System Impact Assessment of a Proposed GIC Field Test at a Dominion Energy Substation

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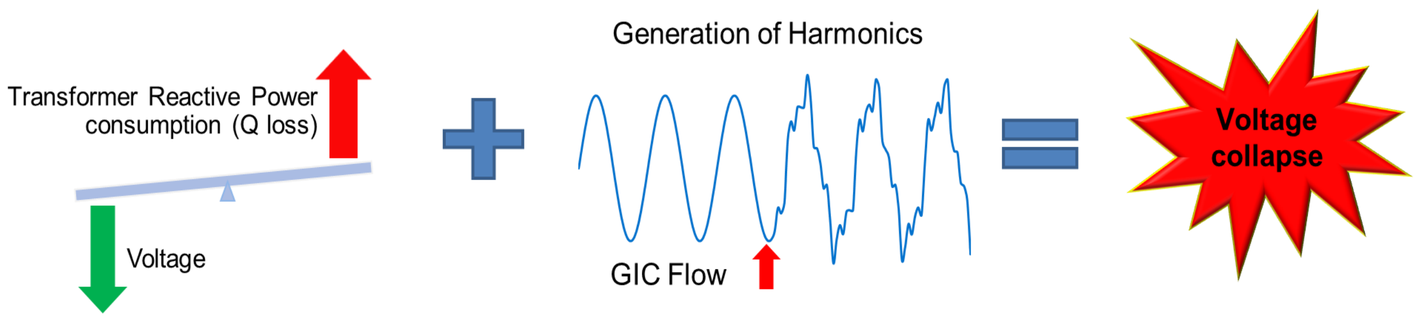
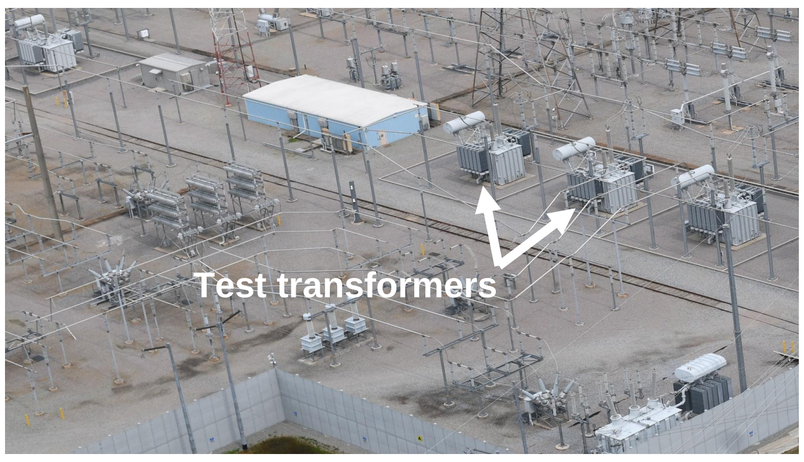
Project Background

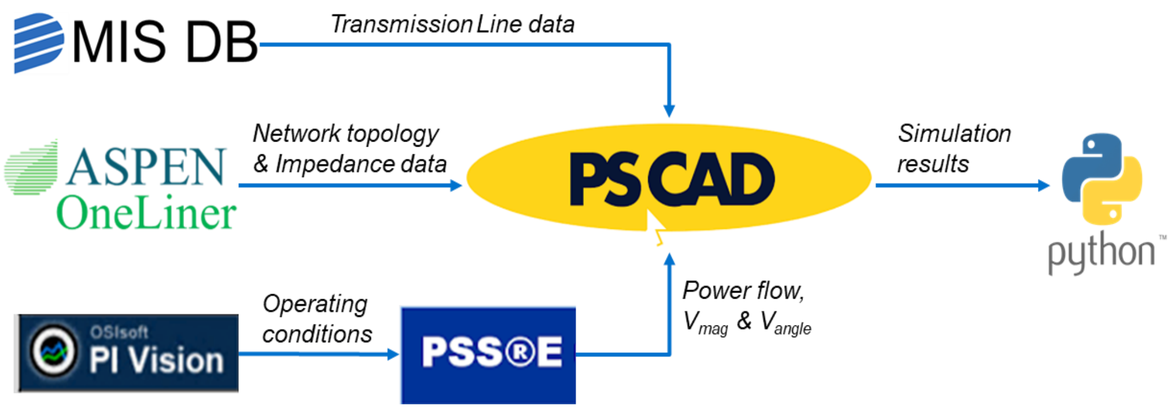
- Geomagnetically-induced current (GIC) due to space weather can have undesirable effects on the power system
- Dominion Energy plans to perform the first GIC field test in the U.S. at one of its substations
- DC current will be injected into the 500/230 kV test transformers to replicate GIC effects
- This study examines the test's potential system impact to ensure continuity and quality of power supply during the test



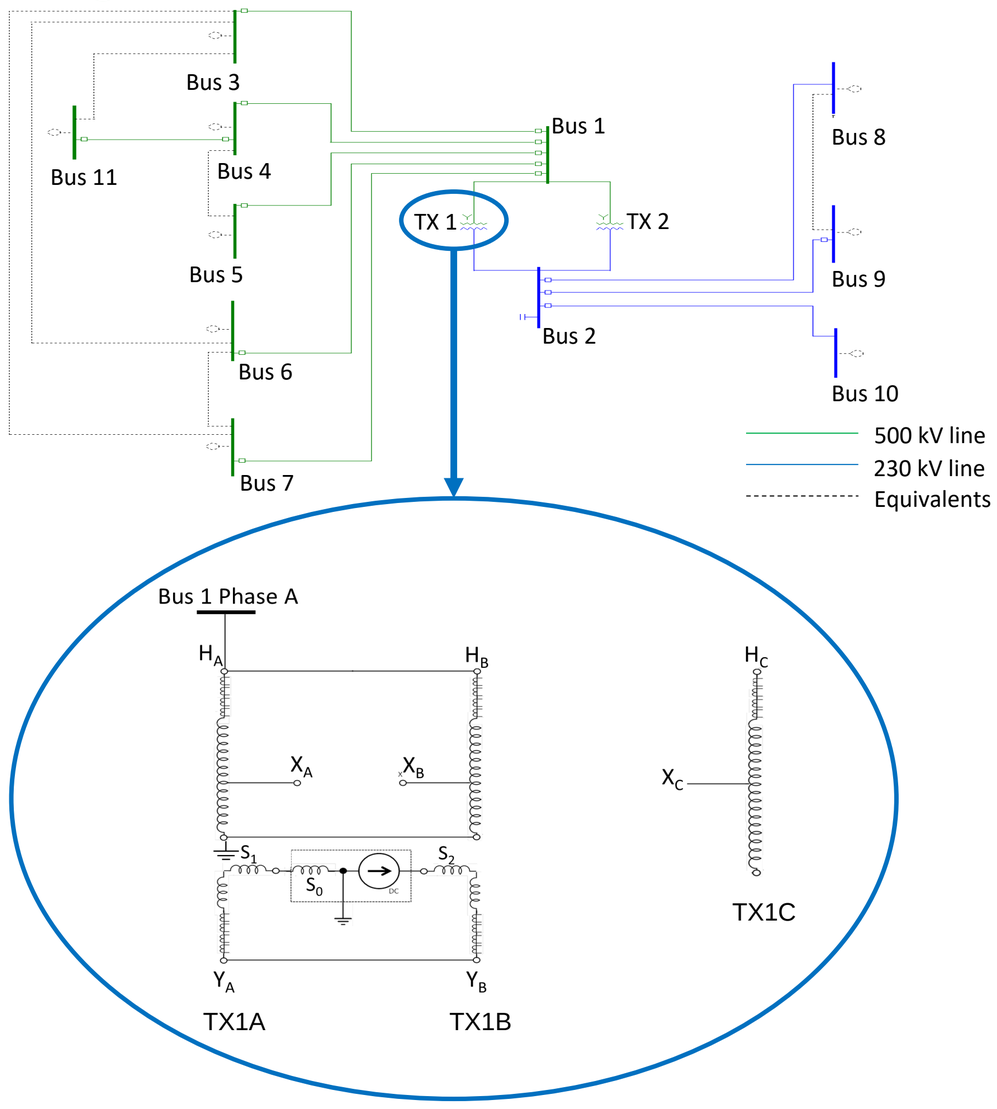


Overall Approach

- This study employs an electromagnetic transient (EMT) simulator to model a portion of Dominion grid and the test setup.

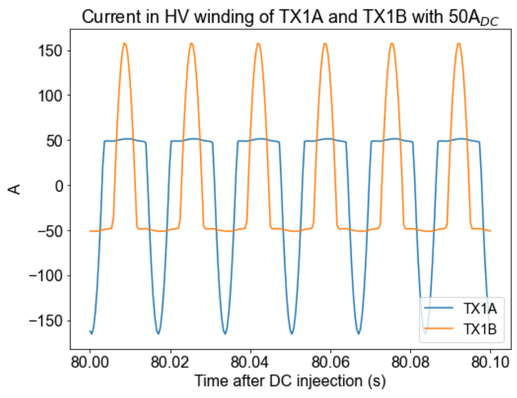


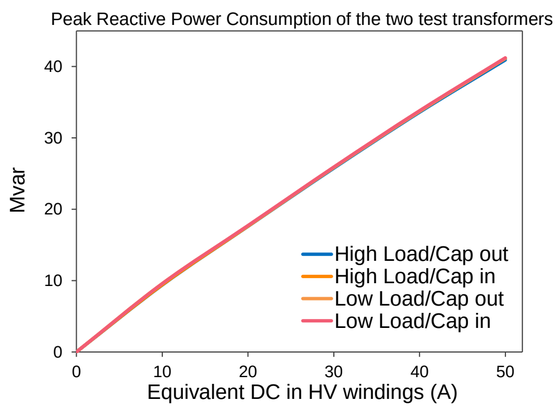
Modeling

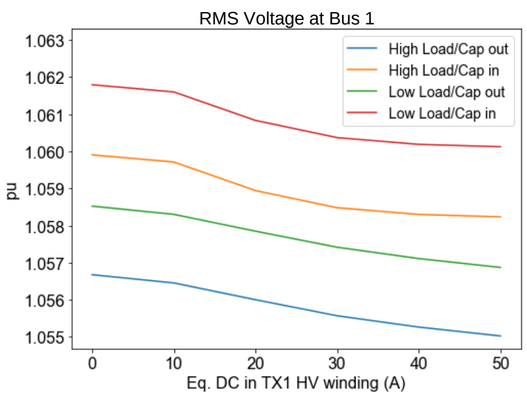


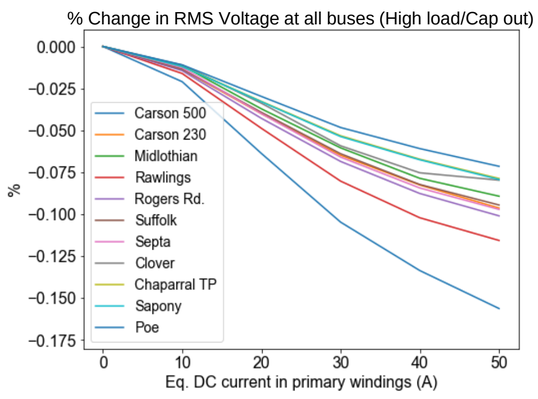
Simulation Results

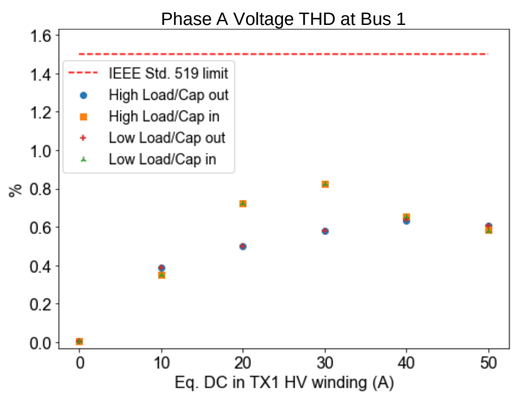
- Single-phase transformers, TX1A and TX1B, saturated at different halves of a cycle.
- Maximum reactive power consumption of TX1 was 41 Mvar and consumption was independent of operating conditions.
- Observed voltage drop was minimal
- Total harmonic distortion (THD) in voltage was less than IEEE Std. 519 limit but current THD was greater than limits for DC injection above 20 A/phase.

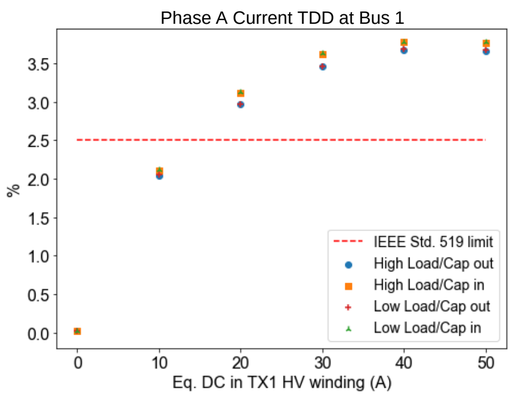


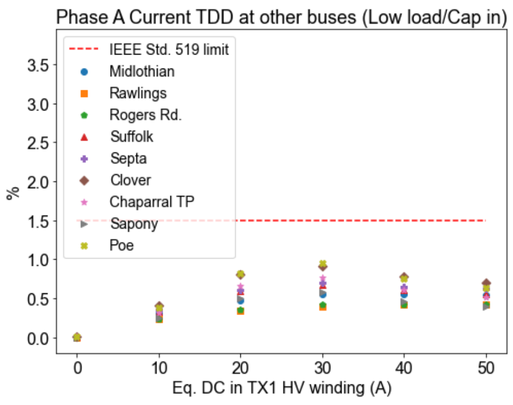












Other Findings

- Maximum voltage unbalance was less than ANSI unbalance limit.
- Low magnitude 120 Hz active and reactive power oscillations were observed.
- Effects of the test on TX2 were minimal.

Conclusion

The simulation results show that the GIC field test at the Dominion Energy substation will not impact the continuity and quality of power supply in the Dominion grid.