



2020 Benchmark GMDVA Scope and Process

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Transmission Planning Assessment

July 2020 RPG

Agenda

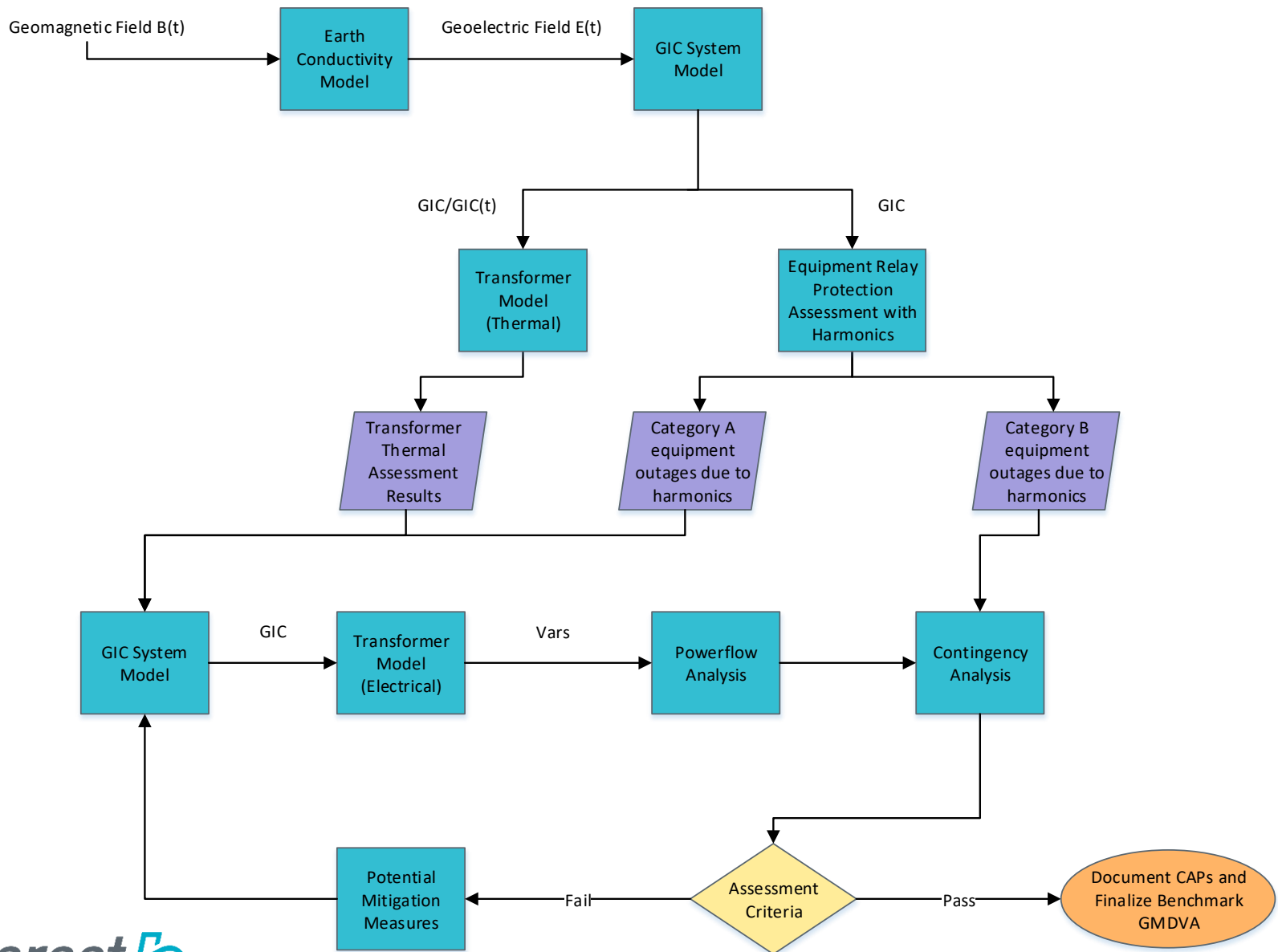
- 2020 Benchmark Geomagnetic Disturbance Vulnerability Assessment (GMDVA) Scope and Process
 - Flowchart
 - Start Cases
 - Input Assumptions
 - Case Preparation
 - Benchmark GMDVA Event Caused Outages
 - Reactive Power Losses
 - Steady-State Voltage and Cascading Analysis
 - Corrective Action Plans (CAPs)
 - Deliverables
- Questions
- Appendix



2020 Benchmark GMDVA

- ERCOT presented a brief [GMD introduction](#) at the May 2020 RPG meeting
- A draft of the 2020 Benchmark GMDVA Scope and Process is posted to July 2020 RPG meeting page
- Governing standard for the Benchmark GMDVA:
 - NERC TPL-007-3 Reliability Standard, currently effective
 - NERC TPL-007-4 Reliability Standard, effective October 1, 2020

2020 Benchmark GMDVA: Flowchart

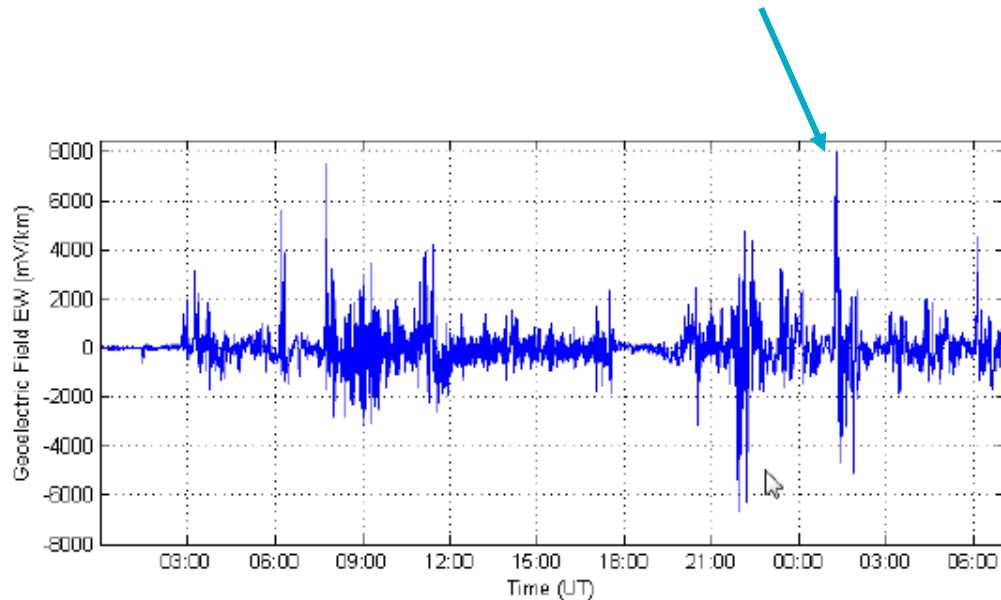


2020 Benchmark GMDVA: Start Cases

- Final GIC System models (the GIC DC and AC models) posted in November 2019 will be used as 2020 Benchmark GMDVA start cases which include the 2022 Summer Peak Load and 2022 Minimum Load models

2020 Benchmark GMDVA: Input Assumptions

- The NERC defined geoelectric field amplitude for the benchmark GMD event of 8 V/km will be used



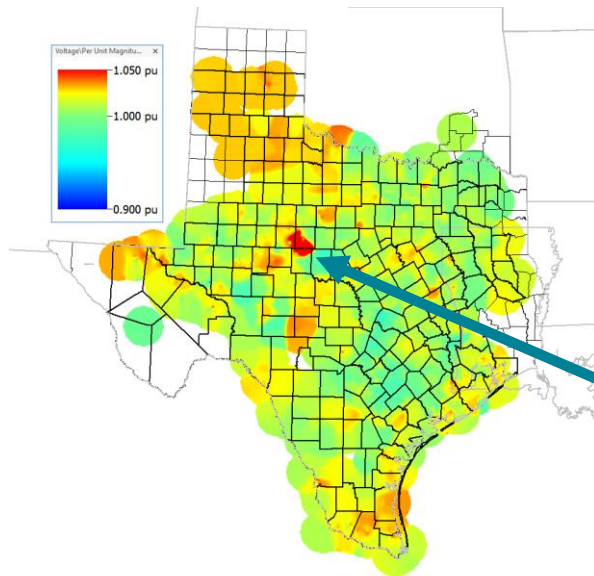
**Figure 4: Benchmark Geoelectric Field Waveform
E_E (Eastward)**

2020 Benchmark GMDVA: Input Assumptions

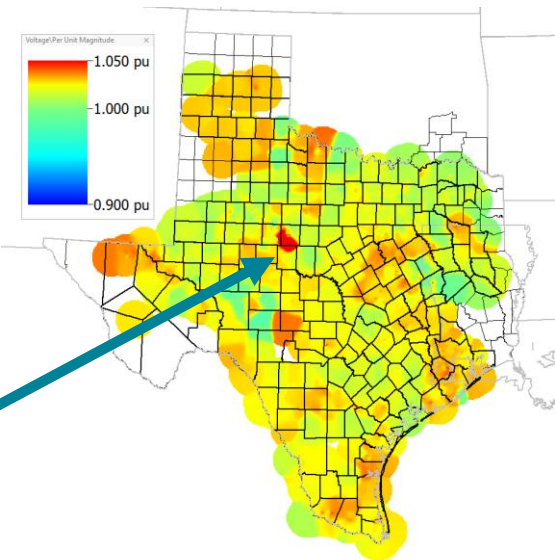
- Geomagnetically Induced Reactive Power Losses
 - Reactive power losses produced by transformers modeled in the system are automatically generated by the GIC analysis software
 - Reactive power losses produced by DC Ties modeled without transformers are not automatically generated and will be calculated separately to be incorporated
- Stability limits will be modeled, as appropriate

2020 Benchmark GMDVA: Input Assumptions

2022 Summer peak case with Category A outages and reactive losses applied



2022 Minimum load case with Category A outages and reactive losses applied



Series compensated area

- The current recommendation is to use the steady-state voltage criteria from Planning Guide Section 4.1.1.4 in the 2020 Benchmark GMDVA but may change based on future findings based on the supplemental GMDVA

2020 Benchmark GMDVA: Input Assumptions

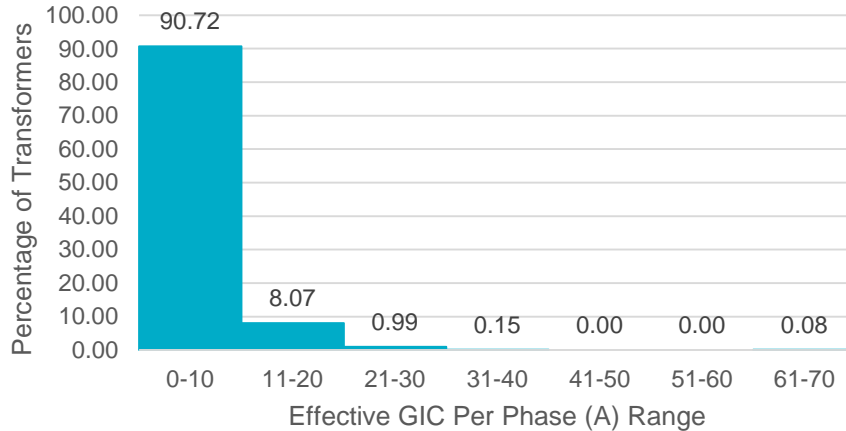
- Relay loadability limits used in the 2020 RTP will be used for the 2020 Benchmark GMDVA
- Under-Voltage Load Shed information and generator over and under-voltage trip settings from applicable Resource Registration Data will be modeled

2020 Benchmark GMDVA: Case Preparation

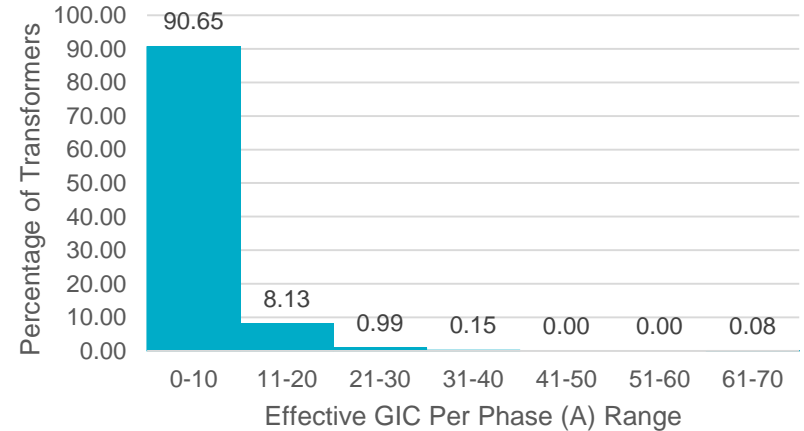
- The GIC System model will be updated and conditioned in collaboration with PGDTF
- Voltages will be tuned in the cases with feedback from corresponding TSPs and REs on specific tuning measures
- If applicable, suggested actions resulting from thermal impact assessments for transformers with maximum effective GIC flows exceeding the 75 A/phase benchmark GMD threshold will be incorporated

2020 Benchmark GMDVA: Case Preparation

2022 Summer Peak: Maximum Effective GIC Flow Distribution



2022 Minimum Load: Maximum Effective GIC Flow Distribution



- There were no transformers with maximum effective GIC flows exceeding the 75 A/phase threshold as a result of the benchmark GMD event

2020 Benchmark GMDVA: Benchmark GMD Event Caused Outages

- TSPs and REs were required to provide a list of potential equipment that might be removed from service as a result of Protection System operation or misoperation due to harmonics that could result from the benchmark GMD event

2020 Benchmark GMDVA: Benchmark GMD Event Caused Outages

- Submitted potential GMD event outages were categorized by TSPs and REs as either:
 - Category A: equipment anticipated to have a high probability of tripping offline due to harmonics during the benchmark GMD event and may be studied simultaneously in the benchmark GMDVA
 - Category B: equipment anticipated to have a lower probability of tripping offline due to harmonics during the benchmark GMD event and may be studied one at a time in the benchmark GMDVA

2020 Benchmark GMDVA: Reactive Power Losses

- A degree scan will be performed across the GIC system model, with Category A outages applied, in 10-degree increments to determine reactive power losses produced for different orientations
- The reactive power losses will be incorporated into the GIC AC model for each orientation selected by the degree scan

2020 Benchmark GMDVA: Steady-State Voltage Performance and Cascading Analysis

- Steady-state voltage performance analysis will be conducted for different storm orientations on the GIC System model with Category A outages and reactive power losses and also with Category B outages applied one at a time as contingencies
- Unsolved powerflows, which may indicate potential voltage collapse issues, will be investigated
- Cascading analysis will be conducted to identify any potential cascading or uncontrolled separation events

2020 Benchmark GMDVA: CAPs

- CAPs will be developed in conjunction with TSPs and REs to resolve steady state voltage violations, voltage collapse, cascading, and uncontrolled islanding issues
- CAPs will be reviewed by ERCOT to ensure that they address reliability criteria

2020 Benchmark GMDVA: Deliverables

- MIS Certified Area for TSPs:
 - Initial GIC System model (GIC DC and AC models)
 - TSP and RE identified Category A and B outages
 - GIC System model cases with Category A outages
- MIS Secure Area:
 - GMDVA study cases (AC model)
 - Reactive power losses for all orientations
 - Preliminary Benchmark GMDVA Assessment results with preliminary CAPs
 - Final Benchmark GMDVA Report and CAPs

Questions?

Please send any questions or comments to
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