

# TEP Saturation Study Results

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# Strategies Evaluated

- Strategy A-A
  - 500kV loop around Tucson
  - 2 - 345kV lines through Tucson
    - TO-MA-SS30-SO
- Strategy B'-A
  - 500kV loop around Tucson
  - 1 – 345kV line through Tucson
    - TO-NL-EL-VL
- Strategy C-A
  - 500kV loop around Tucson
  - 345kV Reach-in to NL, SS30, and EL

# 500kV Loop Around Tucson

- 2 - WN-VL lines
- VL-SO
- PW-SO
- PW-PS
- 2 – PS-TO lines
- TO-WN

# Common 345kV Projects

- Three Points/CS1 Loop-in of the Pinal West – South Line
- Tortolita – Marana – Three Points/CS1 Line
- Hartt Loop-in of the Vail-Bicknell 345kV Line
- Vail Transformer Additions
  - 1 transformer parallel to the existing transformers
- North Loop and Hartt Transformer Additions
  - 2 – 345/138kV transformers
- Tortolita Transformer Additions
  - 1 - 500/138kV transformer
  - 2 – 500/345kV transformers

# 500/345 kV Transformers

- Tortolita
- Winchester
- Vail
- South
- Quantity/Ratings dependent upon Strategy

# Strategy B'-A

- 345 kV Through Tucson
  - TO-NL
  - NL-EL
  - EL-VL
- 2 – 345/138kV Transformers at NL, EL, South, and Hartt
- 4 – 345/138kV Transformers at Vail
- 3 – 500/138kV Transformers at Tortolita
- 500/345kV Transformers at Vail, South, and Tortolita

# Power Flow Results

- 72 Unsolved Double Outages
  - 61 involved Gateway 345/138kV transformer or both SO-GW 345kV lines
  - 6 involved SP-VL 345kV line
    - Adjusting solution parameters resulted in solved cases
  - 4 combinations of SP-MK #1 or #2 345kV line and SPR units #3 or #4
    - Adjusting solution parameters resulted in solved cases
  - GL-CV and GL-GLSW

# Power Flow Results (continued)

- Voltage Deviations
  - Green Valley – Hartt 138kV outage
    - Green Valley 138kV – 5.49% voltage drop
    - Canoa Ranch 138kV – 5.20% voltage drop

# Power Flow Results (continued)

- EHV Overloads
  - Vail 345/138 (busses)
    - Max loading: 135%
    - Worst Outage: SP-VL and parallel transformer
  - Vail 345/138 (Express Line)
    - Max Loading: 107%
    - Worst outage: SP-GL and parallel transformer
  - East Loop 345/138
    - Max Loading: 101%
    - Worst Outage: 1 Vail 345/138 (busses) and parallel transformer
  - Tortolita 500/345
    - Max Loading: 107%
    - Worst Outage: PW-3Pts 345 and parallel transformer

# Interpretation of Strategy B'-A Power Flow Study Results

- Strategy B'-A EHV Configuration appears to be adequate to deliver power from external resources to the TEP local area system interface
- Quantity/rating of transformers or RAS for SP-VL line will mitigate EHV problems

# Strategy C-A

- 345kV Reach-in to Tucson
  - Vail – East Loop
  - Vail – SS30
  - South – SS30
  - Tortolita – North Loop
  - Tortolita – Marana – North Loop
- 2 – 345/138kV Transformers at NL, EL, South, and Hartt
- 4 – 345/138kV Transformers at Vail
- 3 – 500/138kV Transformers at Tortolita
- 500/345kV Transformers at Vail, South, and Tortolita

# Power Flow Results

- 76 Unsolved Double Outages
  - 65 involved Gateway 345/138kV transformer or both SO-GW 345kV lines
  - 9 involved SP-VL 345kV line
    - Adjusting solution parameters resulted in solved cases
  - CH-SA 500 and VL-SO 345
    - Adjusting solution parameters resulted in solved case
  - GL-CV and GL-GLSW

# Power Flow Results (continued)

- Voltage Deviations
  - Green Valley – Hartt 138kV outage
    - Green Valley 138kV – 5.46% voltage drop
    - Canoa Ranch 138kV – 5.17% voltage drop

# Power Flow Results (continued)

- EHV Overloads
  - Vail 345/138 (Express Line)
    - Max Loading: 107%
    - Worst outage: SP-GL and parallel transformer
- HV Overloads
  - 6 TEP 138kV lines
  - 4 CAP/SWTC/WAPA 115kV lines
  - 1 SWTC 230kV line

# Interpretation of Strategy C-A Power Flow Study Results

- Strategy C-A EHV Configuration appears to be adequate to deliver power from external resources to the TEP local area system interface
- Quantity/rating of transformers or RAS for SP-VL line will mitigate EHV problems

# QUESTIONS