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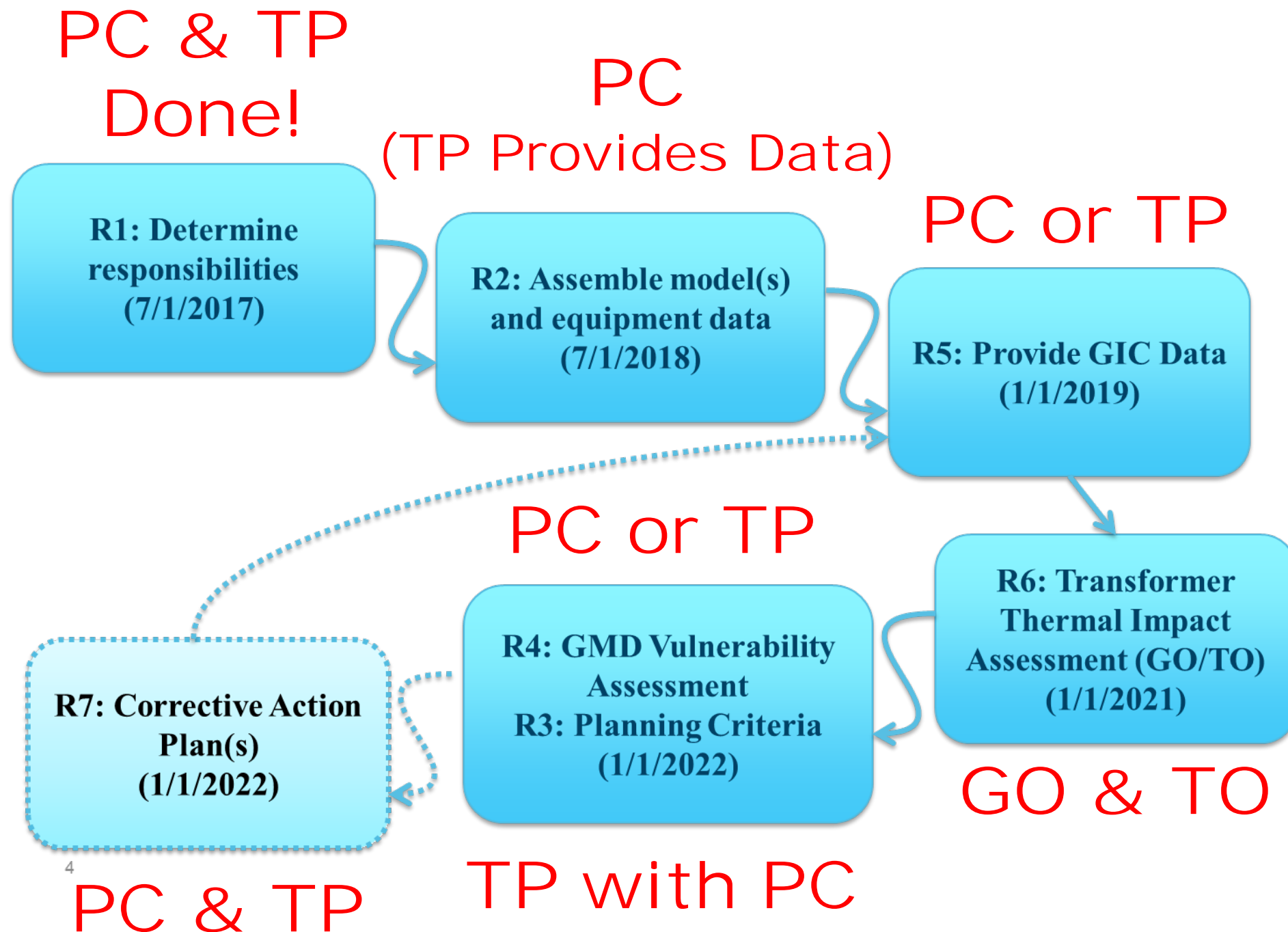
# **Implementing GMD Standard TPL-007-1: Transmission Planner/Owner Viewpoint**

**Michael B. Marz, Principal Transmission Planning Engineer**

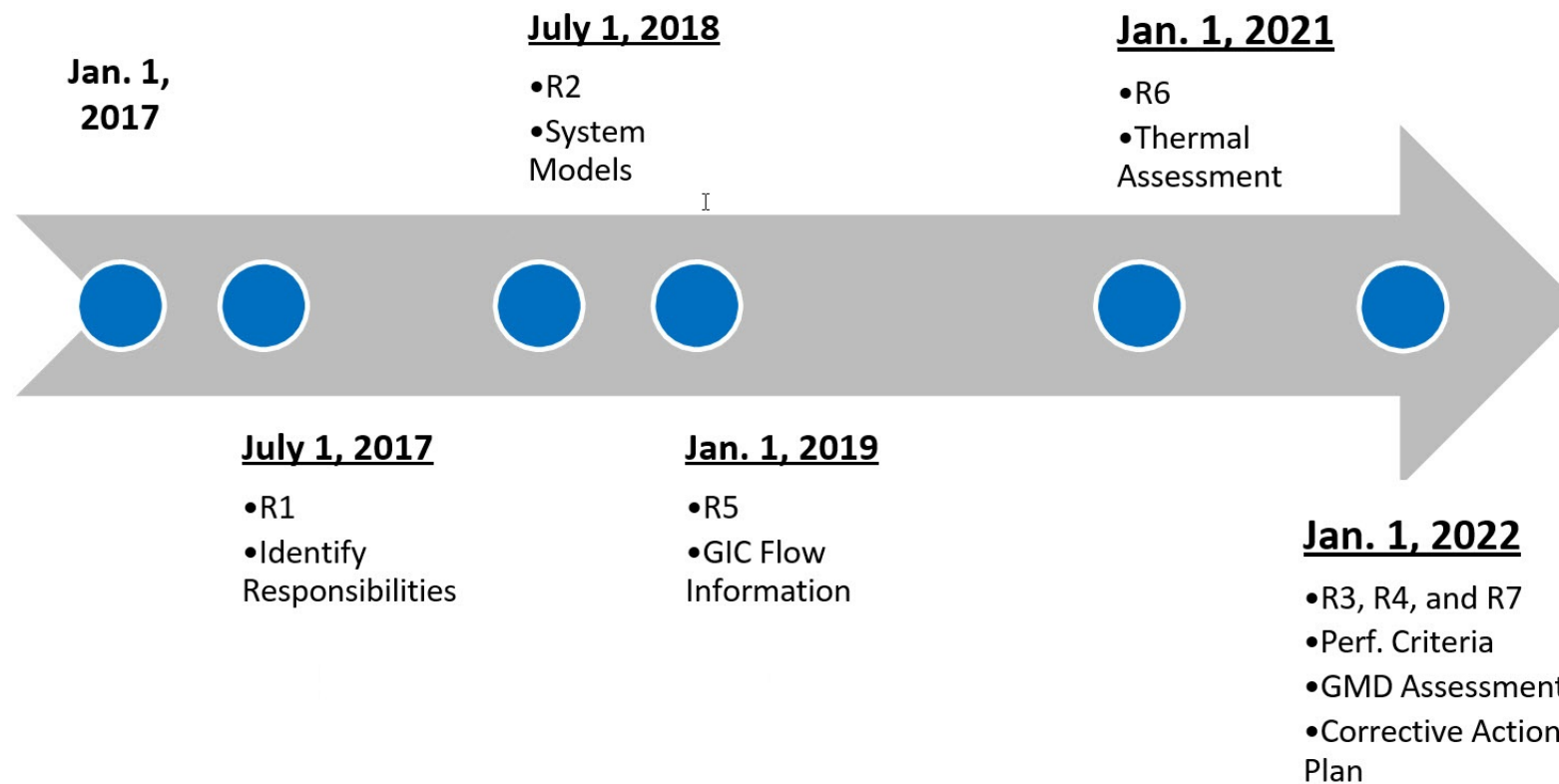
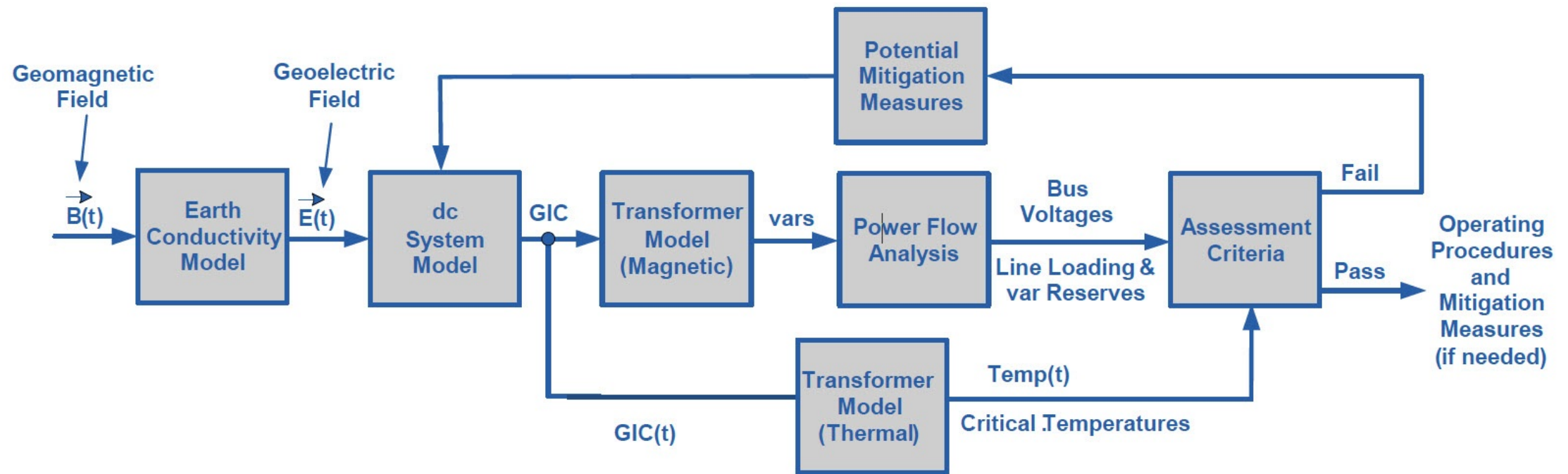
**53rd Annual Minnesota Power System Conference**

**November 8, 2017, St. Paul, MN**

# Who (PC or TP) Does What? When?



# Process Not Linear, Schedule Is



# R2 – GMD Model Assembly (PC)

- **Internal/External Info from TOs, GOs, etc. (MOD-032)**
  - MISO Needs Data by 12/1/2017 to Complete Model by 7/1/2018
- **GMD Models Require Data Not Used in Other Studies**
  - Earth Model, Substation Latitude and Longitude
  - Grounding Resistance (Substation Has One Ground Grid)
  - Transformer Core Design (Available?), Vector Group
  - DC Resistance Information (Lines, Transformers, Shunts, etc.)
  - GIC Blocking Devices, etc.
- **Whatever Significantly Affects GIC Included**
  - Transformers with High Side Y-Grounded Winding > 200 kV
  - System > 200 kV and Short Ties Between 200 kV Busses
  - Shunt Reactors on Delta Tertiaries Not Included
- **Collecting Data & Assembling Model Requires Effort!**

# R5 – Provide GIC Data (PC or TP)

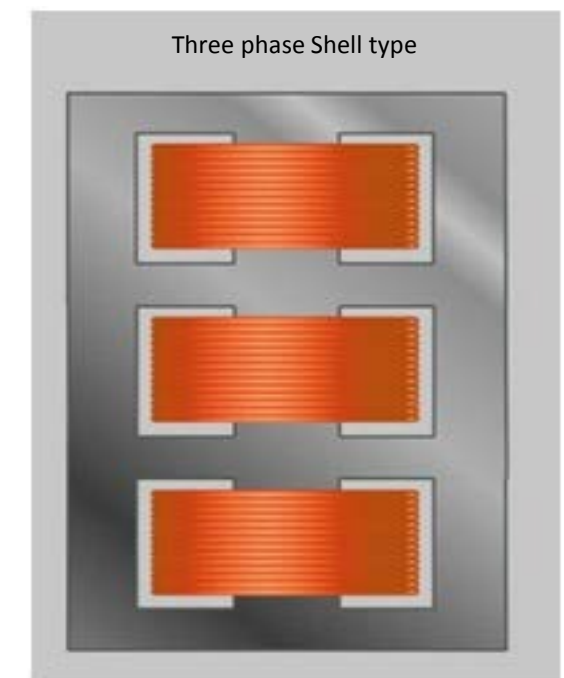
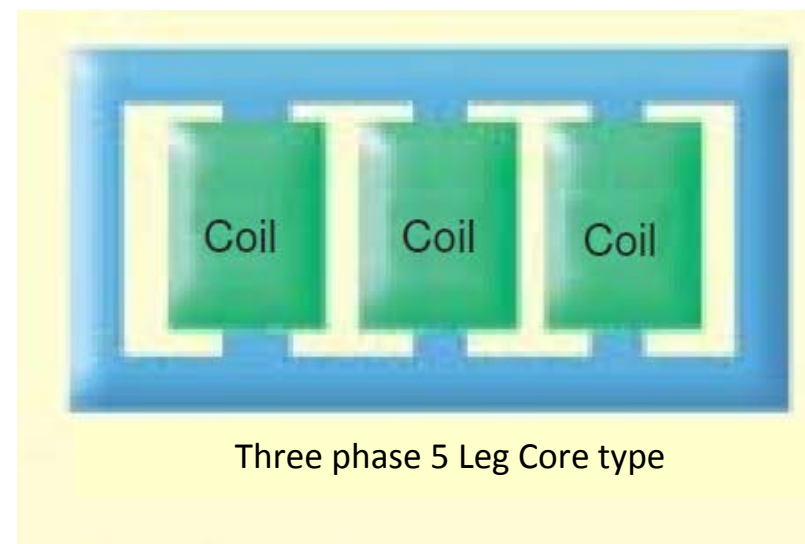
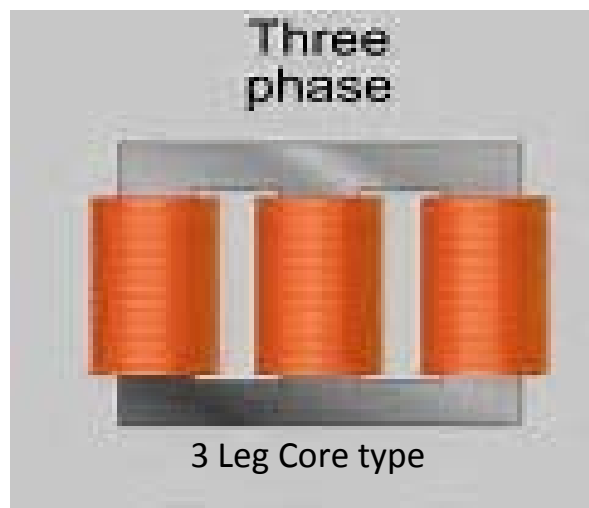
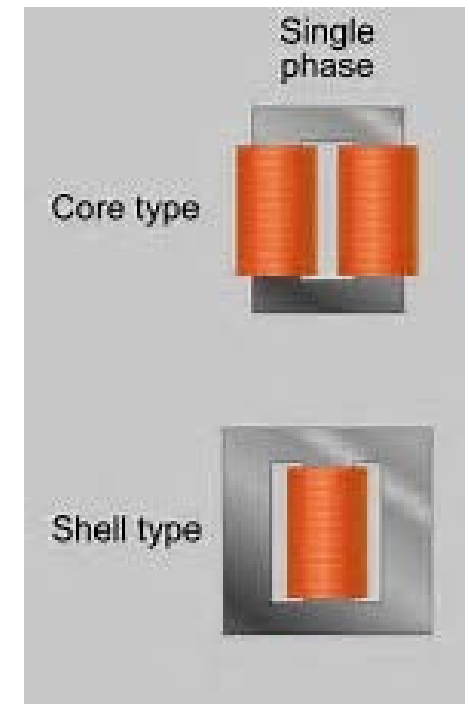
- **GIC Flow Data from Completed GMD Simulations Provided to BES Transformer Owners**
- **R1 Determined if PC or TP Responsible**
- **ATC Agreed to Give PC Responsibility**
  - **Concentrate Efforts on One Study**
  - **Eliminate Conflicting Results (In and Out of ATC)**
  - **Time: Must Be Completed by 1/1/2019**
- **ATC May Repeat MISO Analysis**
  - **Better Understand Phenomena on Our System**
  - **To Effectively Contribute to CAP (R7)**
- **What if ATC Took Responsibility?**

# R6 – Xformer Thermal Assessment (GO/TO)

- **Transformer Owners Done by 1/1/2021**
- **If Benchmark Event GIC  $\geq$  75 A/phase**
- **Base on GIC Flow Provided (R5)**
- **Document Analysis Assumptions**
- **Document Suggested Actions and Analysis to Mitigate GIC Impact (If Any)**
- **Provide Responsible Entities Results (R1)**

# Susceptibility Varies by Design

- **Strongly Susceptible**
  - Single Phase (Shell & Core Form)
  - 3-Phase Shell Form
  - 3-Phase 5 Legged Core Form
- **Weakly Susceptible**
  - 3-Phase 3 Legged Core Form



# Transformer GIC Thermal Analysis

- **GIC Analysis Requirements**
  - Ambient Temperature
  - Preload Condition
  - DC Current: Amplitude and Duration
  - Temperature Limits: Oil, Windings, Steel Structure
- **ATC to have Manufacturers Perform Analysis**
  - Transformer Design Information Proprietary
  - Have Tools, Models and Expertise
  - Archives of Old Designs
  - Design Records of Defunct Manufacturers
  - Schedule and Budget for this Analysis!



# R3 - Planning Criteria (TP with PC)

- **Must Develop Acceptable Steady State Voltage Performance Criteria During Benchmark Event**
  - **By 1/1/2022 (In Reality Much Sooner)**
  - **Probably Not the Same Throughout MISO**
  - **In Addition to Table 1 Requirements**
- **TPL-007 Table 1 Steady State Requirements**
  - **No Collapse, Cascading and Uncontrolled Islanding**
  - **Generation Loss is Acceptable**
  - **System Adjustments, Transmission Configuration Changes and Generation Dispatch Allowed if Executable in Applicable Facility Rating Time Limits**
- **Firm Transmission Interruption and Load Loss Allowed but Must be Minimized**

# R4 – Vulnerability Assessment (TP or PC)

- **ATC Agreed to Give PC the Responsibility (R1)**
- **Required Every 60 Months (First 1/1/2022)**
- **Benchmark Event Using R2 Models**
- **On and Off Peak Load Models for at Least One Year in Near Term Planning Horizon**
- **Table 1 Performance Requirements**
- **Provide Results to (1) Reliability Coordinator, and Adjacent PCs and TPs within 90 Days of Completion and (2) Any Functional Entity that Submits a Written Request and has a Reliability Related Need**

# R7 – CAP (PC and TP) by 1/1/2022

- **Required if Performance Requirements Not Met**
- **List Deficiencies and Actions Required to Fix**
  - **Transmission or Generation Facility Installation, Modification or Removal**
  - **Protection/RAS Installation, Modification or Removal**
  - **Operating Procedures (Must Specify How Long Needed)**
  - **Demand Side Management, New Technologies, etc.**
- **Provide to RC, Adjacent PCs and TPs, Functional Entities Referenced in CAP and Any Entity Submitting a Written Request within Required Time Limits**

# But Wait! There's More: TPL-007-2

The final ballot for TPL-007-2 – Transmission System Planned Performance for Geomagnetic Disturbance Events concluded at 8 p.m. Eastern, Monday, October 30, 2017.

Voting statistics are listed below, and the [Ballot Results](#) page provides the detailed results.

Quorum / Approval
88.74% / 73.35%

## Next Steps

The standard will be submitted to the Board of Trustees for adoption and then filed with the appropriate regulatory authorities.

- **R8 – Supplemental Vulnerability Assessment**
- **R9 – Supplemental GIC Flow to Transformers**
- **R10 – Supplemental Thermal Assessment**
- **R11/12 – Measure GIC & Geomagnetic Data**
- **CAP Timelines – 2 yr Procedure, 4 yr Hardware**
- **Future: GMD Harmonic Analysis (EPRI)**

# Questions?