MITSUBISHI ELECTRIC

Changes for the Better

The 7th Annual University of Pittsburgh Electric Power Industry Conference

"The Power to Innovate: Shining a Light on Clean Energy Solutions & Grid Integration"

November 12 and 13, 2012
Pittsburgh Athletic Association
4215 Fifth Avenue, Pittsburgh

Presentation
November 12, 2012
11:00 AM Session

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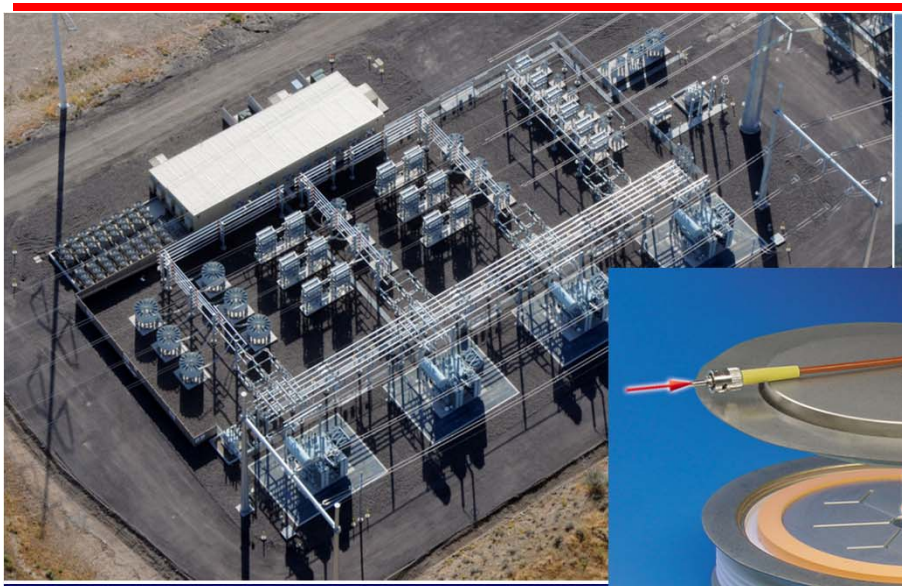
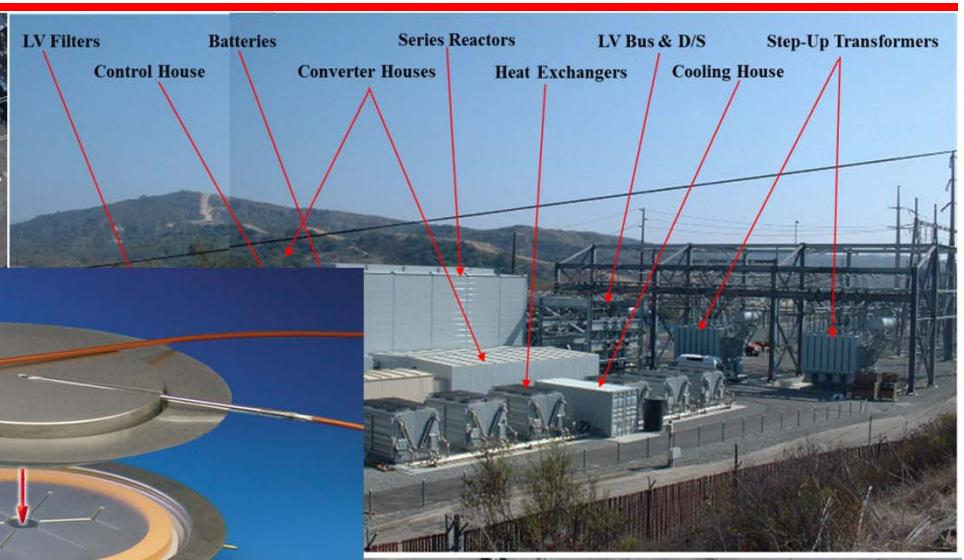
Manager, PSES

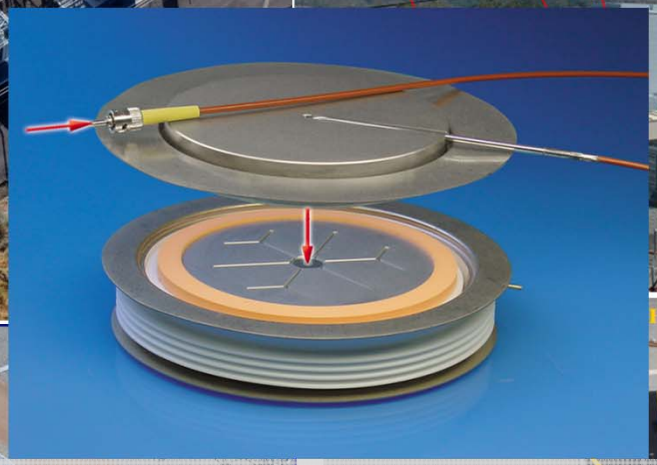
Outline of Presentation

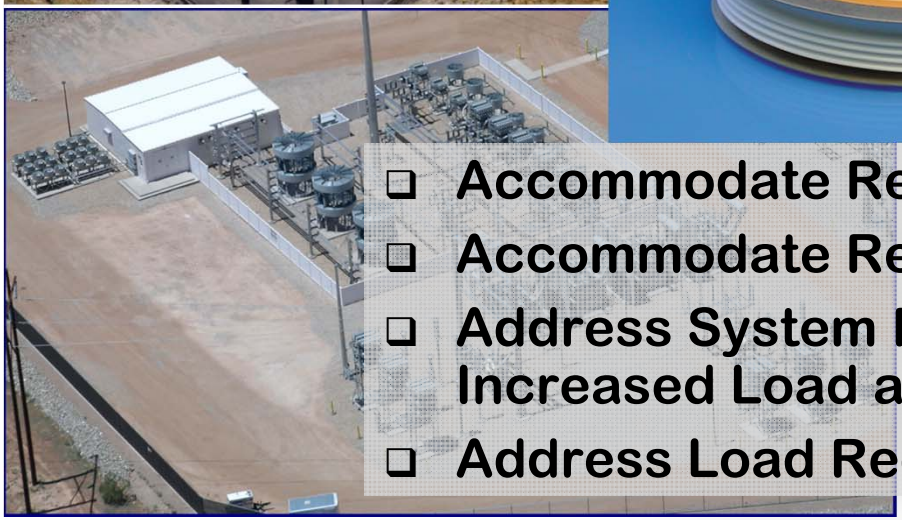
- Application Issues
- What Software is Used?
- Can I Trust Those Results?
- Future Considerations

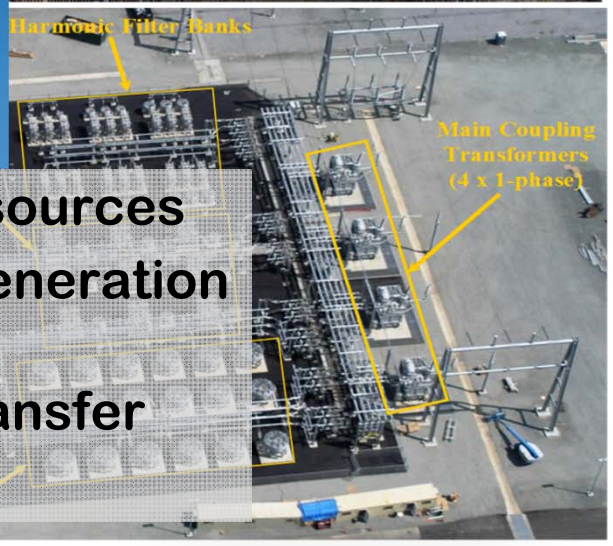
Application Issues





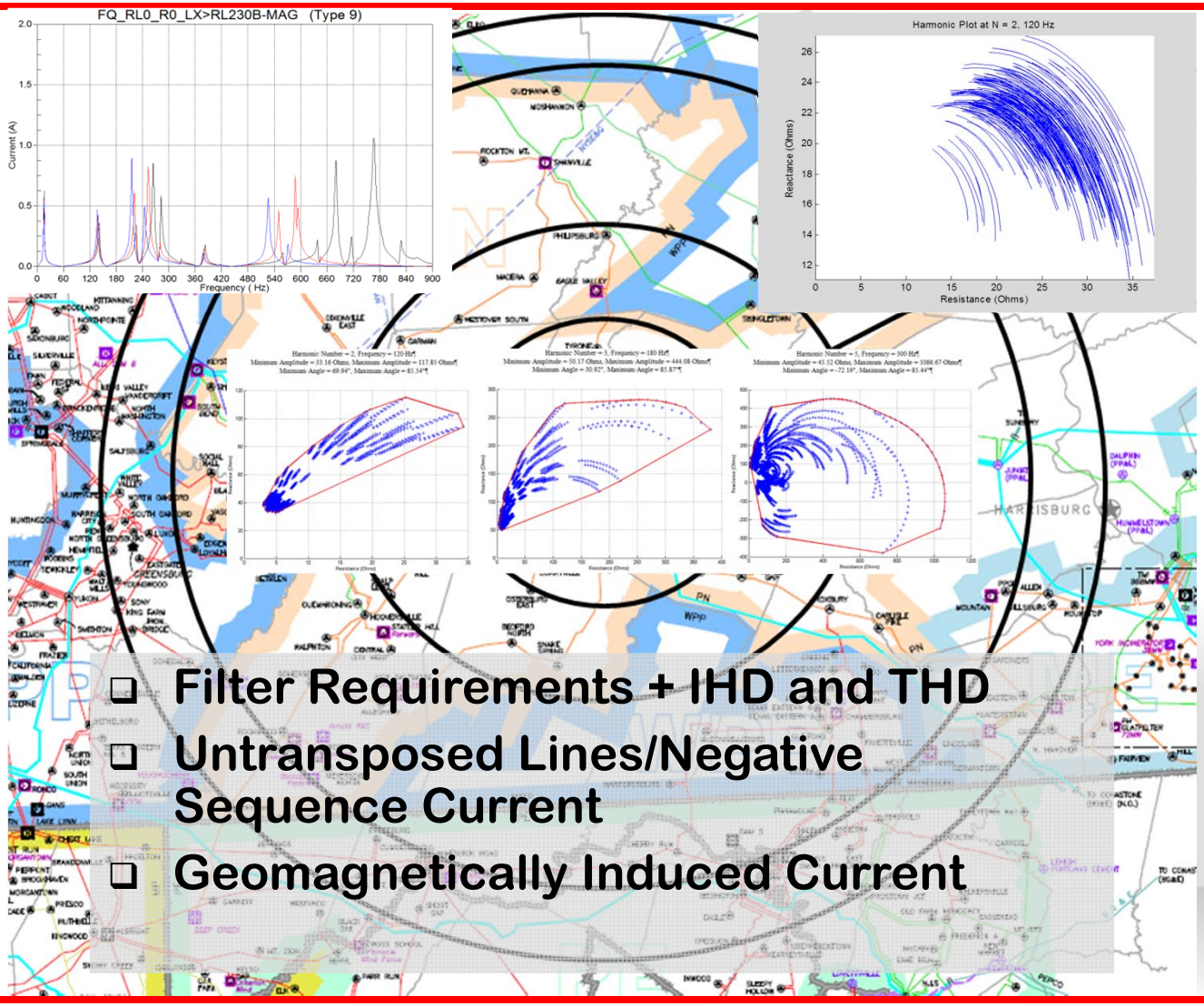






- Accommodate Renewable Resources
- Accommodate Retired Bulk Generation
- Address System Reliability for Increased Load and Power Transfer
- Address Load Requirements

Application Issues



- Filter Requirements + IHD and THD
- Untransposed Lines/Negative Sequence Current
- Geomagnetically Induced Current

Application Issues

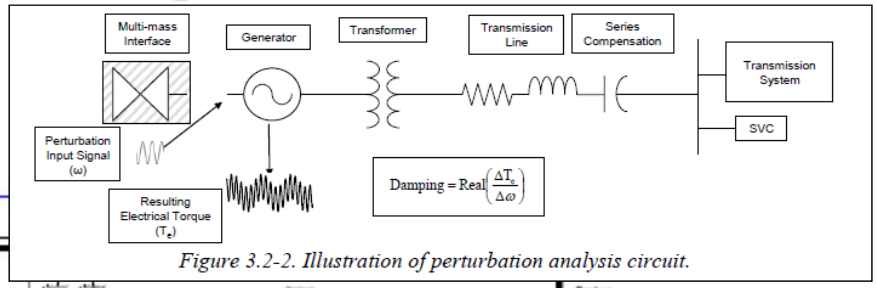
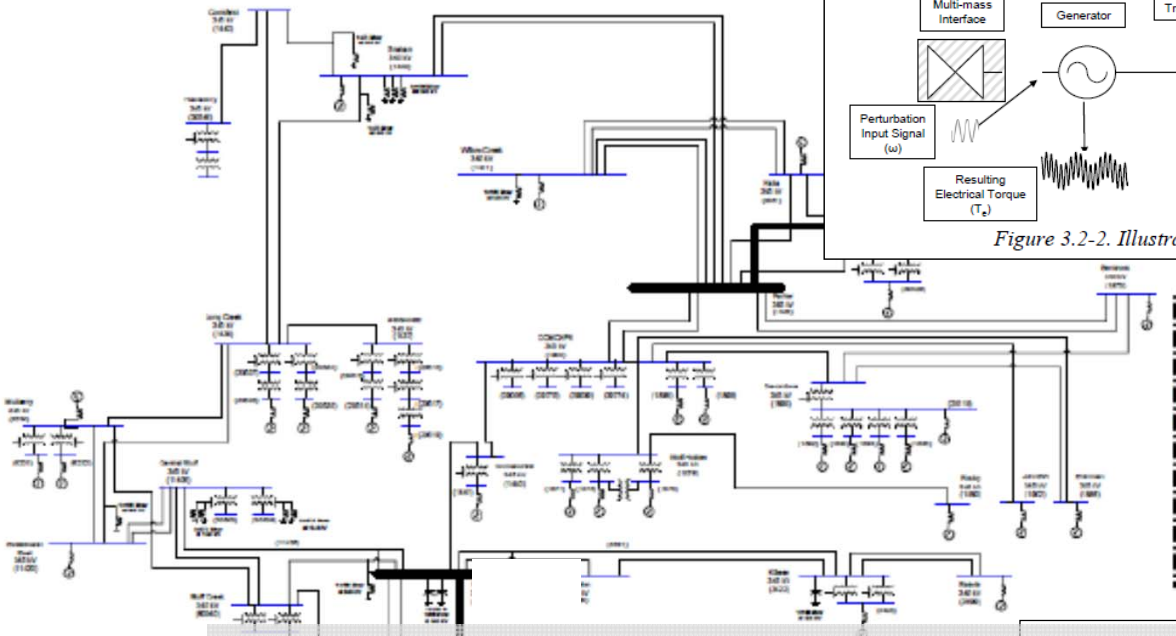
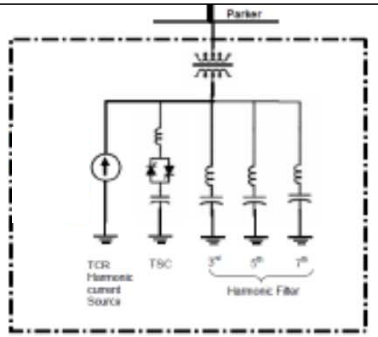


Figure 3.2-2. Illustration of perturbation analysis circuit.





(SVC-3)

- Multiple SVC Interaction
- SVC – Turbine Generation Interaction
- SVC – Wind Generation Interaction
- SVC – HVDC Interaction
- SVC – Series Capacitor Interaction

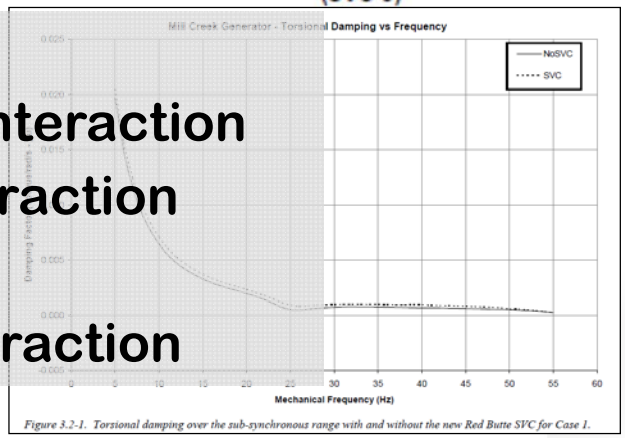
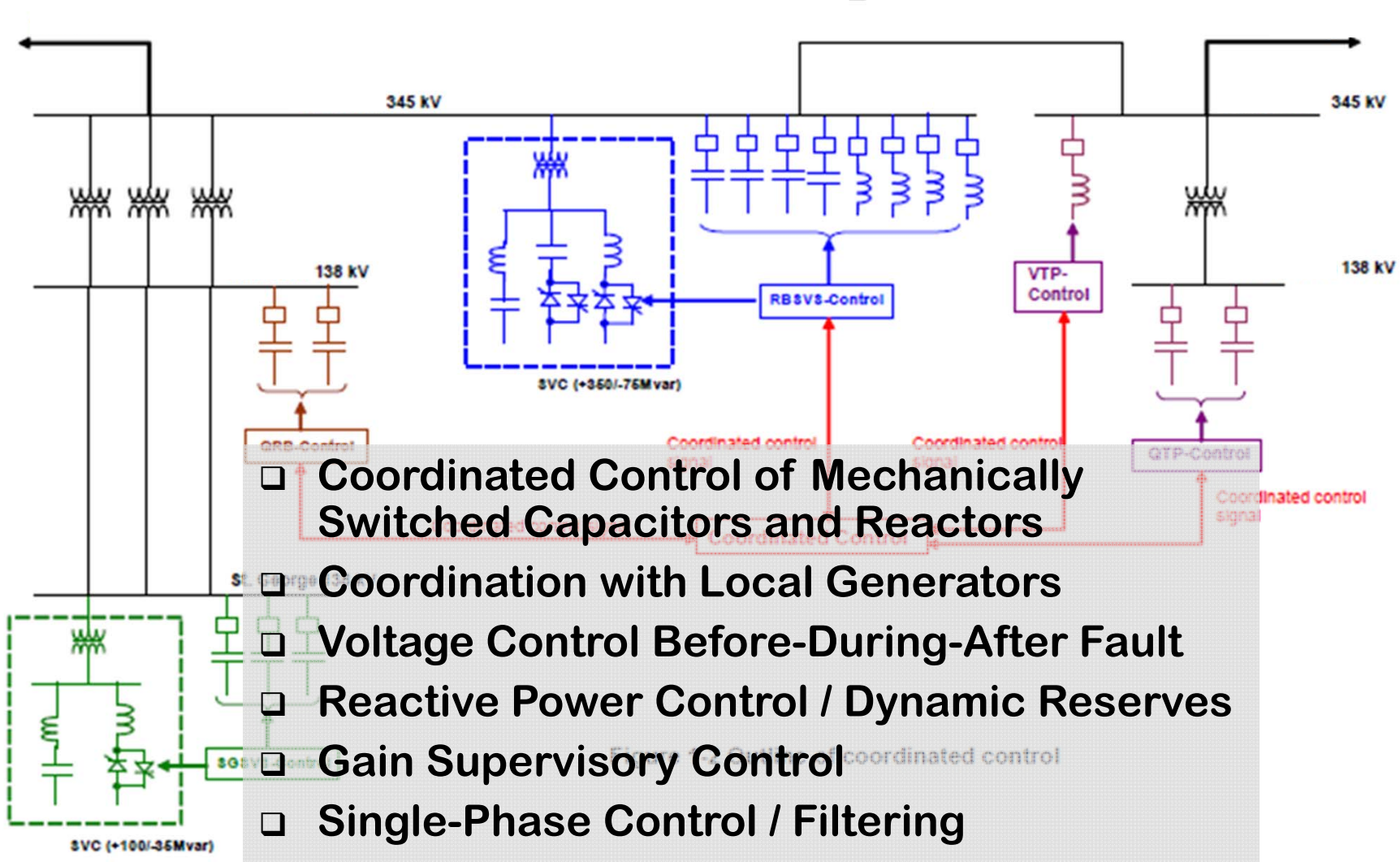


Figure 3.2-1. Torsional damping over the sub-synchronous range with and without the new Red Butte SVC for Case 1.

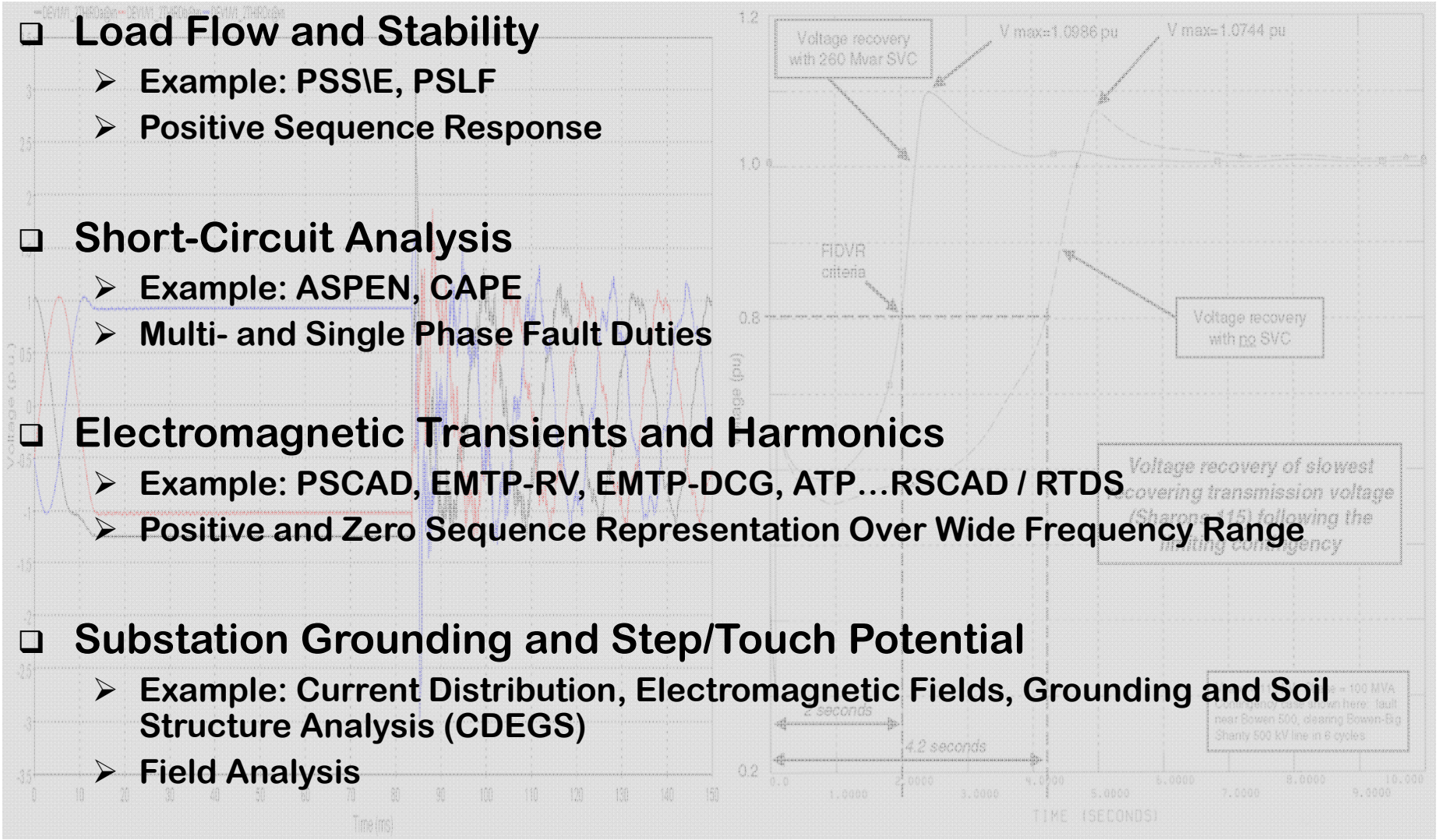
Application Issues



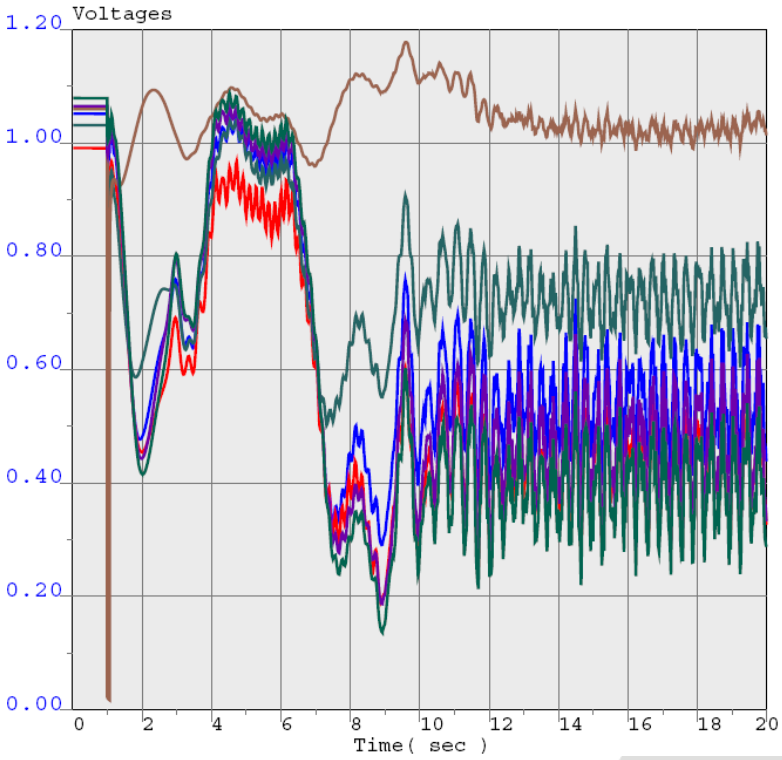
- Coordinated Control of Mechanically Switched Capacitors and Reactors
- Coordination with Local Generators
- Voltage Control Before-During-After Fault
- Reactive Power Control / Dynamic Reserves
- Gain Supervisory Control
- Single-Phase Control / Filtering

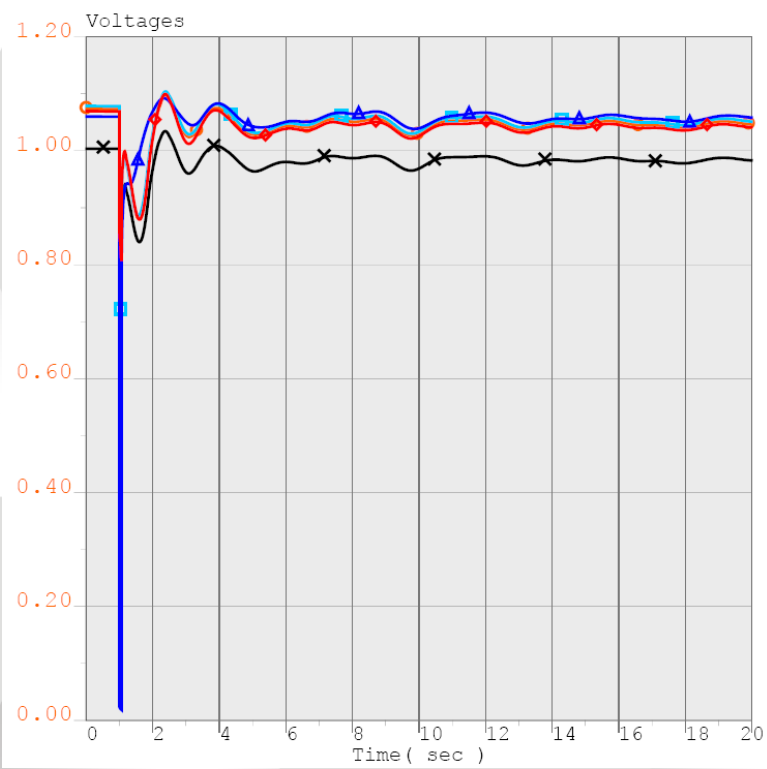
What Software is Used?

- **Load Flow and Stability**
  - Example: PSS\E, PSLF
  - Positive Sequence Response
- **Short-Circuit Analysis**
  - Example: ASPEN, CAPE
  - Multi- and Single Phase Fault Duties
- **Electromagnetic Transients and Harmonics**
  - Example: PSCAD, EMTP-RV, EMTP-DCG, ATP…RSCAD / RTDS
  - Positive and Zero Sequence Representation Over Wide Frequency Range
- **Substation Grounding and Step/Touch Potential**
  - Example: Current Distribution, Electromagnetic Fields, Grounding and Soil Structure Analysis (CDEGS)
  - Field Analysis



Can I Trust Those Results?





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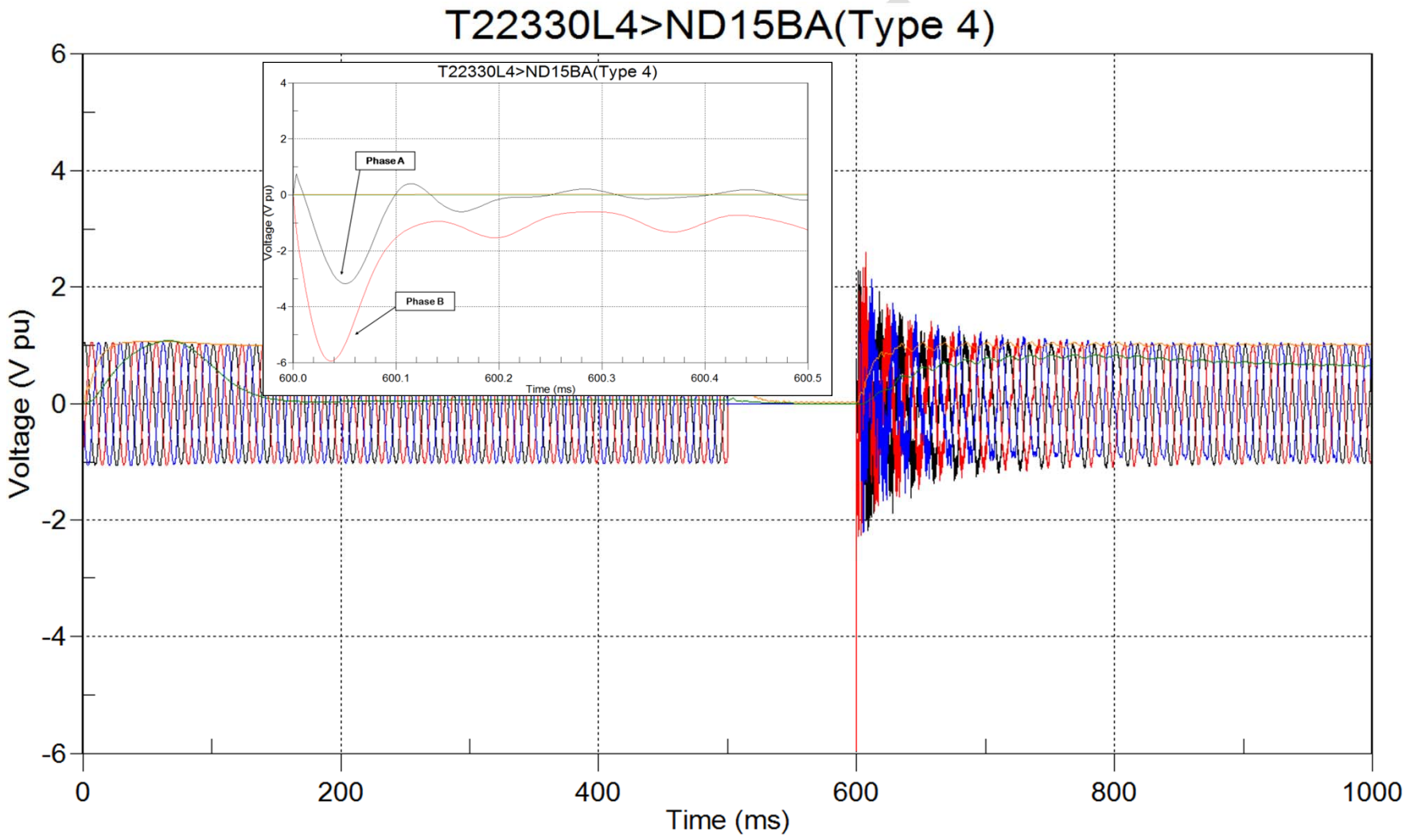

Future Considerations

- Data for Custom Devices and Interface…And Existing Devices
- When Transmission and Load Phenomena Meet
- RTDS, PSCAD, and PSLF / PSS\E
- What Do We Do With All That Data?

Based on Discussion with a Few Planners:

(1) Generation dispatch in market environment
(2) Generation retirements/aging and coal vs gas
(3) Unforeseeable characteristics of new loads and motor load
(4) Voltage control during light-load conditions
(5) Integration of renewable resources
(6) Cooling water issues for remote generation in desert areas
(7) Urban areas/Right-of-Way/Land and Deliverability

Thank You for Your Attention