SERTP - 1st Quarter Meeting

First RPSG Meeting & Interactive Training Session

March 20th, 2019

Charlotte, NC

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

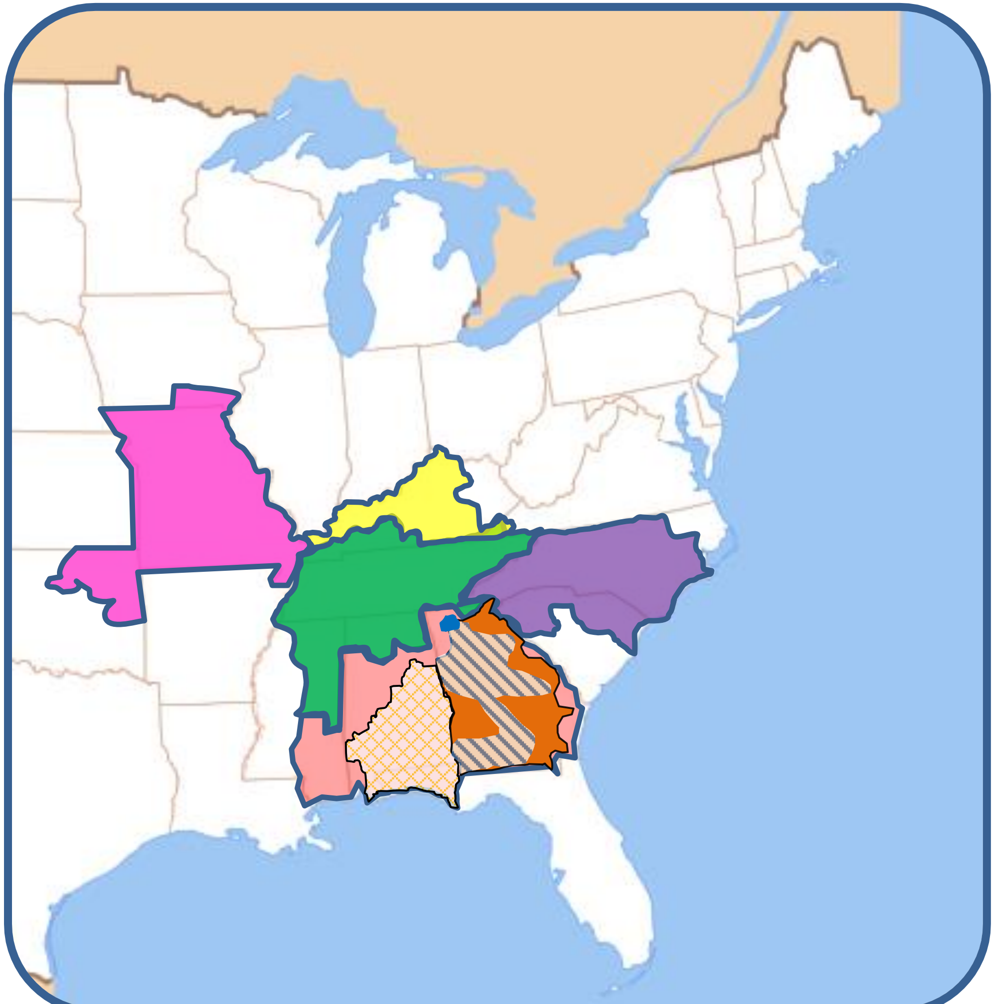
Agenda

- **2019 SERTP Process Overview**
- **Form the "RPSG"**
  - Regional Planning Stakeholders Group
  - Committee Structure & Requirements
- **Economic Planning Studies**
  - Review Requested Sensitivities for 2019
  - RPSG to Select up to Five Economic Planning Studies
- **Interactive Training Session**
  - Inverter Based Generation – Connection Standards
- **Miscellaneous**
  - Public Policy Requirement Stakeholder Requests
- **Next Meeting Activities**

SERTP

2019 SERTP Process Overview

Southeastern Regional Transmission Planning (SERTP)



SERTP Sponsors

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

Upcoming 2019 SERTP Process

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

  March 2019
  - Form RPSG
  - Select Economic Planning Studies
  - Interactive Training Session

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

  June 2019
  - Review Modeling Assumptions
  - Preliminary 10 Year Expansion Plan
  - Stakeholder Input & Feedback Regarding the Plan

Upcoming 2019 SERTP Process

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

  September 2019
  - 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 2019
  - Final Results of the Economic Studies
  - Regional Transmission Plan
  - Regional Analyses
  - Stakeholder Input on the 2020 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**
- **2019 Sector Representatives**

SERTP

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	2020
2		2022
3		2024
4		2025
5		2027
6		2029
7	SHOULDER	2022
8		2024
9		2027
10		2029
11	WINTER	2024
12		2029

* Will be 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 <u>hypothetical</u> 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

- **2018 Economic Planning Studies**
- **2019 Economic Planning Study Requests**
- **Vote on 2019 Economic Planning Studies**

SERTP

Interactive Training Session

Inverter Based Generation – Connection Standards

Manish Patel
Southern Company Services, Transmission Planning

Process Information

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Southeastern Regional
TRANSMISSION PLANNING

Interactive Training

Presentation Outline

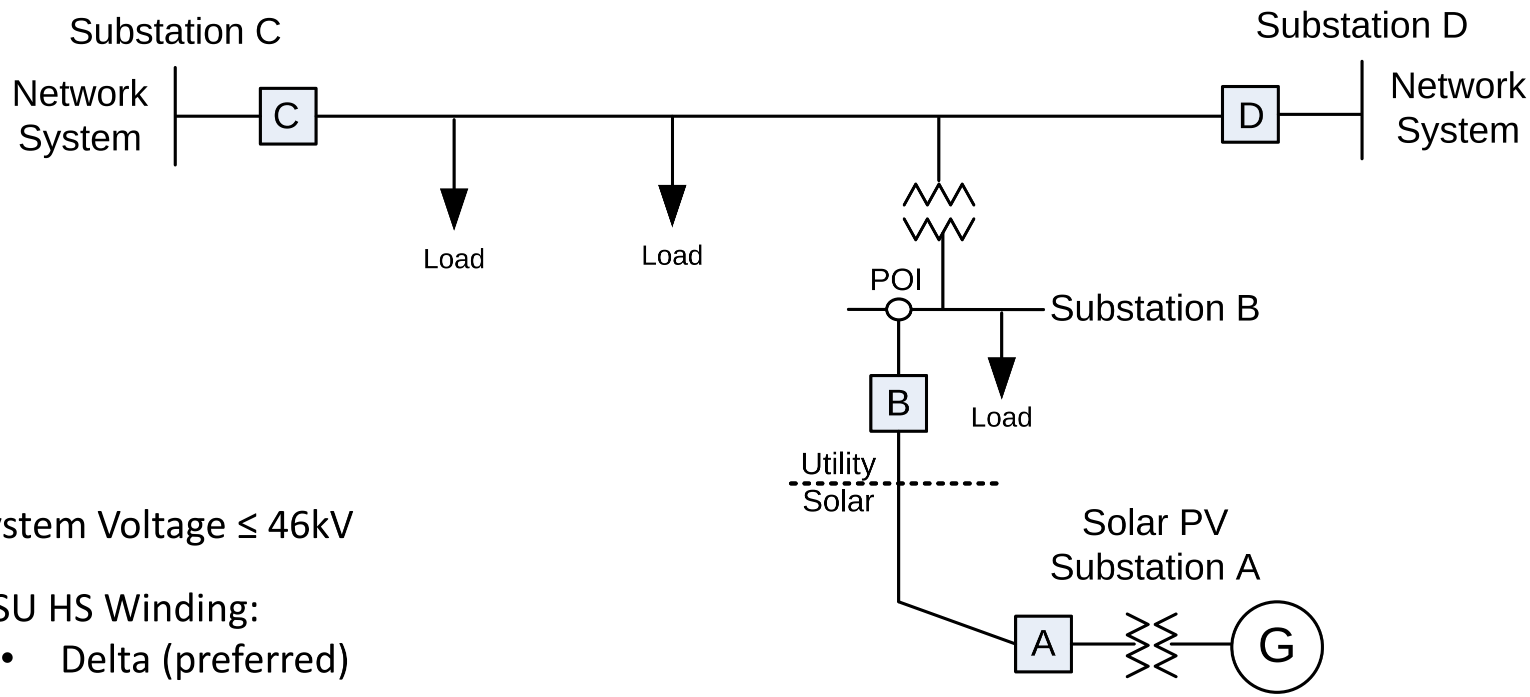
- Penetration in SERTP
- Interconnection Configurations & GSU Connections
- Anti-Islanding Policy
- Ride-through Requirements – Voltage & Frequency
- SCR Calculation – Voltage Stability/Inrush Stability
- Power Quality Policy
- Response to a three phase fault
- IEEE P2800 project
- OASIS Website – Additional Information

Penetration Level

- Existing utility scale IBRs (Transmission ICs)
  - SERTP: ~3170 MW

- Future:
  - 2021: ~5940 MW

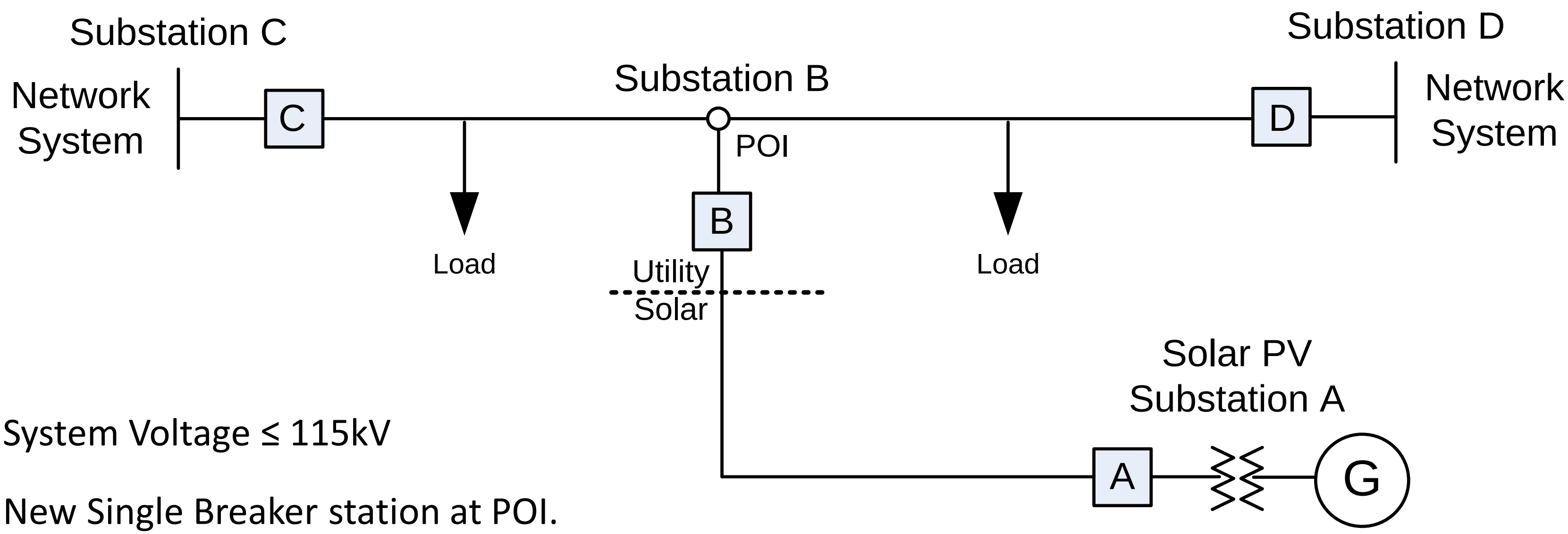
Interconnection Configuration – Express Feeder



- System Voltage ≤ 46kV
- GSU HS Winding:
  - Delta (preferred)

*Southern Company common practice

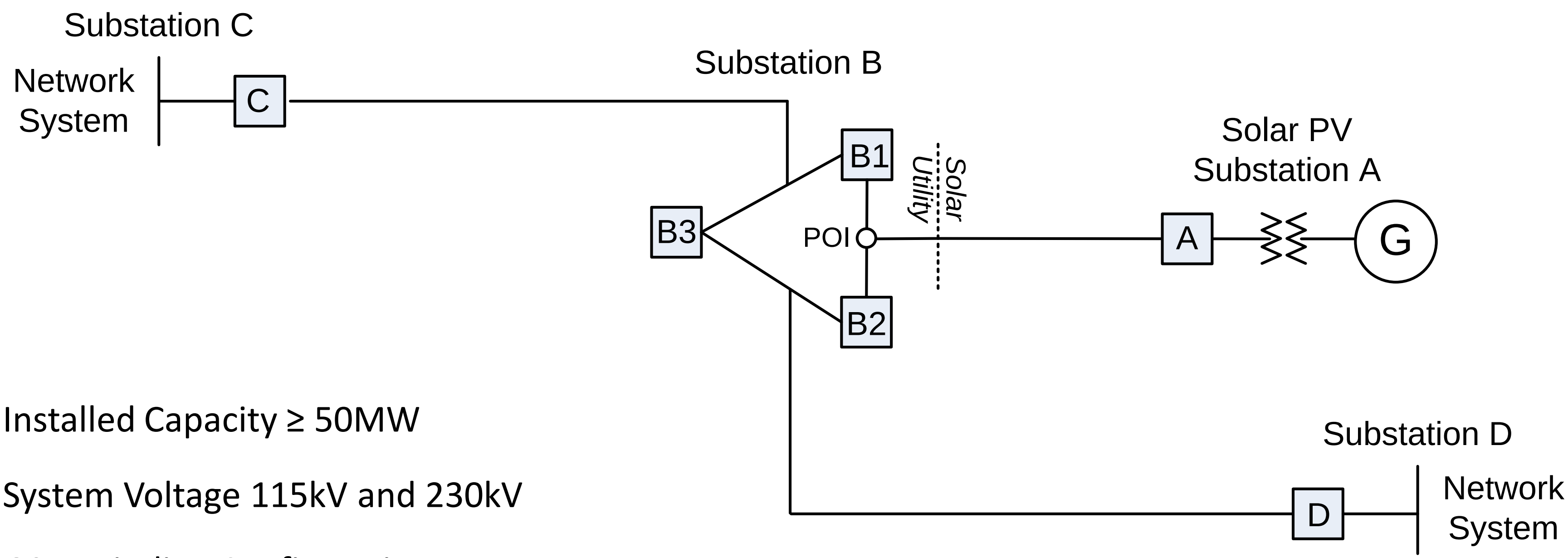
Interconnection Configuration – Line Tap



- System Voltage ≤ 115kV
- New Single Breaker station at POI.
- GSU HS Winding:
  - Delta (preferred)
  - Y-grounded (Delta LS)

*Southern Company common practice

Interconnection Configuration – Ring Bus



- Installed Capacity ≥ 50MW
- System Voltage 115kV and 230kV
- GSU Winding Configurations:
  - Y-grounded on HS and Delta on LS
  - Y-grounded on HS and LS with buried delta tertiary

*Southern Company common practice

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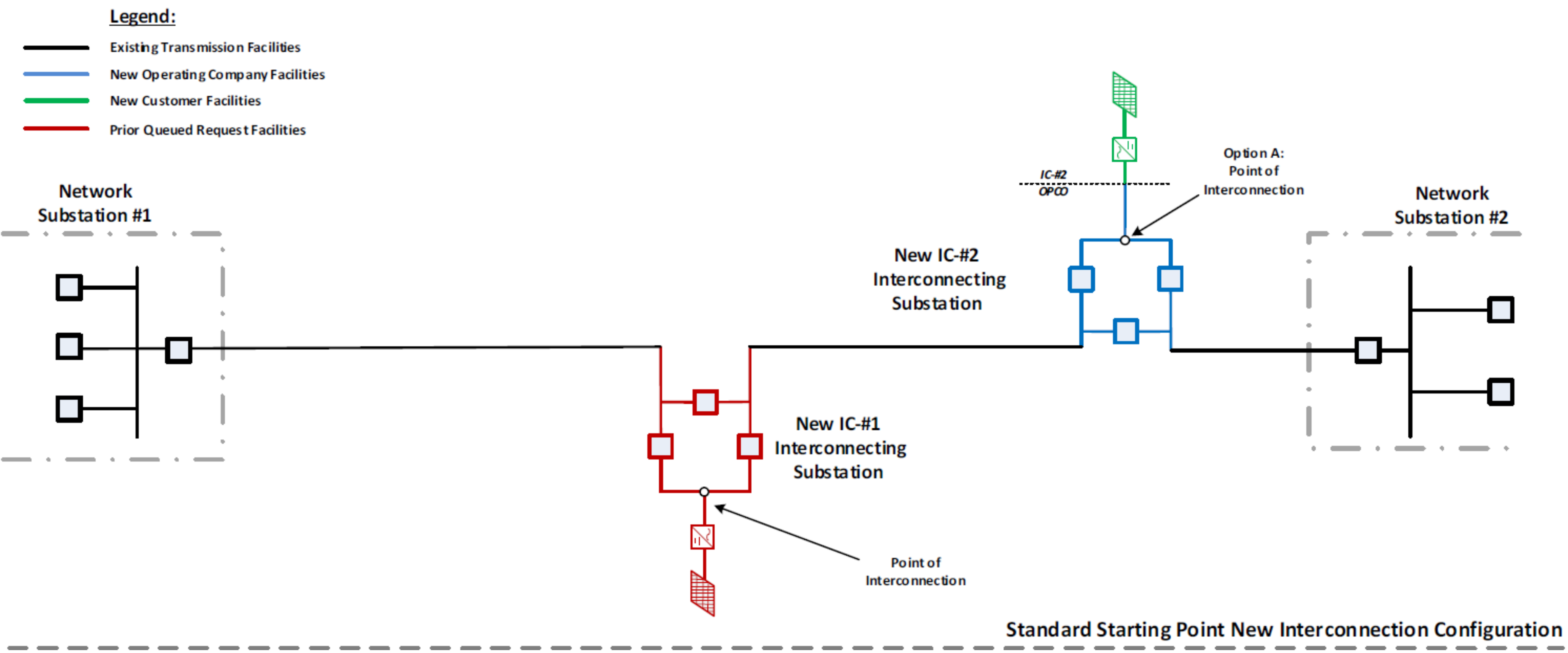
Interactive Training

Multiple Interconnections – Starting Point



*Southern Company common practice

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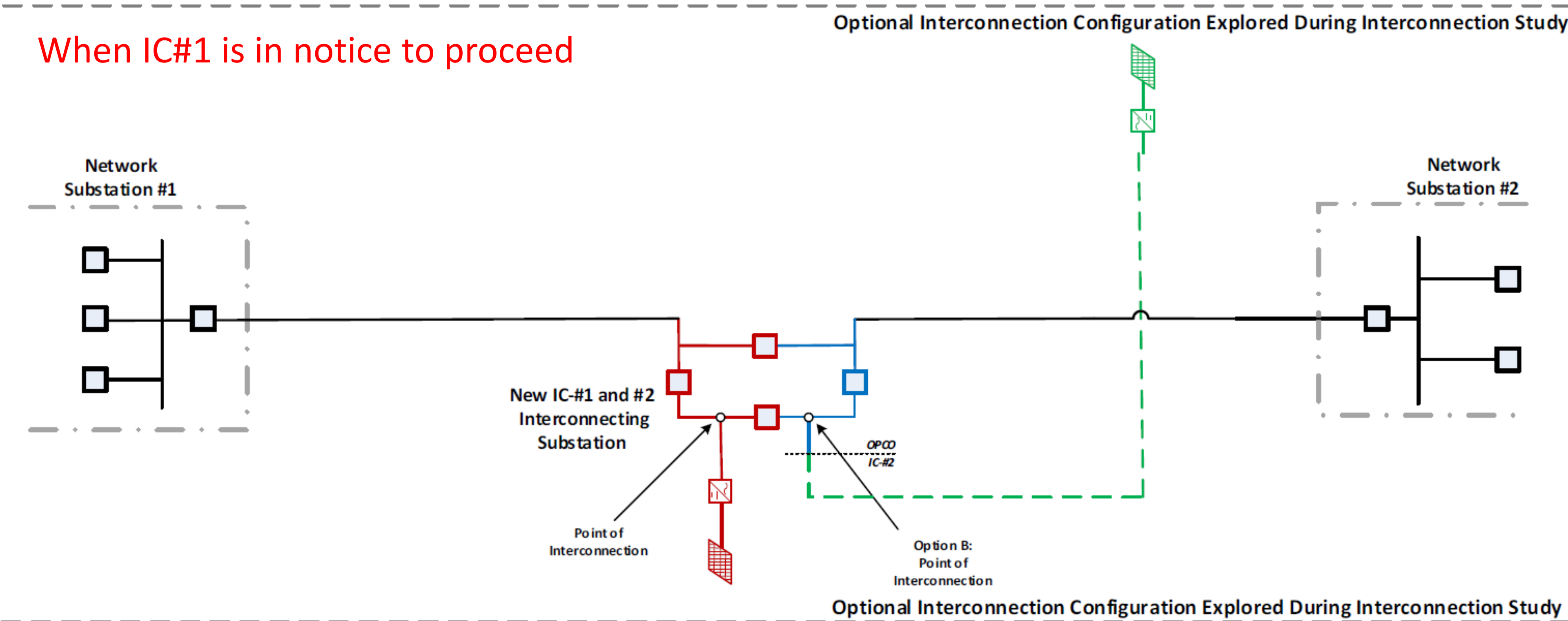
Multiple Interconnections – Optional configuration #1

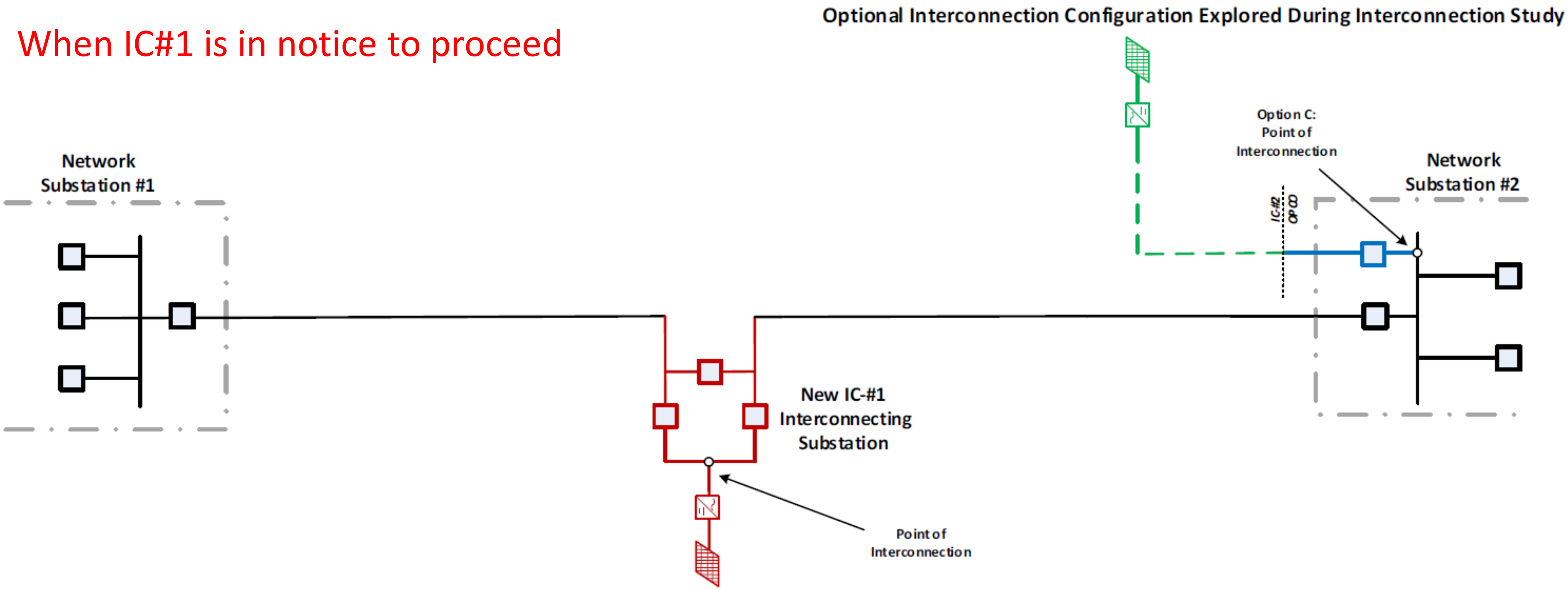
When IC#1 is in notice to proceed



*Southern Company common practice

Multiple Interconnections – Optional configuration #2

When IC#1 is in notice to proceed



*Southern Company common practice

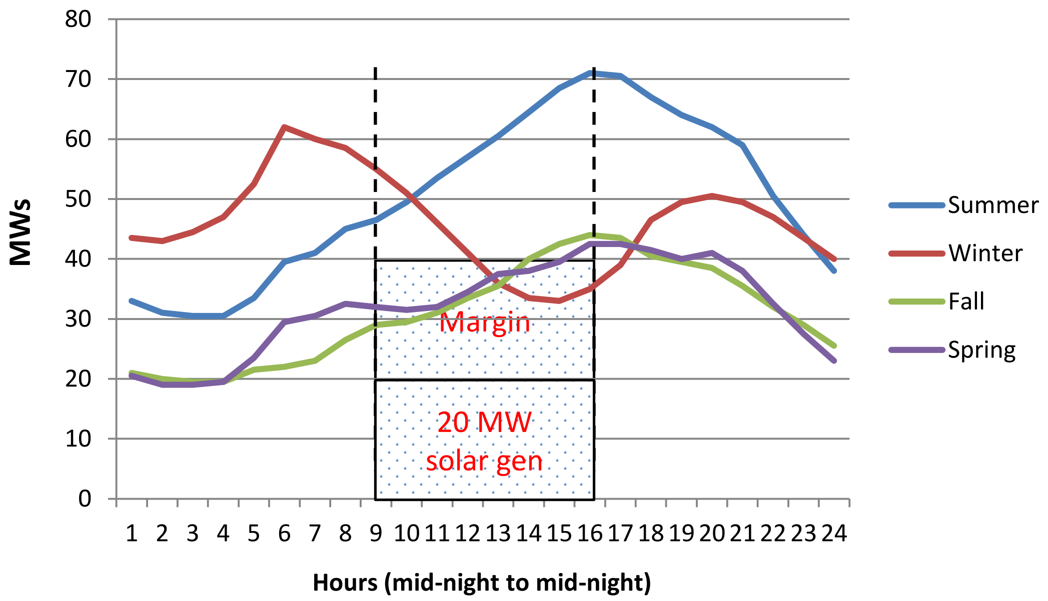
Anti-Islanding Policy (Before 2017)

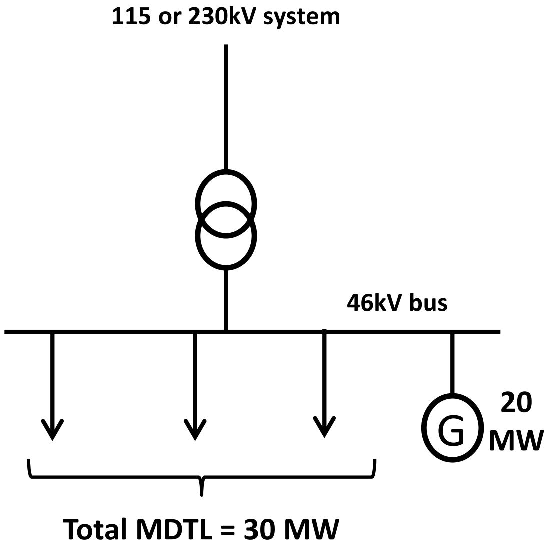
- Policy: Sustained island for an N-1 Contingency is not allowed.
  - Islanded generator may not be able to control voltage and frequency within acceptable limits.
  - Safety concerns for utility personal working in the area.

- With solar generators:
  - Is anti-islanding protection needed?
    - Yes: But why?
      - Line commutated or self commutated inverters.
      - Inverters with ride-through & grid support capabilities.
      - Multiple sites supporting each other.
    - When should anti-islanding protection be required?
    - How to protect for islanding?
      - Communication based DTT

Anti-Islanding Policy

- Policy
  - Anti-islanding protection is required, if MDTL < 2 X Total Generation capacity.
  - Applies to all generation connected directly to transmission, even at distribution voltage.





Anti-islanding protection is required

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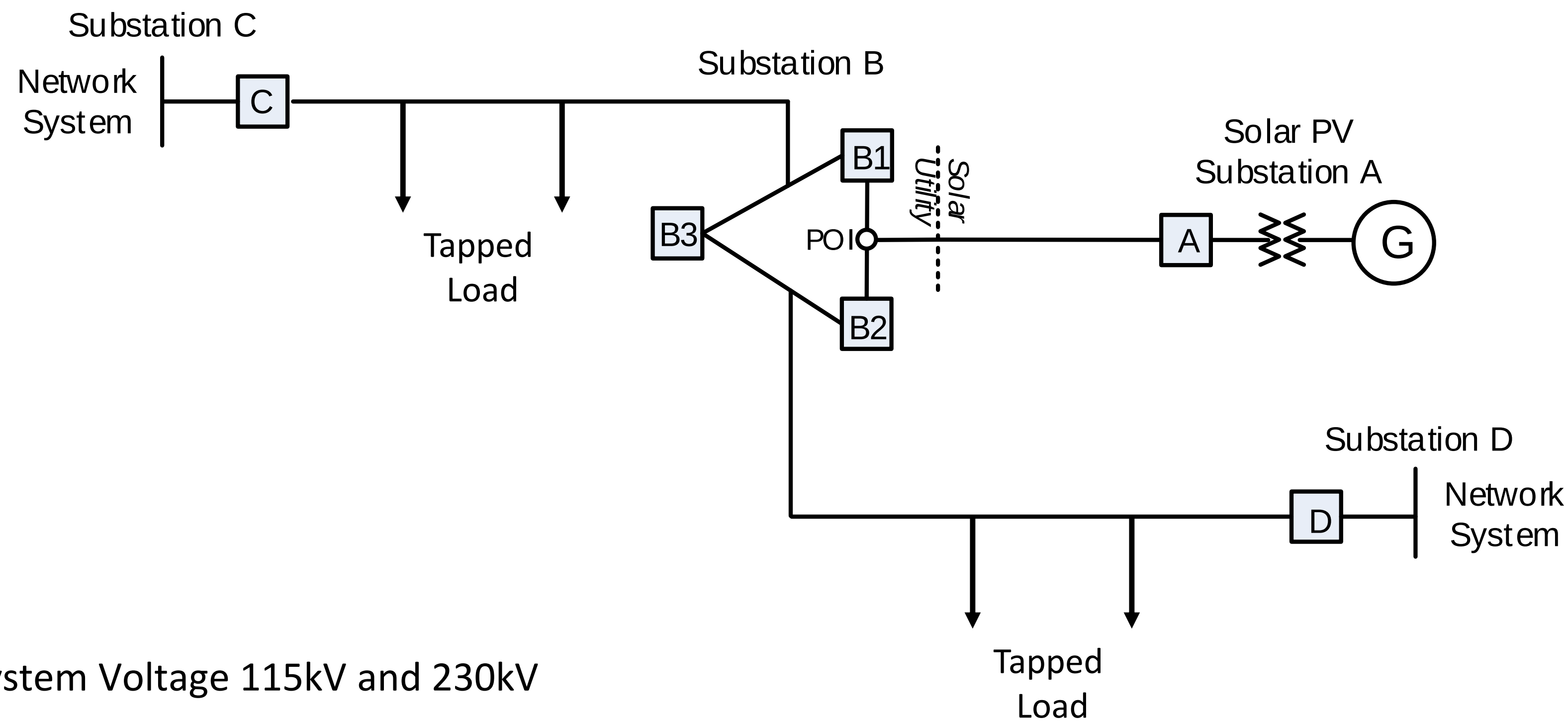
Is anti-islanding protection needed here?



- System Voltage 115kV and 230kV

Anti-Islanding Policy (Now)

- Policy - sustained island for an N-2 contingency is not allowed.

Condition # 1

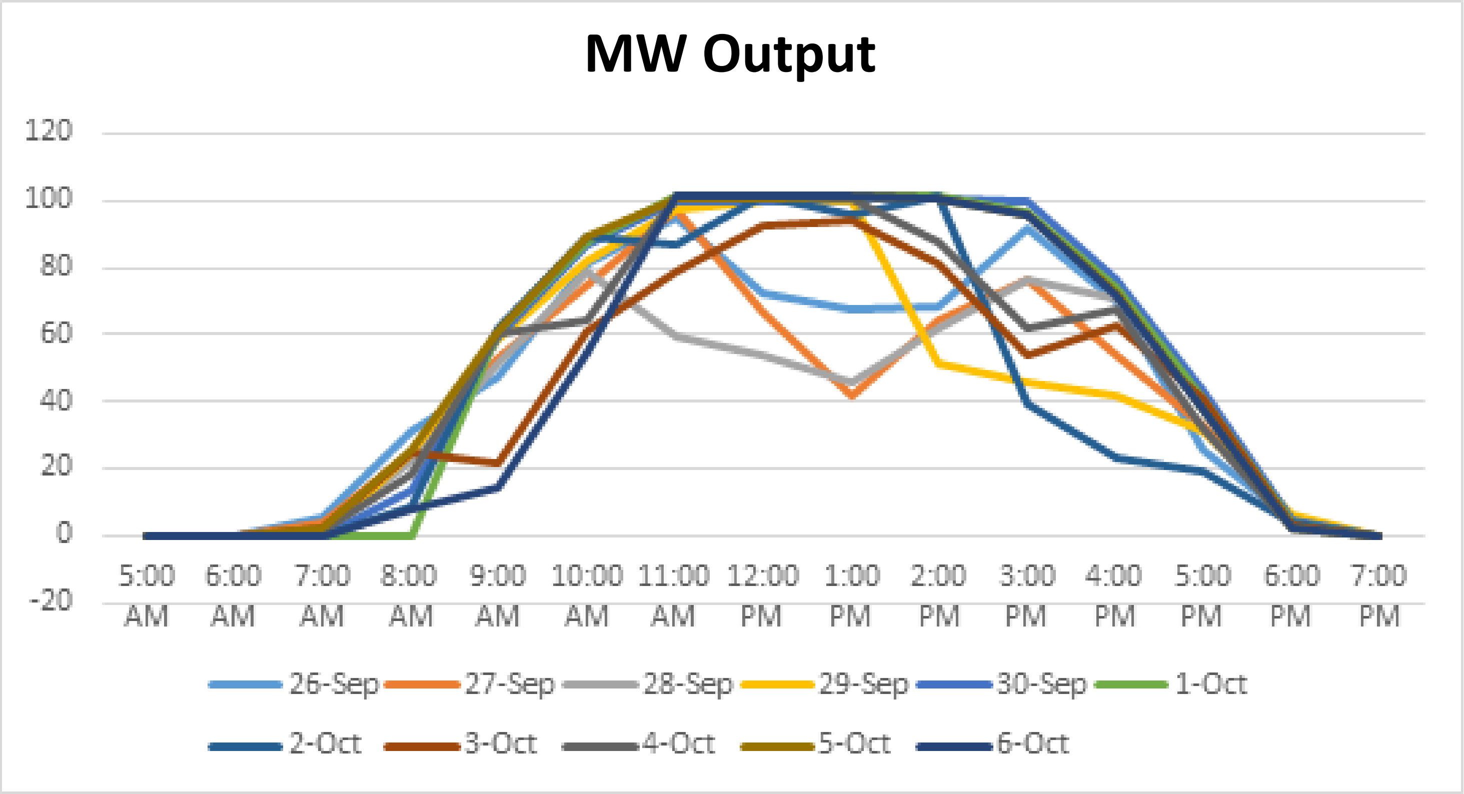
– Anti-islanding protection is required, if MDTL < 2 X Total Generation Capacity.

Can we add another condition to allow exclusion?

No – because of variable nature of the generation.

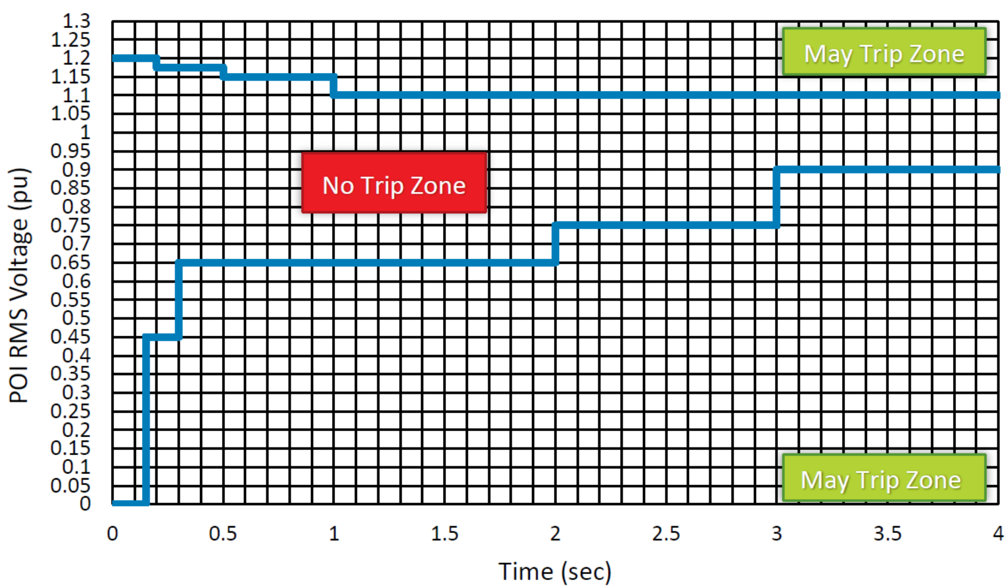
– Anti-islanding protection is required, if Generation Capacity < 2 X Max. Load.

Variable Nature of the Generation



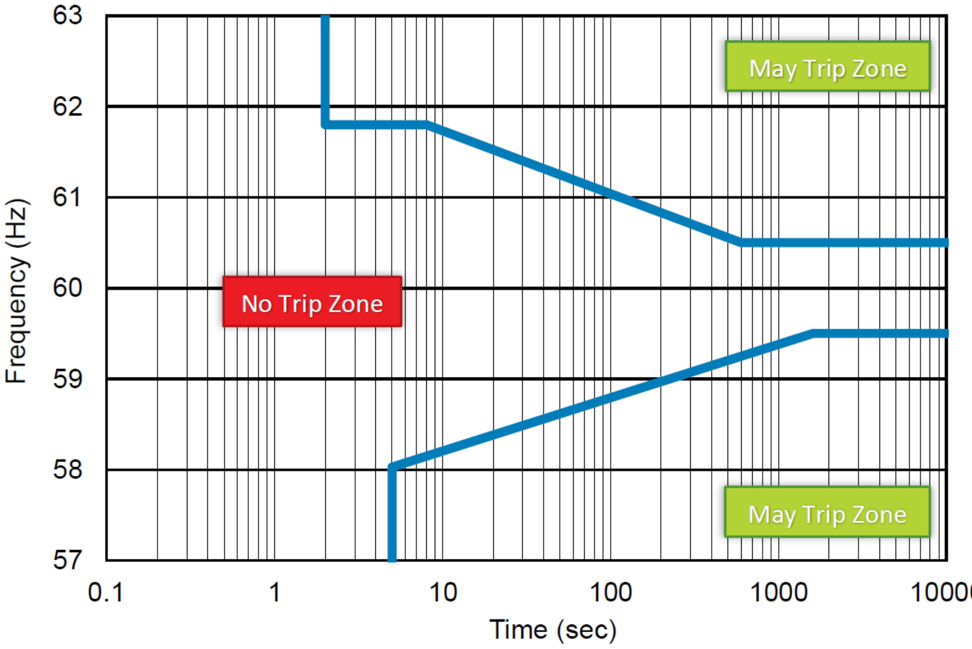
Voltage Ride-Through Requirement

- IBRs are expected to stay connected and operate normally during and following a three-phase fault with clearing not to exceed 9 cycles.
- Momentary Cessation is not allowed.
- Emphasize on “May Trip Zone”
- P/Q priority control settings:
  - Operate in Q-priority mode – optimize its available MVA rating to produce more Q during LV condition.



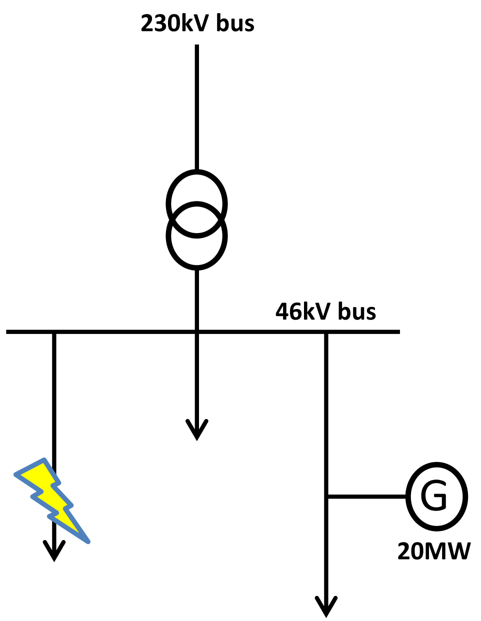
Frequency Ride-Through Requirement

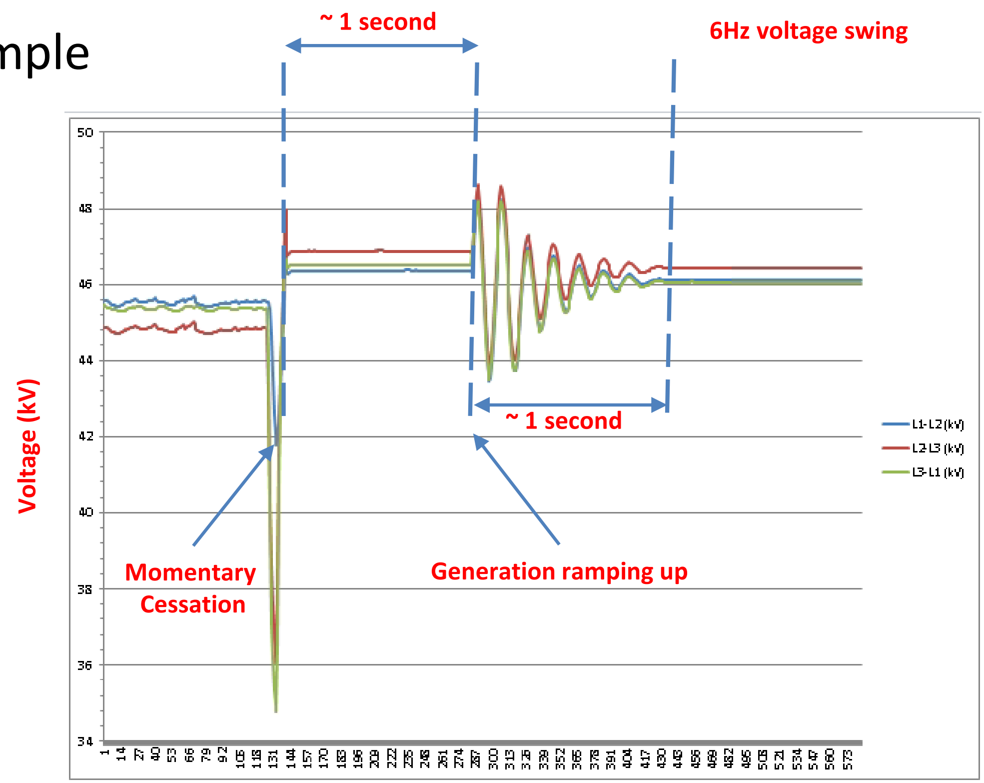
- IBRs shall remain connected to the system during frequency excursion events.
- Momentary Cessation is not allowed.
- Emphasize on "May Trip Zone".
- Frequency Response/Regulation
  - IBRs shall have the capability to provide primary frequency response for over-frequency events.
  - Droop: adjustable with default value of 5%.
  - Deadband: adjustable with a value not to exceed +/- 36mHz.



Voltage Control Stability

- Voltage Control Stability - Example





Short Circuit Ratio Calculation – Before 2019

- The GO must design its facility to reliably operate for the Short Circuit Ratio (SCR) provided in the study report.

$$\text{SCR} = \frac{Three - Phase\ SC\ MVA\ @\ POI}{Max\ rated\ MW\ output\ of\ the\ facility}$$

- The generating facility shall be designed to reliably manage both
  - steady state voltage regulation
  - Provide support when during transient voltage deviations.

- Too conservative when there are multiple interconnections electrically close to each other.

Short Circuit Ratio Calculation – 2019 onwards

- Evaluated GE's Composite and ERCOT's Weighted Short Circuit Ratio calculation methods.
  - Composite SCR: calculated on low side of the GSU
  - WSCR: calculated at the POI.

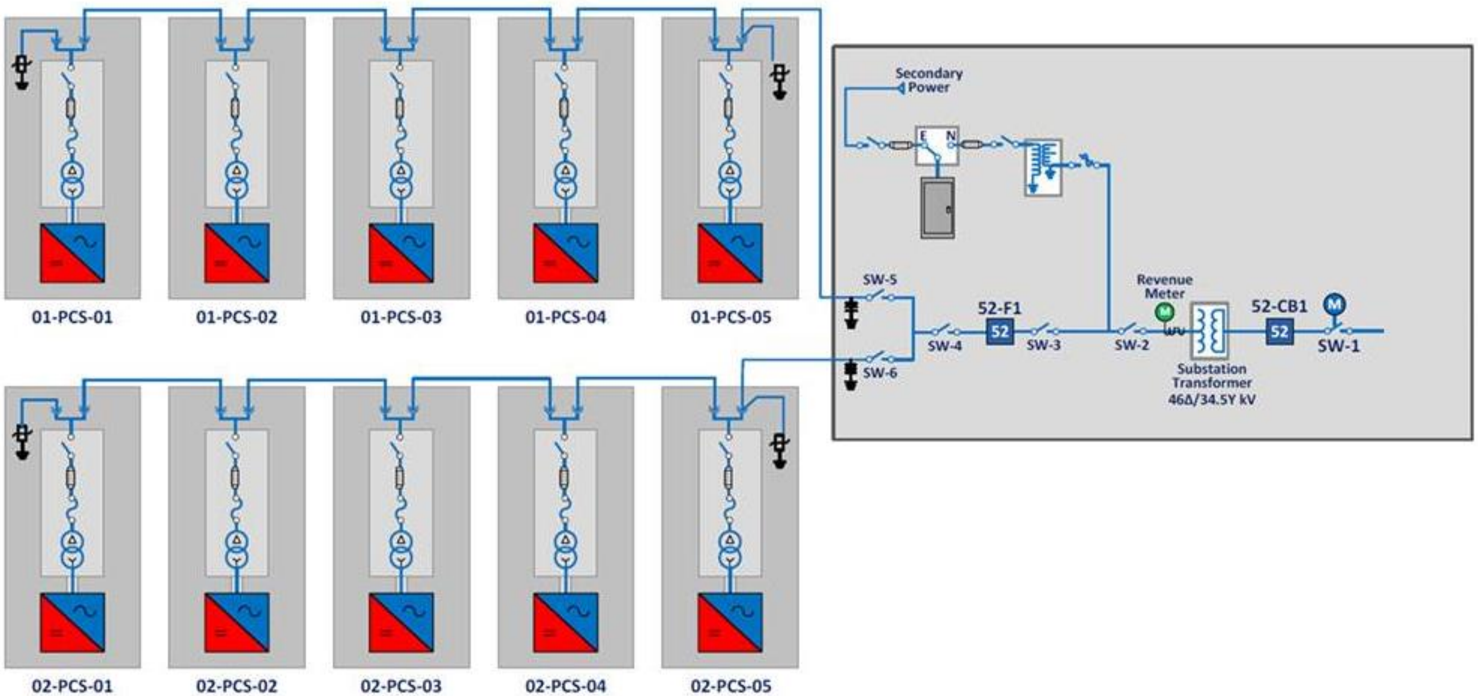
- Adopted WSCR as it offers a correct technical representation of a group of interconnecting facilities to evaluate against the system strength at the POI.

- The GO must design its facility to reliably operate for the Short Circuit Ratio (SCR) of 2.0 or higher.

- If WSCR < 2.0, assign delivery related transmission capital projects designed to maintain relative system strength **OR** impose delivery limits
  - Capital projects may include:
    - New transmission elements
    - Adding synchronous machines or condensers

Transformer Inrush Performance

- Transformer Inrush - Example



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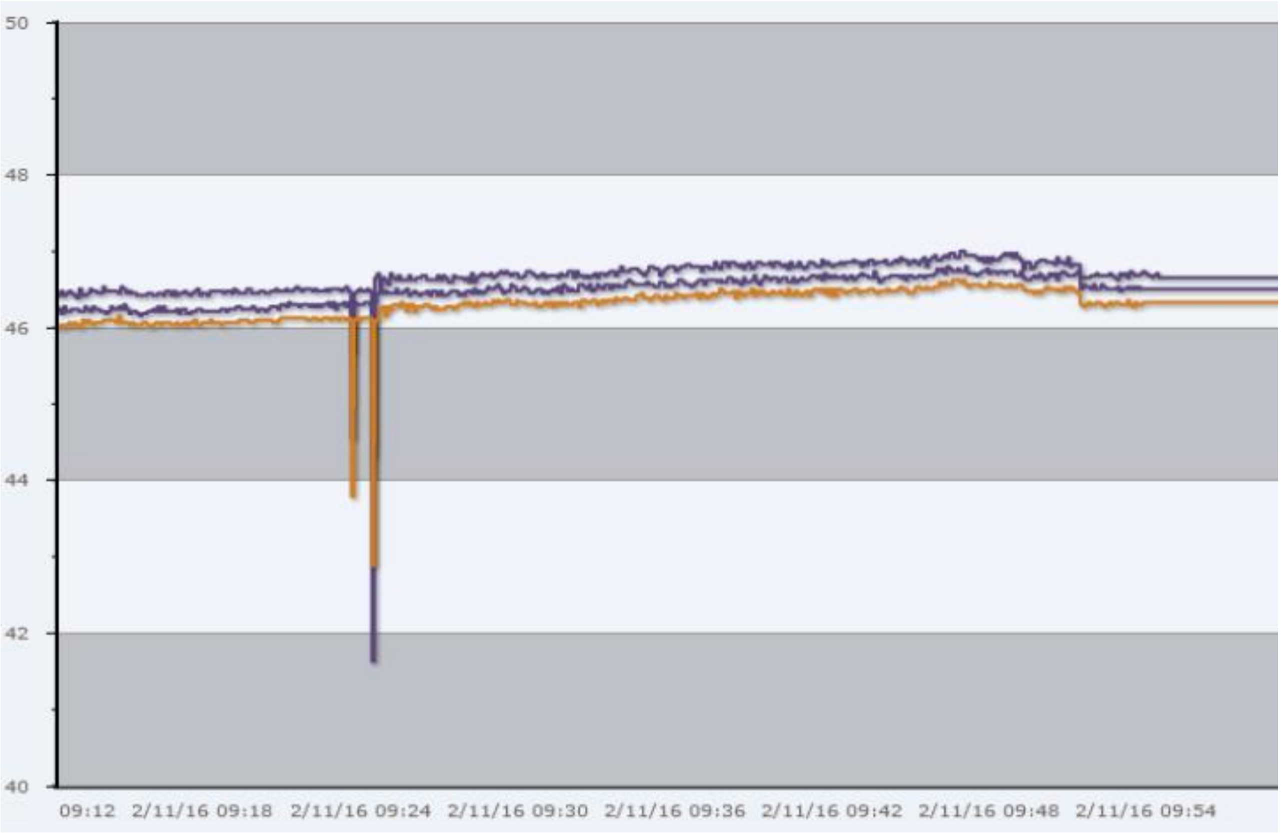
Transformer Inrush Performance

- Transformer Inrush - Example

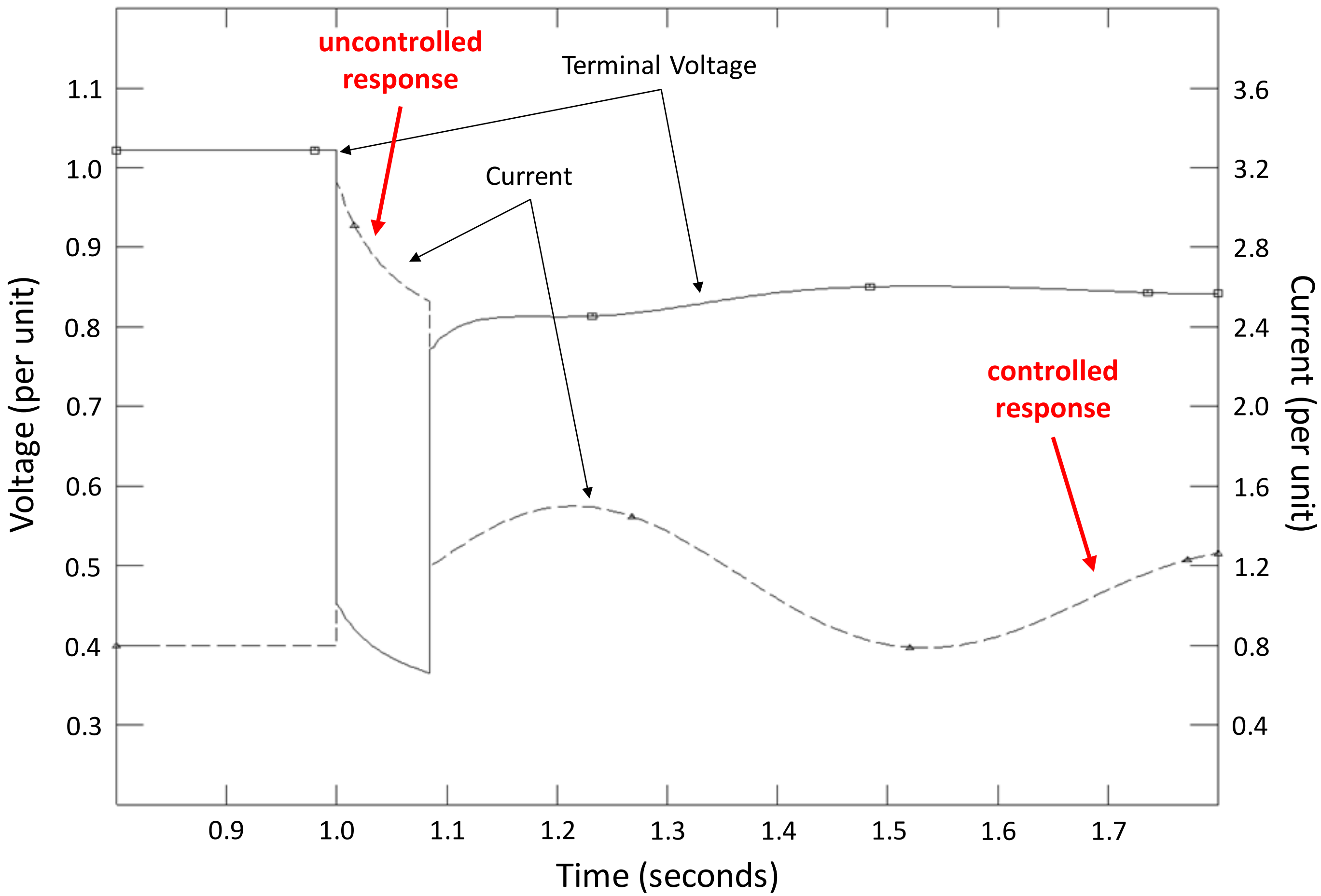


Power Quality Policy

- All IBRs shall comply with company's Power Quality Policy.
  - Consists of harmonics, voltage fluctuations & voltage imbalance.
- Permanent power quality monitoring device is installed at the POI for monitoring purposes.
- Interconnection Studies:
  - Determine impact of harmonics produced by IBRs on electrically close synchronous generators.
  - Determine if mitigation plan is necessary
  - This could result in stricter harmonic injection limits.
  - Transformer energization studies:
    - ➢ Energization of large transformers could have impact on power quality. (voltage drop and/or TOV)

Interactive Training

Synchronous Machine – Response to a Three Phase Fault



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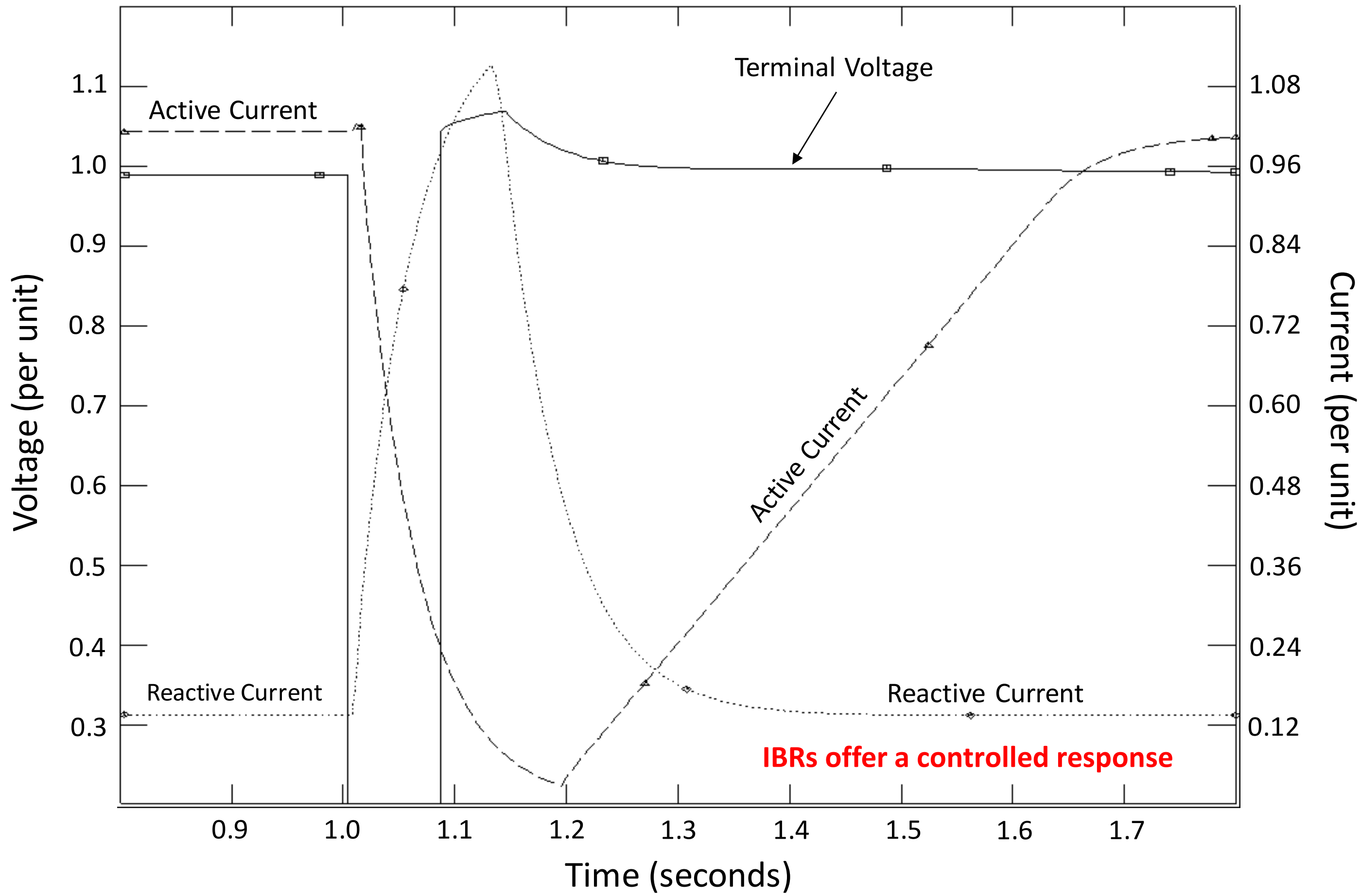
Inverter Based Resource – Response to a Three Phase Fault



Southern Company OASIS Website

Documents

- NAESB Home Page
- Performance Metrics
- Business Practices, Waivers, and Exemptions
- ATC Information
- Contacts
- OASIS Notices
- NITS on OASIS Implementation
- Open Access Transmission Tariff (OATT)
- Transmission Studies
- Transmission Service Request (TSR)
- Generator Interconnection
  - Active Generator Interconnection Requests
  - Active OATT LGIA / SGIA
  - Large Generator Interconnection (> 20 MW)
  - Small Generator Interconnection (<= 20 MW)
  - Solar & Wind Generator Interconnection Requests
    - Interconnection Requirements for Inverter-Based Generation
    - Additional Technical Data Form for Solar Generation
    - Additional Technical Data Form for Wind Generation
  - Generator Pre-Sync & Pre-COD Data Requirements
  - Generator Operating Requirements
    - Voltage Schedule Procedure (BPO-1)
    - Reactive Power Requirements
    - Power System Stabilizer Policy
    - Power Quality Policy
    - Interconnection Requirements for Inverter-Based Generation
    - Generating Facility Test Energy Guidelines

– Additional & Detailed information available on Southern Company's OASIS website.
  - Interconnection requirements for inverter based generation
  - Voltage Schedule Procedure
  - Reactive Power Requirements
  - Power Quality Policy

IEEE P2800 Project

- Title: Standard for Interconnection and Interoperability of IBRs Interconnecting with Associated Transmission Electric Power Systems

- Scope: This standard establishes the recommended **interconnection capability and performance criteria** for inverter-based resources interconnected with transmission and networked sub-transmission systems. Included in this standard are recommendations on performance for reliable integration of inverter-based resources into the bulk power system, including, but not limited to, **voltage and frequency ride-through**, active power control, reactive power control, dynamic active power support under abnormal frequency conditions, **dynamic voltage support under abnormal voltage conditions**, power quality, **negative sequence current injection**, and system protection.

IEEE P2800 Leadership Team

Role	Name	Affiliation	Stakeholder Group	Liaison
Chair	Jens C. Boemer	EPRI	Academic/Research	EDP&G, SCC21
Secretary	Wesley Baker	Power Grid Eng.	Service Provider/ Consulting	EMC, IRPTF
Vice-Chair	Bob Cummings	NERC	Regulatory and Governmental Bodies	NERC IRPTF
Vice-Chair	Kevin Collins	FirstSolar	Users, Industrial	NERC IRPTF
Vice-Chair	Babak Enayati	NationalGrid	Stakeholders represented in IEEE Power & Energy Society	T&D, SCC21, PES GovBrd
Vice-Chair	Ross Guttromson	SANDIA National Lab	Academic/Research	DOE
Vice-Chair	Chenhui Niu	State Grid Corporation of China	Stakeholders represented in IEEE P2800.1 Working Group	IEEE P2800.1
Vice-Chair	Manish Patel	Southern Company	Utility, Transmission	PSRC, IRPTF

IEEE P2800 Project – Tentative Sub-Working Groups

I. Overall Document
II. General Requirements
III. Active Power – Frequency Control
IV. Reactive Power – Voltage Control
V. Low Short-Circuit Power VI. Power Quality
VI. Ride-Through Capability Requirements
VII. Ride-Through Performance Requirements
VIII. Inverter-Based Resource Protection
IX. Modeling, Validation, Measurement Data and Performance Monitoring
X. Interoperability, information exchange, information models, and protocols
XI. Tests and verification requirements

- Sub-WG scoping is currently underway
- If you are interested, please sign up at https://www.surveymonkey.com/r/MRW9SLQ
- Plan to kick off Sub-WG soon (likely bi-weekly calls)

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 2019 planning cycle. Therefore, no transmission needs have been identified for further evaluation of potential transmission solutions in the 2019 SERTP planning cycle.**

Next Meeting Activities

- **2019 SERTP 2nd Quarter Meeting**
  - **Location: Louisville, KY**
  - **Date: June 2019**
  - **Purpose:**
    - Review Modeling Assumptions
    - Discuss Preliminary 10 Year Expansion Plan
    - Stakeholder Input & Feedback Regarding the Plan

Questions?

www.southeasternrtp.com