

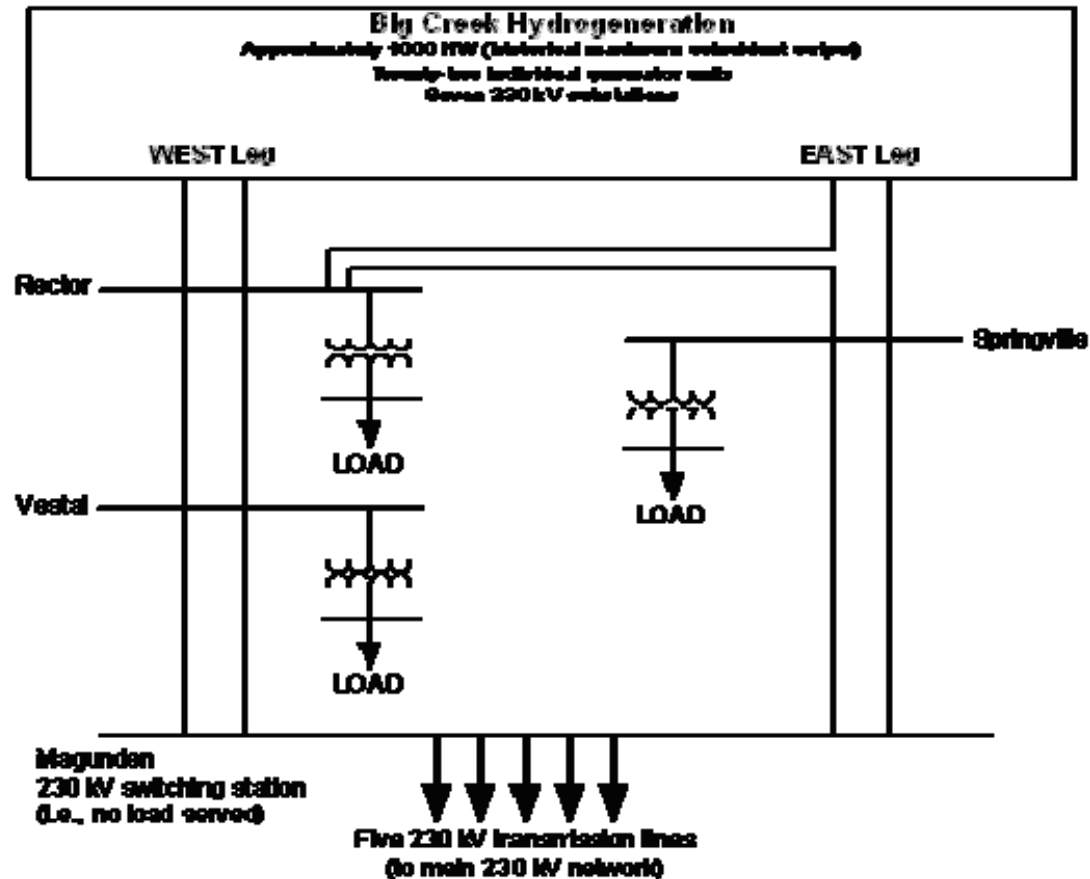


# Successful Utilization: Phasor Data in Closed Loop Control

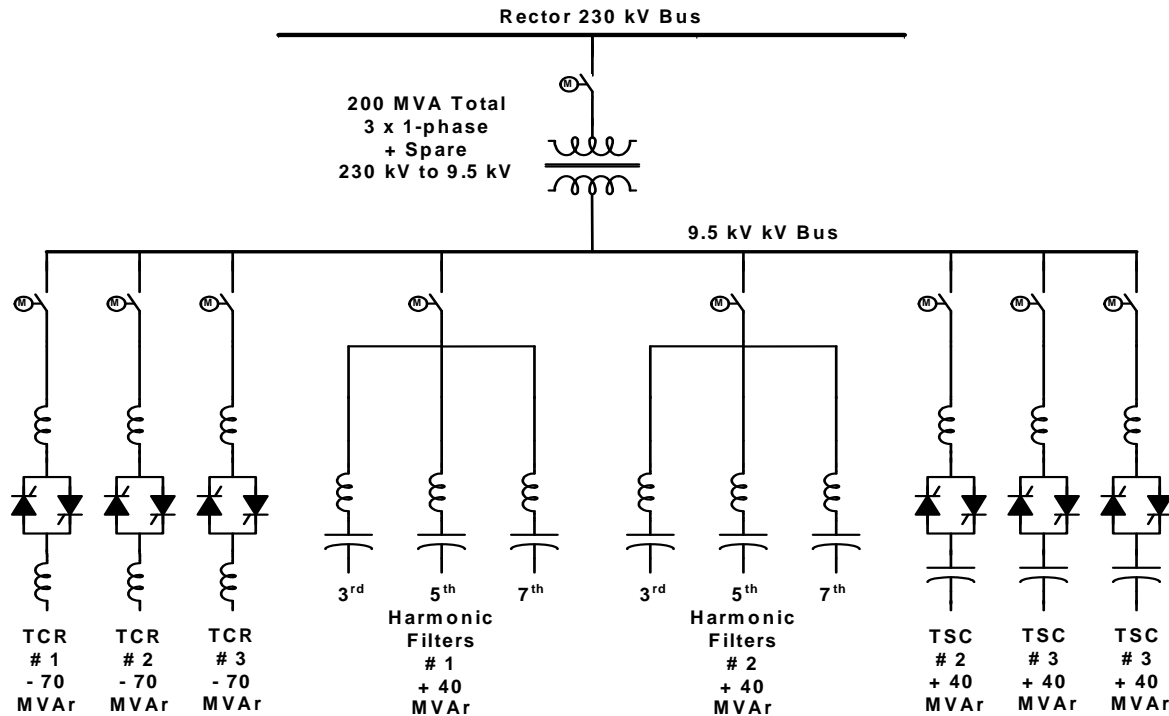
# Areas of Success

- ◆ Rector SVC Control
- ◆ EMS Data Integration
- ◆ 2009 Rate Case Submission
- ◆ Real Time Stability Measurement
- ◆ SMART: Synchronized Measurement and Analysis in Real Time
- ◆ Event Analysis

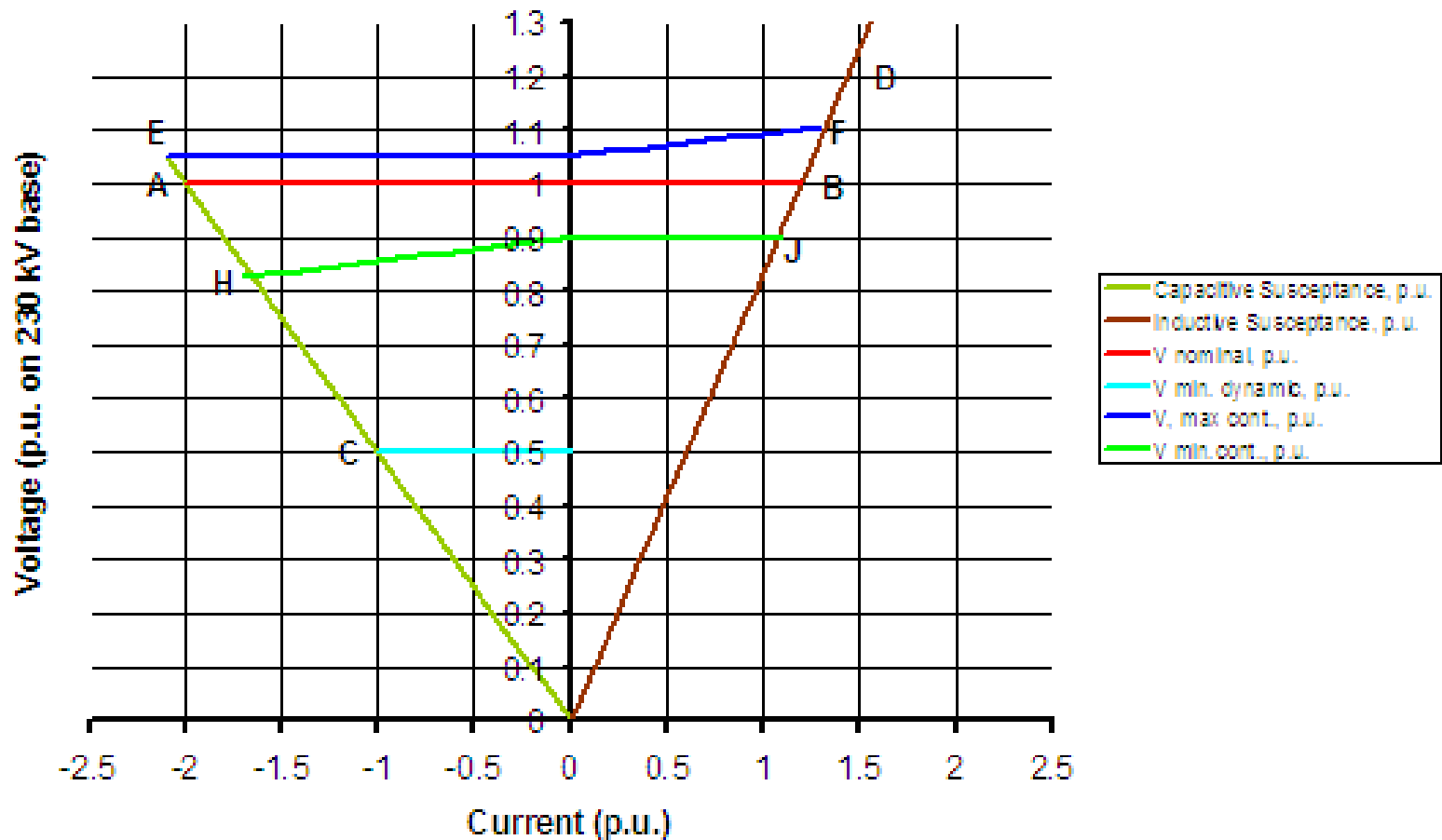
# Planned Corridor Upgrades



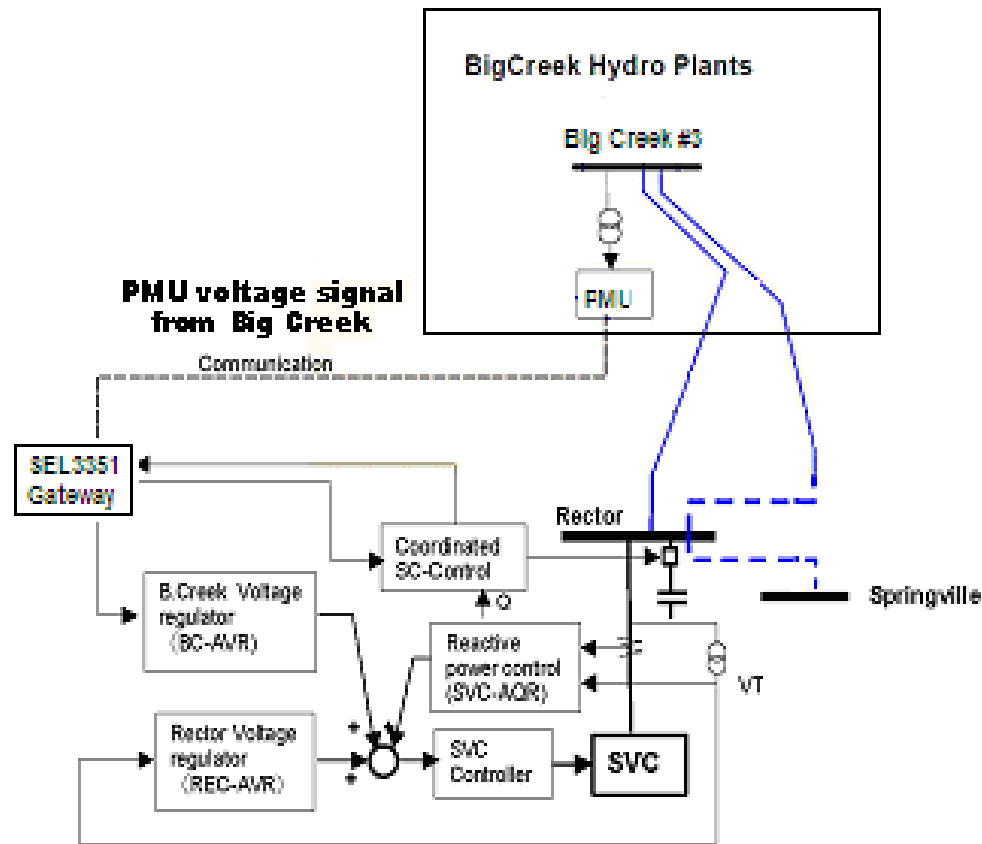
# Rector SVC One-Line



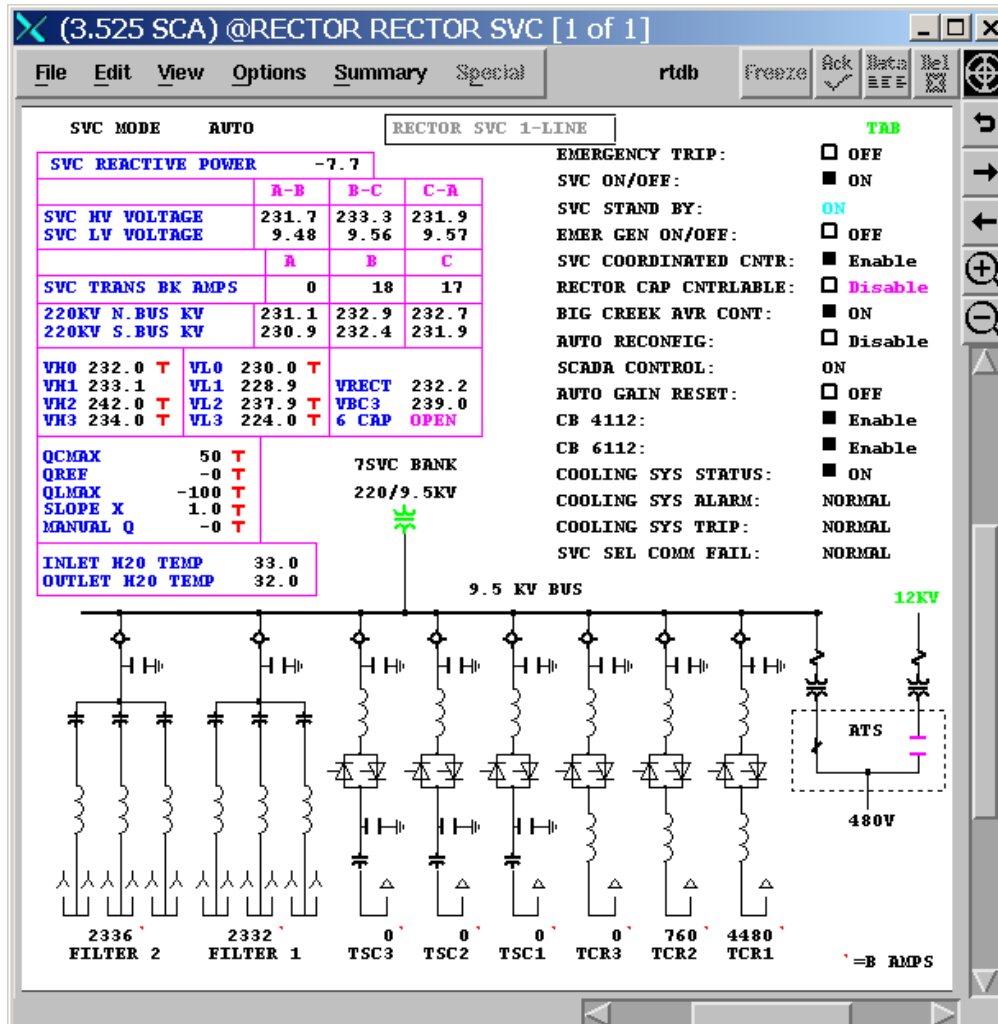
# Rector SVC Operating Characteristics



# Coordinated Voltage/Var Control Scheme

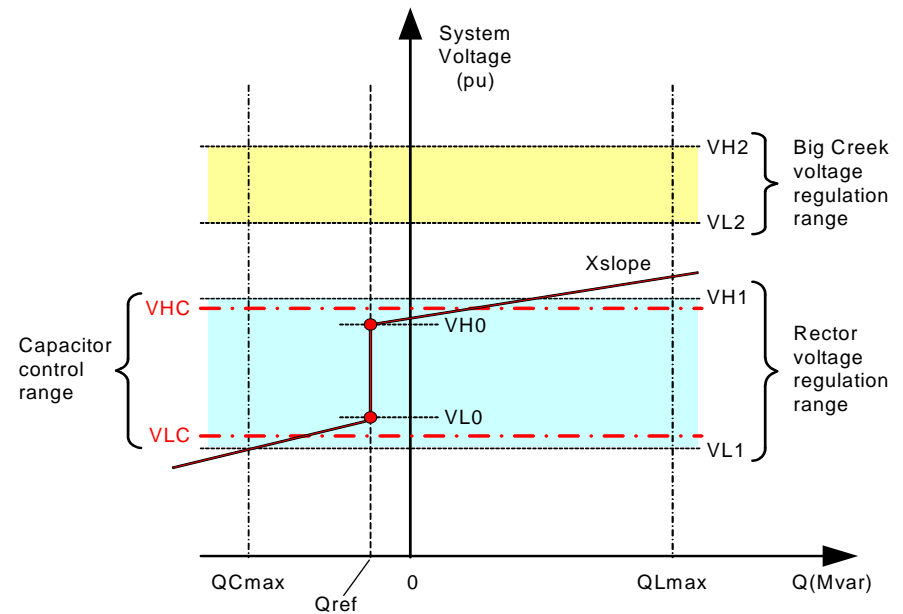


# EMS Operation Screen (Color Inversion for Clarity)



# Rector SVC Coordinated Control # 1 Priority

- ◆ Maintain Big Creek #3 230 kV bus voltage below its upper (VH2) limit (BC-AVR) and maintain SVC steady-state output below QCmax (SVC-AQR)





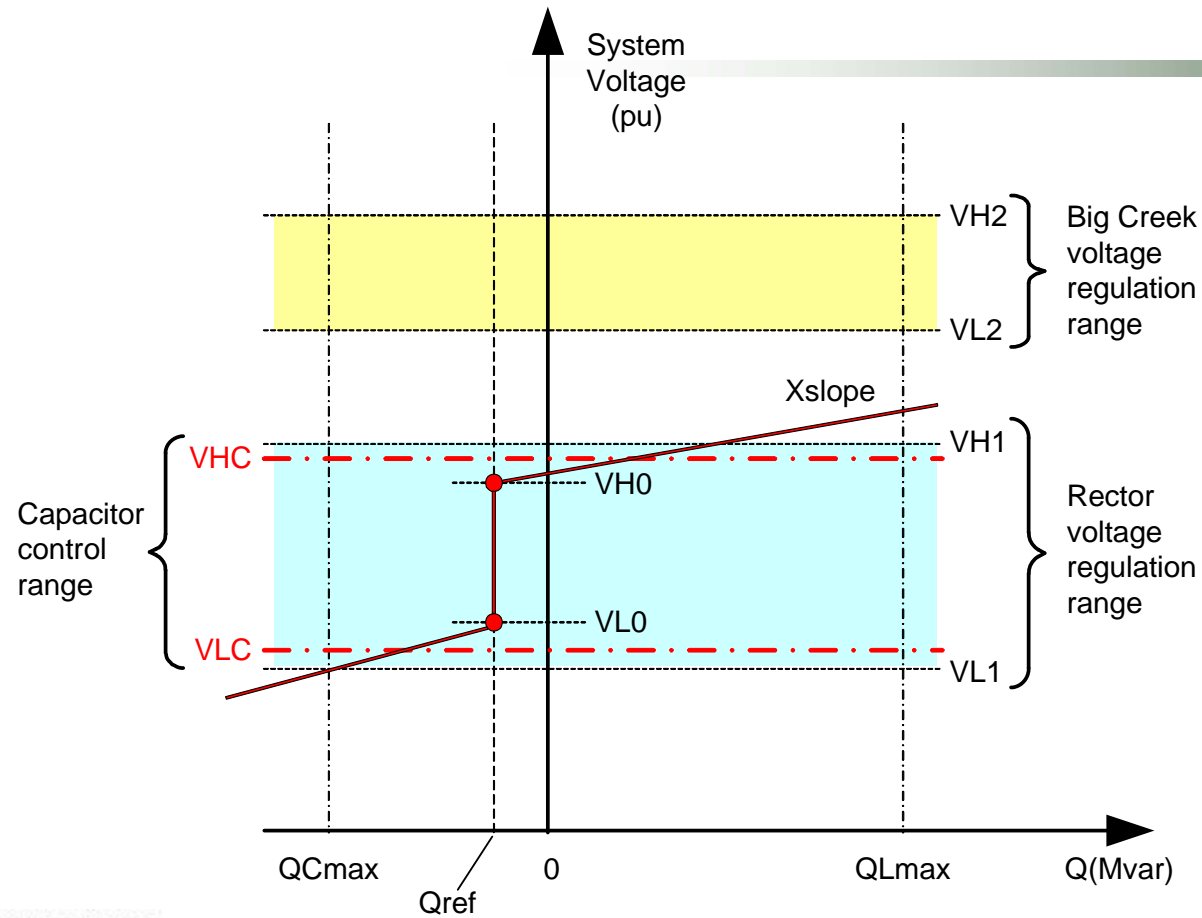


# Rector SVC Coordinated Control Priorities 2 & 3

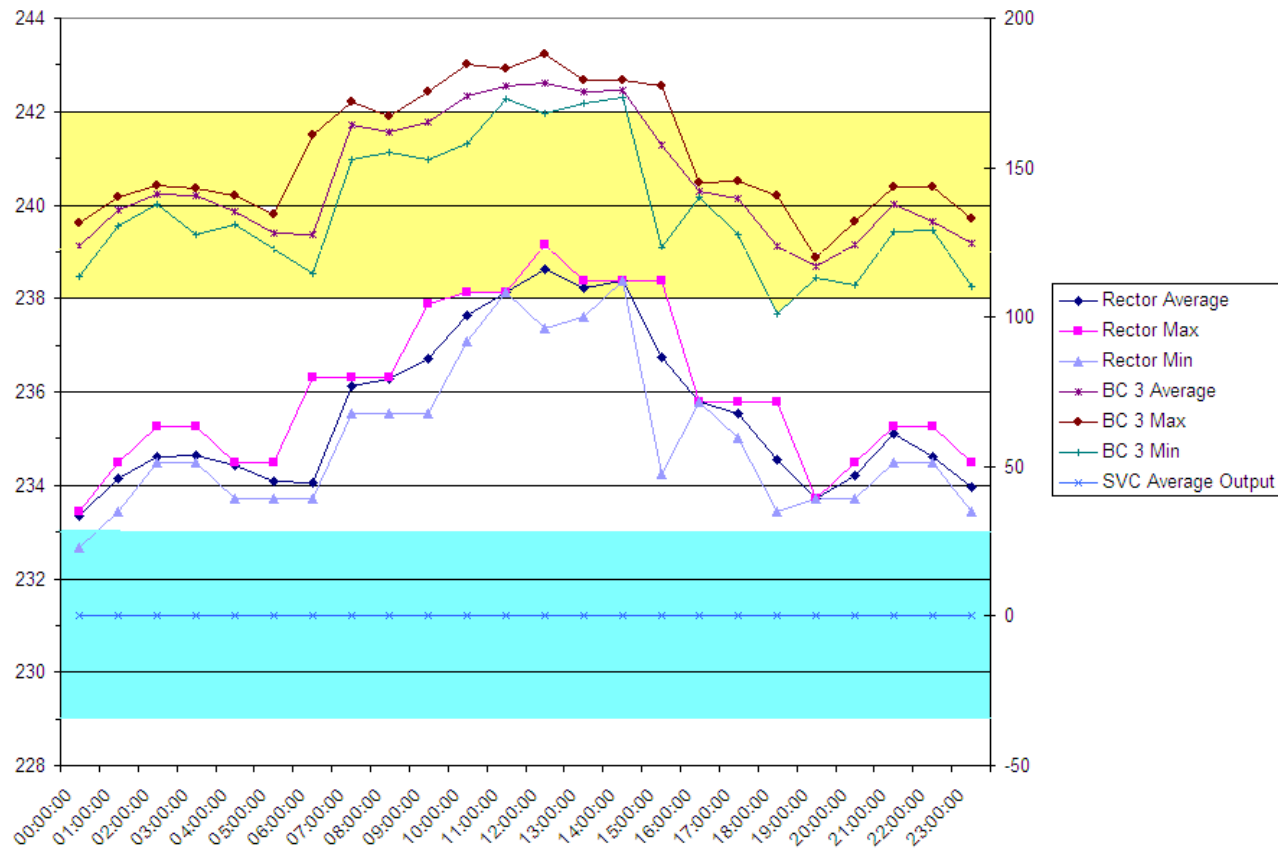
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- ◆ Maintain Rector 230 kV bus voltage within its upper (VH1) and lower (VL1) limits with Priority #1 maintained (REC-AVR)
- ◆ If Big Creek #3 230 kV bus voltage is below VL2, the SVC should control it within VL2 with Priorities 1 and 2 maintained

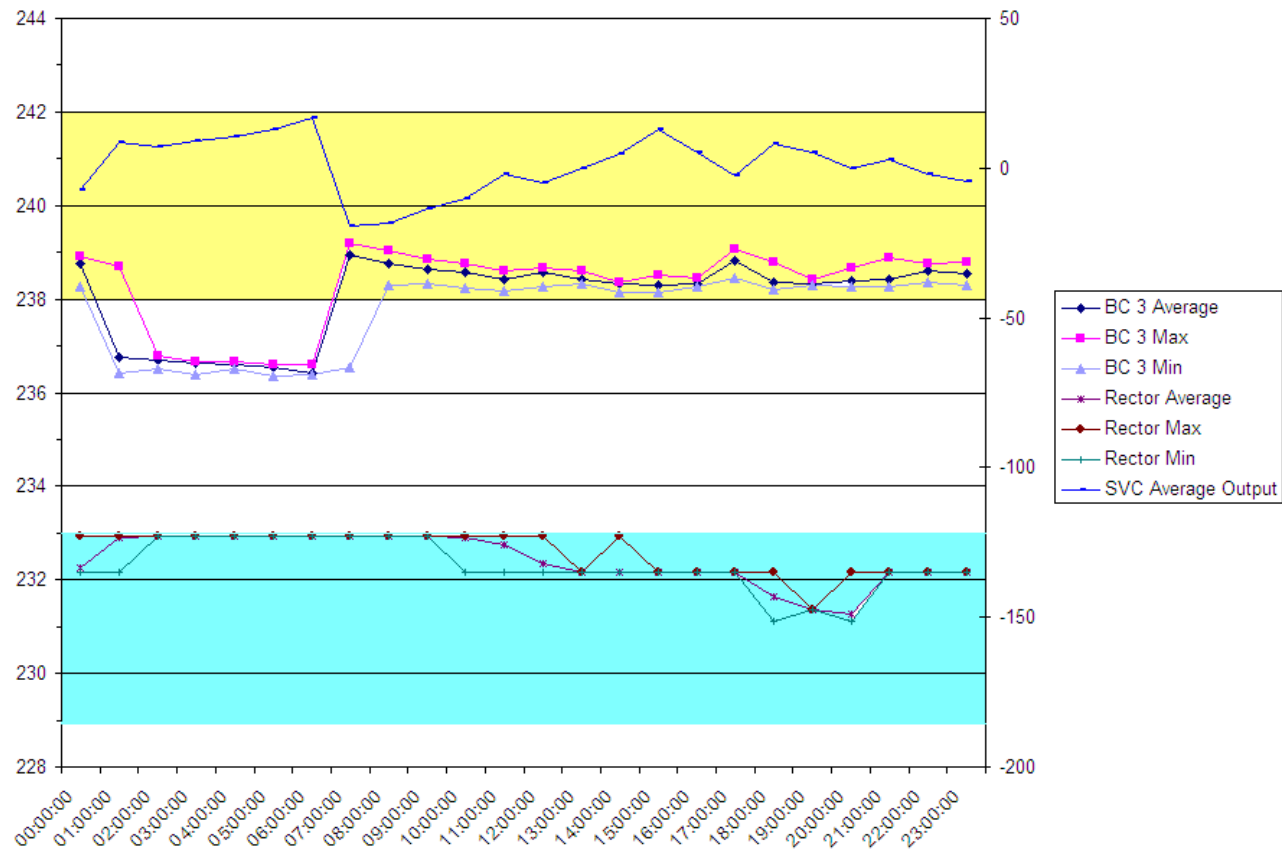
# V-Q Characteristics of Rectifier SVC Coordinated Control



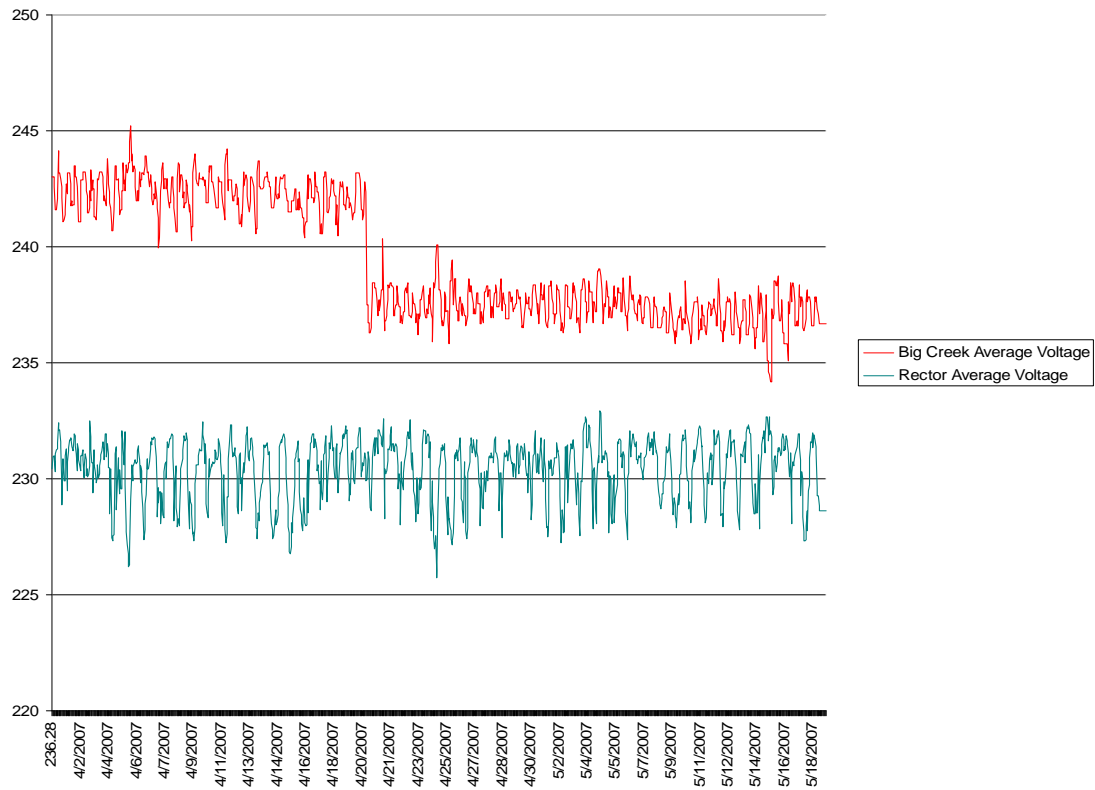
# Effect of SVC Operation on Big Creek



# Effect of SVC Operation on Big Creek



# Voltage Calibration Need



# EMS Data Integration

- ◆ State Estimation
- ◆ Data Historian

# 2009 Rate Case Submission

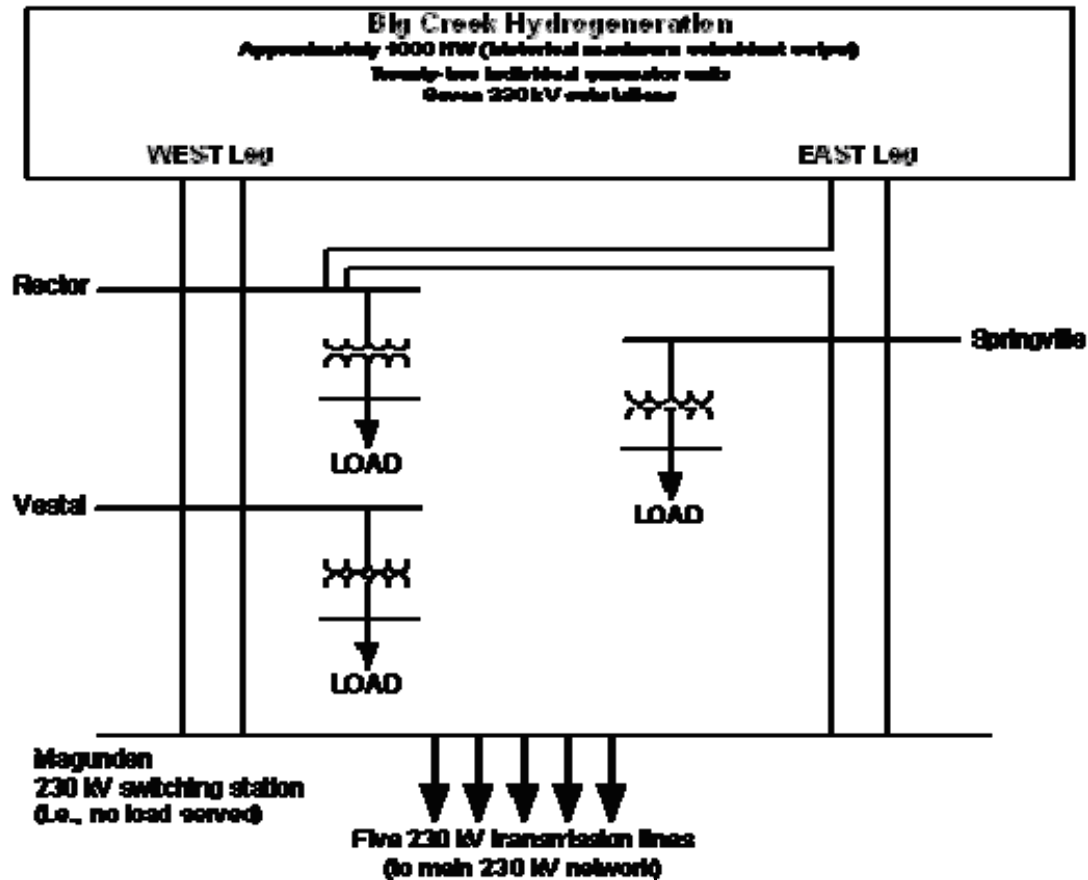
- ◆ Transition to “Commercial” Applications
- ◆ Wide Area Monitoring
  - View of entire WECC
- ◆ Wide Area Control
  - Voltage/Var resource optimization

# Real Time Stability

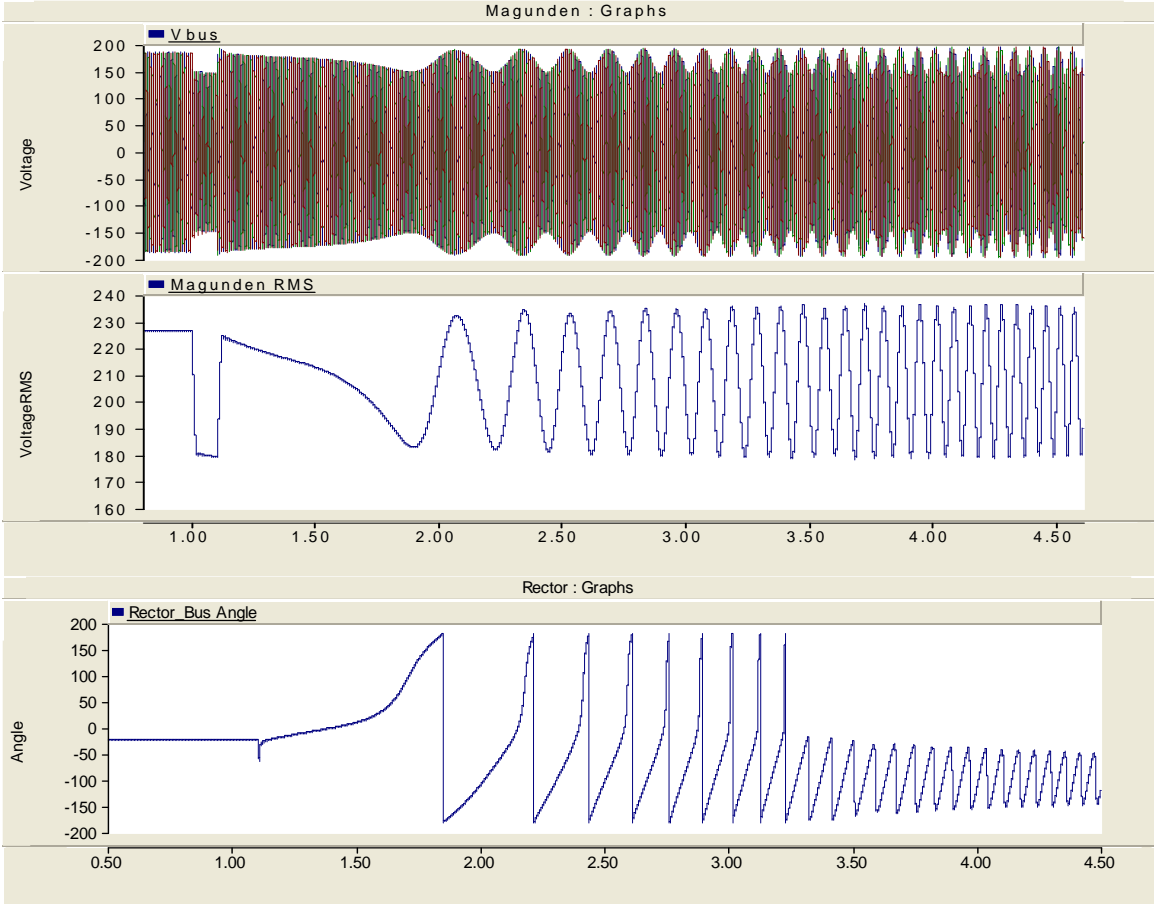
- ◆ Stability Measurement due to synchronized sampling
- ◆ System configuration independent
- ◆ Project proposed for fall 2008/spring 2009



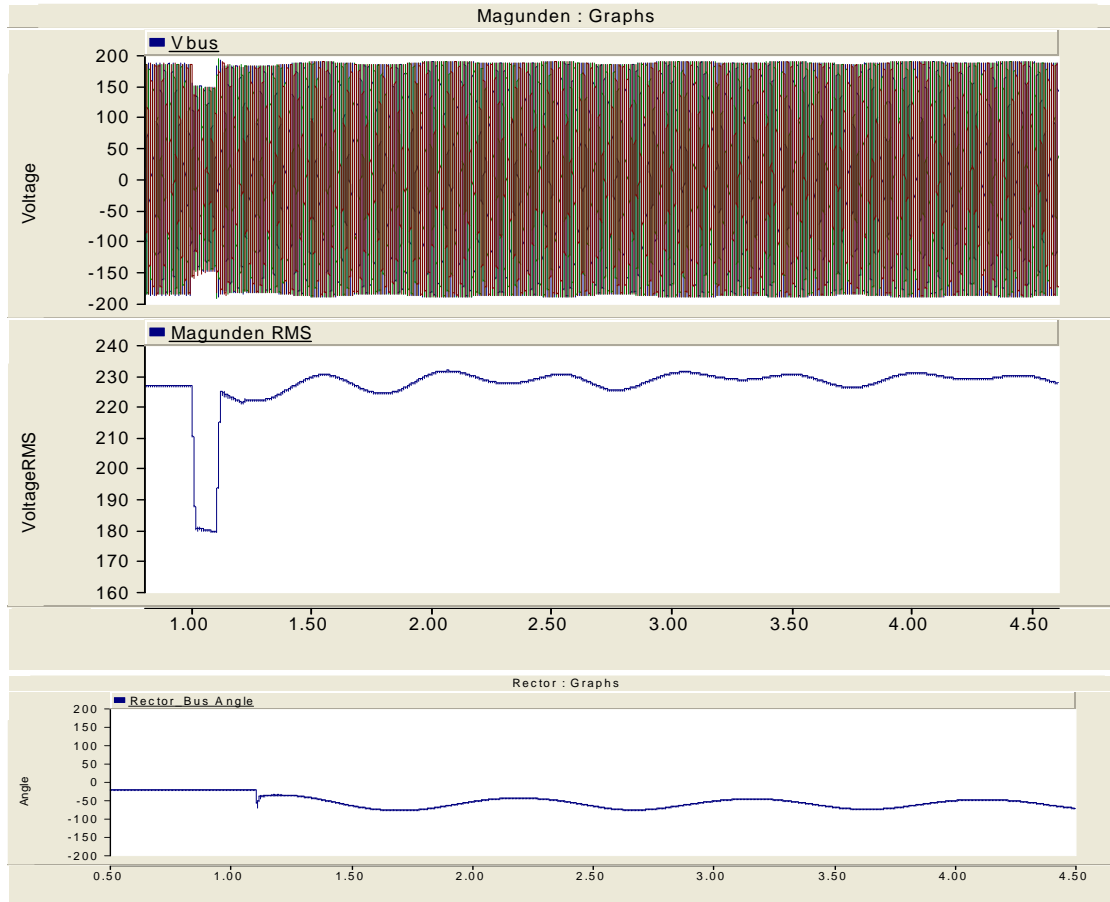
# System



# RAS: No Action Taken



# RAS: Action Taken



# SMART: Synchronized Measurement and Analysis in Real Time

- ◆ Real Time Visualization
- ◆ Placed in Grid Control Center
- ◆ Has identified “issues” to grid operations
- ◆ Co-Winner of Automation Project of the Year Award at Distributech 2008

# Event Analysis

- ◆ Years of experience analyzing events