Welcome

SERTP 2011

"First RPSG Meeting & Interactive Training Session"

9:00 AM – 3:00 PM

Southeastern Regional TRANSMISSION PLANNING

2011 SERTP

- The SERTP process is a transmission planning process.
- Please contact the respective transmission provider for questions related to real-time operations or OATT transmission service.

Southeastern Regional TRANSMISSION PLANNING

2011 SERTP

Purposes & Goals of the Meeting

- 2011 SERTP Process Overview
- Form the "RPSG"
  - Regional Planning Stakeholders Group
  - Committee Structure and Requirements
- Economic Planning Studies
  - Review Previous Study Selections
  - Review Requested Sensitivities for 2011
  - RPSG To Select The Five Economic Planning Studies
- Interactive Training Session
  - Model & Expansion Plan Development
- Next Meeting's Activities

Southeastern Regional
TRANSMISSION PLANNING

2011 SERTP
Process Overview

2011 SERTP Process Overview

- **1st Quarter Meeting**
  - "First RPSG Meeting & Interactive Training Session"
  - Form RPSG
  - Select Five Economic Planning Studies
  - Interactive Training Session
- **2nd Quarter Meeting**
  - "Preliminary Expansion Plan Meeting"
  - Review Modeling Assumptions
  - Discuss Preliminary 10 Year Expansion Plan
  - Stakeholder Input and Feedback Regarding the Plan

2011 SERTP Process Overview

- **3rd Quarter Meeting**
  - "Second RPSG Meeting"
  - Discuss the Preliminary Results of the Five Economic Studies
  - Stakeholder Input and Feedback Regarding the Study Results
  - Discuss Previous Stakeholder Input on the Expansion Plan
- **4th Quarter Meeting**
  - "Annual Transmission Planning Summit & Assumptions Input Meeting"
  - Discuss Final Results of the Five Economic Studies
  - Discuss the 10 Year Transmission Expansion Plan
  - Obtain Stakeholder Input on the Transmission Model Assumptions Used in Developing Next Year's Plan

The SERTP Stakeholder Group: "RPSG"

- **Serves Two Primary Purposes**

1) The RPSG is charged with determining and proposing up to five (5) Economic Planning Studies on an annual basis

1) The RPSG serves as the representatives in interactions with the Transmission Provider and Sponsors for the eight (8) industry sectors

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 Owners / 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 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 Reformulation**
  - Reformed annually at each 1st Quarter Meeting
  - Sector members will be elected for a term of approximately one year
  - Term ends at the start of the 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
  - There is 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**

2011 Economic Planning Study Requests

Previous Economic Planning Studies

Current Economic Planning Study Requests

RPSG Formation

2010 Sector Representatives

2011 Sector Representatives

2011 Economic Planning Studies

Vote on Economic Planning Studies

Interactive Training Session

Interactive Training Session

- Explain and discuss the underlying methodology and criteria that will be utilized to develop the transmission expansion plan

- Planning Criteria:
  - On the SERTP Website

Interactive Training Session

- **Model Development**
  - **SERTP Model**
    - **Southern Balancing Authority, PowerSouth, SMEPA**
  - **Eastern Interconnect Model**
- **Expansion Plan Development**

Interactive Training Session

- **SERTP Model**
  - **Basic Principles**
  - **Area Interchange**
  - **Loads**
  - **Generation**
  - **Transmission System Topology**

Interactive Training

Transmission Model Development

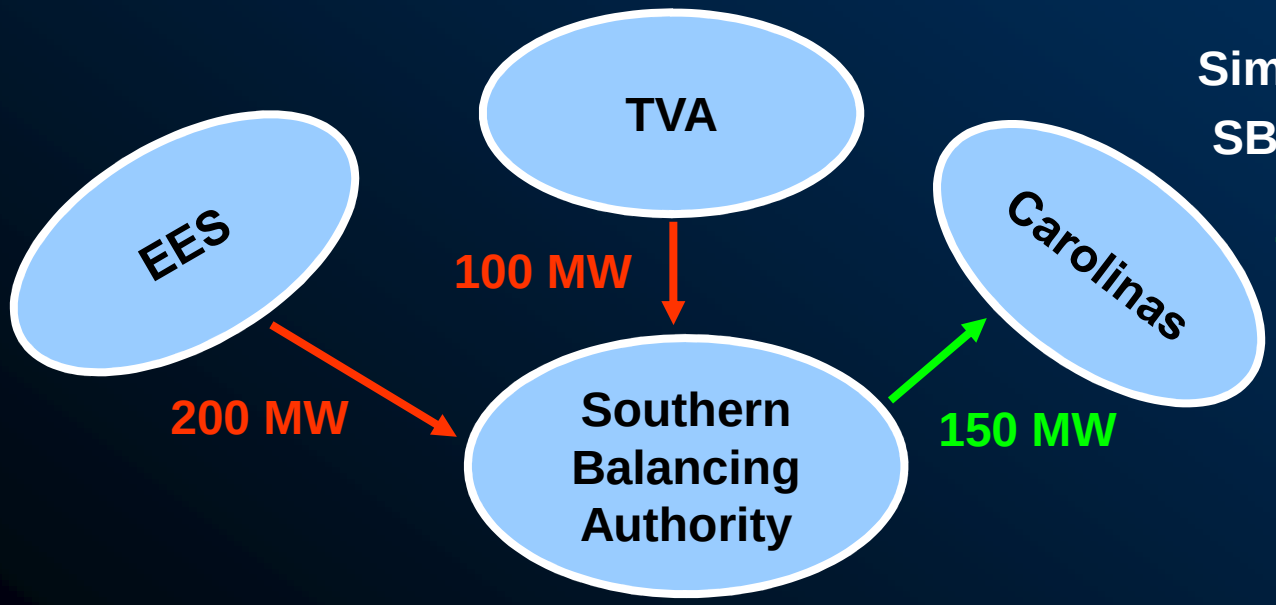
- Basic Principles
  - **Generation = Load + Losses + Interchange**
  - The model includes:
    - The **Projected Load** for each year and season
    - The **Losses** produced in serving that load (produced from transmission line & transformer impedances)
    - The **Area Interchange** of long-term firm commitments across the interface
    - The **Generation** needed to balance all of the above
    - The **Current Transmission System Topology & Expansion Plan**

Interactive Training Session

- **SERTP Model**
  - Basic Principles
  - **Area Interchange**
  - Loads
  - Generation
  - Transmission System Topology

TRANSMISSION MODEL DEVELOPMENT

- Area Interchange
  - The net total of all transactions leaving or entering a balancing authority
    - Long-Term Firm Commitments Only



Simplified Example:

SBA Interchange =

150 – 100 – 200

= -150

Interactive Training Session

- **SERTP Model**
  - Basic Principles
  - Area Interchange
  - **Loads**
  - Generation
  - Transmission System Topology

Interactive Training

Transmission Model Development

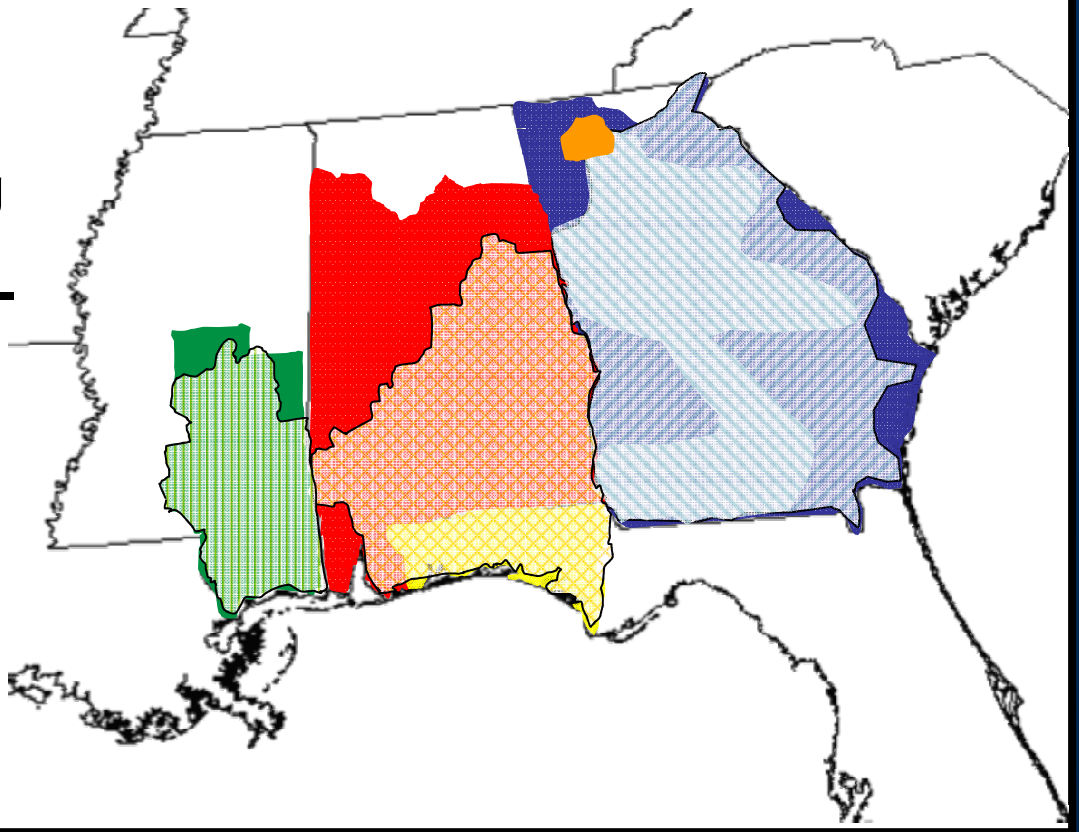
- Loads
  - Models include forecasted MW & MVAR amounts for each season (Summer, Winter, Spring, Fall)
  - Provided by Load Serving Entities

TRANSMISSION MODEL DEVELOPMENT

- Loads

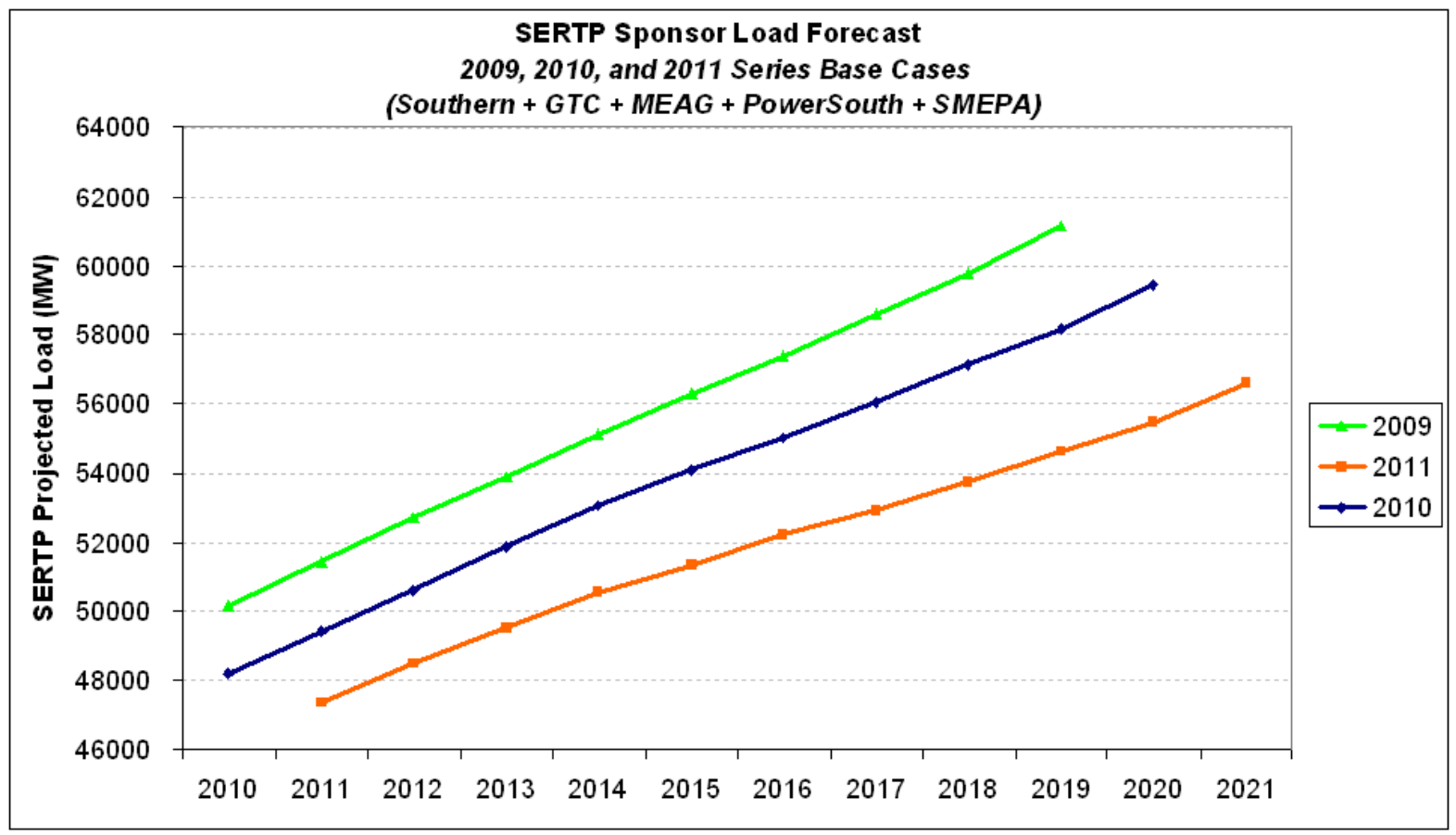
Provided by Load Serving Entities (LSEs)

- Alabama Power
- Georgia Power
- Gulf Power
- Mississippi Power
- GTC
- MEAG
- City of Dalton
- Power South
- SMEPA



TRANSMISSION MODEL DEVELOPMENT

- SERTP Sponsor Load Forecasts



Interactive Training Session

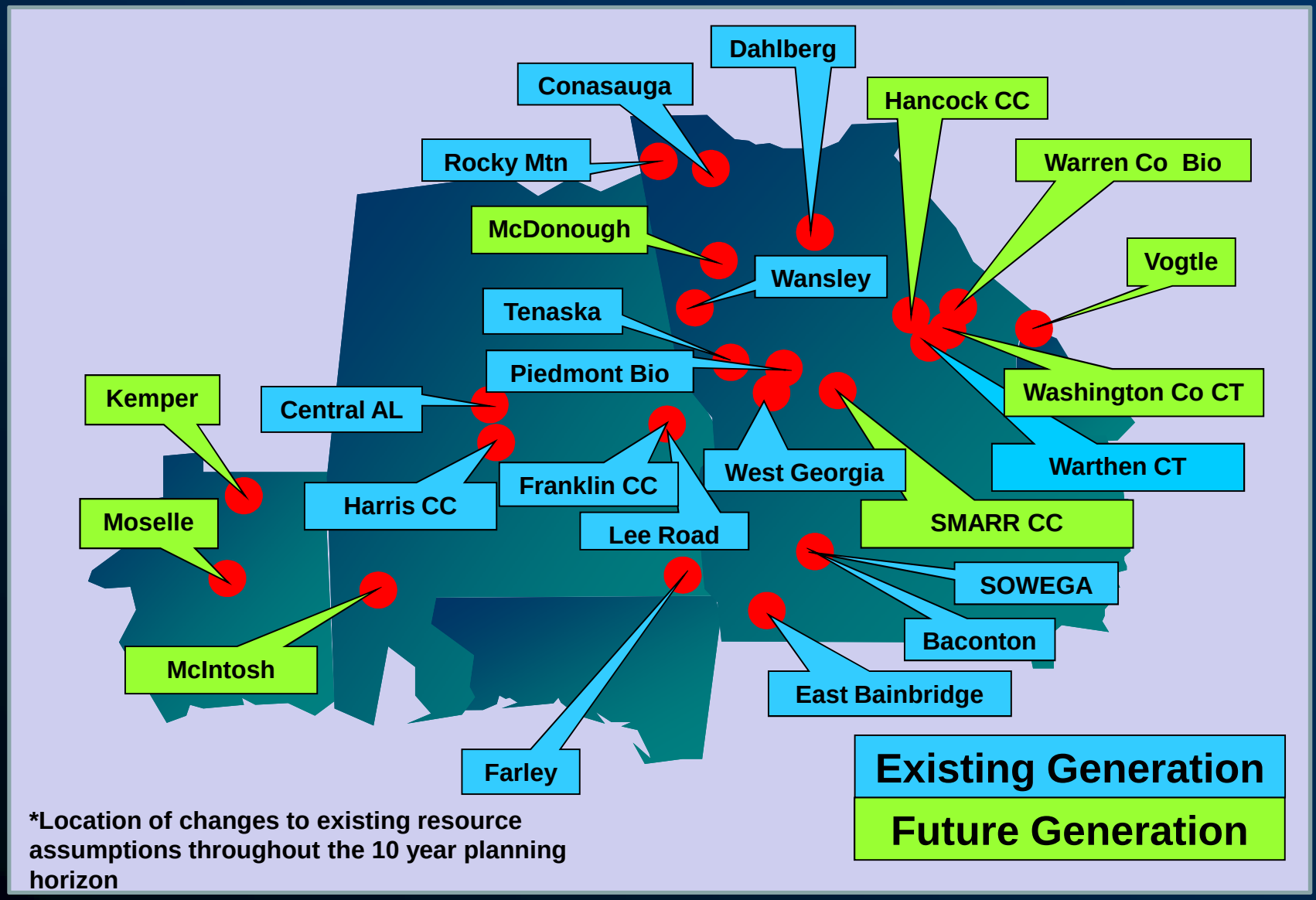
- **SERTP Model**
  - Basic Principles
  - Area Interchange
  - Loads
  - **Generation**
  - Transmission System Topology

Transmission Model Development

- Generation Assumptions
  - Receive resource assumptions from LSEs to serve load
    - Generator Locations
    - Amounts (MW)
  - Models also include generator assumptions for Point to Point Transmission Service commitments
    - i.e. Harris 1 – FPL (584 MW)

Southeastern Regional TRANSMISSION PLANNING

Interactive Training



*Location of changes to existing resource assumptions throughout the 10 year planning horizon

TRANSMISSION MODEL DEVELOPMENT

- Generation Models
  - Models include:
    - Voltage Schedule
    - Real Power Capabilities (MOD – 24)
    - Reactive Power Capabilities (MOD – 25)

Interactive Training Session

- **SERTP Model**
  - Basic Principles
  - Area Interchange
  - Loads
  - Generation
  - **Transmission System Topology**

Interactive Training Session

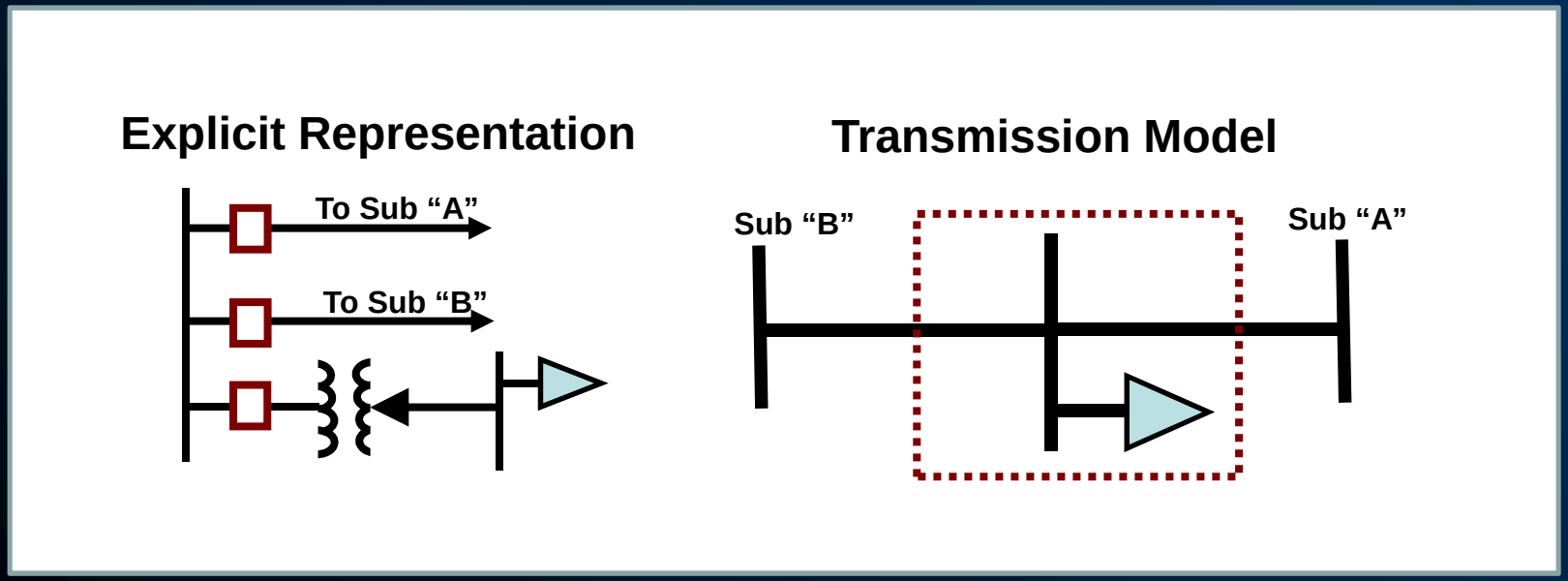
- **Transmission System Topology**
  - **Transmission Lines & Substations**
  - **Transformers**
  - **Switched Shunts**

Interactive Training Session

- **Transmission System Topology**
  - **Transmission Line Design Groups calculate the impedance and ratings of the transmission elements, which are then provided as inputs for use by the Transmission Planner.**
  - **The subsequent slides are a brief overview of the modeling of these inputs.**

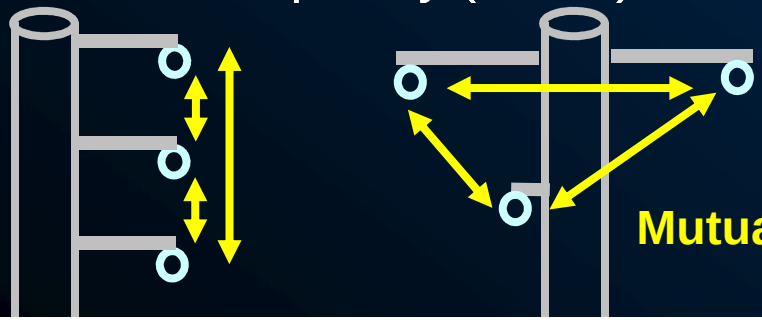
TRANSMISSION MODEL DEVELOPMENT

- Transmission Lines & Substations
  - Modeled as branches & nodes (buses)
  - Impedances & ratings included for each branch
    - Values provided by Transmission Line Design Groups
    - Based on Facility Rating Methodology (FAC – 008)

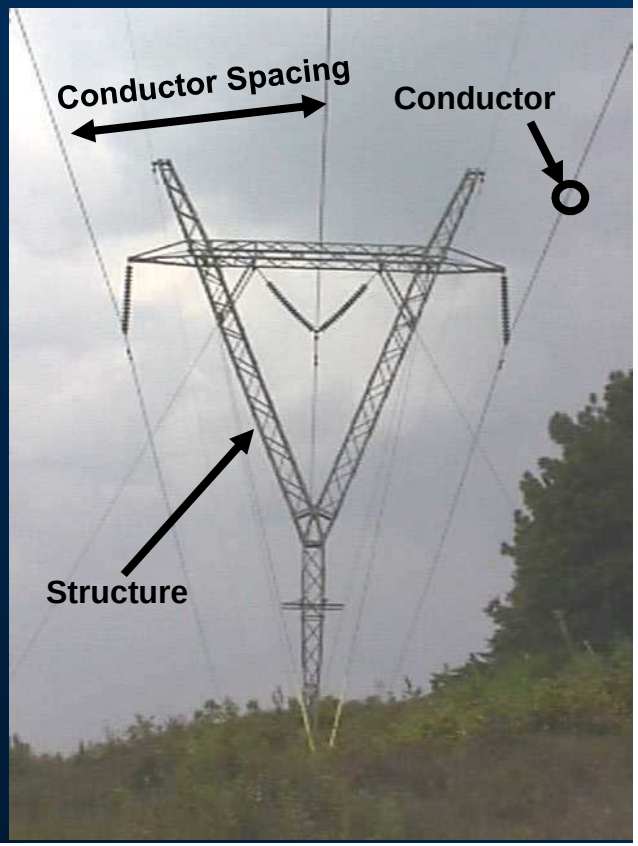


TRANSMISSION MODEL DEVELOPMENT

- Transmission Lines & Buses
  - **Transmission Line Impedance** is based on factors such as:
    - Conductor type
    - Structure Type
      - » Conductor Spacing
      - » Height
    - Terrain
    - Line Length
    - Frequency (60 Hz)



Mutual Impedances

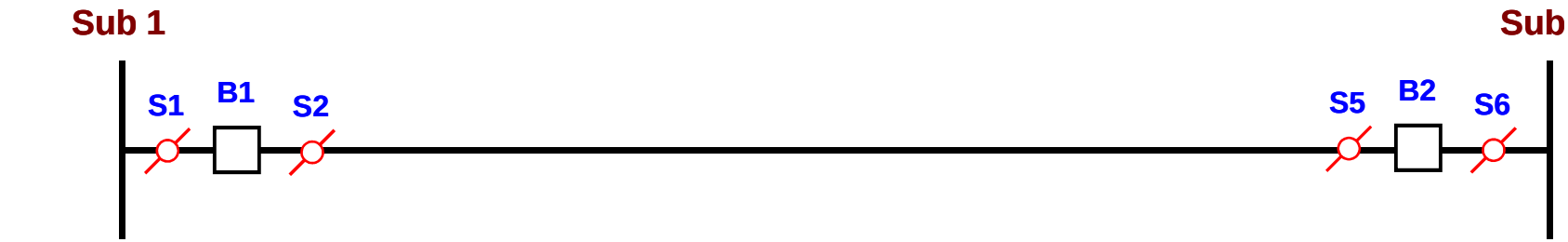


TRANSMISSION MODEL DEVELOPMENT

- Transmission Line Ratings
  - **Ampacity** is based on factors such as:
    - » Conductor Type (Ampacity)
    - » Ambient Temperature / Wind Speed
    - » Conductor Operating Temperature
  - **MVA rating** is based on:
    - » Operating Voltage
    - » MVA = $\sqrt{3}$ * Ampacity * ($Voltage_{line\text{-}line}$)
- Branch Ratings
  - Based on:
    - » **Lower** of the line rating or the terminal equipment ratings

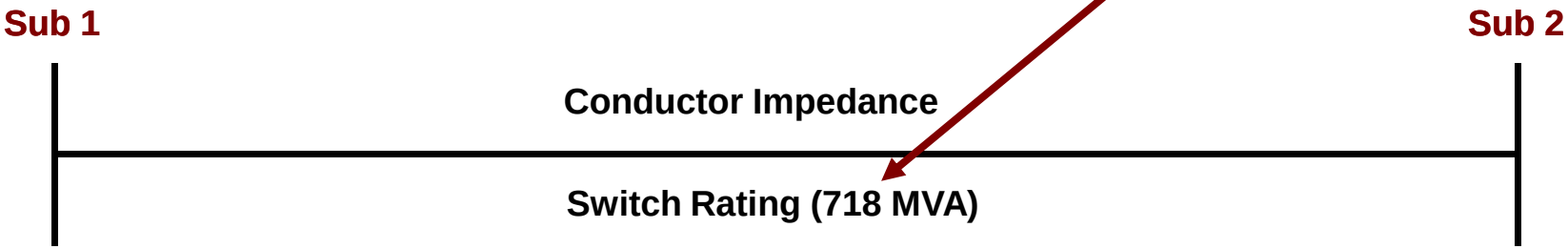
TRANSMISSION MODEL DEVELOPMENT

- Transmission Line Ratings



Switches (S1 – S2): 898 MVA	Line Conductor: 807 MVA	Switches (S5 – S6): 718 MVA
Breakers (B1): 828 MVA		Breakers (B2): 828 MVA

How it modeled:



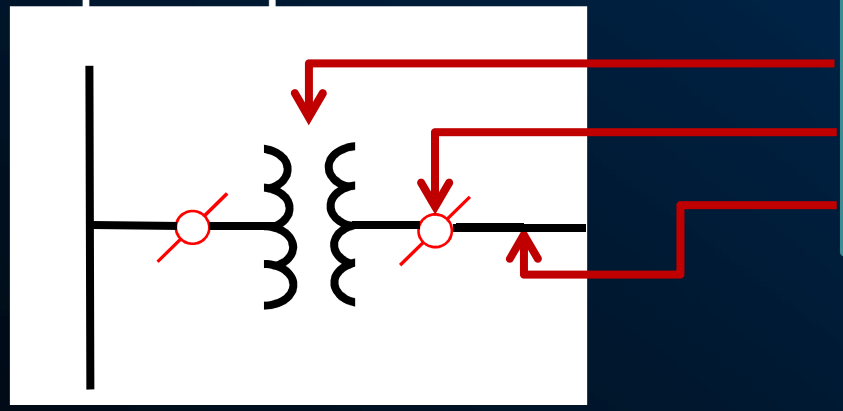
Interactive Training Session

- **Transmission System Topology**
  - Transmission Lines & Substations
  - **Transformers**
  - Switched Shunts

TRANSMISSION MODEL DEVELOPMENT

- Transformers
  - Impedances and Ratings included for each transformer
  - Models include transformer winding ratio

Explicit Representation



Rating based on lowest of:

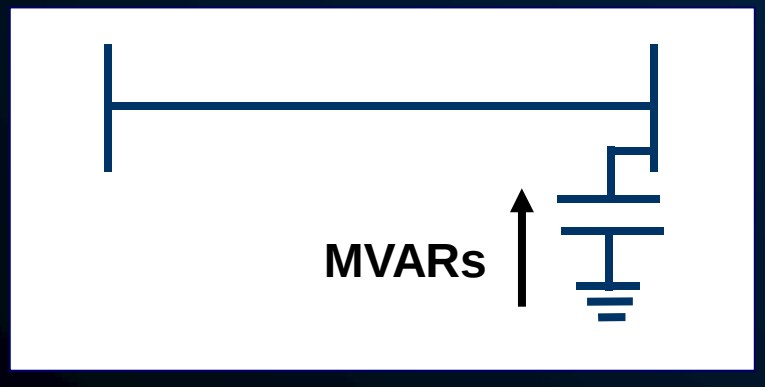
- **Transformer Rating**
- **Switch Ratings**
- **Buswork Rating**

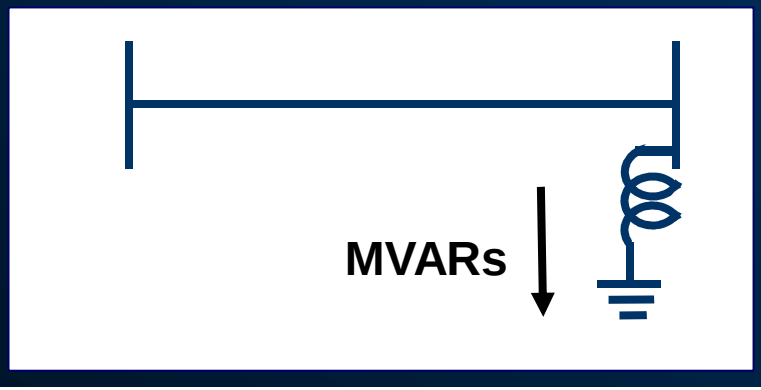
Interactive Training Session

- **Transmission System Topology**
  - Transmission Lines & Substations
  - Transformers
  - **Switched Shunts**

TRANSMISSION MODEL DEVELOPMENT

- Switched Shunts
  - Supply MVARs (Capacitors) or Consume MVARs (Reactors)
  - Set to operate at voltage set points to control area voltage
  - Models Include:
    - » Number of steps
    - » MVARs / step
    - » Voltage Schedule





Interactive Training Session

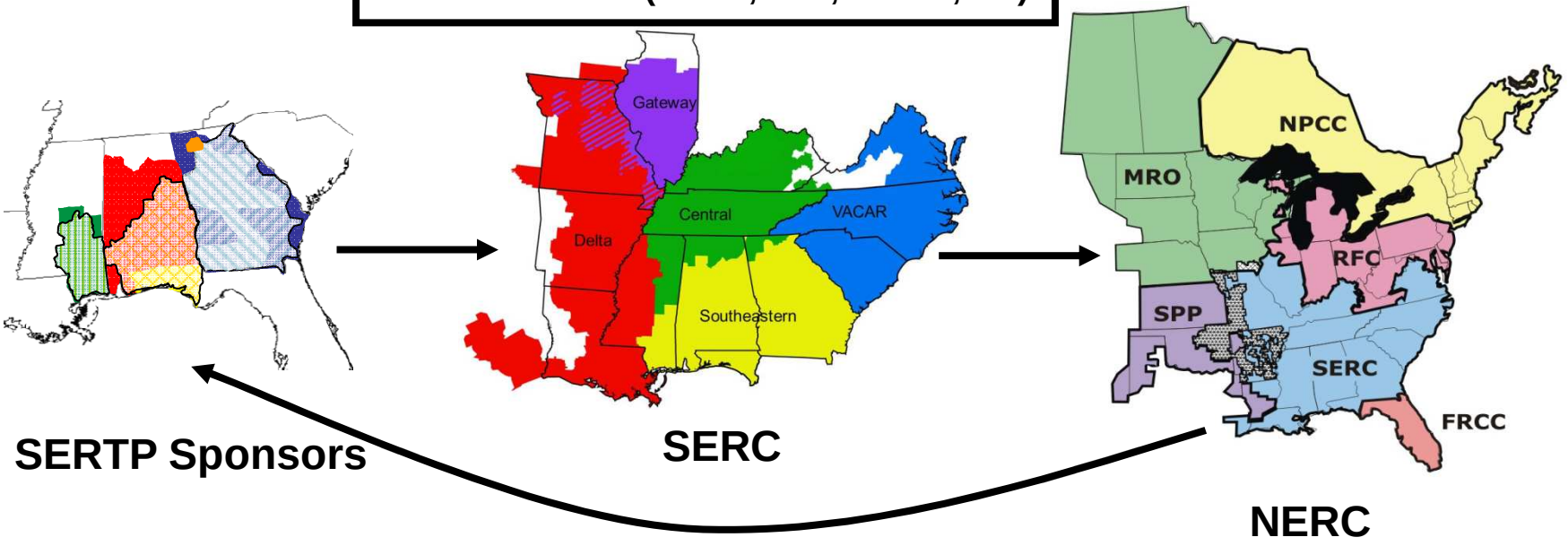
- **Model Development**
  - **SERTP Model**
    - **SBA, PowerSouth, SMEPA**
  - **Eastern Interconnect Model**
- **Expansion Plan Development**

TRANSMISSION MODEL DEVELOPMENT

- Eastern Interconnect Model Development

Coordination

- **Transfers (Interchange)**
- **Tie Lines**
- **Voltage Schedules**
- **Model Numbers (Areas, Bus, Owner, etc)**



SERTP Sponsors

SERC

NERC

Interactive Training Session

- Model Development
  - SERTP Model
    - SBA, PowerSouth, SMEPA
  - Eastern Interconnect Model
- Expansion Plan Development

Interactive Training Session

- **Expansion Plan Development**
  - Power Flow Analyses
  - Planning Criteria
  - Project Identification
  - Expansion Plan Timeline

TRANSMISSION EXPANSION PLAN

- Power Flow Solutions
  - Performed using PSS\E and MUST
  - Non-linear, iterative solutions for bus voltages and branch currents
- Power Flow Analyses
  - Base Case Analysis
    - All Bulk Electric System facilities in-service
  - Contingency Analysis
    - Bulk Electric System elements out of service
      - » Generator
      - » Transmission Circuit
      - » Transformer

Interactive Training Session

- **Expansion Plan Development**
  - Power Flow Analyses
  - **Planning Criteria**
  - Project Identification
  - Expansion Plan Timeline

TRANSMISSION EXPANSION PLAN

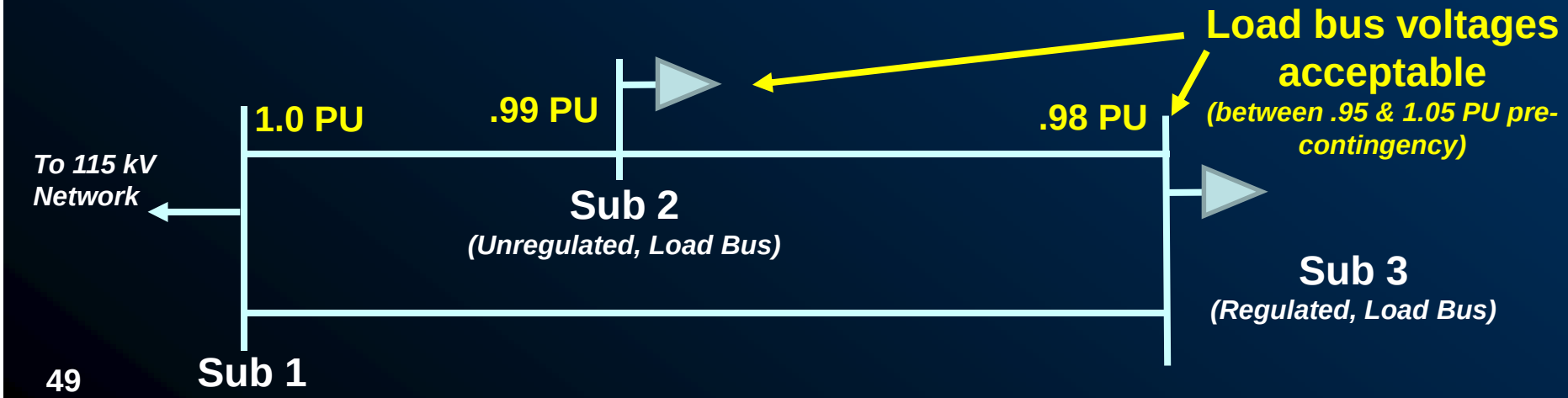
- Planning Criteria
  - Similar for all SERTP Sponsors
    - » Meet NERC TPL Standards
  - The subsequent slides apply directly to Southern Company guidelines

TRANSMISSION EXPANSION PLAN

- Voltage
  - Generating Plants: Terminal voltage on high side of GSU should not exceed the maximum or minimum allowable voltage limits for all facilities in service and during planning contingency conditions

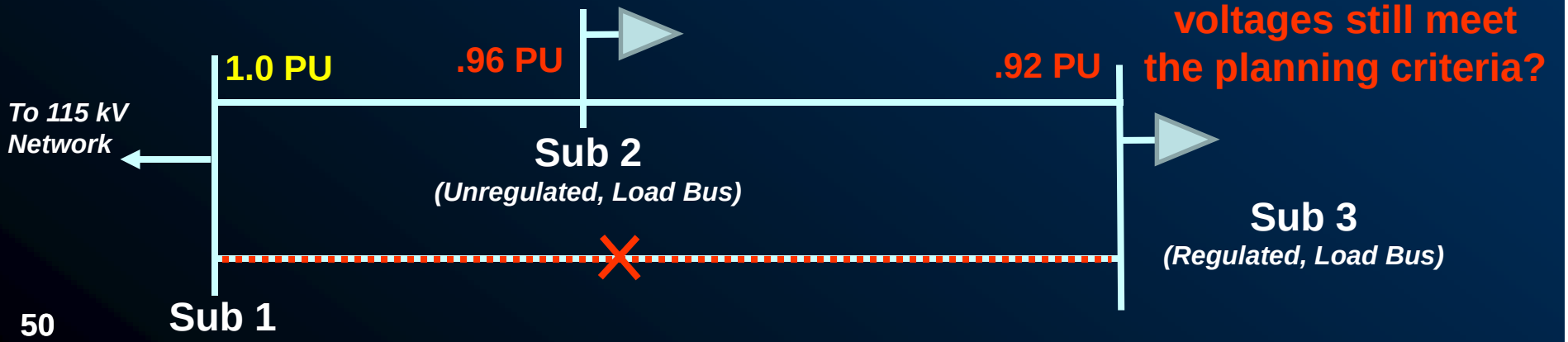
TRANSMISSION EXPANSION PLAN

- Voltage
  - Load Buses:
    - No contingency:
      - » < 500 kV: 95% to 105% of connected transformer voltage rating
      - » 500 kV: 98% to 107.5% of connected transformer voltage rating



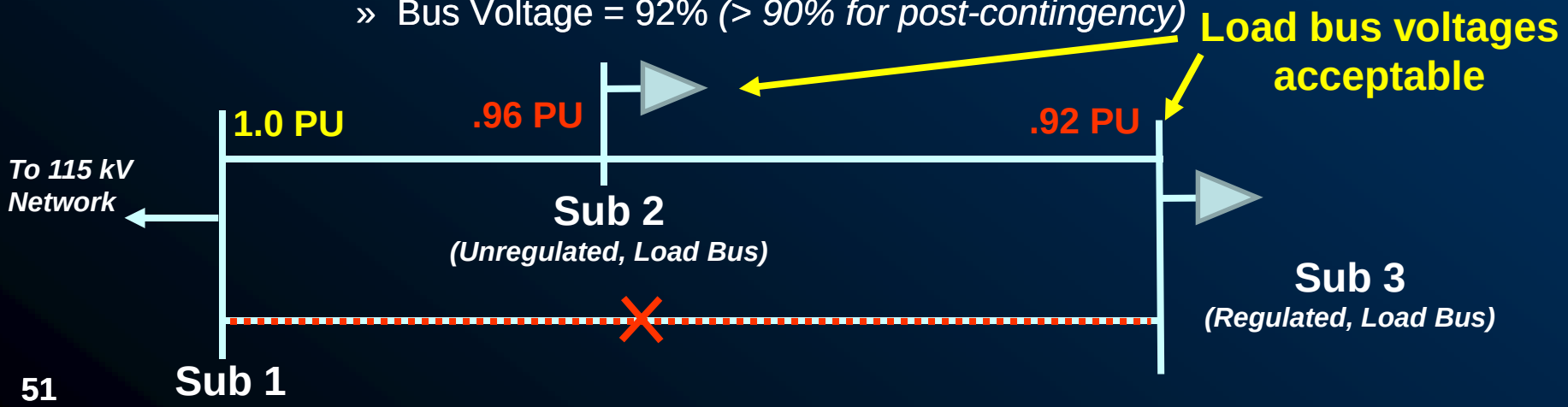
TRANSMISSION EXPANSION PLAN

- Voltage
  - Load Buses:
    - With contingency:
      - » +/- 5% deviation for non-regulated buses
      - » +/- 8% deviation for regulated buses
      - » Voltage should not drop below 97% for 500 kV buses and below 90% for buses less than 500 kV



TRANSMISSION EXPANSION PLAN

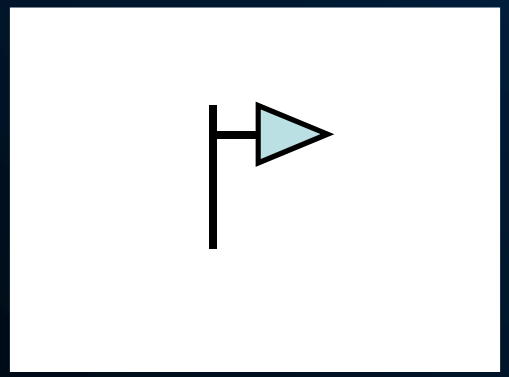
- Voltage
  - Load Buses:
    - Sub 2: **PASS**
      - » Deviation = 99% - 96% = 3% *(<5% for unregulated buses)*
      - » Bus Voltage = 96% *(> 90% for post-contingency)*
    - Sub 3: **PASS**
      - » Deviation = 98% - 92% = 6% *(<8% for regulated buses)*
      - » Bus Voltage = 92% *(> 90% for post-contingency)*



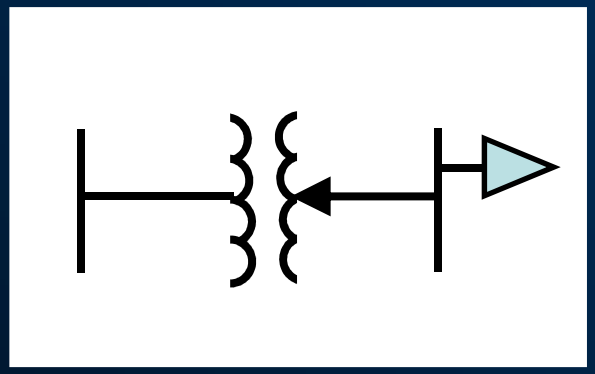
TRANSMISSION EXPANSION PLAN

- Voltage
  - Load Buses:
    - Why can regulated buses deviate more than unregulated buses?
    - Transmission model only captures distribution load, not bus regulators or transformer load tap changers (LTCs)

Transmission Model



Explicit Representation



TRANSMISSION EXPANSION PLAN

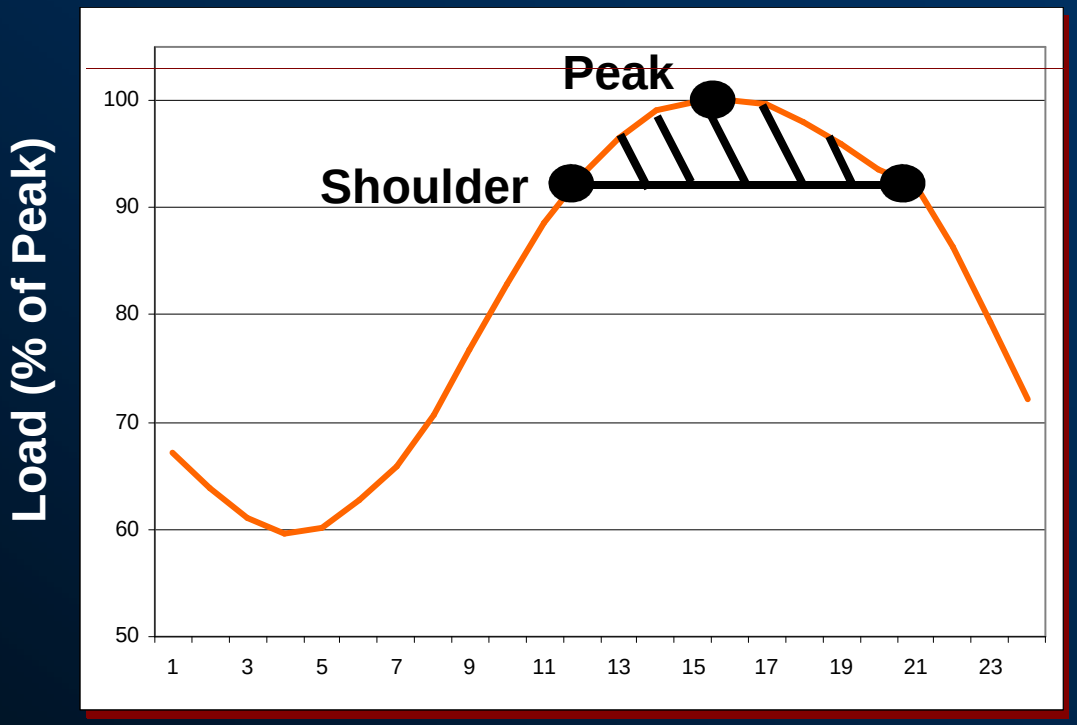
- Thermal Loading
  - Transmission Lines: Line loadings should not exceed design specifications of terminal connections, substation infrastructure or the line itself
  - Transformers: Transformer loading should not exceed nameplate rating for normal conditions. Transformer loading should not exceed calculated capability rating for contingency conditions.

TRANSMISSION EXPANSION PLAN

- Planning Contingencies
  - Summer Peak
    - Loss of one transmission element and one critical generating unit
  - Shoulder Conditions
    - 93% of summer peak load
    - Hydro generation off-line
    - Loss of one transmission element and one critical generating unit

TRANSMISSION MODEL DEVELOPMENT

- Daily Load Curve – Summer
  - Summer Load Levels Evaluated
    - Peak
    - Shoulder



Transmission Expansion Plan

- Additional Evaluations
  - Stability Studies
  - Interface Screens

Interactive Training

Transmission Expansion Plan

- Additional Studies (as appropriate)
  - Multiple unit and voltage levels at plants
  - Breaker failure/bus differential scenarios
  - Loss of common tower or ROW outages
  - Low probability, high consequence scenarios
  - Valley, Winter, and Hot Weather conditions
  - Below 93% of forecasted peak with loss of multiple units and/or transmission elements

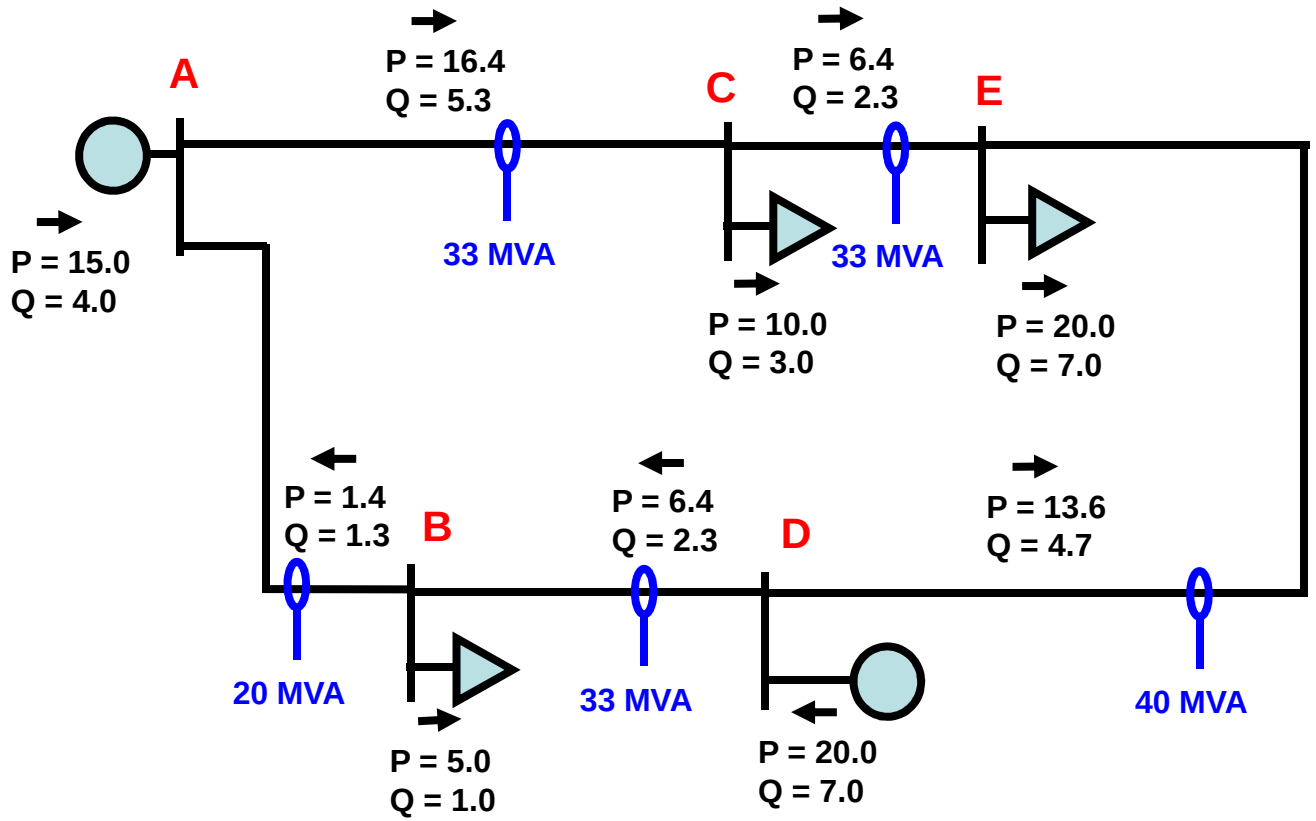
Interactive Training Session

- **Expansion Plan Development**
  - Power Flow Analyses
  - Planning Criteria
  - **Project Identification**
  - Expansion Plan Timeline

TRANSMISSION EXPANSION PLAN

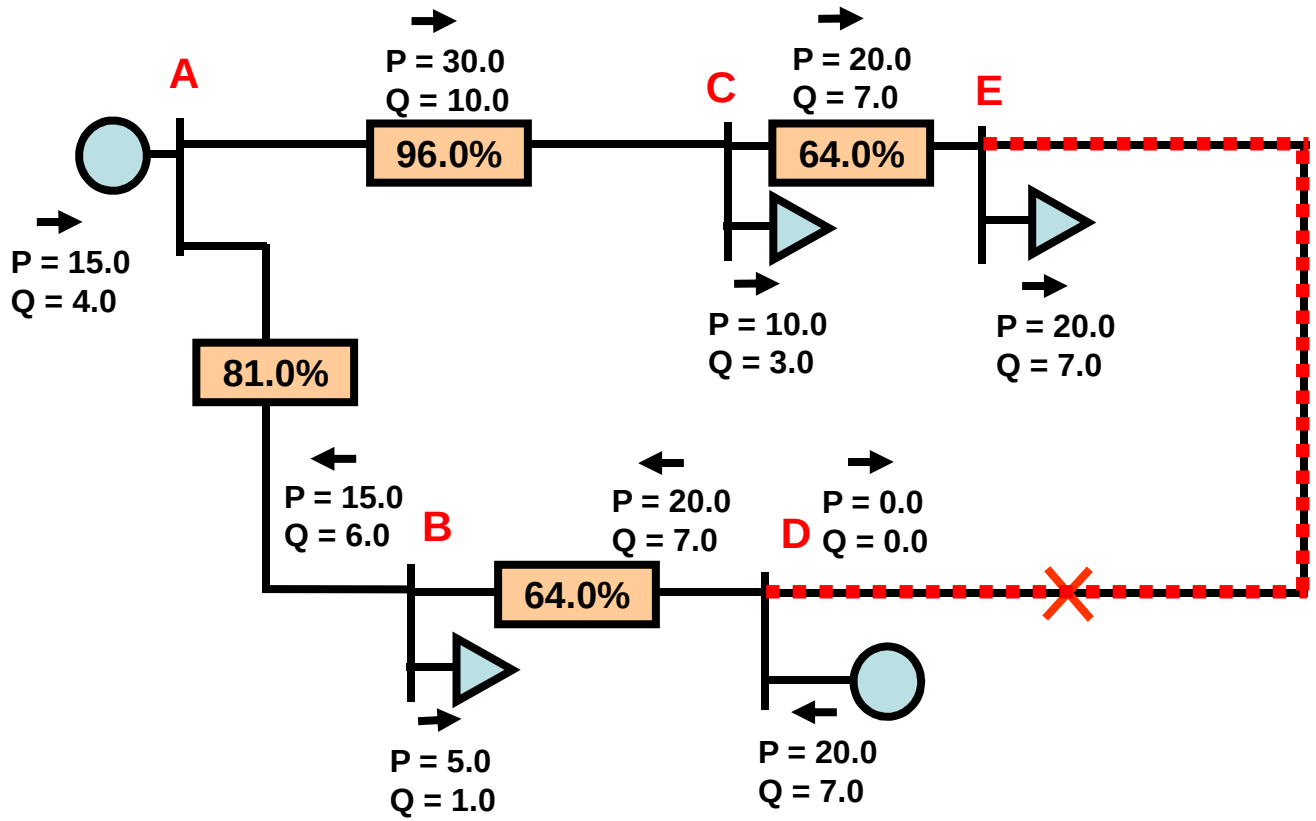
- Simple Example
  - Neglects transmission losses
  - N – 1 evaluation only (no unit offline scenarios)
  - Voltage impacts not assessed

TRANSMISSION EXPANSION PLAN



No transmission lines overloaded <u>without</u> contingencies

TRANSMISSION EXPANSION PLAN



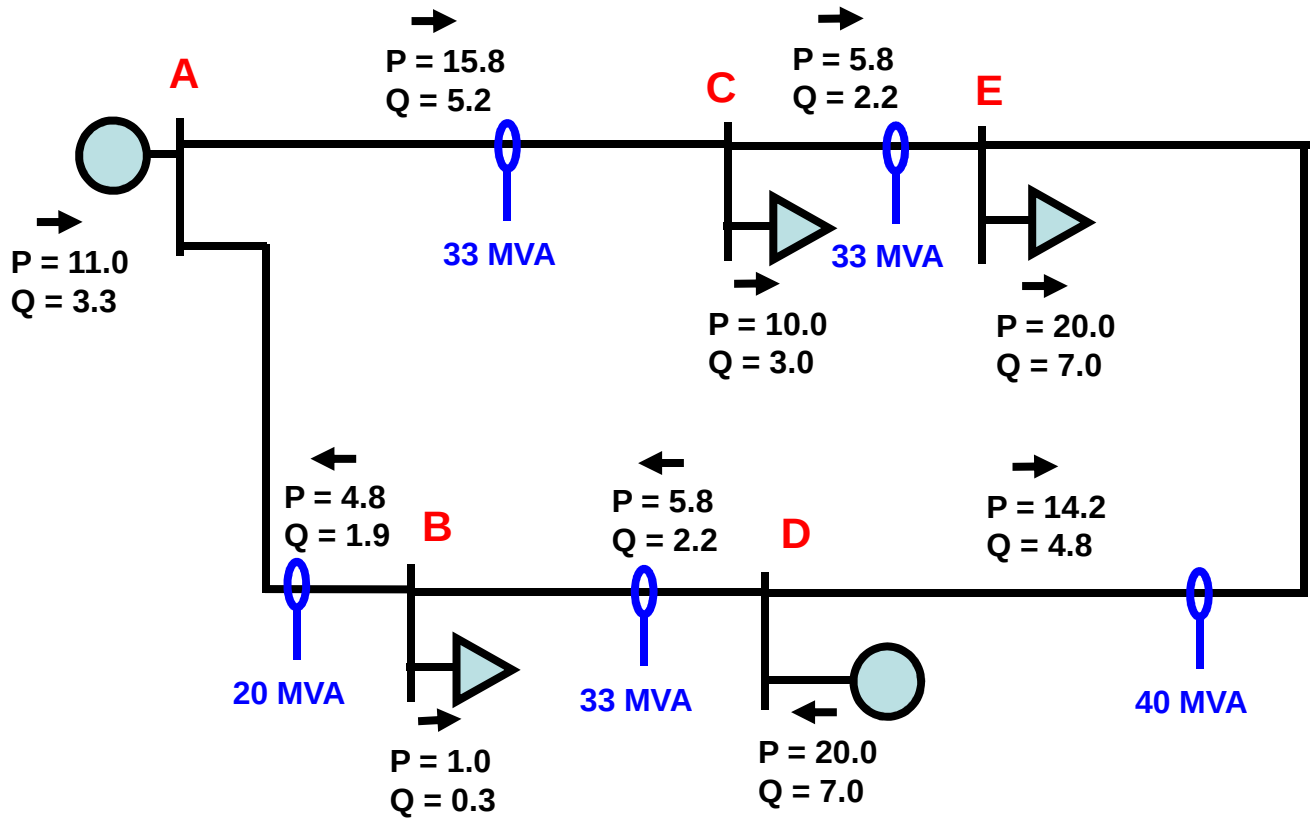
No transmission lines overloaded <u>with</u> contingencies

(Highest loading shown: Line A – C)

Transmission Expansion Plan

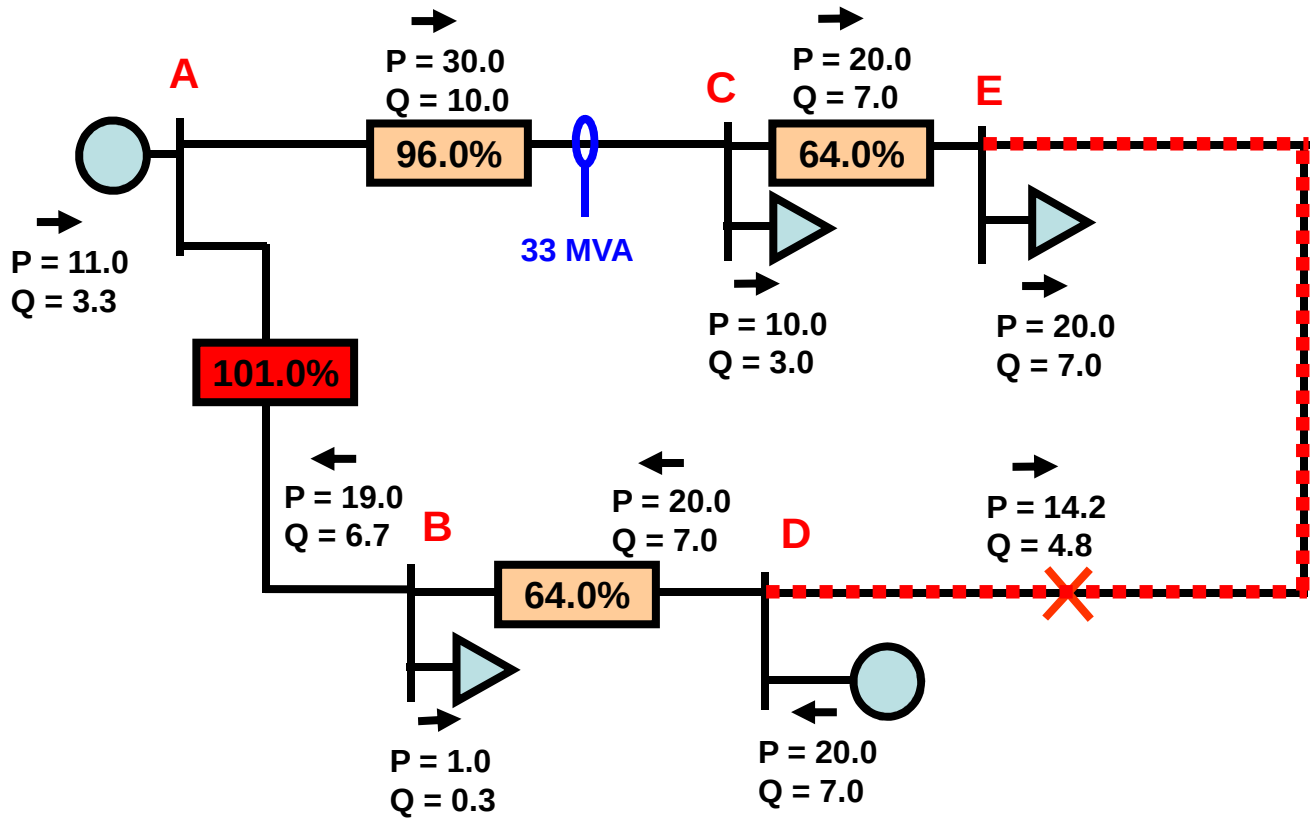
- What if the load at substation “B” was significantly reduced?
  - Real Power (5.0 → 1.0 MW)
  - Reactive Power (1.0 → 0.3 MVAR)
  - Generation at Bus A reduced to balance MW / MVARs

TRANSMISSION EXPANSION PLAN



No transmission lines overloaded <u>without</u> contingencies

TRANSMISSION EXPANSION PLAN



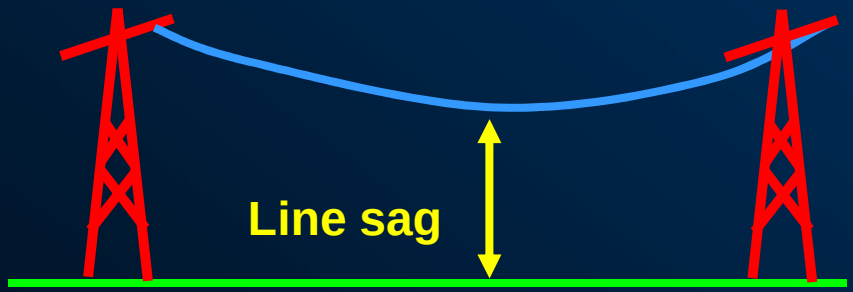
Line A – B overloaded for contingency D – E

TRANSMISSION EXPANSION PLAN

- Potential Solutions for A – B
  - "Upgrade"
    - Increase the conductor operating temperature of A – B
  - "Reconductor"
    - Replace the existing A – B conductor with a higher-rated conductor
  - "New Transmission Line"
    - Construct a new transmission line that alleviates the loading on A – B

TRANSMISSION EXPANSION PLAN

- "Transmission Line Upgrade"
  - Increasing conductor operating temperature
  - The more current, the higher the operating temperature
    - » Higher maximum temperature = higher line ampacity
    - » Maximum temperature based on transmission line sag, ambient conditions, and conductor specifications
  - ACSS versus ACSR
    - » ACSS aluminum is fully annealed & intended for higher temperatures (>100 ºC)



TRANSMISSION EXPANSION PLAN

- Reconductor
  - Replacing the existing conductor with a higher rated conductor type
  - Differences in conductors
    - Ampacity
    - Weight / Thickness
    - Sag
    - Span Lengths
  - Therefore, structure replacement may be necessary

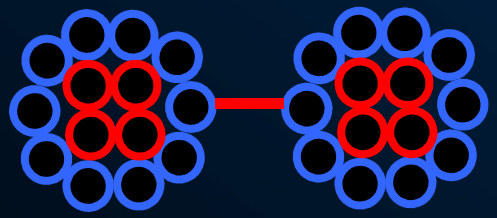
Interactive Training Session

- **Stakeholder feedback at the 2010 SERTP Summit:**
  - **Unfamiliar with transmission line conductors and sizes**

TRANSMISSION EXPANSION PLAN

- Conductors
  - ACSR (Aluminum Conductor Steel Reinforced)
  - Ex: 1351 ACSR 54/19
    - » 1351 indicates the overall conductor size (cross sectional area - kcmil)
    - » 54 Aluminum Strands / 19 Steel Strands
    - » Approximately 1.5” in diameter

Aluminum
Steel



This would represent a bundled (2) 10/4 ACSR

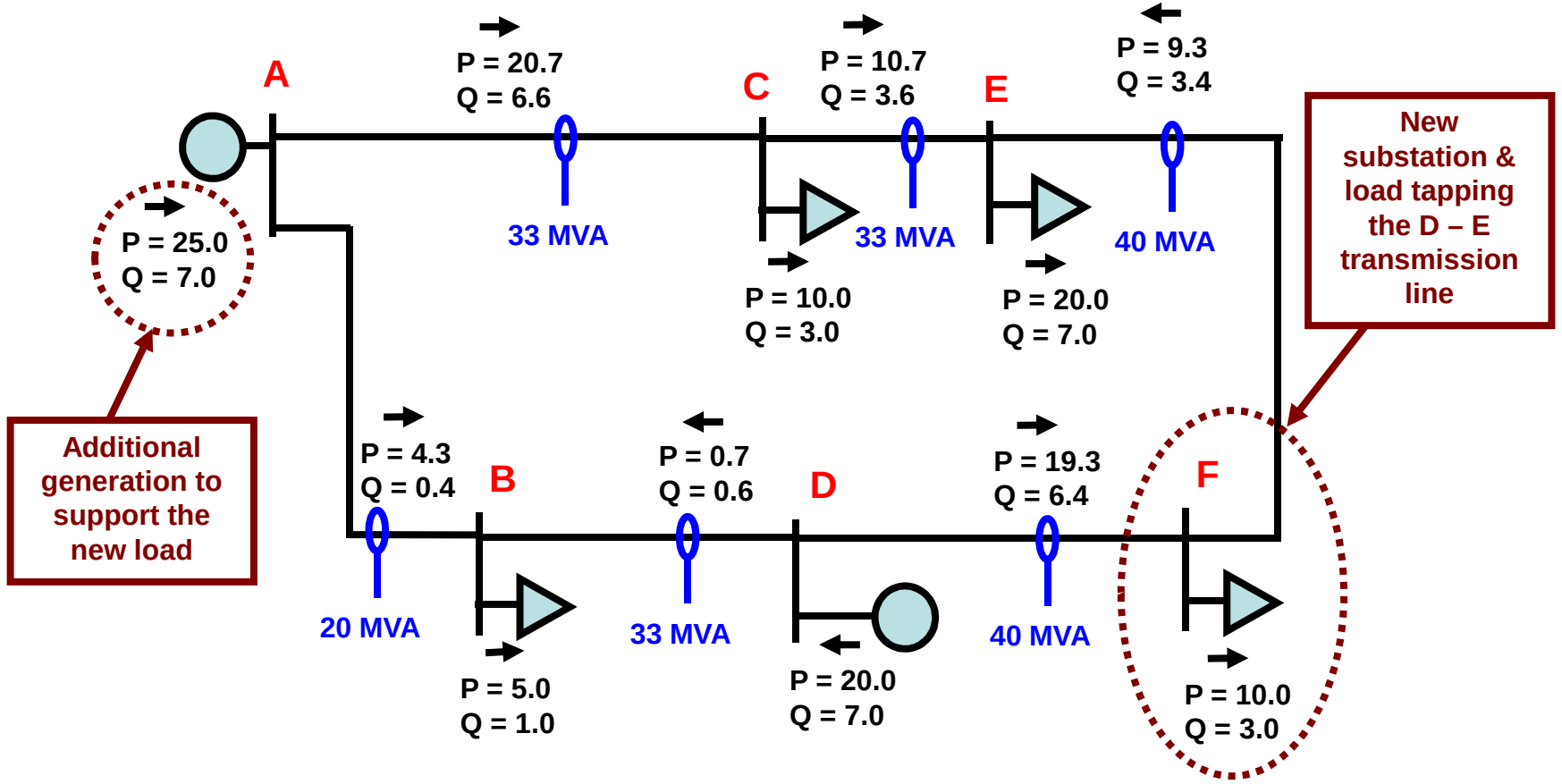
TRANSMISSION EXPANSION PLAN

- New Transmission Line
  - Some potential applications:
    - Multiple overloads in an area
    - Voltage support
    - Overload of a long transmission line
    - Stability Needs
  - Considerations:
    - Right of Way

TRANSMISSION EXPANSION PLAN

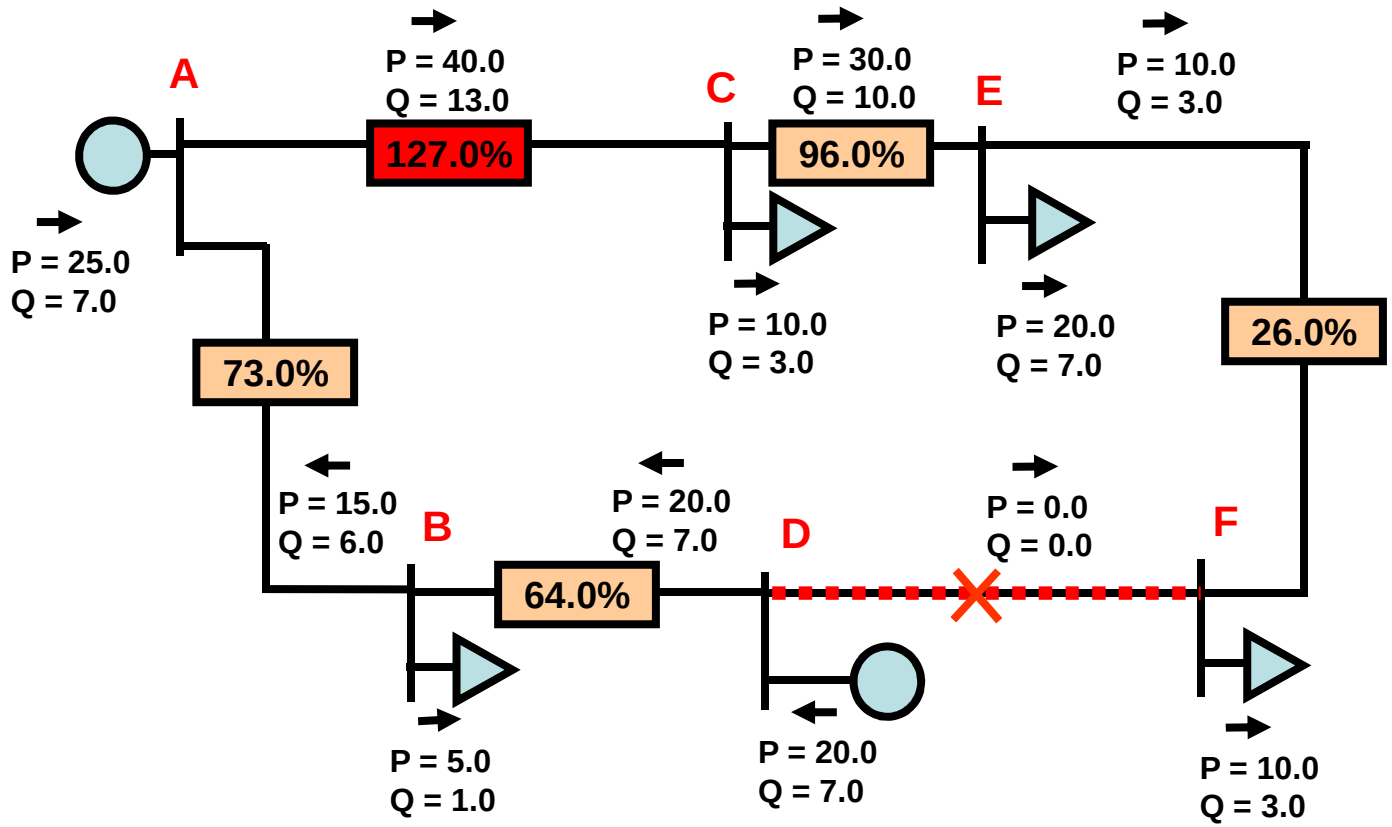
- In previous example, assume Line "D – F" is tapped with a new load
  - Real Power = 10.0 MW
  - Reactive Power = 3.0 MVAR
  - Generation at Bus A is designated by the LSE for an additional 10 MW to serve the new load

TRANSMISSION EXPANSION PLAN



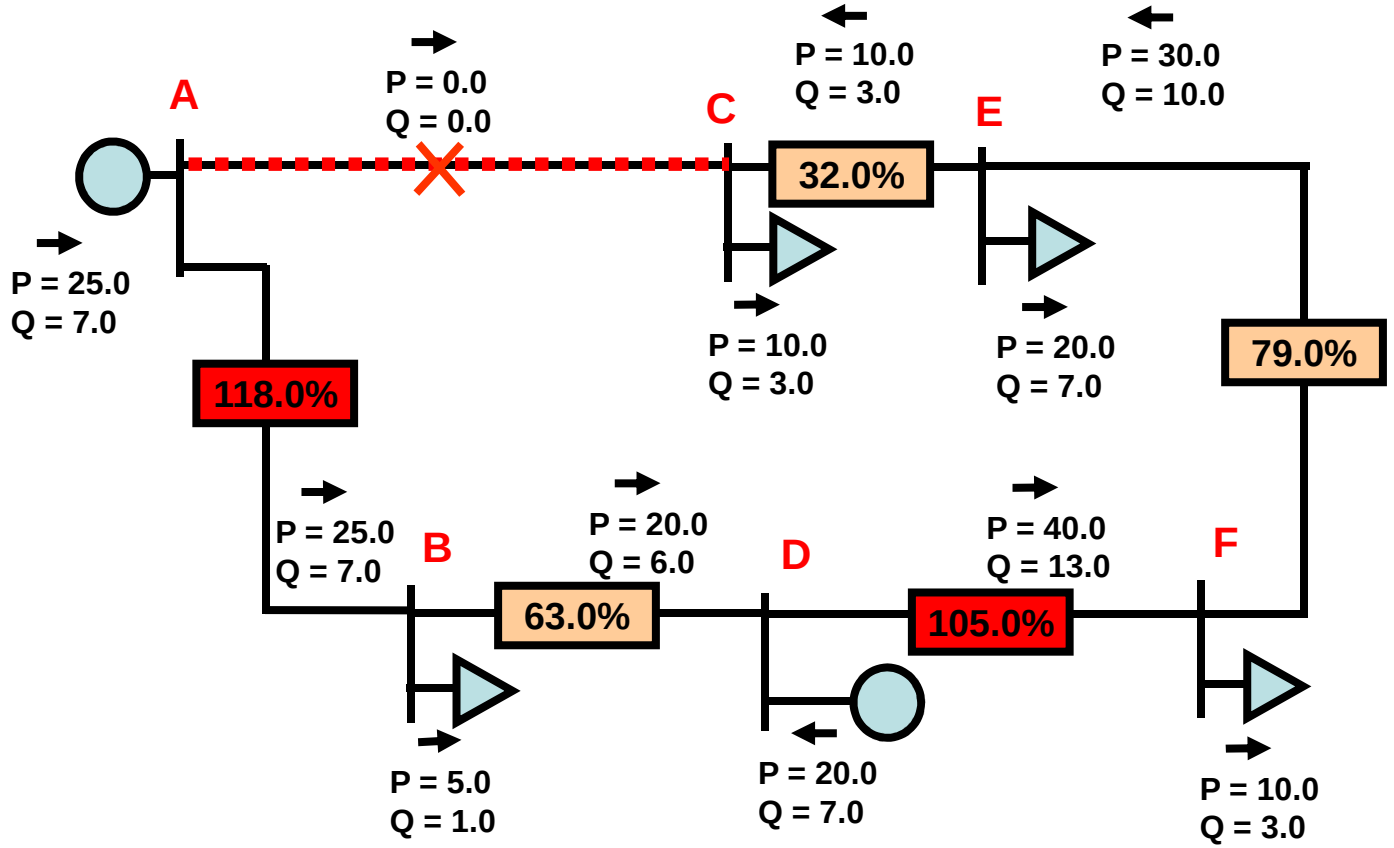
No transmission lines overloaded <u>without</u> contingencies

TRANSMISSION EXPANSION PLAN



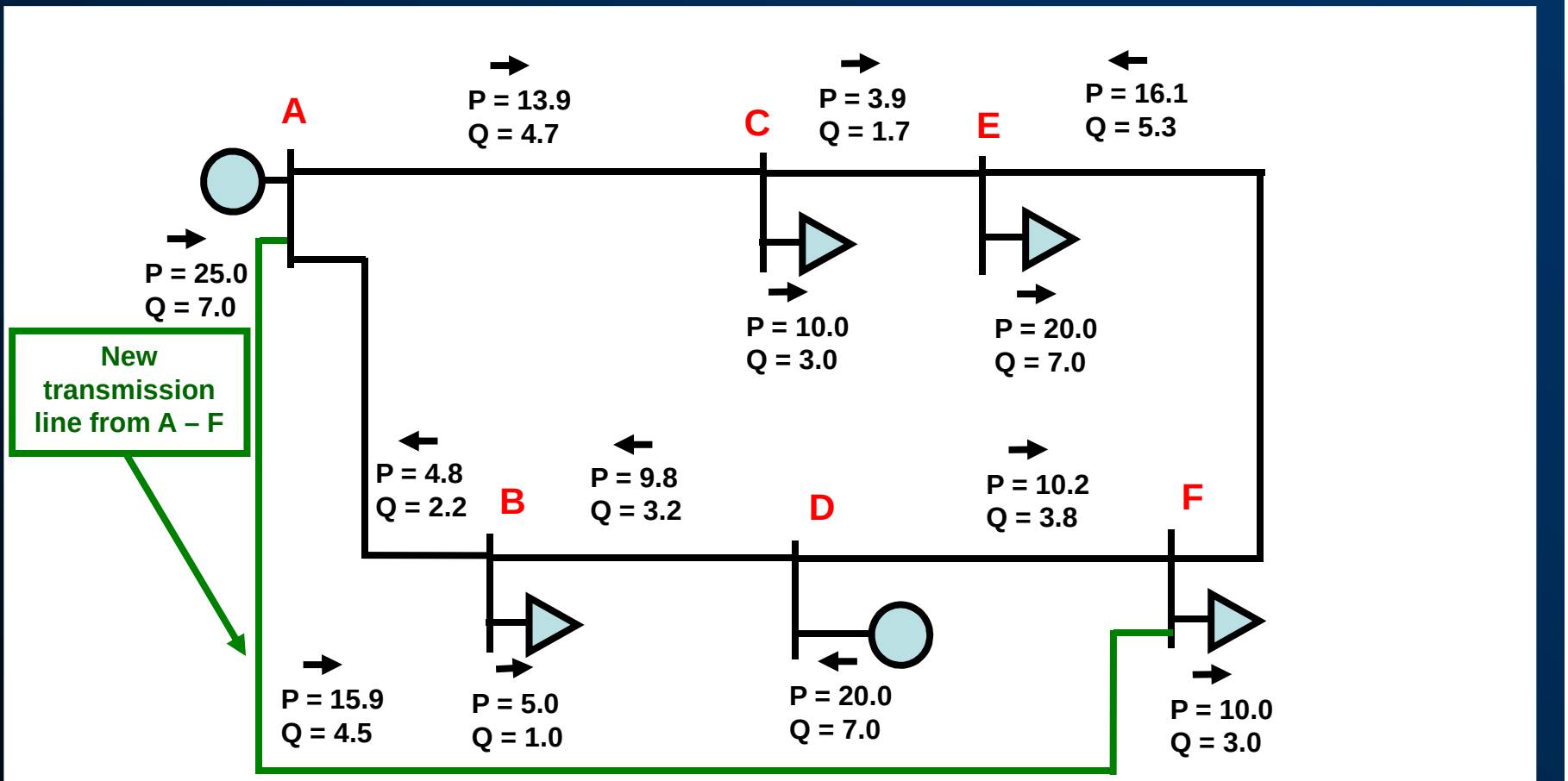
Line A – C overloaded for contingency D – F

TRANSMISSION EXPANSION PLAN



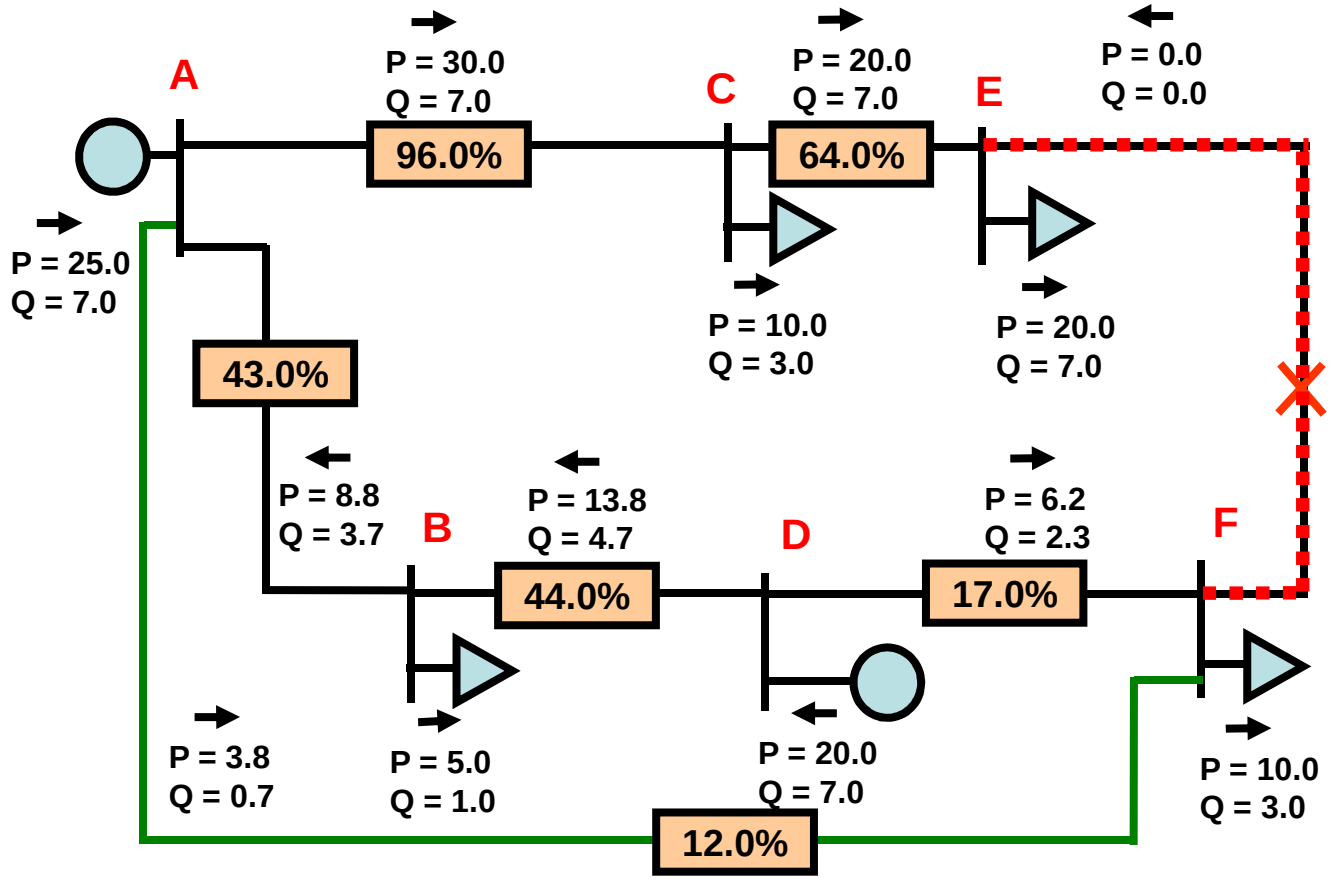
Line A – B overloaded for contingency A – C
Line D – F overloaded for contingency A – C

TRANSMISSION EXPANSION PLAN



No transmission lines overloaded <u>without</u> contingencies

TRANSMISSION EXPANSION PLAN



No transmission lines overloaded <u>with</u> contingencies (worst case shown)

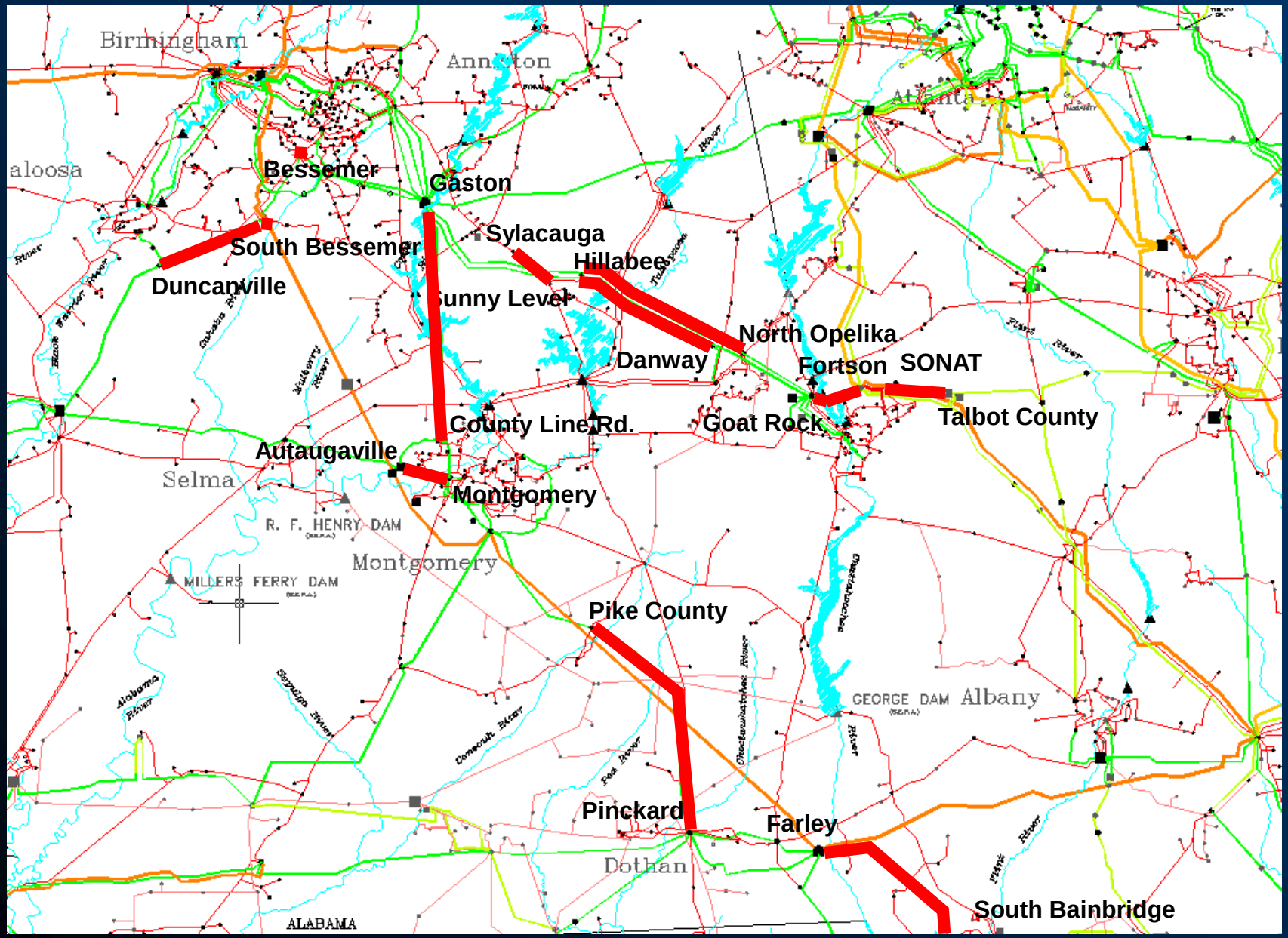
Transmission Expansion Plan

- Alternative solutions
  - Reconductor “A – B”, “A – C”, and “D – F”
  - New transmission line from “D – C” and reconductor “A – B”
  - Many more options

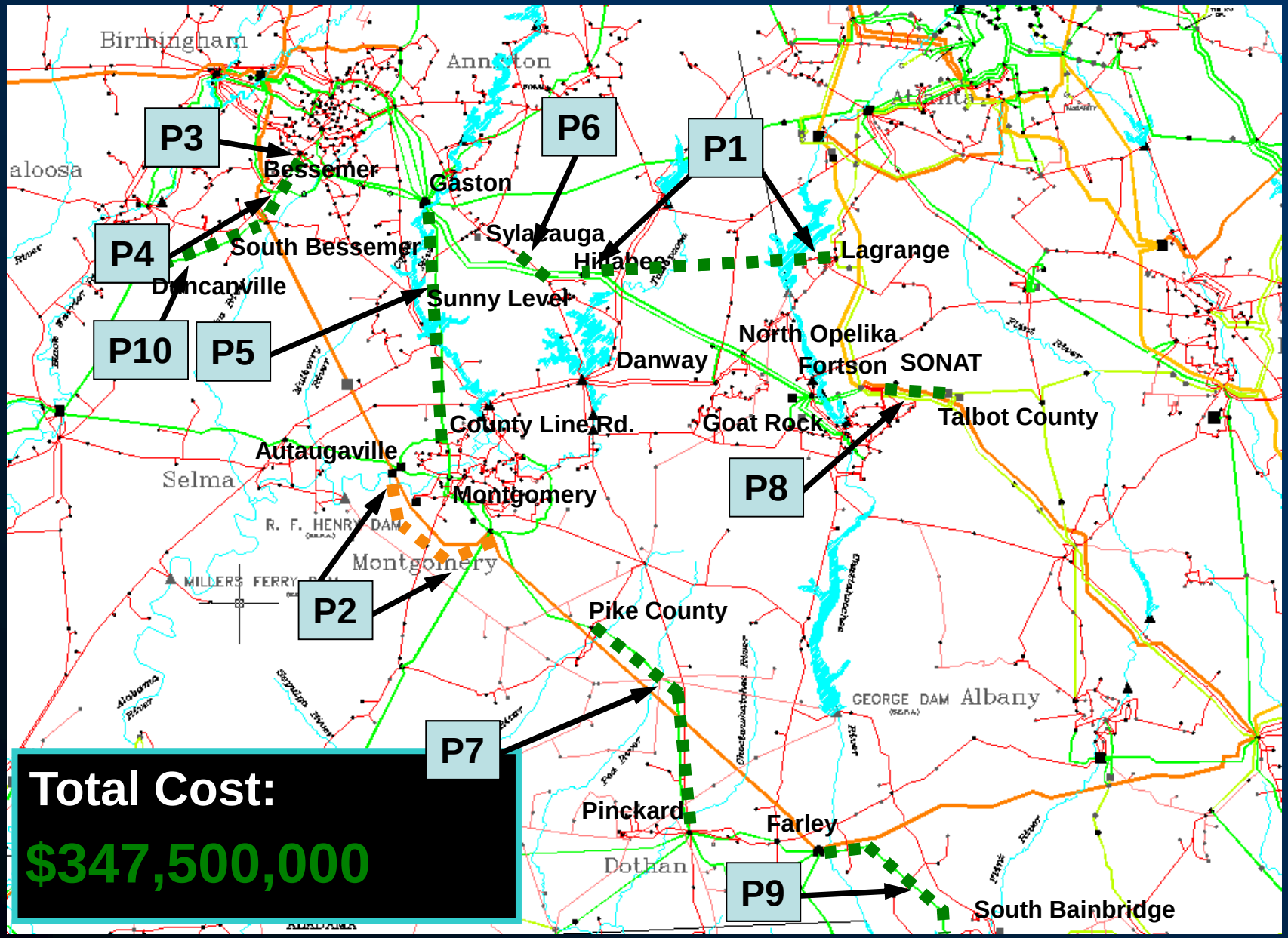
TRANSMISSION EXPANSION PLAN

- Example
  - 2010 SERTP Study:
    - Birmingham, AL – GA ITS 1000 MW
    - 2016 Study Year

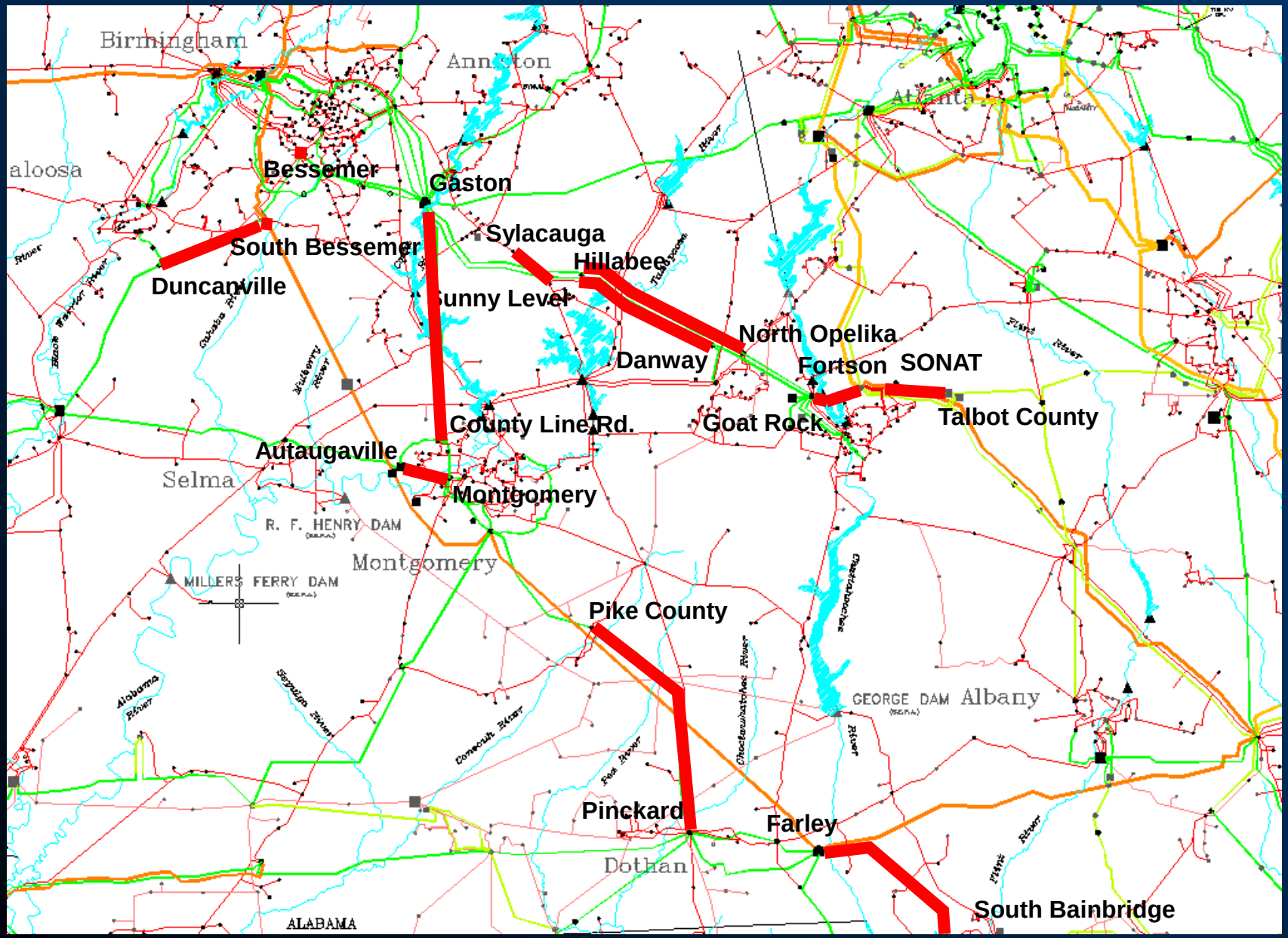
Overloaded Elements



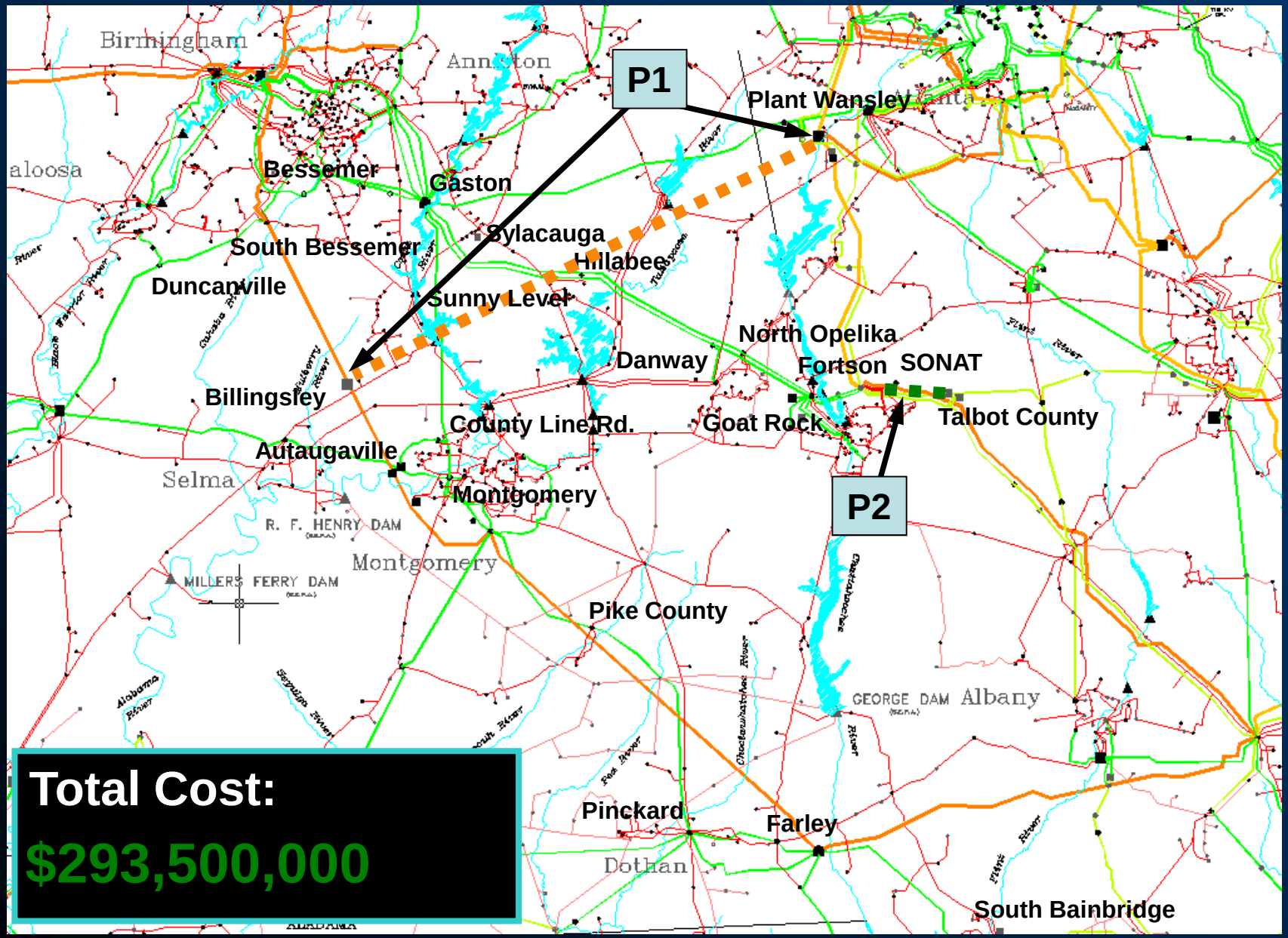
Potential Enhancements - Option 1



Overloaded Elements



Potential Enhancements - Option 2



Interactive Training Session

- **Expansion Plan Development**
  - Power Flow Analyses
  - Planning Criteria
  - Project Identification
  - **Expansion Plan Timeline**

TRANSMISSION EXPANSION PLAN

- Expansion Plan Timeline
  - First Five Year Focus
  - Second Five Year Focus

Interactive Training

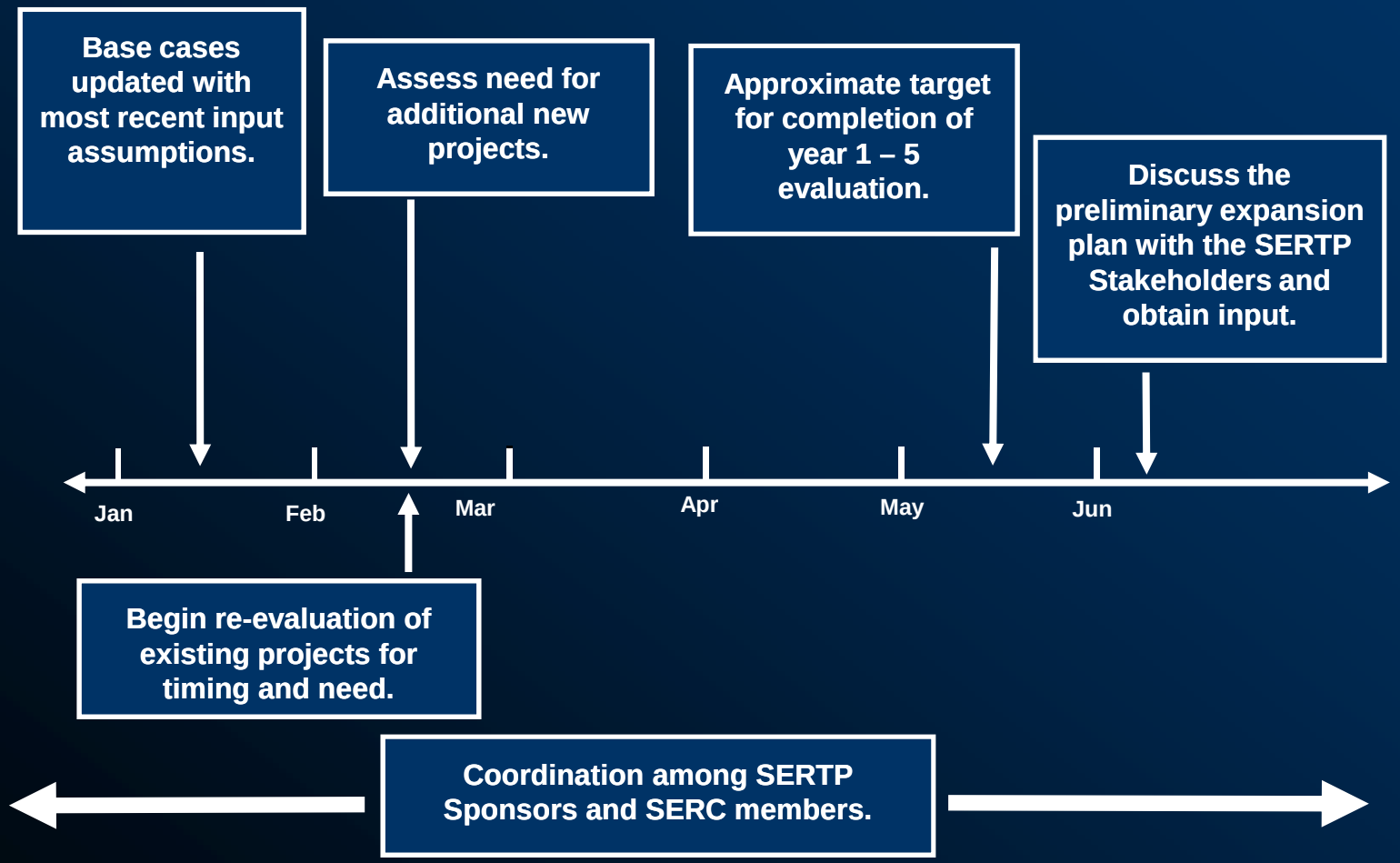
First Five Year Focus

- Focus is on near-term reliability constraints
- Utilize the most recent base case assumptions
- Re-evaluate existing projects for timing and need
- Assess the need for additional projects
- Coordinate with SERTP Sponsors and SERC Members
- Input from SERTP Stakeholders
  - Preliminary plan discussed, along with years 6-10 (projected), at the “Preliminary Expansion Plan Meeting” in the 2nd Quarter

Southeastern Regional TRANSMISSION PLANNING

Interactive Training

Approximate Time Line for Area Planning (Years 1 – 5)



Interactive Training

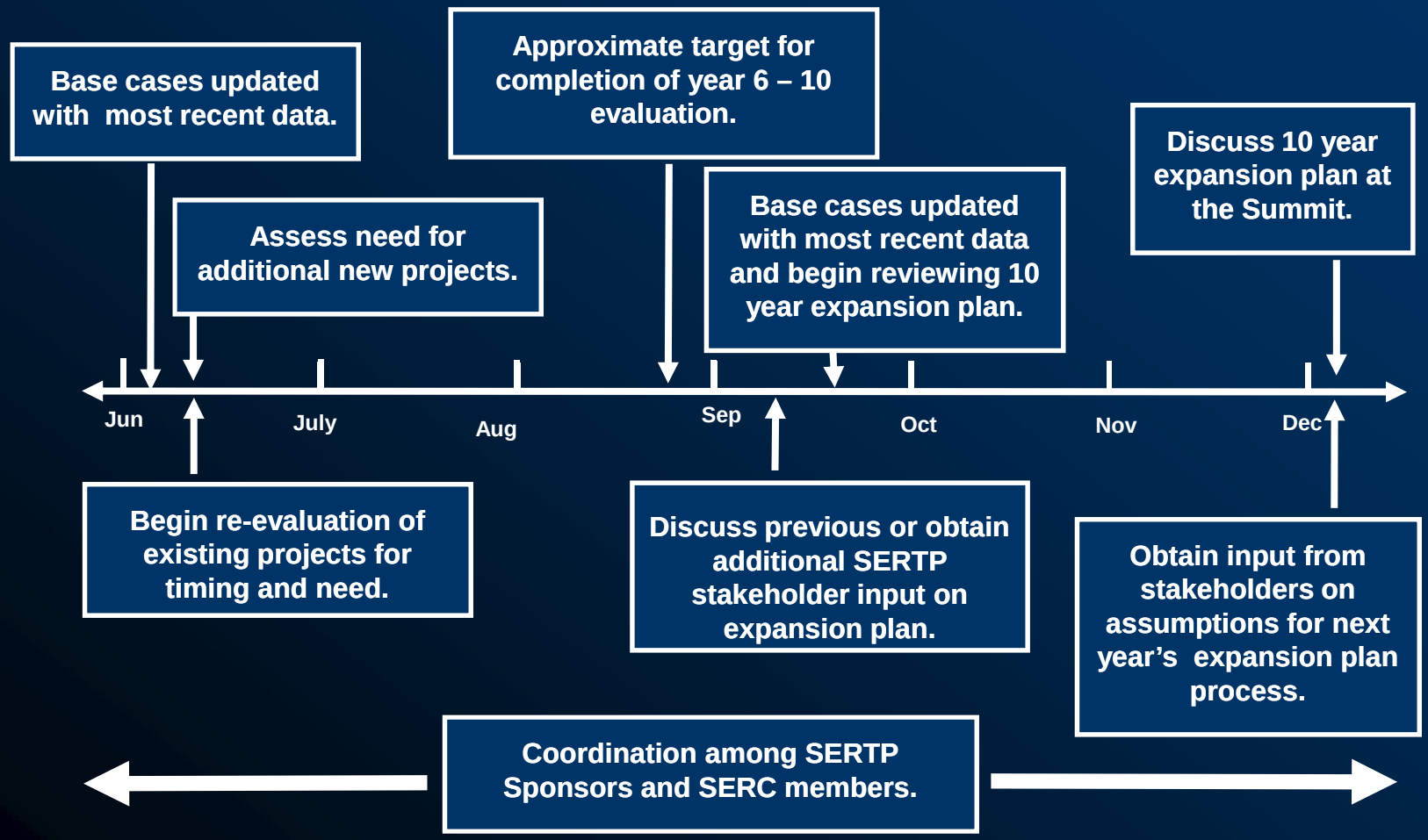
Second Five Year Focus

- Focus is on outer-year reliability constraints
- Update the base cases
- Re-evaluate existing projects for timing and need
- Assess the need for additional projects
- Coordinate with SERTP Sponsors and SERC Members
- Input from SERTP Stakeholders
- Year-end review of 10 year expansion plan
- Update the base cases for next year's evaluation

Southeastern Regional TRANSMISSION PLANNING

Interactive Training

Approximate Time Line for Area Planning (Years 6 – 10)



Questions on the Interactive Training?

2011 SERTP

❖Next Meeting Activities

- 2011 SERTP 2nd Quarter Meeting
  - ➢Location: TBD
  - ➢Date: June 2011
  - ➢Purpose:
    - Discuss preliminary 10 year expansion plan
    - Obtain stakeholder input and feedback regarding the plan

Questions?