Southeastern Regional TRANSMISSION PLANNING

2018 SERTP

# SERTP - 1st Quarter Meeting

## *First RPSG Meeting & Interactive Training Session*

March 29th, 2018

Associated Electric Cooperative, Inc. Corporate Headquarters

Springfield, MO

# Process Information

- The SERTP process is a transmission planning process.
- Please contact the respective transmission provider for questions related to real-time operations or Open Access Transmission Tariff (OATT) transmission service.
- SERTP Website Address:
  - www.southeasternrtp.com

# Agenda

- **2018 SERTP Process Overview**
- **Form the "RPSG"**
  - Regional Planning Stakeholders Group
  - Committee Structure & Requirements
- **Economic Planning Studies**
  - Review Requested Sensitivities for 2018
  - RPSG to Select up to Five Economic Planning Studies
- **Interactive Training Session**
  - Geomagnetically Induced Currents and TPL-007-1: Transmission System Planned Performance during Geomagnetic Disturbance (GMD) Events
- **Miscellaneous**
  - Public Policy Requirement Stakeholder Requests
  - OVEC Integration into PJM
- **Next Meeting Activities**

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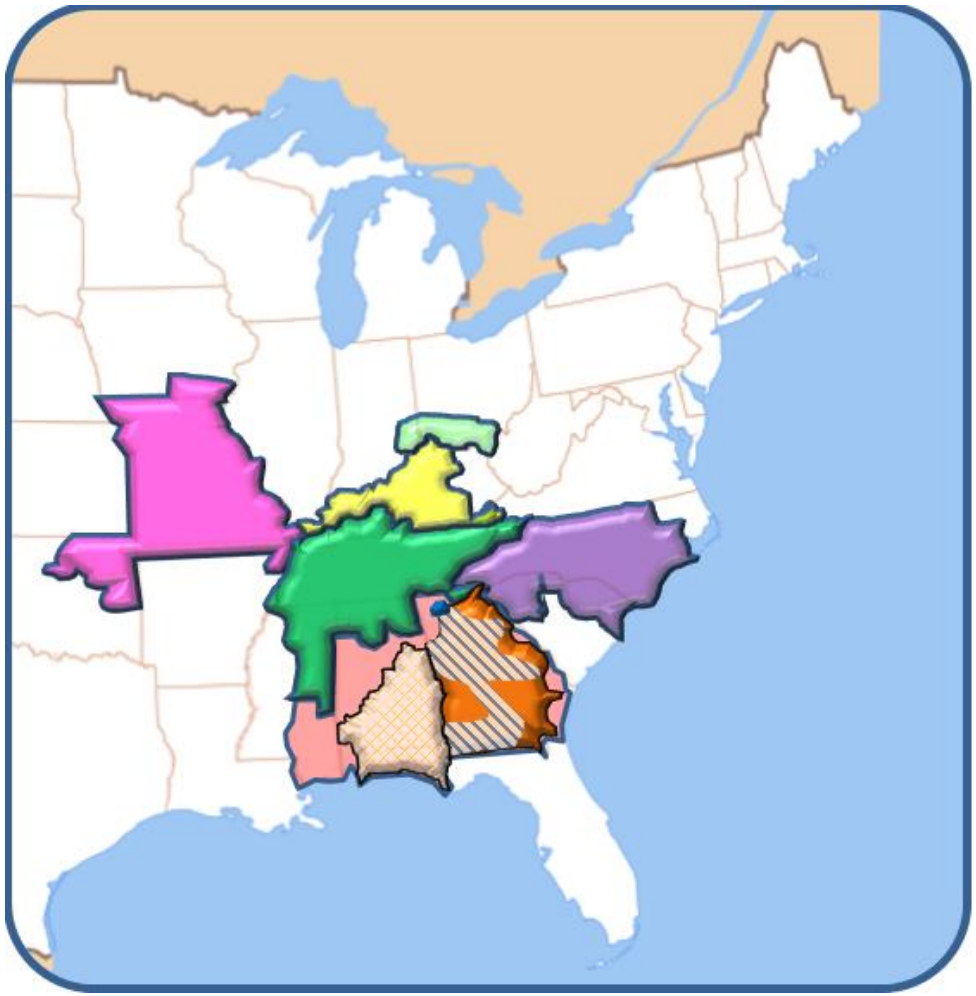
# 2018 SERTP Process Overview

# 2018 SERTP

## Southeastern Regional Transmission Planning (SERTP)



### SERTP Sponsors

- Associated Electric Cooperative Inc.
- Dalton Utilities
- Duke Energy
- Georgia Transmission
- LG&E KU
- MEAG Power
- OVEC IKEC
- PowerSouth Energy Cooperative
- Southern Company
- TVA

# Upcoming 2018 SERTP Process

- **SERTP 1st Quarter –** ***1st RPSG Meeting & Interactive Training Session***

  **March 2018**
  - Form RPSG
  - Select Economic Planning Studies
  - Interactive Training Session

- **SERTP 2nd Quarter –** ***Preliminary Expansion Plan Meeting***

  **June 2018**
  - Review Modeling Assumptions
  - Preliminary 10 Year Expansion Plan
  - Stakeholder Input & Feedback Regarding the Plan

# Upcoming 2018 SERTP Process

- **SERTP 3rd Quarter – *2nd RPSG Meeting***

  **September 2018**

  – Preliminary Results of the Economic Studies
  – Stakeholder Input & Feedback Regarding the Study Results
  – Discuss Previous Stakeholder Input on the Expansion Plan

- **SERTP 4th Quarter – *Annual Transmission Planning Summit & Input Assumptions***

  **December 2018**

  – Final Results of the Economic Studies
  – Regional Transmission Plan
  – Regional Analyses
  – Stakeholder Input on the 2019 Transmission Model Input Assumptions

## SERTP

# Regional Planning Stakeholder Group (RPSG)

# The SERTP Stakeholder Group

- RPSG – Regional Planning Stakeholder Group
- Serves Two Primary Purposes
  1) The RPSG is charged with determining and proposing up to five (5) Economic Planning Studies on an annual basis
  2) The RPSG serves as stakeholder representatives for the eight (8) industry sectors in interactions with the SERTP Sponsors

# RPSG Committee Structure

## RPSG Sector Representation

1. Transmission Owners / Operators
2. Transmission Service Customers
3. Cooperative Utilities
4. Municipal Utilities
5. Power Marketers
6. Generation Owner / Developers
7. Independent System Operators (ISOs) / Regional Transmission Operators (RTOs)
8. Demand Side Management / Demand Side Response

# RPSG Committee Structure

- Sector Representation Requirements
  - Maximum of two (2) representatives per sector
  - Maximum of sixteen (16) total sector members
  - A single company, and all of its affiliates, subsidiaries, and parent company, is limited to participating in a single sector

# RPSG Committee Structure

- Annual Reformation
  - Reformed annually at 1st Quarter Meeting
  - Sector members elected for a term of approximately one year
  - Term ends at start of following year's 1st Quarter SERTP Meeting
  - Sector Members shall be elected by the Stakeholders present at the 1st Quarter Meeting
  - Sector Members may serve consecutive, one-year terms if elected
  - No limit on the number of terms that a Sector Member may serve

# RPSG Committee Structure

- Simple Majority Voting
  - RPSG decision-making that will be recognized by the Transmission Provider for purposes of Attachment K shall be those authorized by a simple majority vote by then-current Sector Members
  - Voting by written proxy is allowed

# RPSG Formation

- **2017 Sector Representatives**
- **2018 Sector Representatives**

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# Economic Planning Studies

# SERTP Regional Models

- SERTP Sponsors developed 12 coordinated regional models*
- Models include the latest load forecasts and resource decisions as provided by Load Serving Entities (LSEs) within the SERTP region

| No. | Season | Year |
|---|---|---|
| 1 | SUMMER | 2019 |
| 2 | | 2021 |
| 3 | | 2023 |
| 4 | | 2024 |
| 5 | | 2026 |
| 6 | | 2028 |
| 7 | SHOULDER | 2021 |
| 8 | | 2023 |
| 9 | | 2026 |
| 10 | | 2028 |
| 11 | WINTER | 2023 |
| 12 | | 2028 |

* Available on the secure area of the SERTP website upon satisfying access requirements

# Economic Planning Study Process

- **SERTP Sponsors identify the transmission requirements needed to move large amounts of power above and beyond existing long-term, firm transmission service commitments**
  - Analysis is consistent with NERC standards and company-specific planning criteria

- **These studies represent analyses of hypothetical scenarios requested by the stakeholders and do not represent an actual transmission need or commitment to build**

- **Scoping Meeting typically held in April/May**

# Economic Planning Study Process

- **2017 Economic Planning Studies**
- **2018 Economic Planning Study Requests**
- **Vote on 2018 Economic Planning Studies**

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# Interactive Training Session

***Geomagnetically Induced Currents & TPL – 007–1: Transmission System Planned Performance During Geomagnetic Disturbance (GMD) Events***

*Kevin Dowling*
*Southern Company Services, Transmission Planning*

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# Interactive Training Session

## Outline

- **Scientific Background**
  - Solar weather
  - Geomagnetic Disturbances & Geomagnetically Induced Currents
  - Transformer half cycle saturation
- **1989 event**
- **Regulatory Timeline**
- **Southern Company Progress Update**

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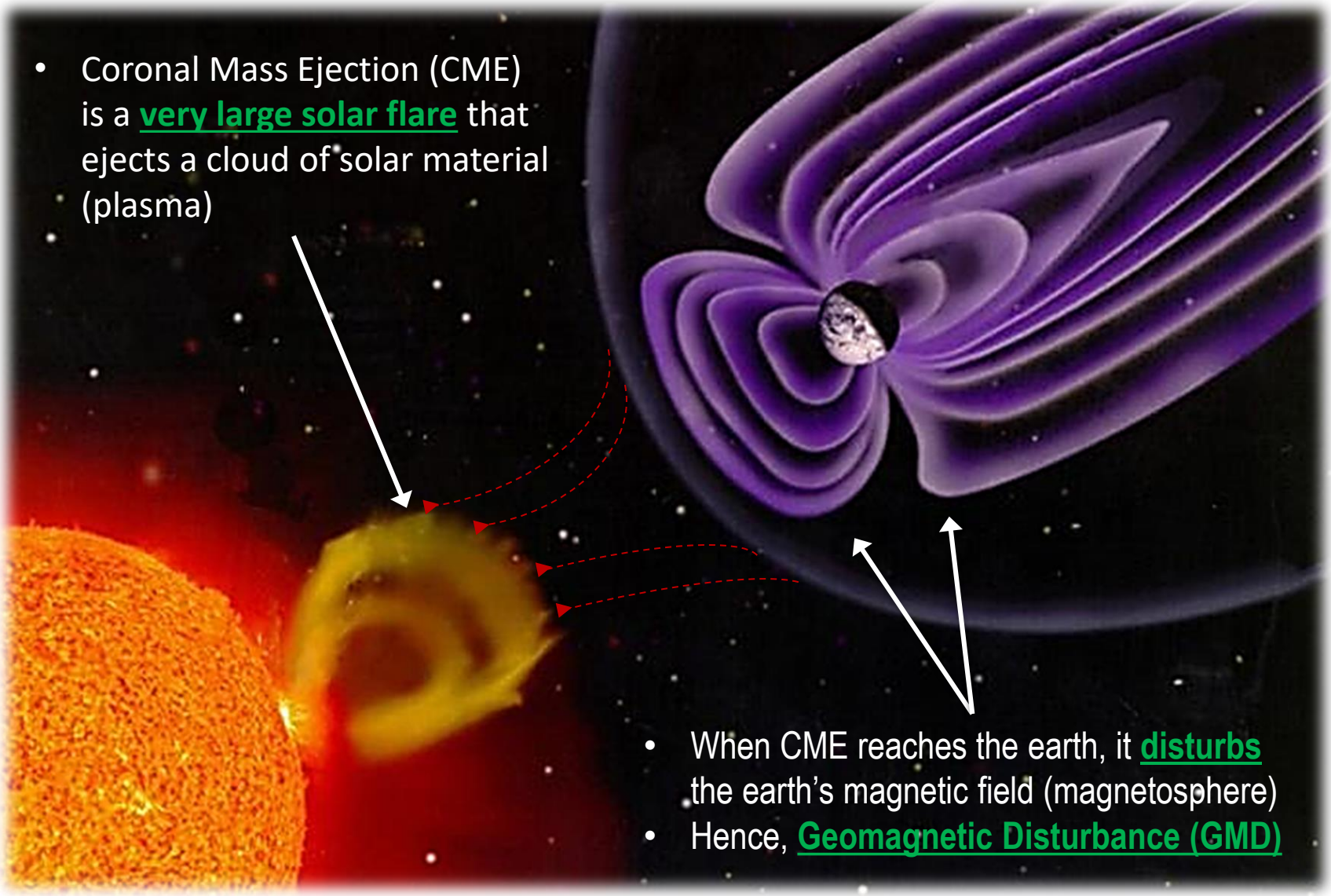
# Solar Weather




source: www.nasa.gov

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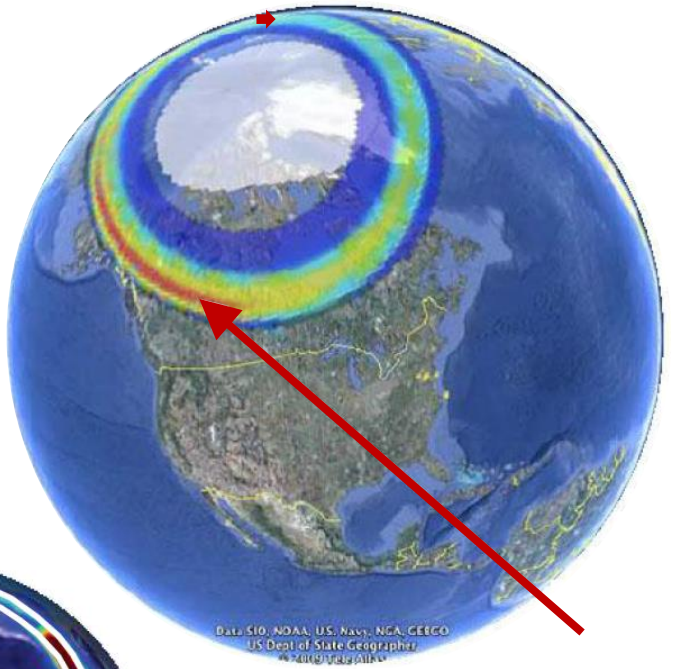
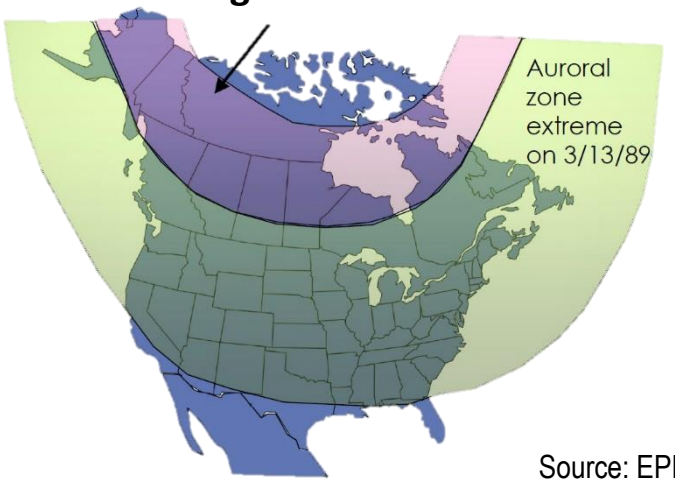
# Geomagnetic Disturbances

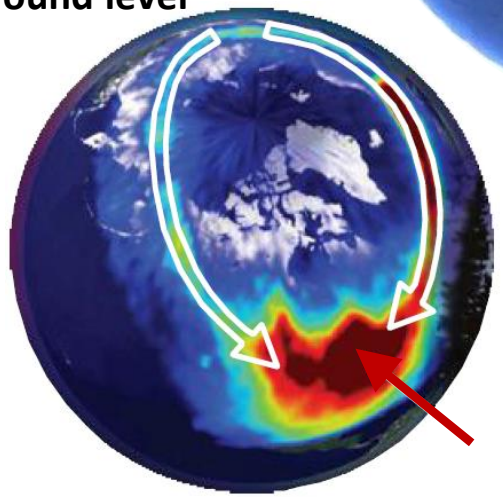
- **Geomagnetic Disturbances intensify electrojets (circulating current)**
  - **Electrojets exist due to natural circulating currents**
    - **Millions of Amperes**
    - **100 – 300 km altitude**
    - **Quasi DC**
  - **Intense solar activity (CME) intensifies electrojet and shifts coverage area**
  - **Fluctuations in electrojet current drive magnetic field fluctuations at ground level**




Red area shows greatest electrojet intensity




Source: EPRI



Electrojet has intensified and shifted southward

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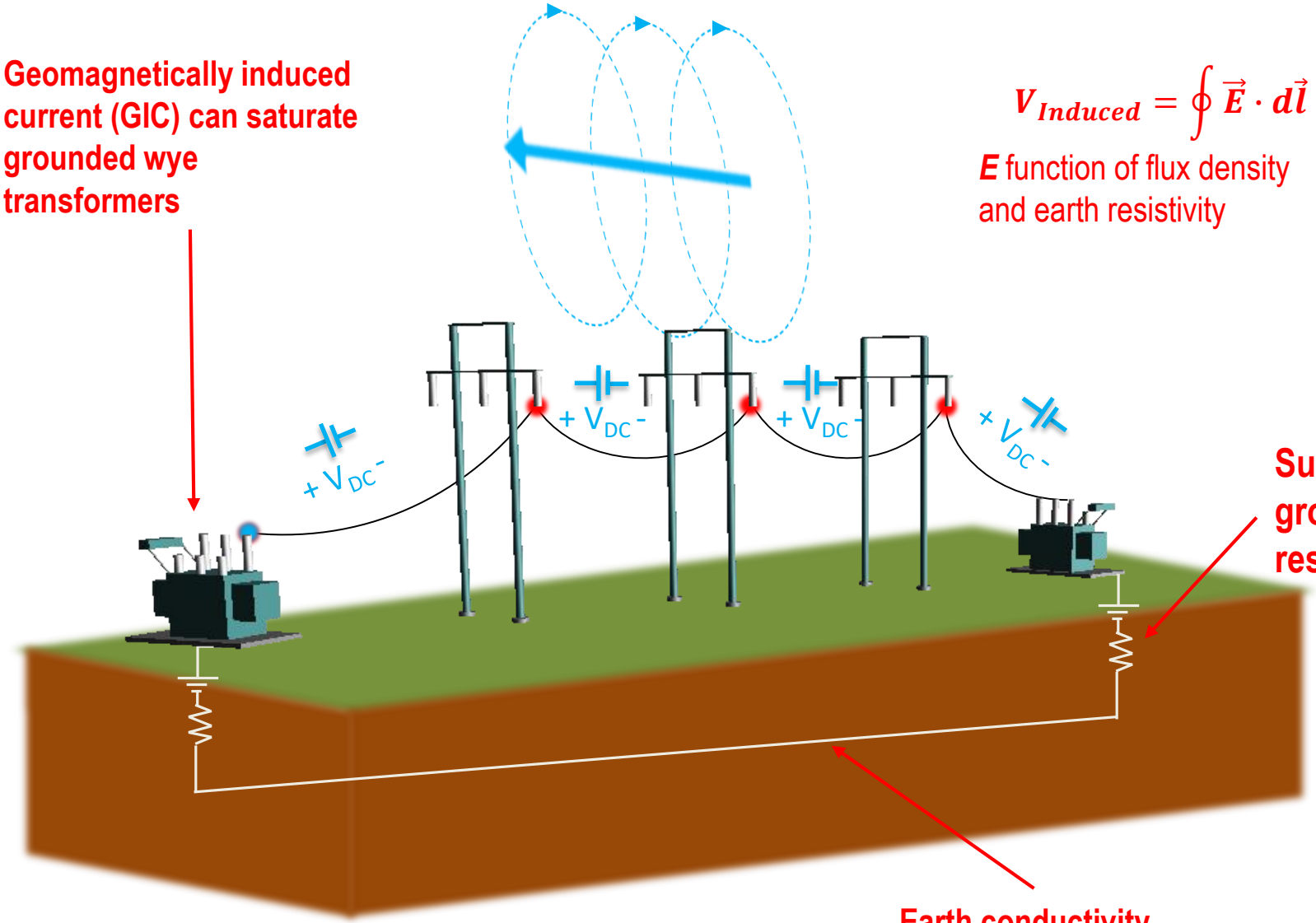
# Geomagnetic Induced Currents

**Geomagnetically induced current (GIC) can saturate grounded wye transformers**

$$V_{Induced} = \oint \vec{E} \cdot d\vec{l}$$

***E*** function of flux density and earth resistivity

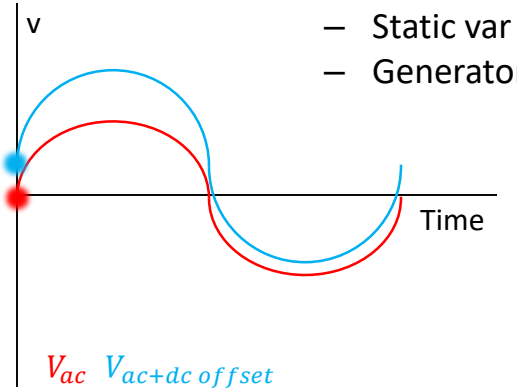


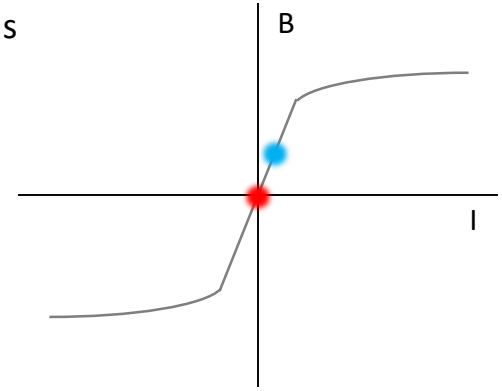

**Substation ground resistance**

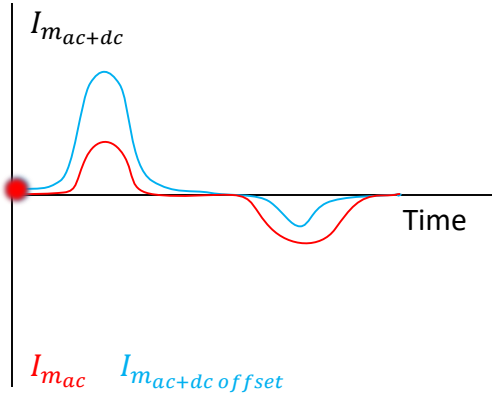
**Earth conductivity**

# Transformer Half Cycle Saturation

- **GIC are quasi DC (0.1 Hz)**
- **dc current can saturate transformers during one half of ac cycle**
- **Transformer half cycle saturation causes problems**
  - Large magnetizing current creates voltage stability problems
    - Transformer acts like a shunt reactor
    - Reactive power consumption depresses local system voltages
  - Large magnetizing current creates hot spots
    - Localized heating of transformer can permanently damage equipment
  - Asymmetrical magnetizing current injects harmonics into power system
    - Increased harmonics can cause protection misoperation
      - Capacitor banks
      - Static var systems
      - Generators

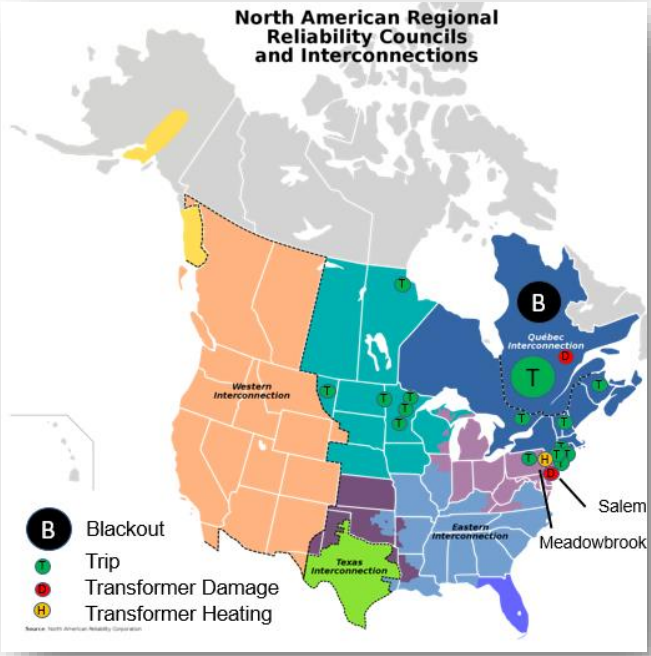


# Interactive Training Session

## 1989 Event



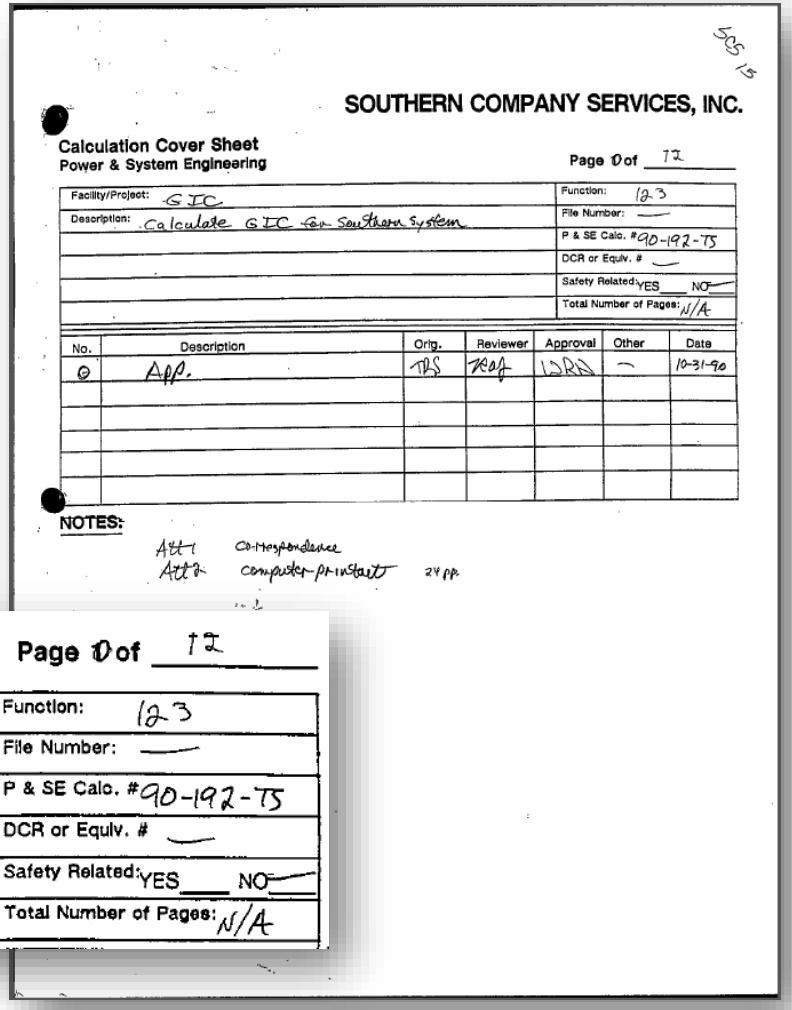

Source: NERC

- Collapse of Hydro Québec system
  - 6 Million people without power
- 211 Events reported to NERC
- Issues were widespread
  - (8) SVCs tripped (7 in HQ)
  - (2) Transmission lines tripped
  - (1) DC converter station tripped
  - (22) capacitor banks tripped (including 1 converter filter)
  - (1) 230/69 kV transformer tripped
  - (1) 700 MW Generator tripped
- Transformers were affected (US and UK)
  - Salem and Meadowbrook (heating)
  - La Grande (overvoltage)
- Damage to equipment ~$6.5 million and the net cost of failure to $13.2 million.
- Subsequent mitigation measures, at a cost of about $1.2 billion Canadian dollars.
- Reactive demand increased by 1600 Mvar.
- **Harmonics played a key role.**

# Interactive Training Session

## 1989 Event

- **Southern Company's very first GIC analysis was conducted in 1990**



SOUTHERN COMPANY SERVICES, INC.

Calculation Cover Sheet
Power & System Engineering

Page 1 of 12

| | |
|---|---|
| Facility/Project: GIC | Function: 123 |
| Description: Calculate GIC for Southern System | File Number: — |
| | P & SE Calc. # 90-192-TS |
| | DCR or Equiv. # — |
| | Safety Related: YES ___ NO — |
| | Total Number of Pages: N/A |

| No. | Description | Orig. | Reviewer | Approval | Other | Date |
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| 0 | App. | TBS | RAF | LDRA | — | 10-31-90 |

NOTES:

Att 1 Correspondence
Att 2 computer printout 24 pp

Calculation Cover Sheet
Power & System Engineering

Page 1 of 12

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# Interactive Training Session

## Regulatory Milestones

### 2010

- Meta-R-319 Geomagnetic Storms and Their Impact on the US Power Grid
  - Hypothesized that 1 in 30 year storm would result in loss of 216 transformers and large MVAR demand (10,000 Mvars in SERC)

### 2011

### 2012

- NERC Special Reliability Assessment: Effects of Geomagnetic Disturbances on the Bulk Power System

### 2013

- FERC Order 779
  - Directed NERC to develop a GMD operating standard, followed by a planning standard

### 2014

### 2015

- EOP-010-1
- GMD Operational Procedure becomes effective

### 2016

- FERC Order 830 (TPL-007-1 approved)
- NERC directed to start work on TPL-007-2 to address corrective action plan timing, refining transformer thermal assessments, requiring installation of monitoring equipment, and factors affecting the GIC calculation including: spatial averaging, earth conductivity models, and latitude scaling factors

### 2017

- TPL-007-1 R1 (July 1): Responsible entity identified

# Regulatory Milestones

## 2018

- TPL-007-1 R2 (July 1): Responsible entity constructs model for GMD vulnerability studies including substation coordinates, dc resistances, ground grid resistances, and transformer winding configurations
- NERC submitted TPL-007-2 to FERC

## 2019

- TPL-007-1 R5 (Jan. 1): Responsible entity provides max steady state GIC flow to each transmission and generation owner who owns a transformer connected > 200 kV
- TPL-007-2 review window

## 2020

- TPL-007-2 review window

## 2021

- TPL-007-1 R6 (Jan 1): Transmission and generation owners perform thermal assessment on transformers identified as likely to experience > 75 amps GIC per phase and provide results to responsible entity

## 2022

- TPL-007-1 R3 (Jan 1): Responsible entity develops criteria for acceptable system steady state voltage performance
- TPL-007-1 R4 (Jan 1): Responsible entity completes GMD vulnerability assessment (considering thermal assessment results from R6)
- TPL-007-1 R7 (Jan 1): Responsible entity develops corrective action plan

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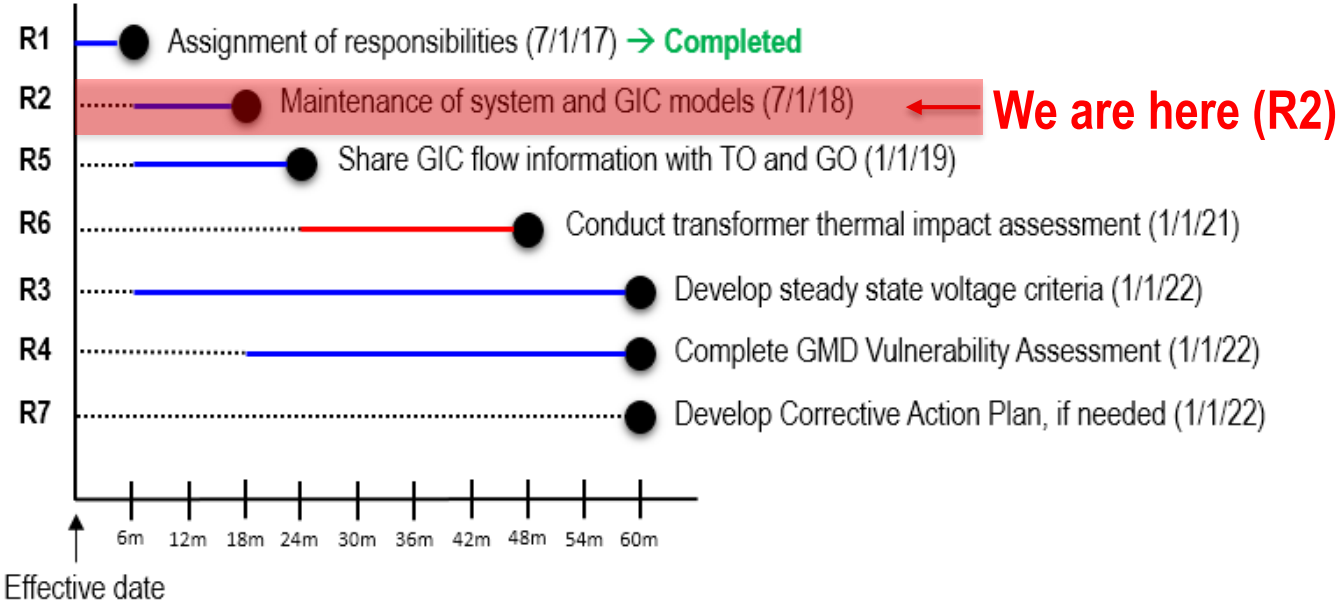
# TPL – 007-1

## Southern Company Progress Update

- **TPL-007-1**




  - R1
    - Southern Company Services serving as responsible entity
  - R2
    - Soliciting substation coordinates, dc resistances, ground grid resistances, and transformer winding resistances and configurations from relevant transmission and generation owners
  - R5
    - Building scripting tools to conduct analysis

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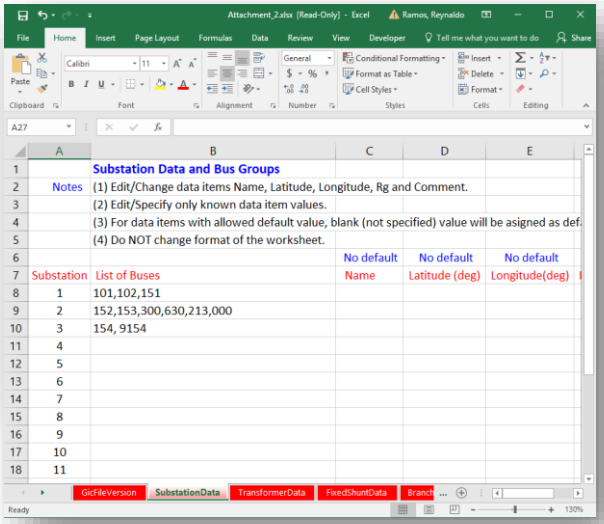
# TPL – 007-1

## Official Data Request

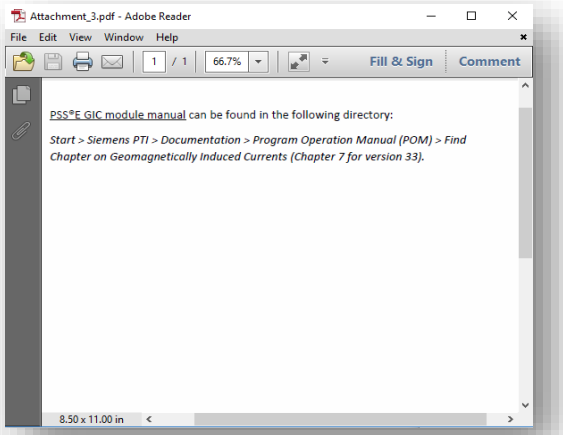
- Approach
  - Official request sent on December 27, 2017 to relevant transmission owner(s) and generation owner(s) and adjacent systems.
- Workbook and Training
  - Provided to facilitate the development and maintenance of the GIC System Models.
  - Provided training material and webinars (internal + external).

Attachment 1


Attachment 2



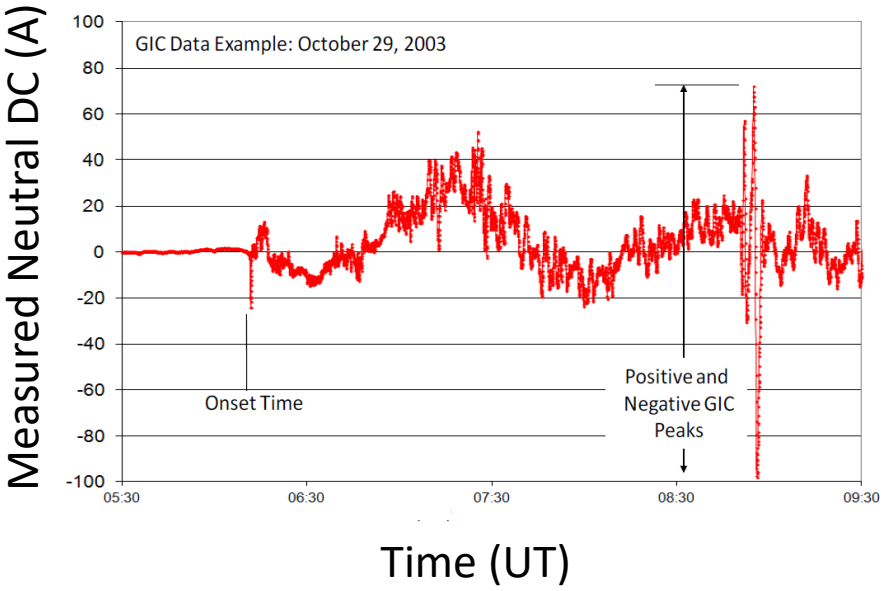

Attachment 3



# TPL – 007-1

## Southern Company Progress Update

- **NERC 1600 Data Request**
  - FERC Order No. 830 includes directives for collecting and sharing GIC data
  - *"**Data reporting is anticipated to begin in 2019**. Requested data for historical GMD events K7 or greater between May 1, 2013 to March 31, 2019 shall be provided to NERC by June 30, 2019. Thereafter, requested data for GMD events K7 or greater shall be provided to NERC by **June 30 of each reporting year** …"*
  - Currently reviewing capabilities of installed GIC monitoring equipment and evaluating opportunities to expand monitoring locations



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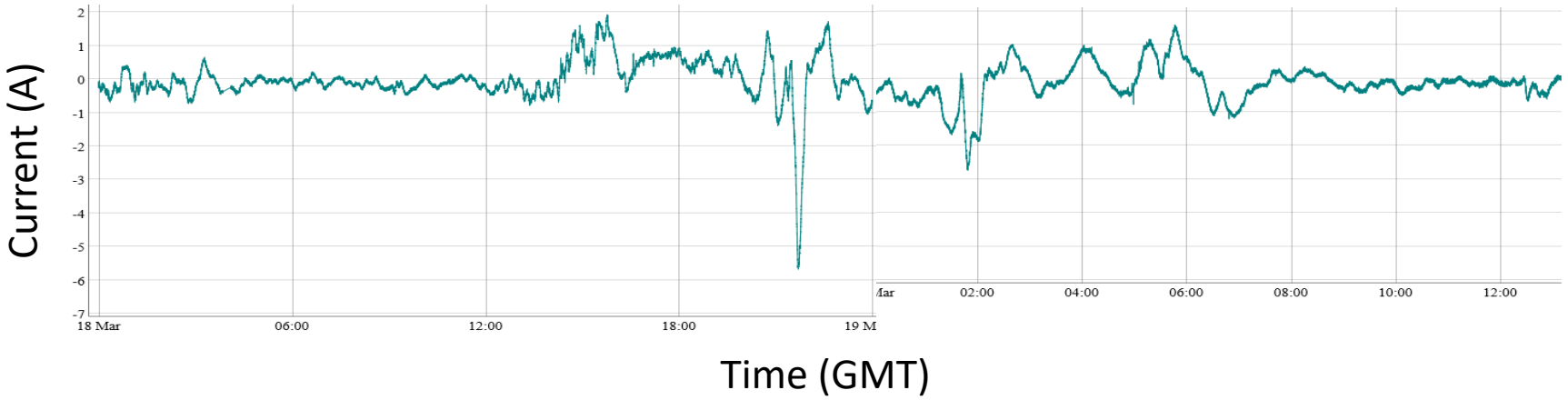
# TPL – 007-1

## Southern Company Progress Update

- **March 18-19 Geomagnetic Disturbance**
  - K-6 (G-2) storm predicted
    March 18 21:41 – March 19 3:00
  - Peak GIC measured -5.37 A at 21:41:22
    on autobank in south Georgia
  - No issues reported

NERC 1600 Threshold

| NOAA | K-Scale | Description |
|---|---|---|
| G-5 | K-9 | Extreme |
| G-4 | K-8 | Severe |
| G-3 | K-7 | Strong |
| G-2 | K-6 | Moderate |
| G-1 | K-5 | Minor |



SERTP

# Public Policy Requirements Stakeholder Proposal

# SERTP Evaluation

**Transmission Needs Driven by Public Policy Requirements (PPRs)**

- **The SERTP process did not receive any proposals for transmission needs driven by Public Policy Requirements for the 2018 planning cycle. Therefore, no transmission needs have been identified for further evaluation of potential transmission solutions in the 2018 SERTP planning cycle.**

# OVEC Integration into PJM

- **December 15, 2017**
  - Ohio Valley Electric Corporation submitted a filing to the Federal Energy Regulatory Commission (FERC) in connection with its' proposed integration into PJM
- **February 13, 2018**
  - FERC approved OVEC's integration proposal to join PJM
- **June 1, 2018**
  - Anticipated date for OVEC integration into PJM and withdrawal from SERTP

# Next Meeting Activities

- **2018 SERTP 2nd Quarter Meeting**
  - **Location: Chattanooga, TN**
  - **Date: June 27, 2018**
  - **Purpose:**
    - Review Modeling Assumptions
    - Discuss Preliminary 10 Year Expansion Plan
    - Stakeholder Input & Feedback Regarding the Plan

# 2018 SERTP

# Questions?

www.southeasternrtp.com