

**NERC**

NORTH AMERICAN ELECTRIC  
RELIABILITY CORPORATION

# Geomagnetic Disturbances

Update on Project 2013-03 to ERCOT WMS 08/06/2014

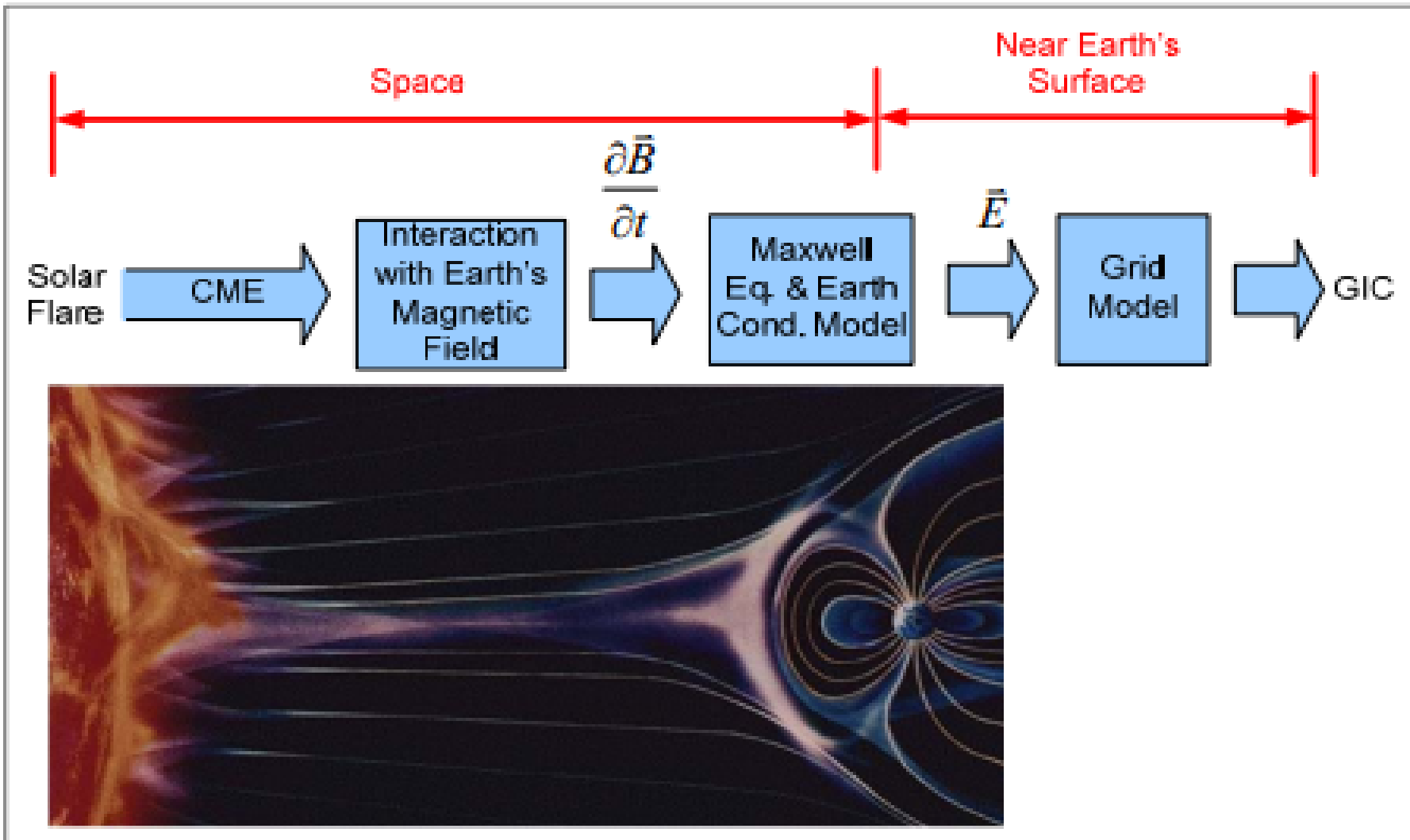
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NERC GMD TF Chairperson

**RELIABILITY | ACCOUNTABILITY**



- Space weather can affect the power system
- High Reactive losses and possible voltage collapse
- Large areas and multiple facilities can be affected
- Can happen at any time, not just at high sun spot activity
- Not just a northern latitude issue and can adversely impact ERCOT
- Higher voltage networks are more at risk
- Potential adverse impact on transformers, SVC's and HVDC ties and possible P&C misoperation

# GMD Concern for the Power System



- Requires a **GMD Vulnerability Assessment** of the system for its ability to withstand a Benchmark GMD Event without causing a wide area blackout, voltage collapse, or damage to transformers, once every 5 years.
  - Applicability: PCs,TPs
- Requires a **Transformer thermal impact assessment** to ensure that all high-side, wye grounded transformers connected at 200kV or higher will not overheat based on the Benchmark GMD Event
  - Applicability: GOs, TOs

- Reordered the requirements
  - Comments indicated some confusion as to the order in which the requirements would be executed
- Established a floor of 15 Amperes for Transformer Thermal Assessment
  - If calculated GIC is 15A or less, no further transformer thermal analysis is required
  - Technical justification: Continuous 15A exposure does not result in temperatures of concern, based on transformer testing
- Tweaked Implementation Plan
  - Moved earlier implementation steps (determine responsibilities, build models)
  - Maintained 4 years duration to develop Corrective Action Plan

- Include RCs as an applicable entity
  - But, RCs included as a recipient of the analyses for information and for situational awareness
- Establish an exemption for lower latitude systems
  - Benchmark definition includes adjustment factors for earth conductivity and geomagnetic latitude, but assessment is required
  - Technical justification not available at this point
- Change the Benchmark GMD Event geoelectric field magnitude

- Benchmark geoelectric field is too low
  - Earlier work by GMD TF had peak fields of 20V/km or more
  - “Spatial averaging” technique is not documented in peer-reviewed technical papers
  
- Benchmark geoelectric field is too high
  - Statistical analysis calculates out to a field of 5.8V/km
  - Visual extrapolation implies a field of 3-8V/km (why not 3V/km or 5.8V/km?)

$$E_{\text{peak}} = E_{\text{benchmark}} \times \alpha \times \beta \quad (\text{in V/km})$$

where,

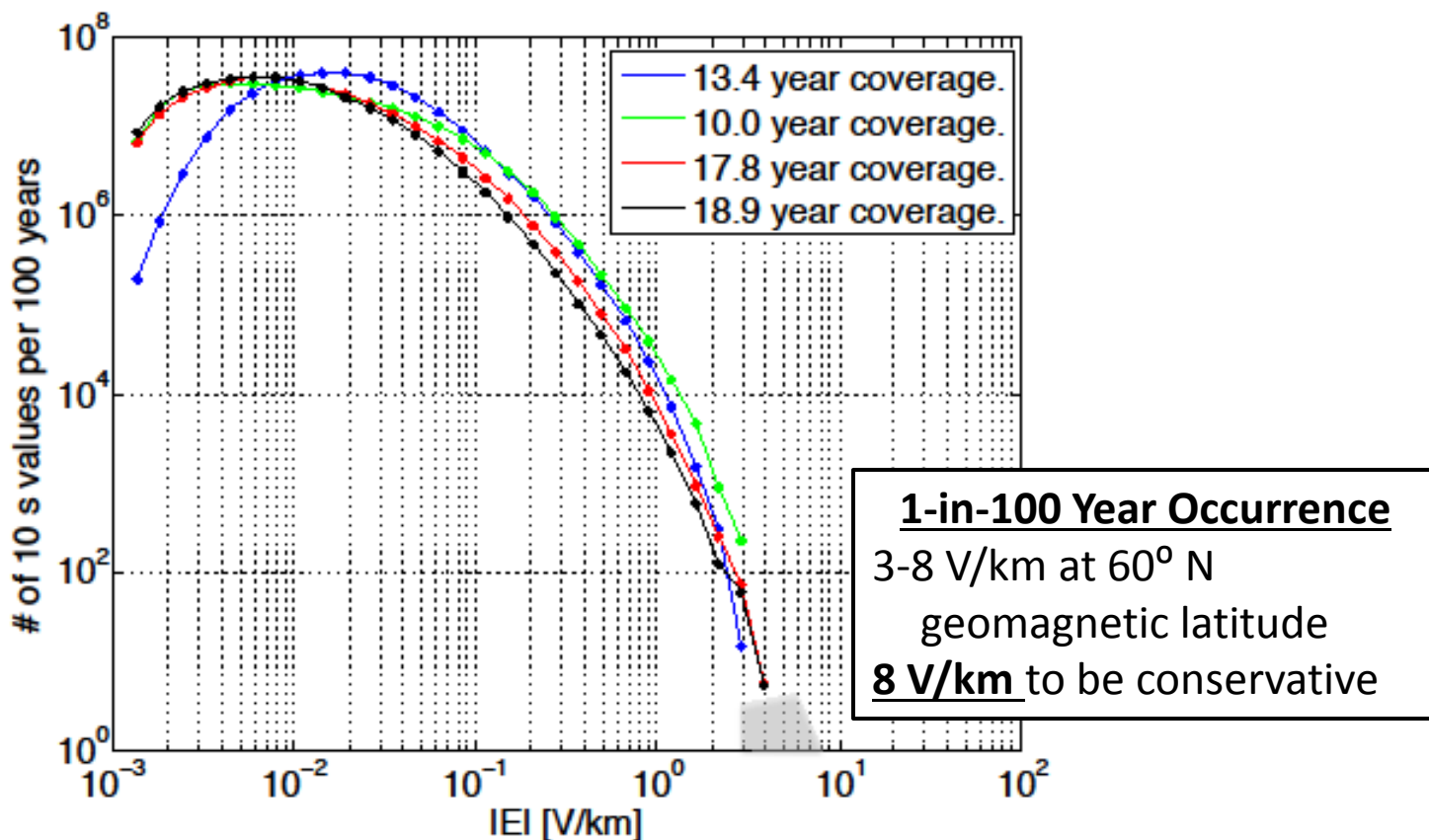
$E_{\text{peak}}$  = Benchmark Geo-electric field magnitude at System location

$E_{\text{benchmark}}$  = Benchmark Geo-electric field magnitude at reference location (60° N geomagnetic latitude, resistive ground model)

$\alpha$  = Factor adjustment for geo-magnetic latitude

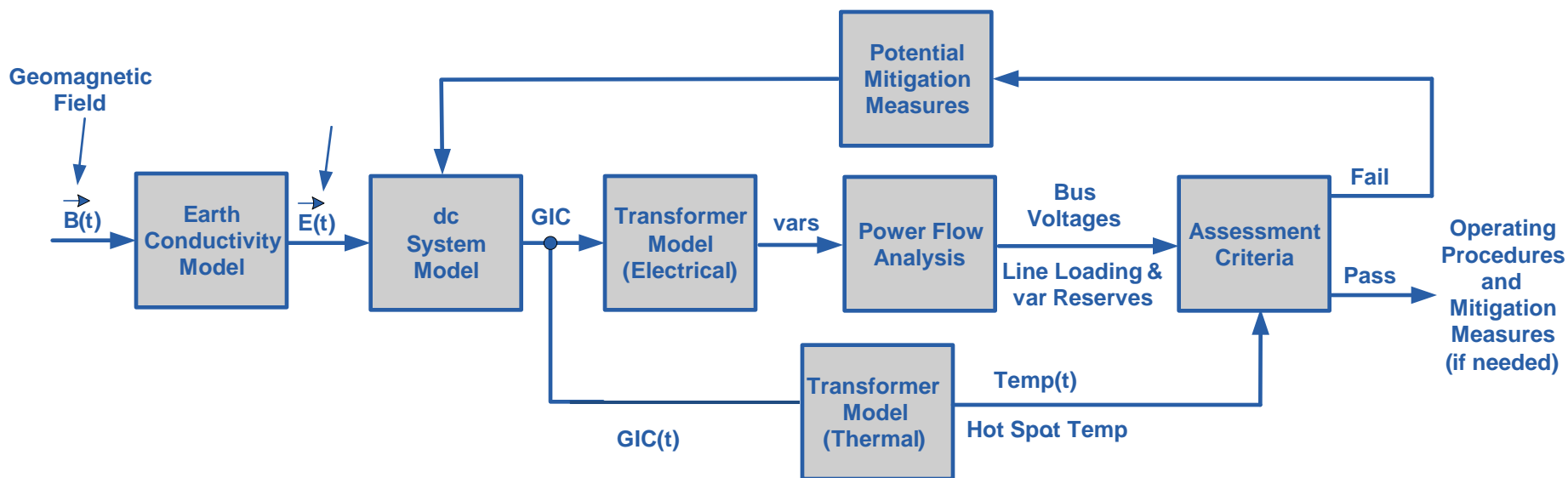
$\beta$  = Factor adjustment for regional Earth conductivity model





Statistical occurrence of spatially averaged high-latitude geoelectric field amplitudes from IMAGE magnetometer data (1993 – 2013)

- Statistical analyses (GMD TF and Standard Work) are based on the same data
- Spatial averaging is a peer-reviewed technique (Authors are preparing a technical paper to address its use in this context)
- Calculated electric fields for the 1989 Quebec storm ( $\sim 2\text{V/km}$ ) are in line with the Benchmark
- Benchmark is conservatively “high” to provide for margin, given the uncertainties associated with these types of calculations



- Project Page: <http://www.nerc.com/pa/Stand/Pages/Project-2013-03-Geomagnetic-Disturbance-Mitigation.aspx>
- Posted for initial ballot and non binding poll—July 21-30
- GMD SDT Technical Conference—July 17
  - Major focus on transformers
- SDT reviews ballot results and comments—August 19-21
- Post for a second ballot—September
- Seek NERC BOT approval at November meeting
- Submit to FERC ahead of January 2015 deadline

*NOAA Space Weather Center*

<http://www.swpc.noaa.gov/>

*NERC GMDTF 2013*

<http://www.nerc.com/comm/PC/Pages/Geomagnetic-Disturbance-Task-Force-%28GMDTF%29-2013.aspx>

*NERC GMDTF 2011 & 2012*

<http://www.nerc.com/comm/PC/Pages/Geomagnetic%20Disturbance%20Task%20Force%20%28GMDTF%29/Geomagnetic-Disturbance-Task-Force-GMDTF.aspx>

*NERC Standard Project 2013-03*

<http://www.nerc.com/pa/Stand/Pages/Project-2013-03-Geomagnetic-Disturbance-Mitigation.aspx>



# Questions and Answers