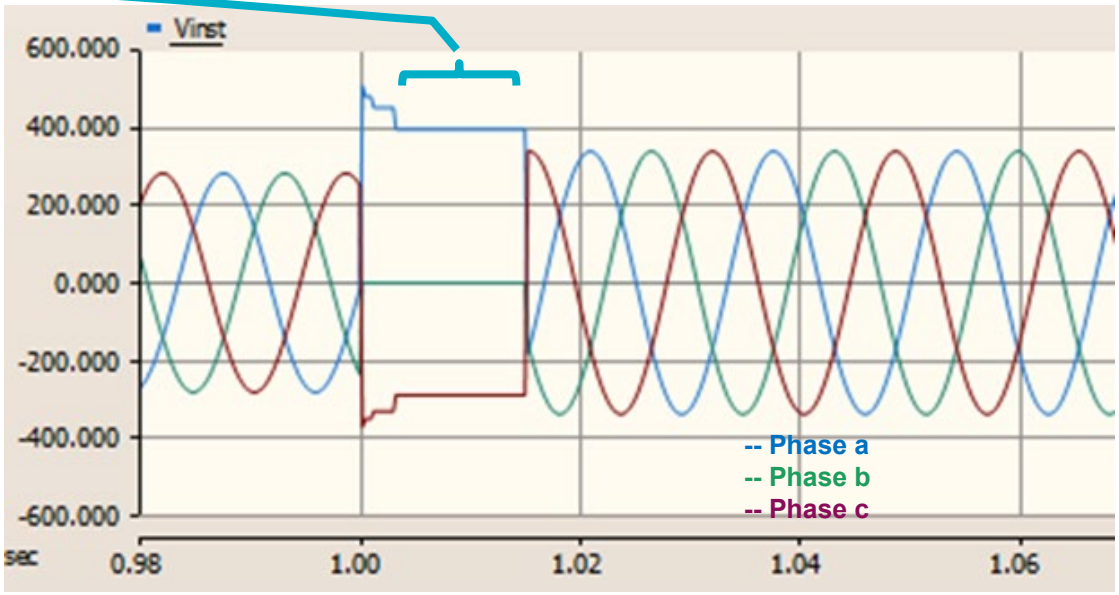


Transient HVRT Curve - PSCAD

Proposal:

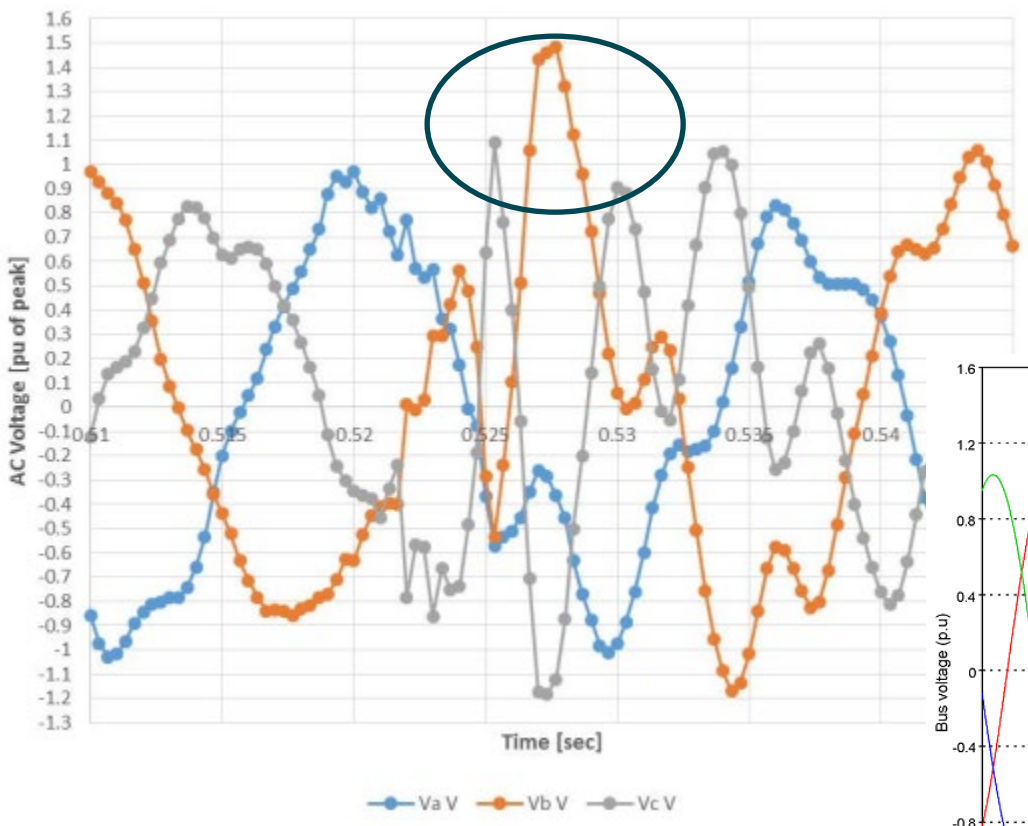
- Transient is applied line-to-line on Phase A and C mimicking over-voltage events that have been seen on power systems.[1][2]
- Question: Should the longer duration 1.4 pu be three-phase sinusoidal?





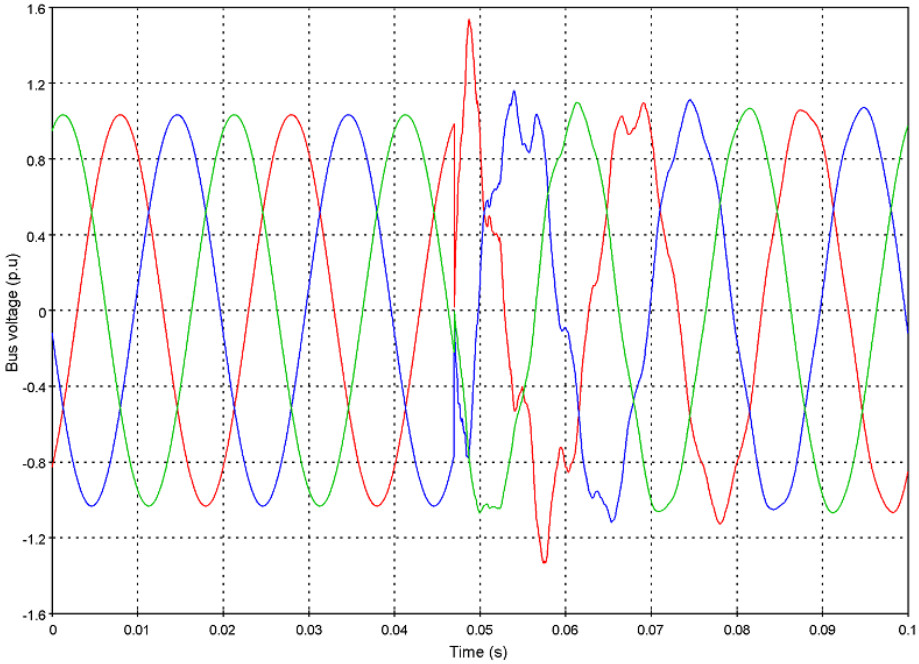
[1] https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Inverter-Based_Resource_Performance_Guideline.pdf
[2]https://www.nerc.com/pa/rrm/ea/1200_MW_Fault_Induced_Solar_Photovoltaic_Resource_/1200_MW_Fault_Induced_Solar_Photovoltaic_Resource_Interruption_Final.pdf

Transient HVRT – Illustrations of Measured Events



Voltages from Canyon 2 Fire disturbance. Phase B peaked at 1.5 per-unit and Phase C experienced a short transient.

https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Inverter-Based_Resource_Performance_Guideline.pdf



https://powersys-solutions.com/application/sub-application/sub-application-software/sub-application-software-details/?study=Power-Transmission-System&software=EMTP

Next Steps

- Other Tests?
  - SLG fault test for PSCAD models?
  - Beyond VRT
- Stakeholder feedback/discussion on VRT tests
  - Open to stakeholder proposals/presentations at future IBRWG meetings
- Draft DWG Procedure Manual language
  - Consider need for revision in higher level document(s) (e.g., Planning Guide)

Thank you!

Stakeholder comments also welcomed through:

John.Schmall@ercot.com

Jonathan.Rose@ercot.com