

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Geomagnetic Disturbance Task Force (GMDTF) – Phase III

Research Plan

GMD Task Force Meeting
February 21-22, 2017

RELIABILITY | ACCOUNTABILITY



Purpose – Improve understanding of geoelectric fields used in defining Benchmark GMD Events by:

- Performing research into spatial scales of localized geoelectric field enhancements caused by severe GMD events

Determining impacts of spatial averaging assumptions on bulk-power system reliability

- Responsible parties – EPRI
- Timeline
 - Duration - (12 months)

Research Activities

- Perform analysis of magnetometer data to characterize spatial structure of GMD events
- Perform magnetohydrodynamic (MHD) simulations to improve understand impact of spatial averaging
- Determine impacts of spatial averaging assumptions on bulk-power system
 - GIC and power flow analysis to determine effects of various sizes of localized geoelectric field enhancements
 - Transformer thermal impact assessment to determine effects of various sizes of localized geoelectric field enhancements

- Purpose
 - Evaluate the geomagnetic latitude scaling factors in Reliability Standard TPL-007-1
- Responsible parties – EPRI
- Timeline
 - Duration - (12 months)

Research Activities

- Perform peer-review of research (updated since publication of Benchmark GMD Event white paper) regarding the effects of geomagnetic latitude on geoelectric fields (for a reference earth model)
- Determine which space weather indices are most effective in predicting the latitude scaling of the maximum local dB/dt.
- Perform analysis to provide:
 - Additional technical support for existing latitude scaling factors, or
 - Updated values

- Purpose
 - Further research is needed to improve the accuracy and efficacy of ~~existing~~ ~~1D~~ earth conductivity models (For example use of magnetotelluric (MT) measurement data)
- Responsible parties – GMDTF and EPRI
- Timeline
 - Duration - (12 months)

Research Activities

- Use magnetotelluric (MT) measurement data to validate/improve existing ~~1D~~ earth conductivity models **available to power industry**

GMD Task Force: Develop techniques and guidelines for using GIC and magnetometer data to perform model validation.

Non-uniform Field Modeling

- Assess coastal effect and develop models
- Develop standardized methods/models for capturing non-uniform geoelectric field.
- Develop benchmark models to assess GIC simulation tools against non-uniform fields
 - **Compare GIC calculations for 3D and 1D models**
- Establish a working group to promote the adoption of modeling non-uniform geoelectric field (including coastal effect)

- Purpose
 - Perform analysis to evaluate the ability of GIC flow calculated as specified in TPL-007 to represent worst-case transformer hot-spot heating conditions.
- Research Activity
 - Determine **method** to determine worst-case hotspot heating in **each individual** transformer in the system from the benchmark geoelectric field wave shape.
- Responsible parties – EPRI
- Timeline
 - Duration - (6 months)

- Purpose
 - Conduct additional research and analysis to assess transformer thermal impact of the Benchmark GMD Event or other realistic GMD events
- Responsible parties – EPRI
- Timeline
 - Duration - (12 months)

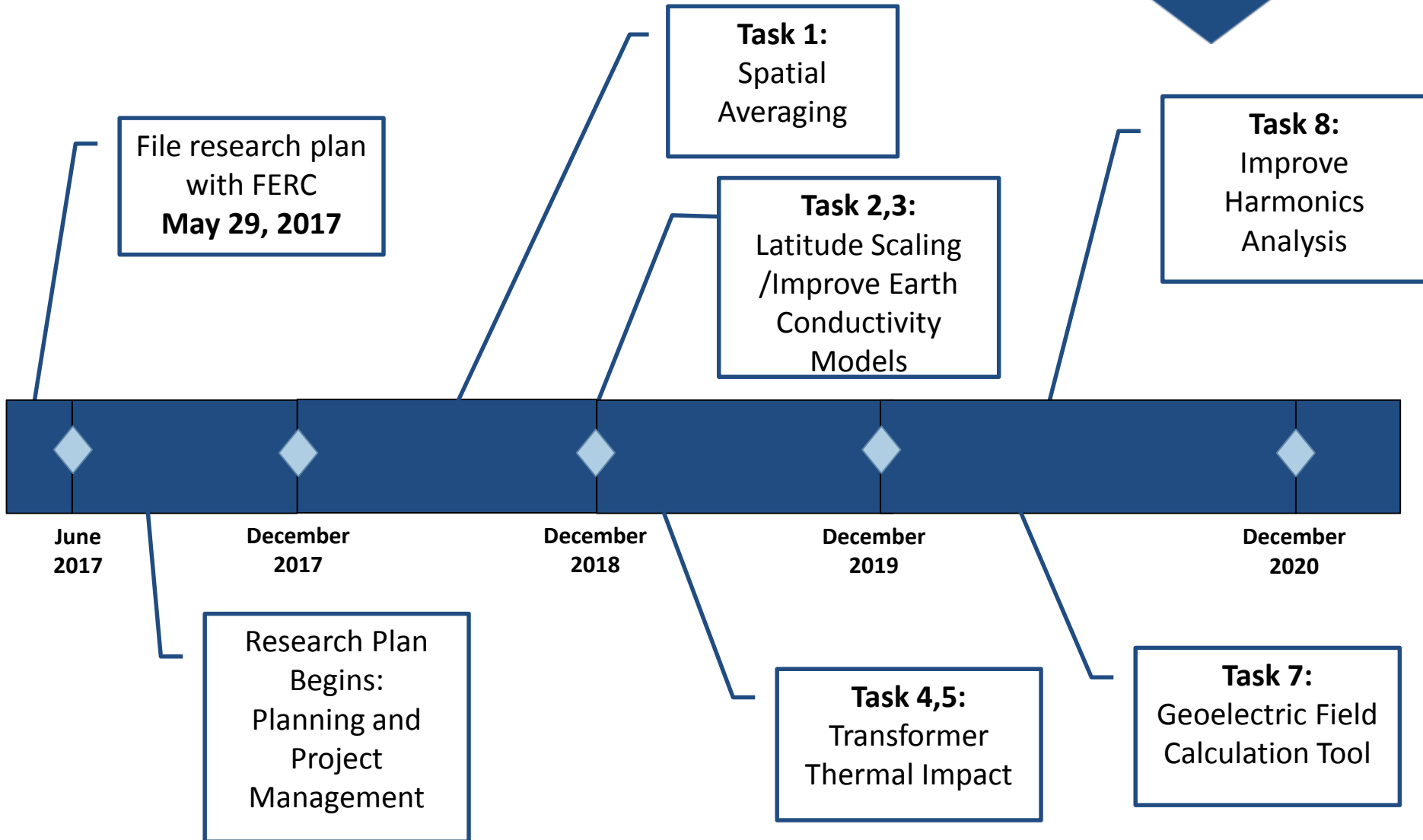
- Research Activities
 - Perform research to determine the effects of short-term harmonic currents resulting from half-cycle saturation on tertiary winding heating.
 - Evaluate the use of alternative performance criteria (e.g. the use of different temperature limits)
 - Create additional thermal models (thermal response during heating and cooling and perform transformer thermal assessment using synthetic GIC).

- Purpose
 - Develop a Section 1600 Data Request for the collection of existing and new GIC and Magnetometer data that can be made available to researchers.
 - GMDTF to develop guidance for the measurement of GIC and geomagnetic field and formatting requirements.
- Responsible parties – GMDTF and NERC
- Timeline
 - Duration - (6 months)

- Purpose
 - Evaluate commercially available tools for calculating geoelectric field from magnetic field data for given earth conductivity structure.
 - Develop open source tool capable of performing geoelectric field calculations of earth conductivity layered model and time series geomagnetic field data.
 - Evaluate the applicability of using impedance tensor directly to transform magnetic field into electric field
- Responsible parties – EPRI
- Timeline
 - Duration - (12 months)

- Purpose
 - Develop models, methods and guideline to improve capability of performing harmonic assessments of benchmark GMD events.
 - Develop models and methods as open source software environment.
 - Host a harmonics modeling workshop
- Responsible parties – EPRI
- Timeline
 - Duration - (24 months)

Preliminary Research Plan Proposal



- What stakeholder concern are not address in the research plan
- Timing
- Additional Industry topics of interest:
 - More complete set of transformer magnetic models
 - Information-sharing on utility experience with mitigation



Questions and Answers