Advanced On-line Voltage Stability Assessment

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Technical conference to discuss opportunities for increasing real-time and day-ahead market efficiency through improved software

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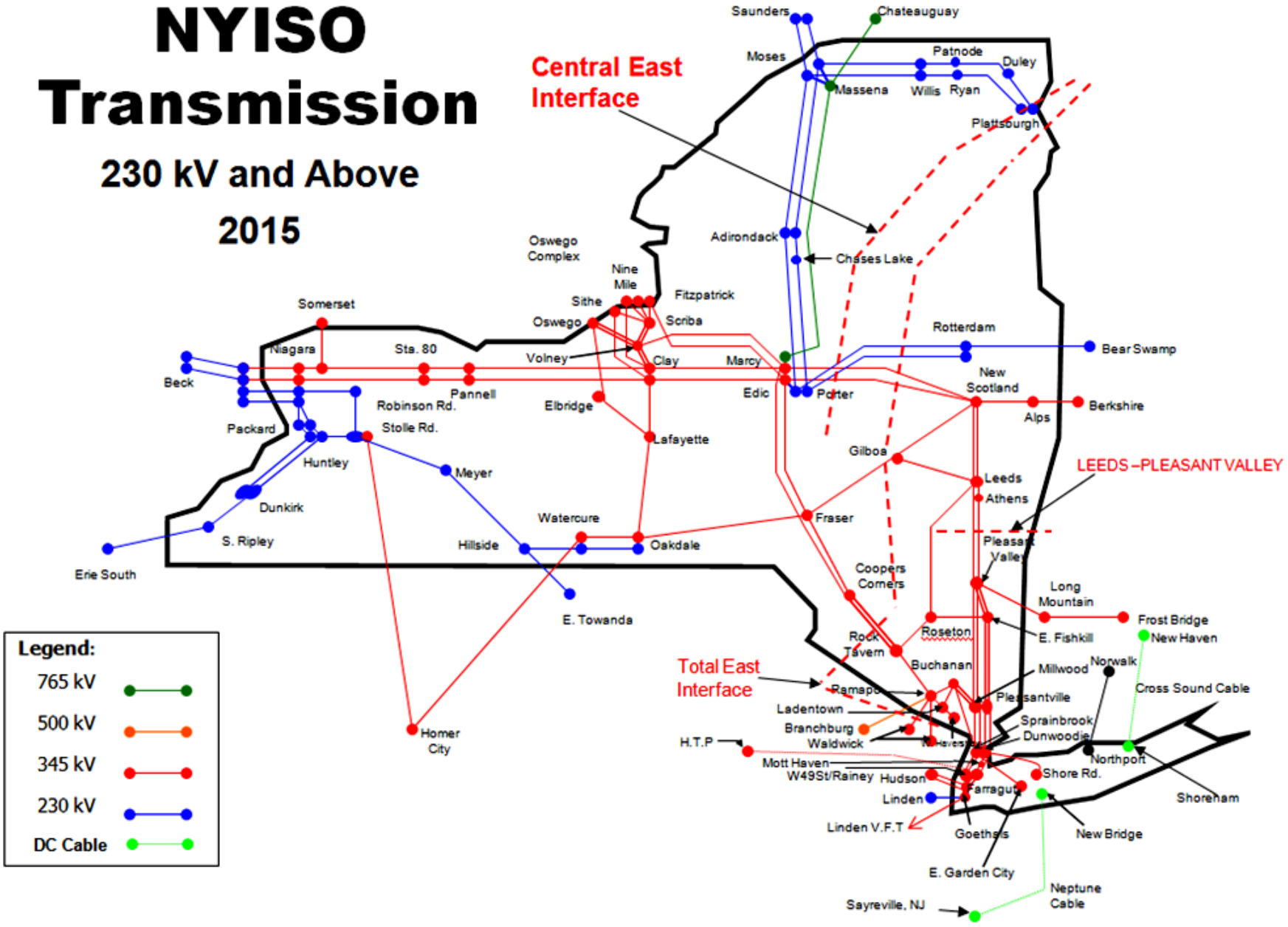
Presentation Overview

- Introduction
- NYCA Congestion Pattern
- Central East Voltage Collapse (VC) Transfer Limits – Offline Analysis
- Voltage Stability Assessment (VSA)
- Benefits of Real-time Calculated Margin

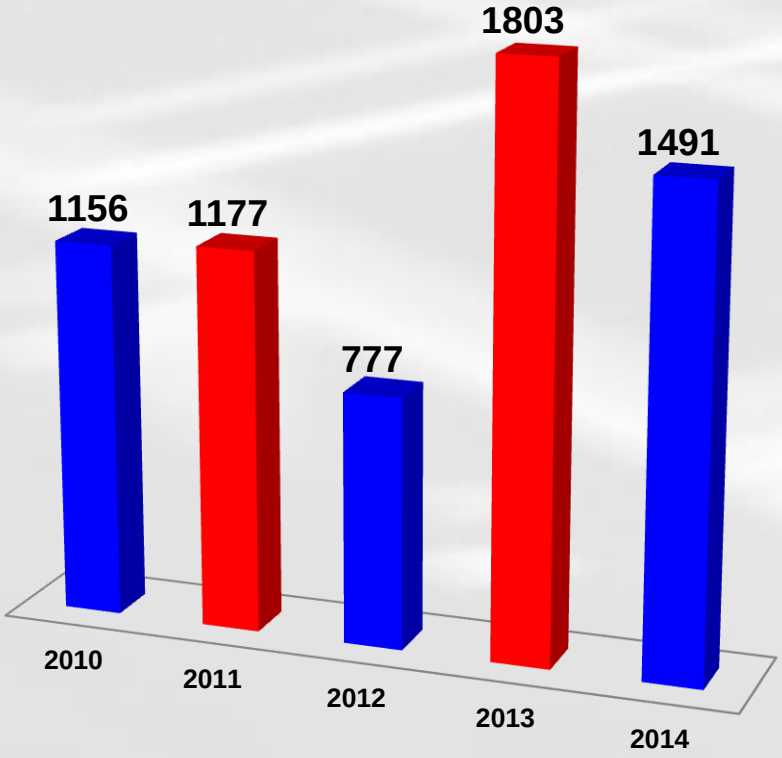
NYISO Transmission

230 kV and Above

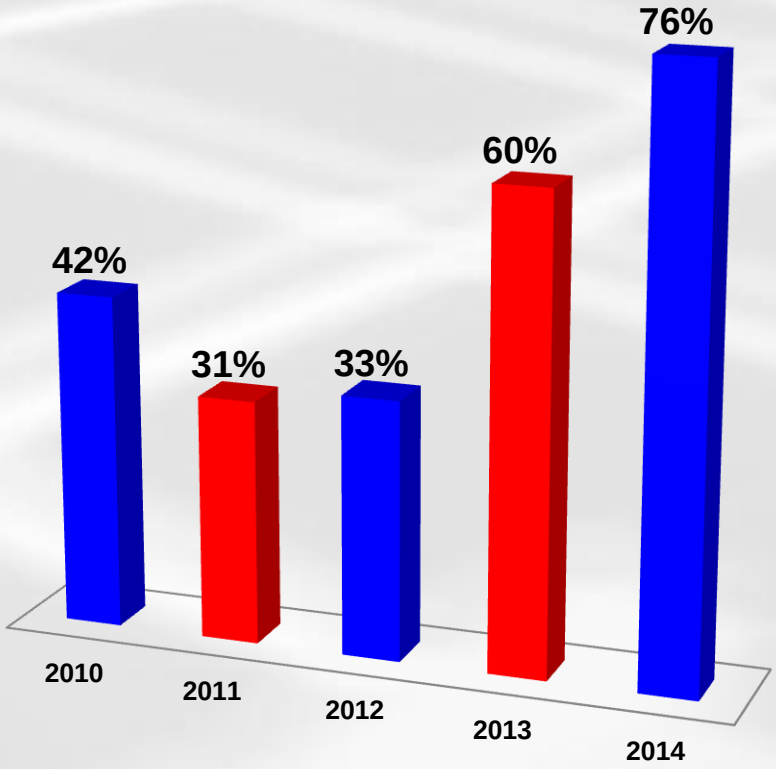
2015



NYCA Congestion($M) 2010-2014

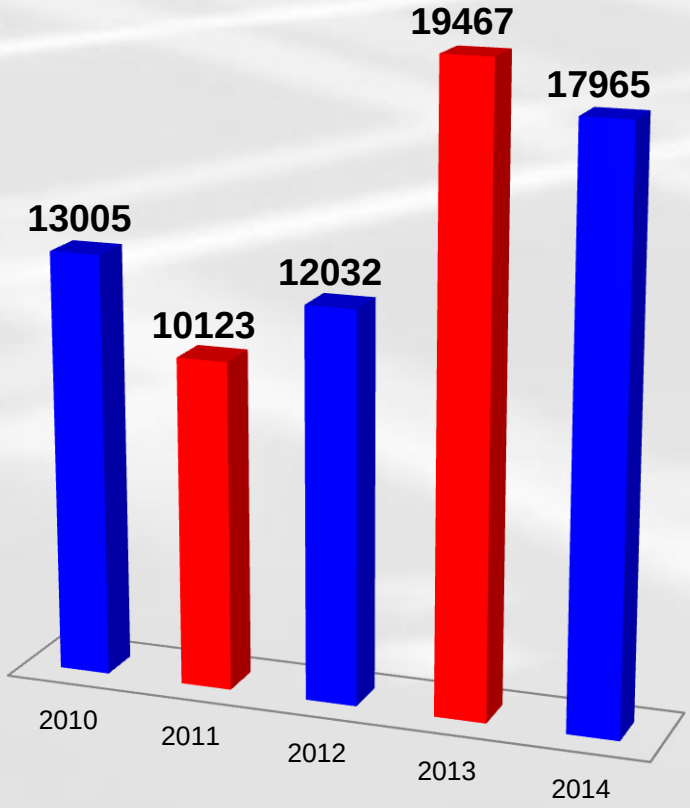


Total NYCA Congestion

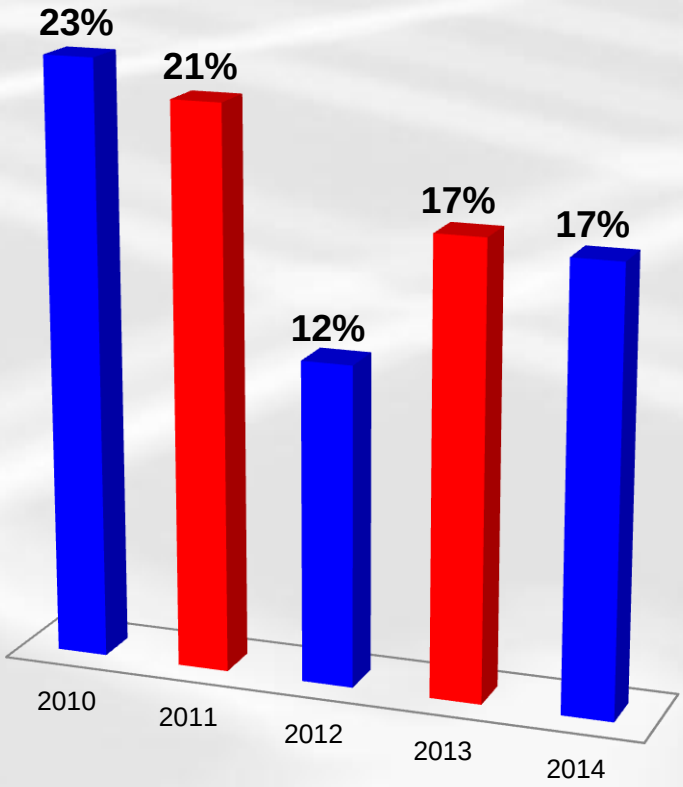


Percent Congested by Central East VC

Congested Hours



Total Congested Hours



Percent Congested Hours by Central East VC

Central-East Interface

Definition

Mohawk Valley (Zone E) – Capital (Zone F)		
Name	**Line ID**	**Voltage (kV)**
Edic-New Scotland	**14**	**345**
Marcy-New Scotland	**18**	**345**
Porter-Rotterdam	**30**	**230**
Porter-Rotterdam	**31**	**230**
East Springfield-Inghams	**942**	**115**
Inghams PAR	**PAR**	**115**
Inghams Bus Tie	**R81**	**115**
North (Zone D) – ISONE		
Plattsburgh-South Hero	**PV-20**	**115**

Central East VC Limit Development

Current Method

- Use PSS/E to conduct the off-line analysis
- Adjust base case dispatch to stressed conditions
- Simulate with various facilities in or out of service
  - *Major generating units*
  - *Major 345 KV circuits*
  - *All the 345 KV shunt devices*
- Record the incremental change limits for different outage conditions

Incremental Limit Change Table

- **All the Incremental Limit data for different scenarios is stored in a "look-up" table for Energy Market software Network Security Analysis applications (RTC & RTD)**
  - ***All line I/S limits***
  - ***De-rate limits for 345KV shunt devices***
  - ***De-rate limits for SVCs and STATCOM***
  - ***De-rate limits for major generator units O/S***
  - ***De-rate limits for particular transmission elements***

Samples of Central East VC Limits

SCENARIOS	LIMITS (MW)	TYPE
Cent-East_VC_14_O/S_[2 Osw]	2175	Absolute
Cent-East_VC_18_O/S_[3 Osw]	2090	Absolute
Cent-East_VC_2_Osw_2_Sithe_I/S	150	Generator Incremental
Cent-East_VC_Fraser_Cap#1_O/S	20	Incremental
Cent-East_VC_LEEDS_SVC_O/S_[3 Osw]	2950	Absolute
Cent-East_VC_Marcy_Statcom_O/S	50	Incremental

Central East VC – Proposed Method – Voltage Stability Assessment (VSA)

- Executes every 5 minutes in real-time
- It takes less than 20 seconds to complete the process
- Uses State Estimator solution as a base case
- Applies Continuation Power Flow (CPF) algorithm to evaluates Normal and Contingency Operations
- Evaluates Operational Margin to Voltage Instability
- Evaluates CA definitions

Voltage Stability Assessment – Output

- Central East-VC interface limits
- Critical Operating Point for Base Case and Worst Contingency Cases
  - *Active reserve MW margin*
  - *Reactive reserve MVAR margin*
- Critical station voltages
- P-V curve for current operation and Worst Contingency
- Stores limits in PI for bench mark and comparison
- Limit for BMS applications (RTC & RTD) - future

P-V Curve

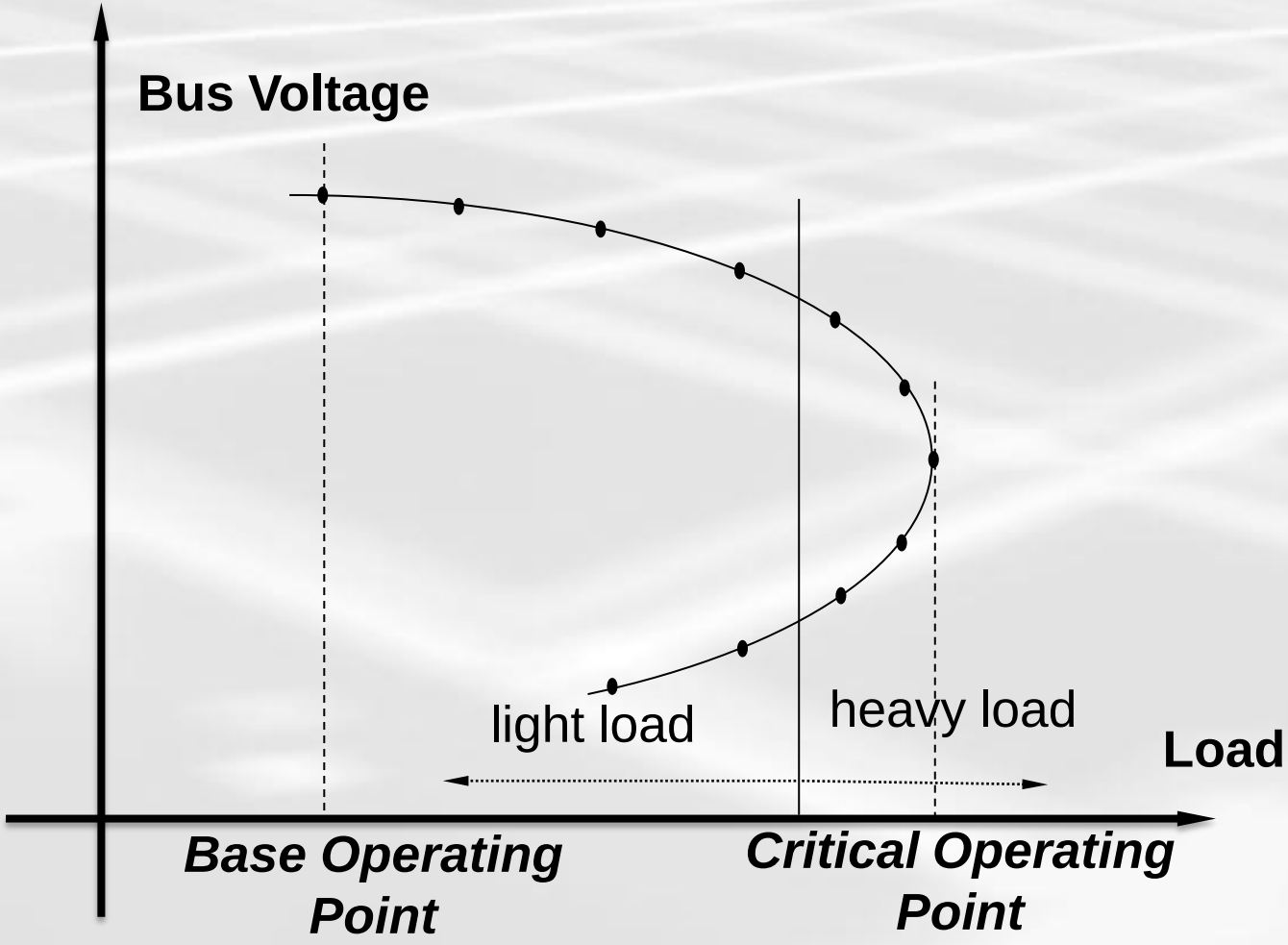


Figure 1 A continuum of power flow solution

Continuation Power Flow Overview

- ***Well conditioned around and at the critical point. Results used to identify the weak bus most prone to voltage collapse.***
- ***The general principle behind the CPF is a prediction-correction scheme on a reformulated power flow equation that includes the load parameter.***

Prediction/Correction Scheme

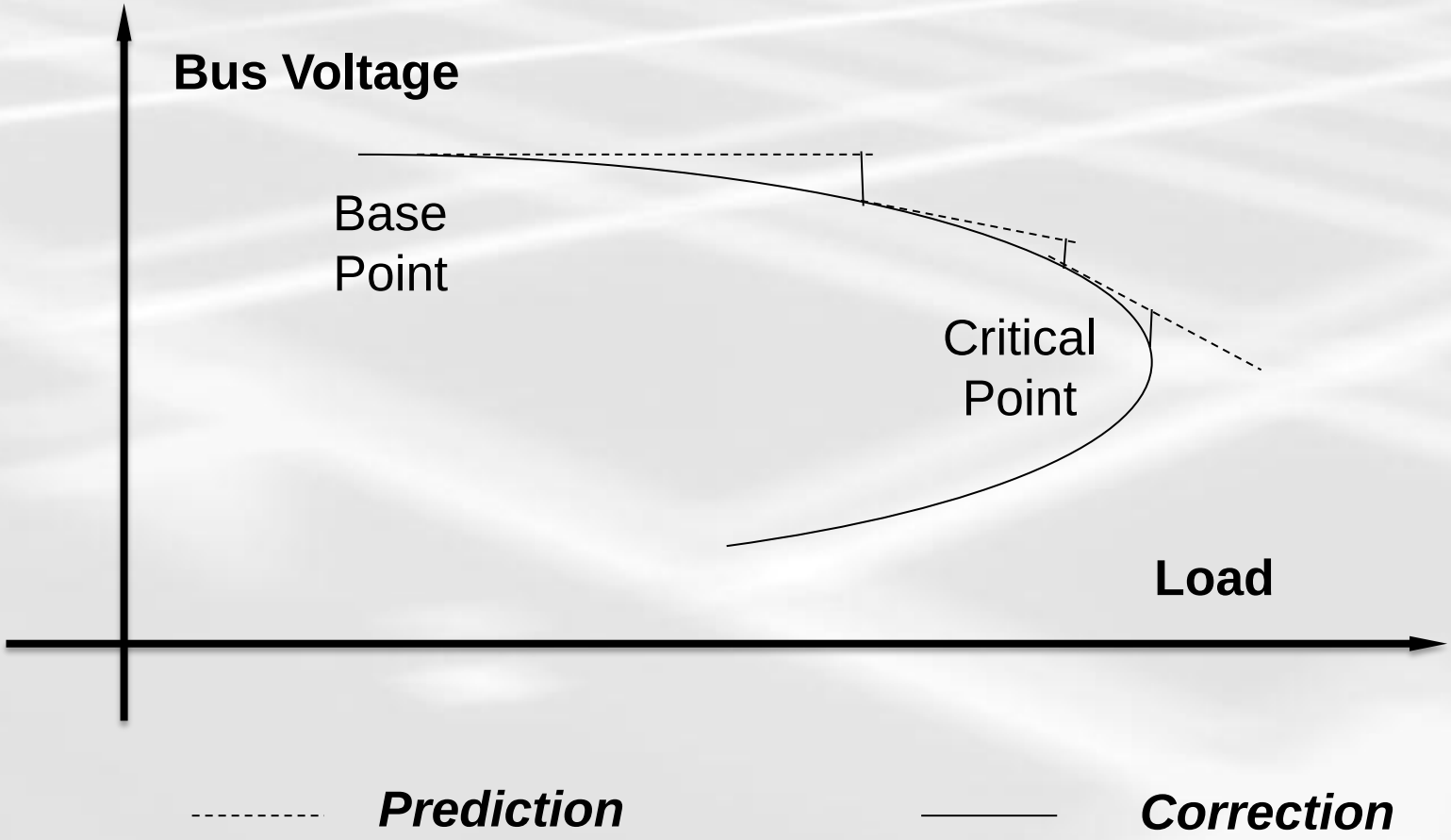
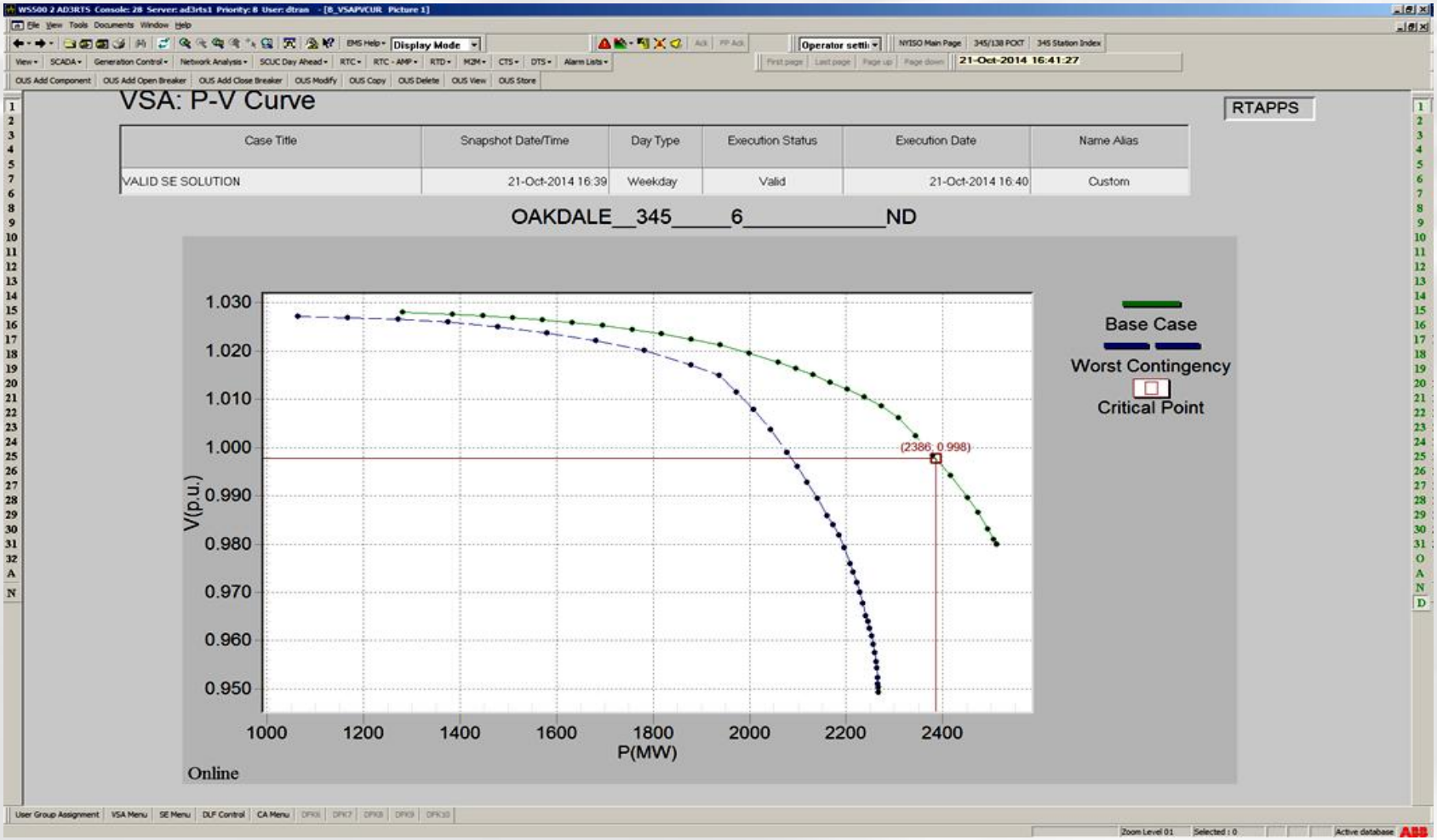


Figure 2 Illustration of the Prediction/Correction Scheme

Sample of the PV Curve



Benefit of Proposed Method

- **VSA Limits are determined based on the current network topology rather than off-line analysis**
- **Explore potential improvement on Network Security Analysis to utilize Central East VC limit directly from the VSA's output**
- **Explore potential improvement on the efficiency of the Real Time Commitment (RTC) and Real Time Dispatch (RTD) functions**

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