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Arrowhead-Stone Lake-Gardner Park 345 kV Line Concerns

September 2, 2005

Overview

- ATC can address reliability concerns raised
- The PST resolves the voltage stability concerns for 2K/2K/3K imports during n-1 conditions
- A Phase Shifting Transformer (PST) was included in the $420M cost estimate approved at the PSCW re-hearing
- WIRES no longer exists
  - Disbanded prior to ATC formation

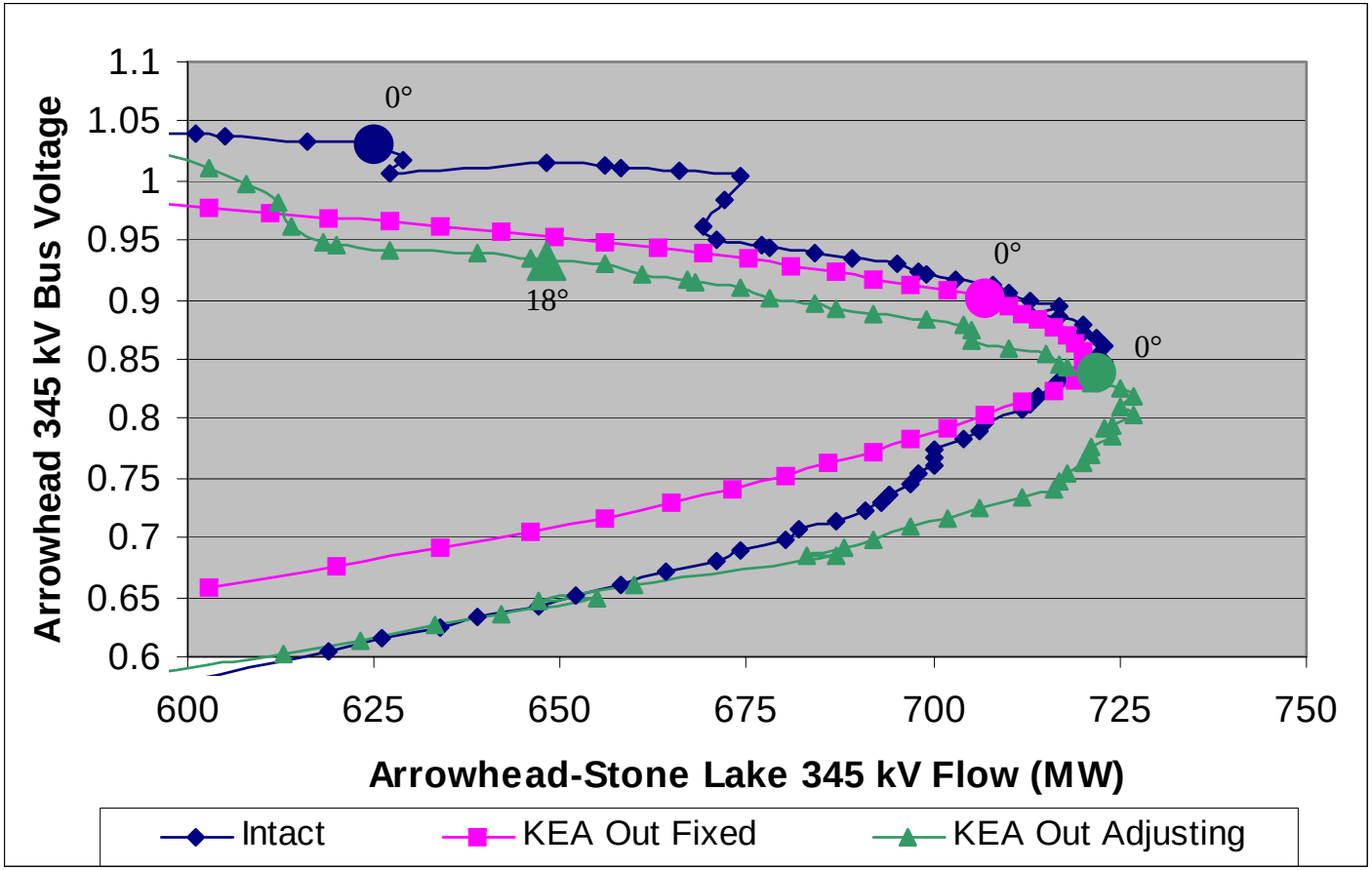
Concern: Use of PST

- Several Options to Improve Voltage Stability
  - Line Relocation/Re-termination: Could be expensive and would add delays and raise other issues, but could add extra capability to line.
  - Series Capacitors: Were found to increase voltage stability flow limit, but also increased flow due to lower line impedance, so post contingent flow remained near the nose of the PV curve. (BAH-2)
  - Phase Shifting Transformer: Minimized changes to line design and offers operational flexibility.

Concern: Stability Limit Exceeded During King-Eau Claire-Arpin Outage

- Under Severe Conditions Simulated Voltage Stability Limit NOT Exceeded with KEA Out (9/24/04 Voltage Stability Analysis Report)
  - An acceptable (10%) margin exists under intact system conditions and a 0° PST angle
  - KEA outage causes line flow to approach limit
  - PST Operation Returns Line Flow to an Acceptable margin following KEA outage
  - Line Flow is reduced less than 10% by PST

3000 MW ATC Import Arrowhead 345 kV PV Curves under Intact and King-Eau Claire-Arpin Outage Conditions



Concern: Line is Undersized

- The Conditions Across the MN-WI Interface Dictate that the Capability of Any New Line Would be Fully Utilized for 3K Import
- Surge Impedance Loading Well Below Thermal Limits
- Long Lines are often Stability (Dynamic or Voltage) Limited
- Can't Be Expected to Have the same Flow Limits as Shorter KEA line

Concern: Arrowhead 230 kV Termination

- The Proposed Line Design Accomplishes Objectives
  - Line Objective is a Specific Import Level
  - No Line Flow Objective Was Ever Specified
- No Justification for the Greater Expense of Connecting to the 500 kV System

Concern: WIRES Study Oversights

- WIRES Study Pre-dates ATC, so we can't Directly Address their Procedures and Processes
  - No NERC Planning Standards in Place when WIRES was Performed
  - WIRES Used a Different Voltage Stability Analysis Methodology (WIRES Study Chapter 5)
  - WIRES did not Consider a Tap at Stone Lake

Concern: Potential for Voltage Instability Not Addressed

- Project Participants believe the PST Addresses Voltage Stability Concerns
- Cost and Timeliness Concerns also Addressed

Concern: PST Not Addressed in 2003 Hearings

- PST Requirements Draft Report (11/5/01, BAH-2) presented at 2003 Hearings
  - Various Line Configurations and Voltage Stability Solutions Evaluated
  - Specific PST Design Concerns were Addressed based on Facts Known at the time
    - MVA Size, Angle range
    - Redundancy
    - Etc.

Concern: Increased Flow on Other Paths

- Decreasing Flows at Arrowhead under Contingency Conditions will increase Flows on Alternate Paths (Iowa and Illinois)
  - Studies have not revealed any problems under this condition
  - Our System is being designed for 3000 MW import, 2000 West & 1000 South or 1000 West & 2000 South
    - Partial Explanation: Forcing Flow South During High West Imports Utilizes Capability Designed into System for High South Flows

Concern: Weston Generator Shaft Stress During Line Reclosure

- Weston 3 Shaft Stress Issues are Eliminated by New Line
  - Delta P 37.2% limit identified by WIRES
  - "Worst Case"
    - 2005 Model, Without Arrowhead Line: 39%
    - 2005 Model, With Arrowhead Line: 32%
    - 2008 Model, Weston 4 on: 23%

Other Line Benefits

- Line Increases Geographic Diversity
- Enhances Network Reliability
- Increases Transfer Levels