

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Geomagnetic Disturbances

Update on Project 2013-03 to ERCOT ROS 07/10/2014

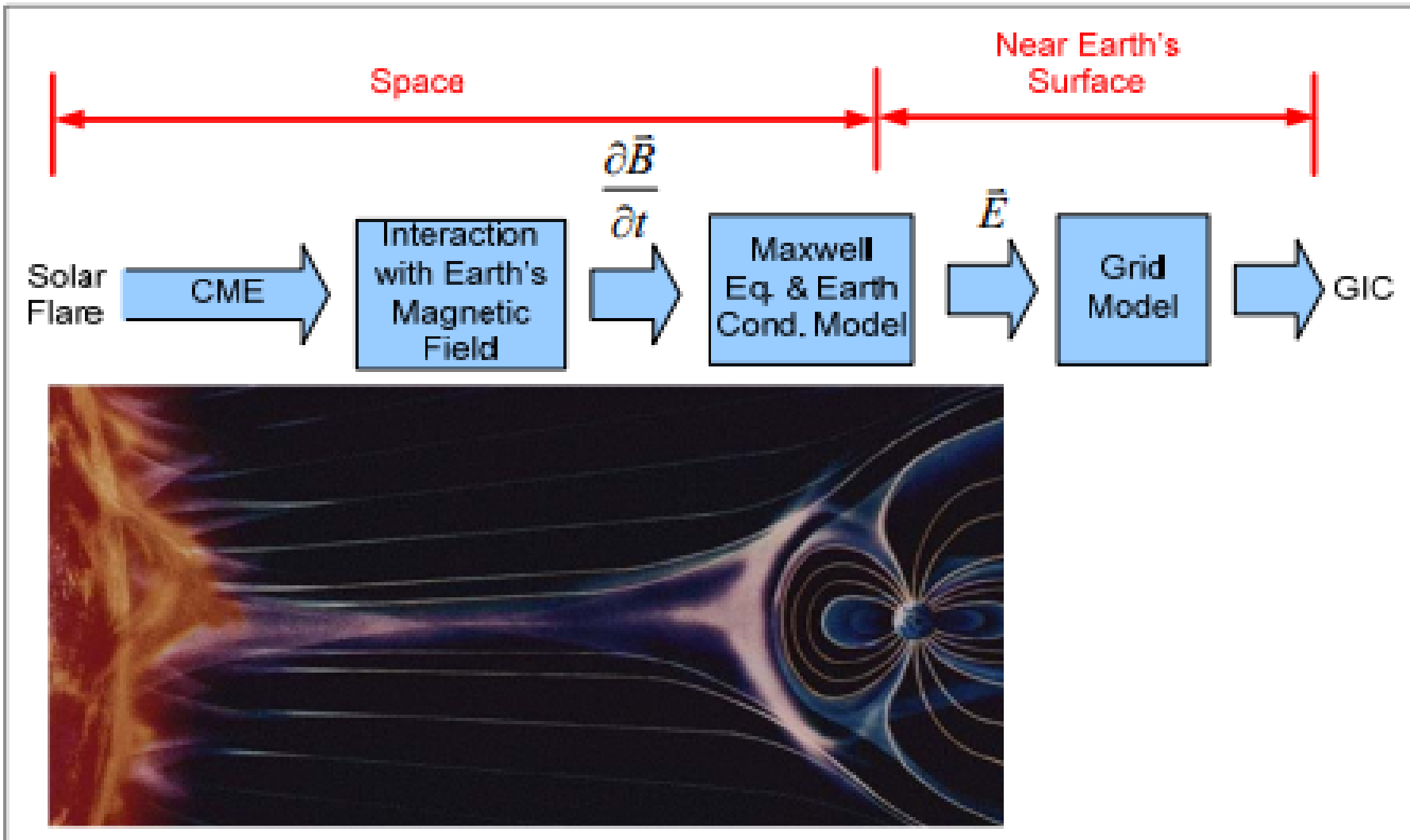
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RELIABILITY | ACCOUNTABILITY



- 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,

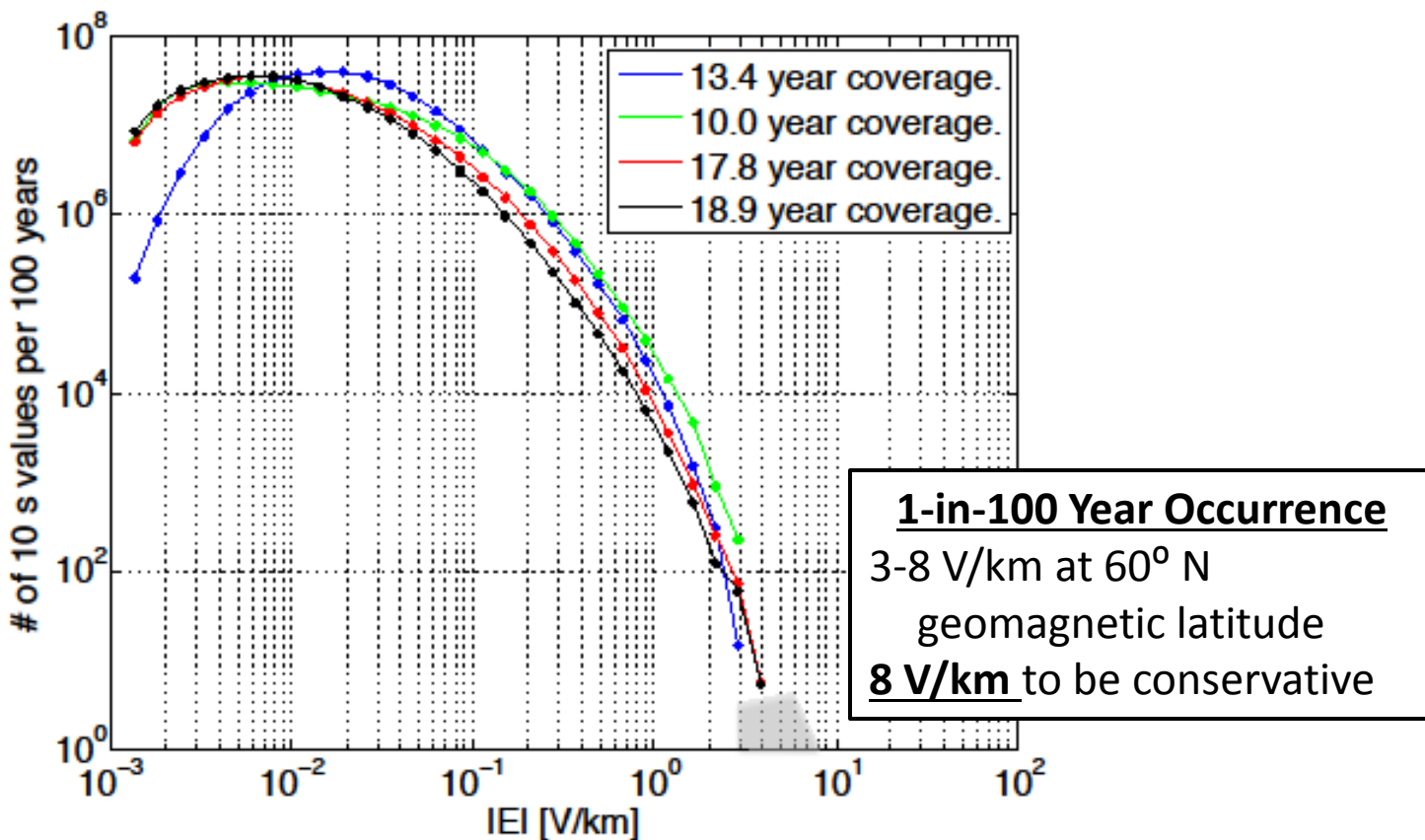
E_{peak} = Benchmark Geo-electric field magnitude at System location

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

α = Factor adjustment for geo-magnetic latitude

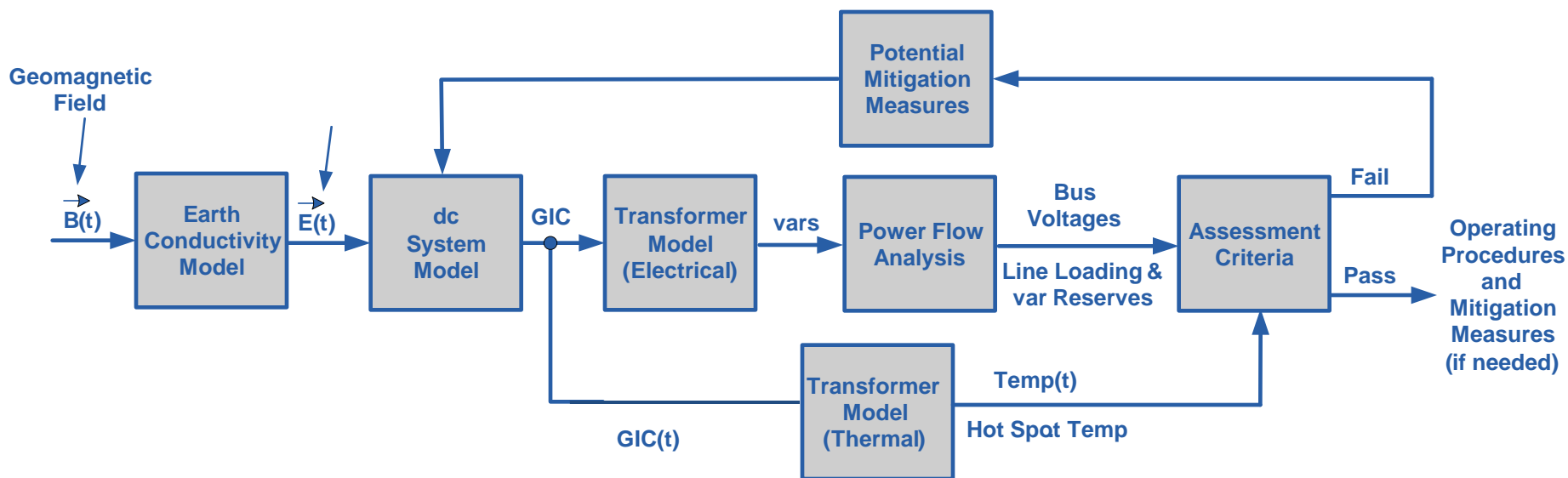
β = Factor adjustment for regional Earth conductivity model

Reference Geoelectric Field Amplitude



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



Questions and Answers