Integrating Voltage Stability Applications into EMS

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A success story...

Manu is not here at Naspi !!
Our Vision

- **Traditional Model-Based Analysis (EMS)**
  - Other EMS Applications
  - SCADA & Alarms
  - State Estimator
  - Small Signal Stability
  - Transient & Voltage Stability
  - Island Management

- **PMU Measurement-Based Analysis (PhasorPoint)**
  - WAMS
  - State Measurement
  - Oscillation Monitoring
  - Stability Monitoring & Control
  - Island Detection, Resynchronization, & Blackstart

- **New Applications**

- **Control Center - PDC**

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**Hybrid Approach to Voltage Stability Assessment**

*“Measurement-based” Voltage Stability Indicators* identify potential stability problems, and include:

- **Wide Area Voltage “Composite” Alarms**: Identify low voltage violations simultaneously detected over a broad area.

- **Voltage Sensitivities**: Assess voltage degradation (i.e. kV/100MW) with increased MW loading bases on operating P-V locus.

- **Reactive Reserves**: Monitor available MVAR reserves in an area (i.e. all capacitors/reactors and units within a sub-network of the power grid).

- **Advanced Metrics (Voltage Instability Predictor, SVD)**: Other indicators based on key properties associated with voltage collapse phenomenon (such as singularity or maximum loadability). *(FUTURE)*

*“Model-based” Voltage Stability Analysis* to evaluate:

- **MW Margins** to potential voltage violation or instability.

- **Weak elements** within the network that will be impacted during a voltage instability.

- **Critical contingencies** responsible for the voltage stability violation.

- **Corrective Actions** to mitigate away from an impending instability.
Online Stability Solution – System Architecture

PMU & RTU

Aggregation

Applications

Wide Area Visualisation

PMUs

RTUs

PHASORPOINT PDC Family

Application Services

Historian

Synchrophasor Framework

Energy Management System

Dynamic Security Assessment

e-terraplatform

e-terrastability

e-terra transmission

DSAtools VSAT

e-terra generation

DSAtools TSAT

e-terra simulator

DSAtools SSAT

e-terra archive

PowerTech

PhasorPoint Workbench

e-terravision

e-terrabrowser
On-Line Voltage Stability Assessment
Integrated “measurement-based” and “model-based” analysis

Real-time $P-V$ locus (and voltage sensitivities) based on PMU measurements.

$\Rightarrow$ monitor current operating condition

MW Margins are computed in real-time using “model-based” Voltage Stability Assessment Tools (VSAT).

$\Rightarrow$ identify proximity to voltage stability violation

Dynamic limit
Comprehensive Voltage Stability Alarms
Linking WAMS “Wide-Area” Low Voltage Alarms to Operator Guides in EMS

WAMS Composite Alarms

WAMS indicate the simultaneous occurrence of Low Voltage over a broad region.

Operator Guides in EMS

Decision making:
Operator Guides (e.g. “Switch On Capacitor Banks”).
Arm Special Protection Schemes

Reactive Reserve Monitoring in EMS

Reactive Reserve (MVAR) monitoring for user-defined areas in EMS.
Voltage Security Assessment Visualization

Voltage Contours, MW Margins, Weak Elements, Remedial Actions
Regional Reactive Reserves
Where are the Vars?

Select region of interest to identify available VAR resources

Detailed summary of existing resources within chosen region
7. Specific Design and Functionality Questions – 1 hr
- Scalability
- Communication
- Logging
- Remote Configuration
- Configuration Management
- Standards Compliance
- Handling redundant data streams
- Failover / Disaster Recovery
- Local storage / buffering
- Platform requirements
- Visualization customization
- Interoperability

• Design for interoperability
• Integration (APIs) with other systems (EMS/SCADA, power analysis apps, etc)

Thank You

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