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Voltage Security Assessment (VSA), Reliability, and Market Efficiency

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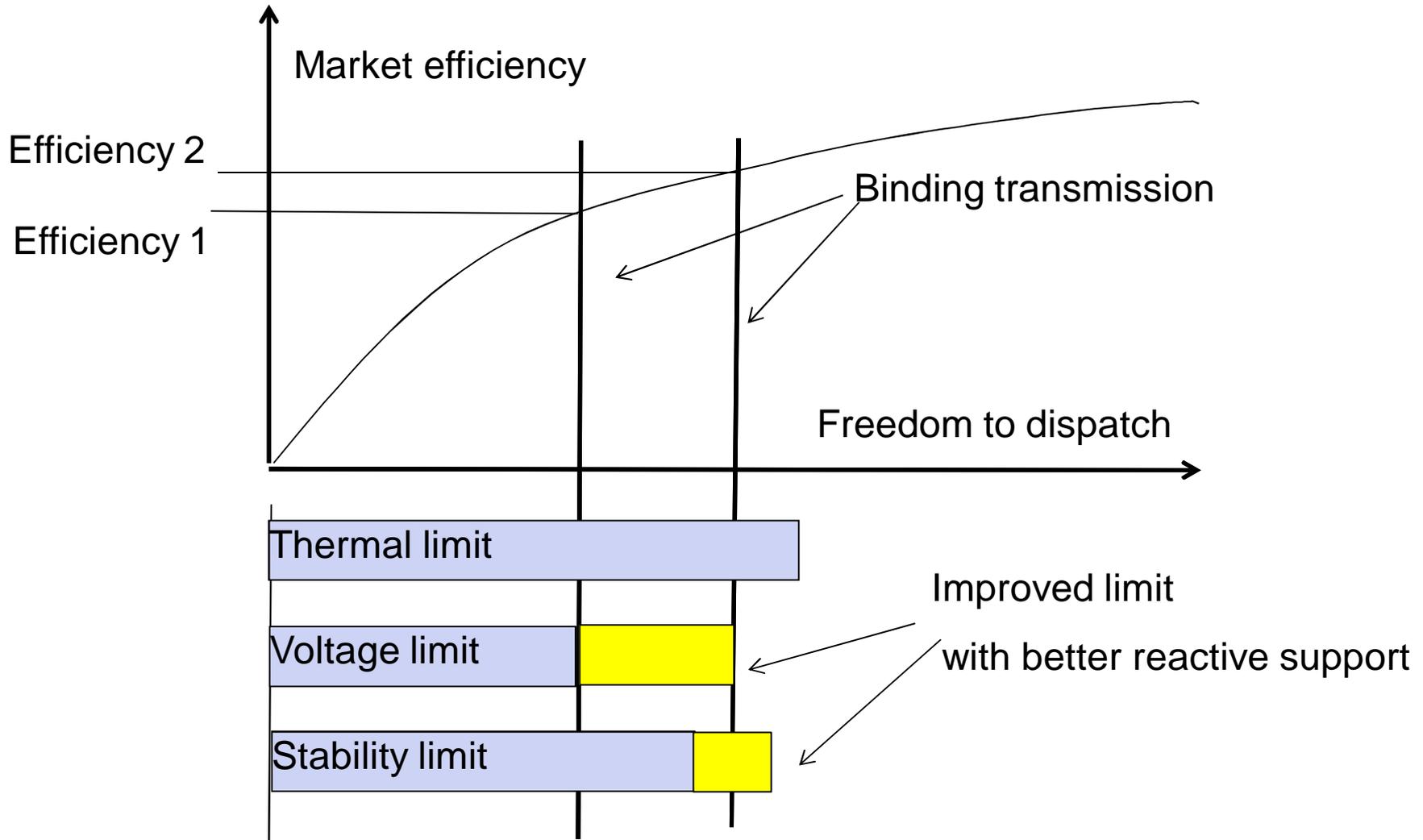
Voltage Collapse - review

- Phenomenon
 - Progressive and uncontrollable decline in voltage
- Triggering events
 - Increase in load
 - Contingence
- Roots cause
 - Inability of the power system to meet the demand for reactive power
 - Load dynamics and interaction with voltage regulation

Voltage support and market efficiency

- Market efficiency limited by binding transmission capacities
- Transmission limits are set by
 - Thermal limit
 - Voltage limit
 - Stability limit
- Sufficient and fast voltage support can increase the last two limits, and possibly market efficiency

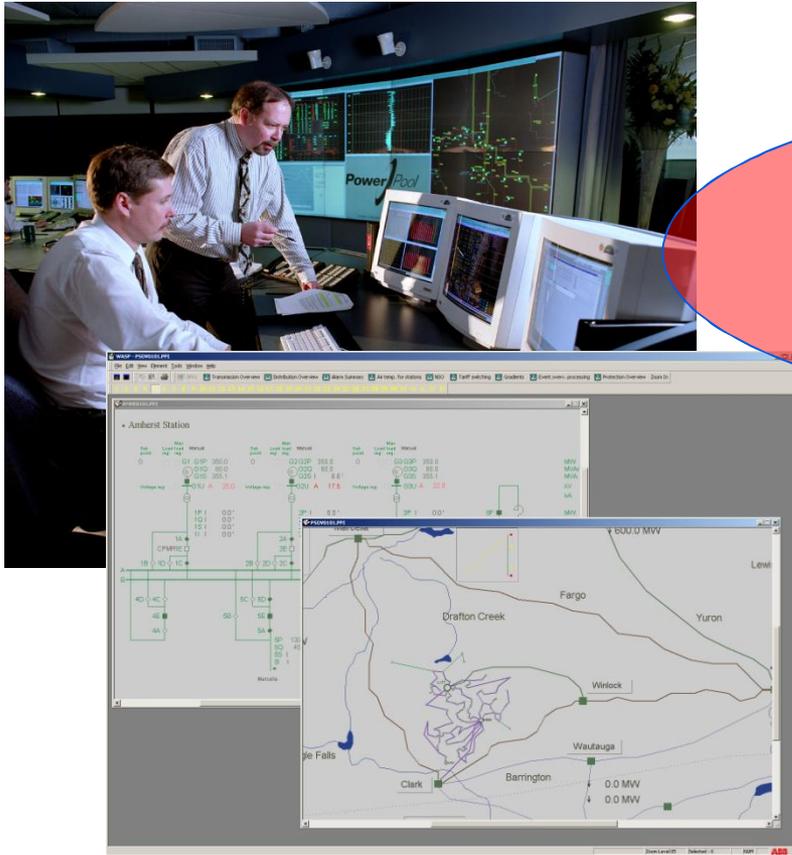
Voltage support and market efficiency illustration



Value of VSA

- In operation – identify the margin and corrective actions, prevent voltage collapse and increase security/reliability
- In planning – identify weak spot for strengthening, increase voltage constrained limit, increase market efficiency

Network Manager - Applications



- **Network Manager/SCADA**

SCADA - Supervisory Control And Data Acquisition for monitoring and control of electrical networks

- **Network Manager /Transmission**

EMS - Energy Management System for advanced operation and planning of Generation/Transmission systems

- **Network Manager /Distribution**

DMS - Distribution Management System for efficient operation and analysis of MV & LV networks

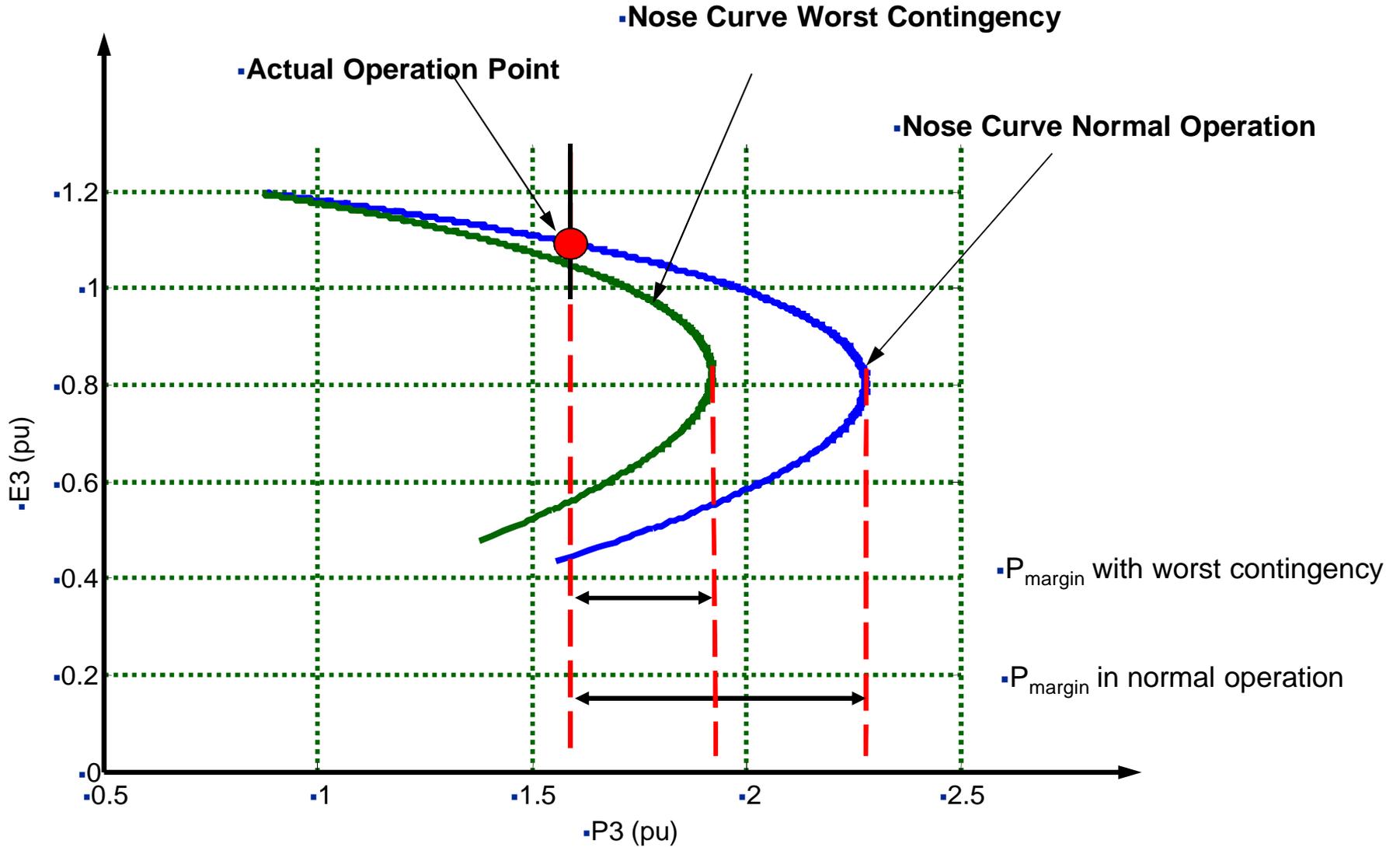
- **Network Manager /Generation**

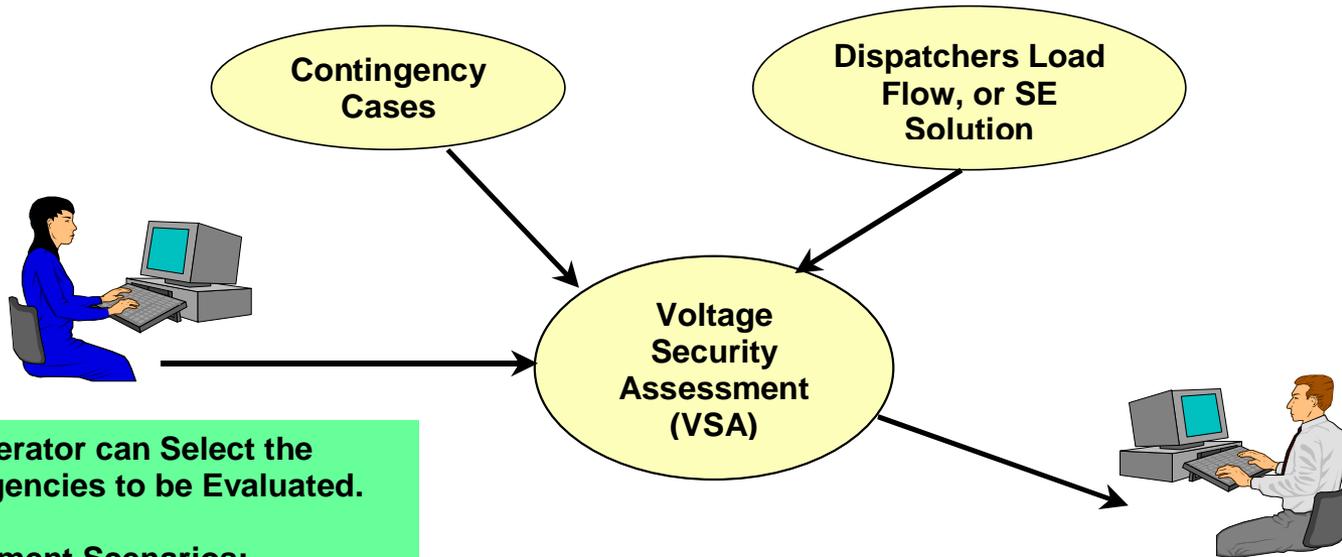
GMS - Generation Management System for advanced operation and analysis of generating power plants for GenCos

Voltage Security Assessment (VSA)

- Evaluates operational margin to voltage instability (Collapse)
- Evaluates Normal Operation and Contingency Cases
- Determines Critical operating Point (weak spots)
 - Critical voltages
 - Critical Reactive reserve
- Monitors Current operating point to critical values
- Evaluates Load increase and load/generation transfers
- Real Time and Study mode
- Determines Flowgate Limit to prevent Voltage collapse
- Performs periodic evaluation of margins
- P-V curve for current operation and worst contingency
- Detailed results for any selected point on the curve

VSA





The Operator can Select the Contingencies to be Evaluated.

Assessment Scenarios:

- Load Increase
- Generation Shift
- Load Decrease

Limit and Margin to Be Monitored:

- MW Load
- MW Generation
- Flowgate MW Flow

Critical Generating Units to be Monitored

Critical Busses to be Monitored

Results of the Voltage Security Assessment displayed:

- Operation Margin
- System Max and Critical MW Loads
- System Critical MVAR Reserve
- Max MW Generation Shift
- Basecase and Contingency Results Summary
- Base Case and Worst Case Critical Bus Analysis Results Summaries
- System P-Q Curve
- Bus P-V Curve and Critical Voltage
- Load Flow Circuit and Bus Results
- Load Flow Circuit Flow and Bus Voltage Violation Summaries

WS500 1 FATRAS Console: 1 Server: bsli03 Priority: 8 User: netmgr - [B_VSACMAIN STUDY 1 APPS Picture 1]

File View Tools Documents Window Help

Display Mode Operator Notes EMS Help First page Last page Page up Page down

AGC Trends Alm Sel Alm Ack FP Ack View SCADA Generation Control Production Planning Network Analysis DTS Alarm Lists

VSA: Main Menu

SMAP01

Case Title	Snapshot Date/Time	Day Type	Name Alias
VALID SE SOLUTION	13/Sep/2005 16:24:22	Weekday	Custom

	Selection	Contingency VSA	Detailed VSA Solution
Execution Status	Off	Off	Off
Time of Last Execution	24/Oct/2005 13:16:56	24/Oct/2005 13:26:17	17/Oct/2005 13:38:22
Completion Status	Valid	Valid	Valid

Summary of Contingency Voltage Stability Assessment * Load Values are gross (losses included)

Max System Load* (Pm), MW	12552.6	Base Case Load*, MW	9300.2
Critical System Load* (Pc-Margin), MW	11276.0	Base Case Reserve, MVAR	3164.7
Critical Reactive Reserve, MVAR	2278.2		

Worst Contingency Case Title Harris 91G 2301

Execute Contingency Selection Execute Contingency VSA

Detailed VSA solution for step Case

Study Scenario	MW Margin
LoadIncr	Load

Displays

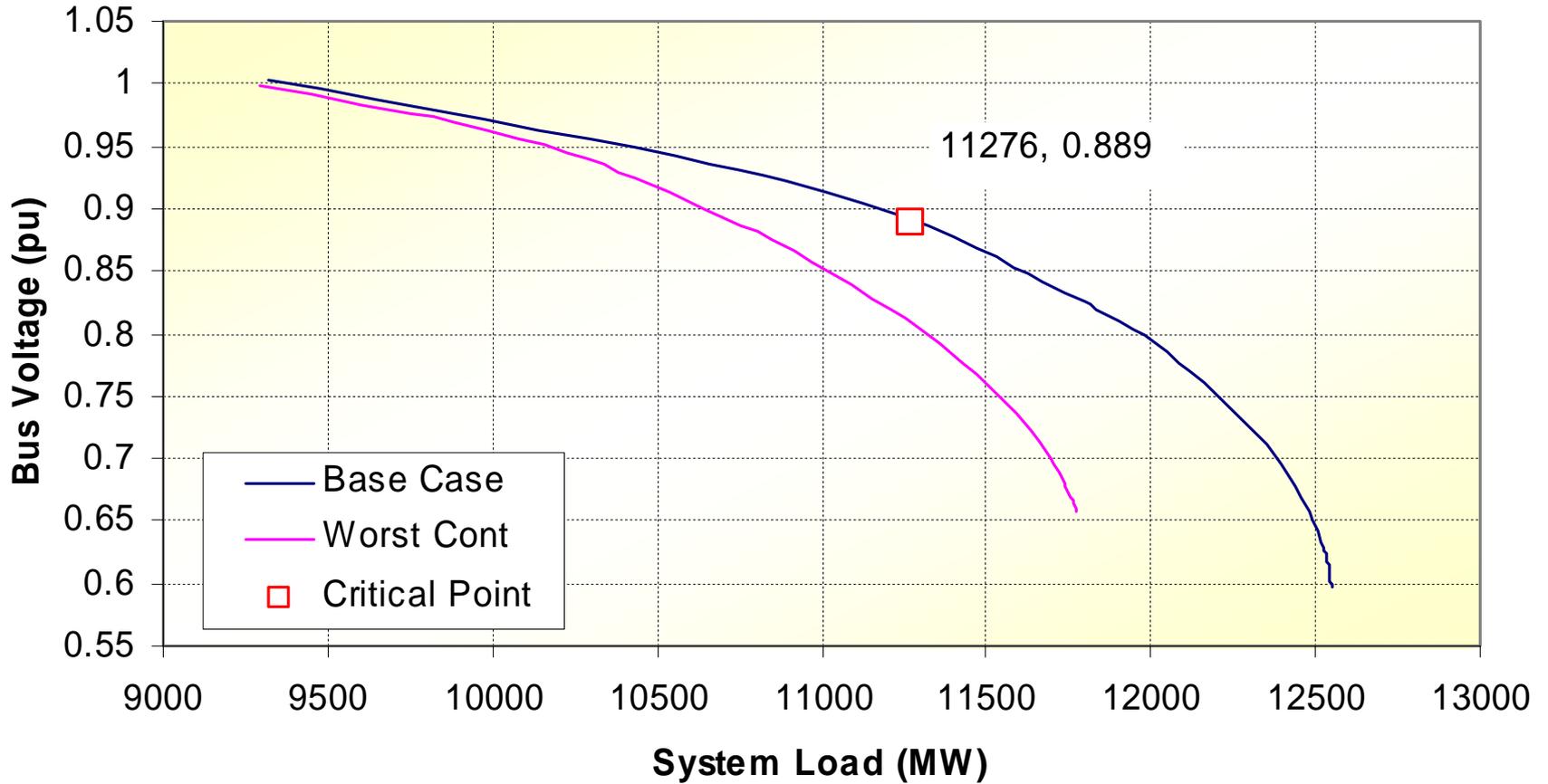
- Definition List
- Contingency Selection
- Contingency Group Information
- Area Factors
- Zone Factors
- Individual Load Factors
- Generator Unit Data
- BIG Point Data
- Tuning/Control Parameters
- Contingency Results Summary
- Busbar Data and P-V Curve Selection
- Flowgate Data and P-V Selection
- Lowest Voltage Buses
- Buses with Greatest Voltage Change
- Bus P-V Curve Results
- Base Case Critical Bus Analysis Results
- Worst Cont. Critical Bus Analysis Results
- Generation Control Area Data
- Load Flow Circuit Results
- Load Flow Bus Results
- Bus Voltage Violations
- Circuit Flow Violations

User Group Assignment VSA Menu SE Menu DLF Control CA Menu DFK6 DFK7 DFK8 DFK9 DFK10

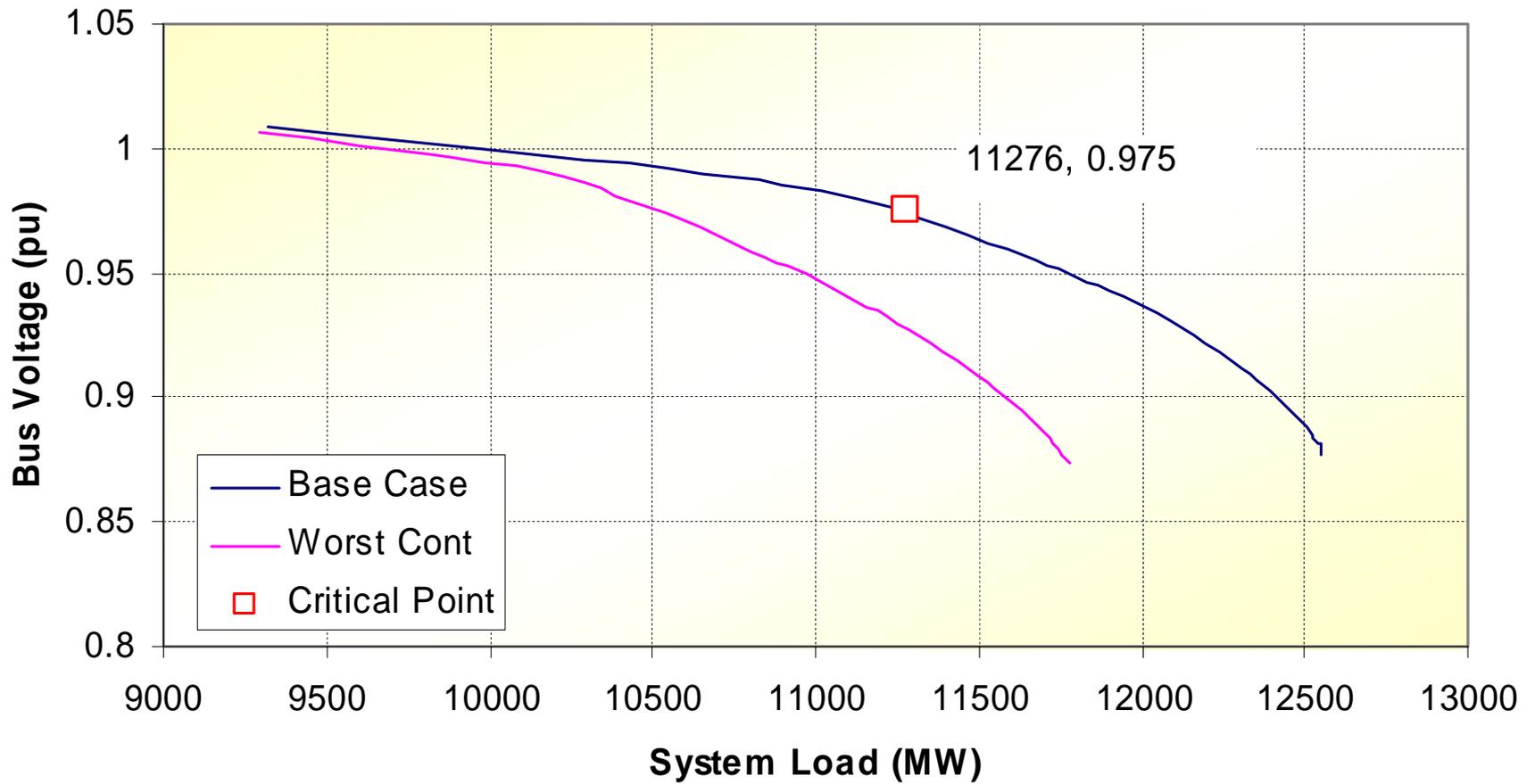
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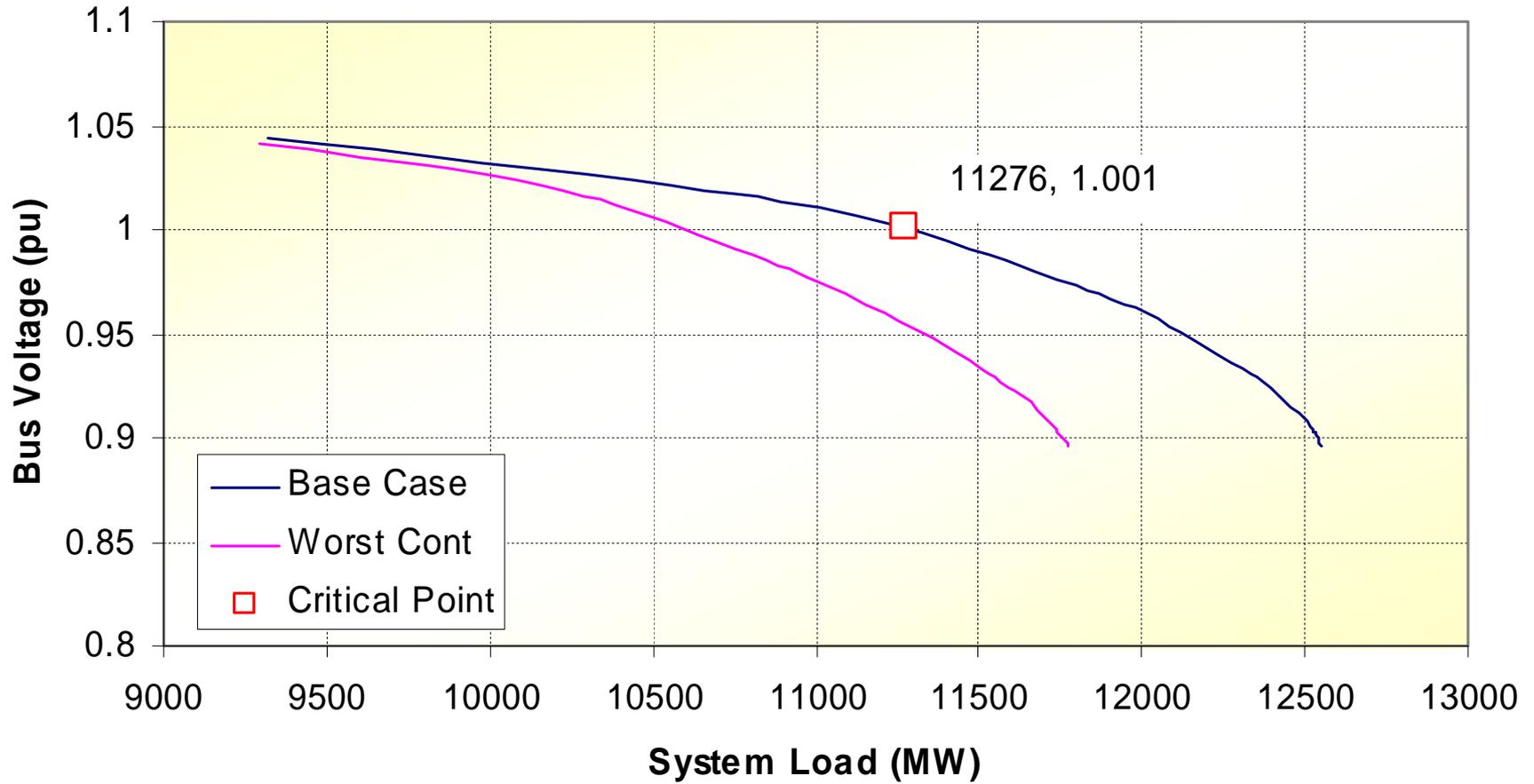
P-V Curves of Aurora Texasgulf 115 A

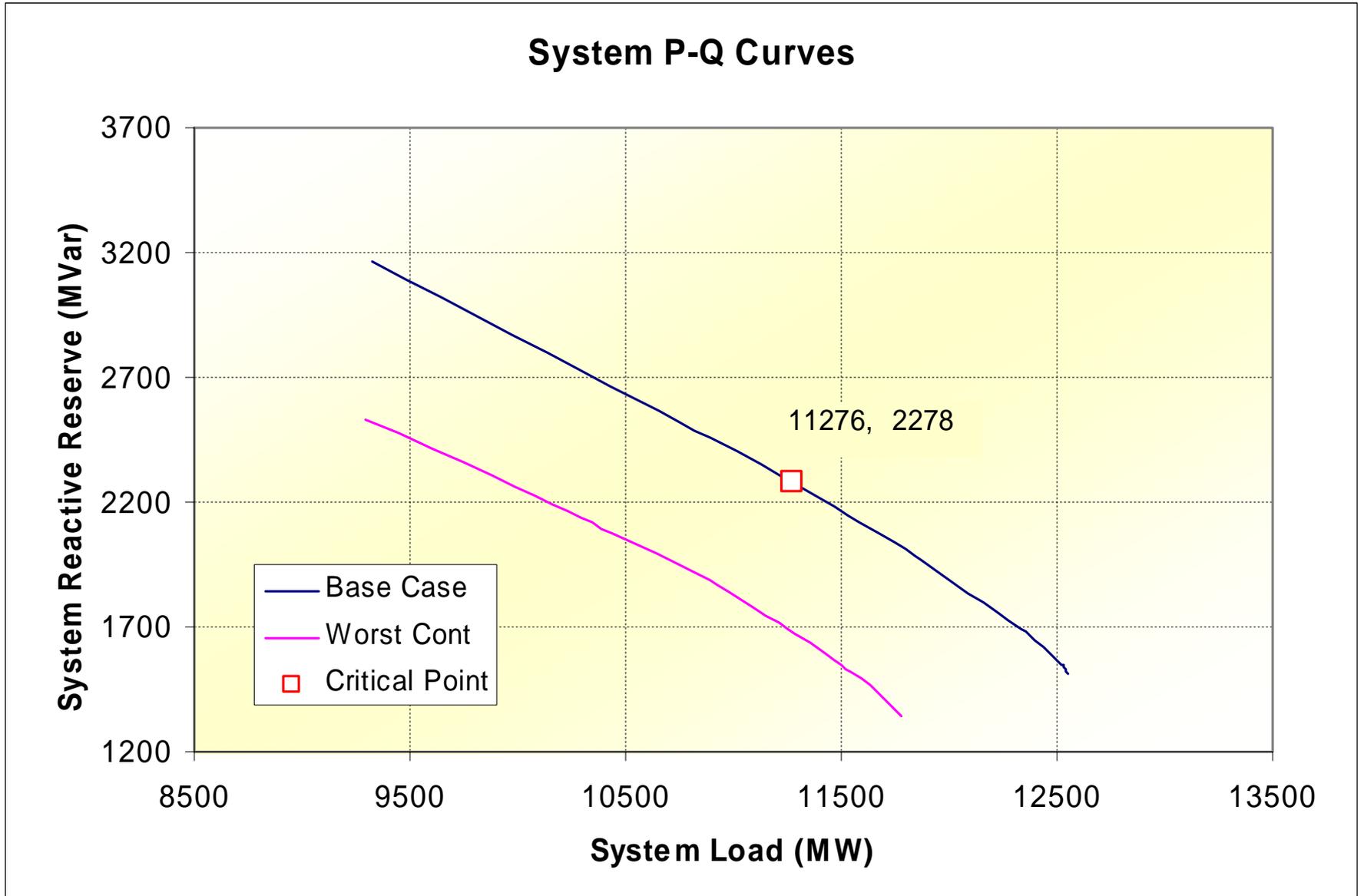


P-V Curves of New Bern 230 S



P-V Curves of Beaufort 115 A





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