San Diego Gas & Electric Transmission Synchrophasor Project

Tariq Rahman, Dan Eklund, Subbu Sankaran (SDG&E)

Jared Bestebreur (SEL)

SDG&E Overview

- Subsidiary of Sempra Energy
- Regulated public utility
- Provides safe and reliable energy service to
  - 3.4 million consumers
    - ➤ 1.4 million electric meters
    - ➤ 868,000 natural gas meters
- 4,100 square mile service territory in San Diego and southern Orange Counties (27 cities)

- 1,800 miles of electric transmission lines and 21,600 miles of electric distribution lines
- Two compressor stations, 160 miles of natural gas transmission pipelines, 8,100 miles of distribution pipelines and 6,200 miles of service lines
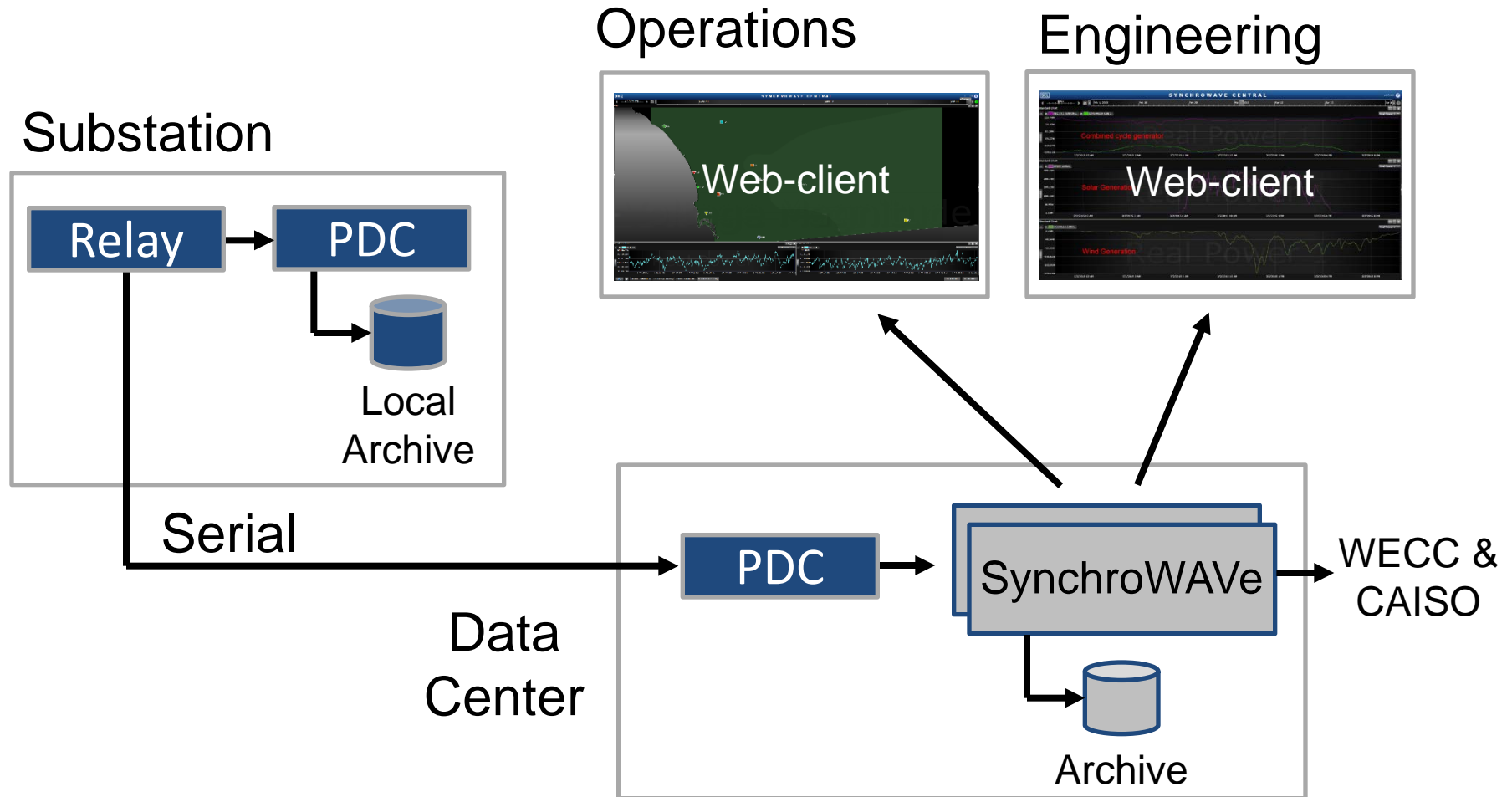- 4,500 employees

Key Implementation Facts

- 103 PMUs Installed

- Leveraged existing protection relays

- > 99.9% Availability

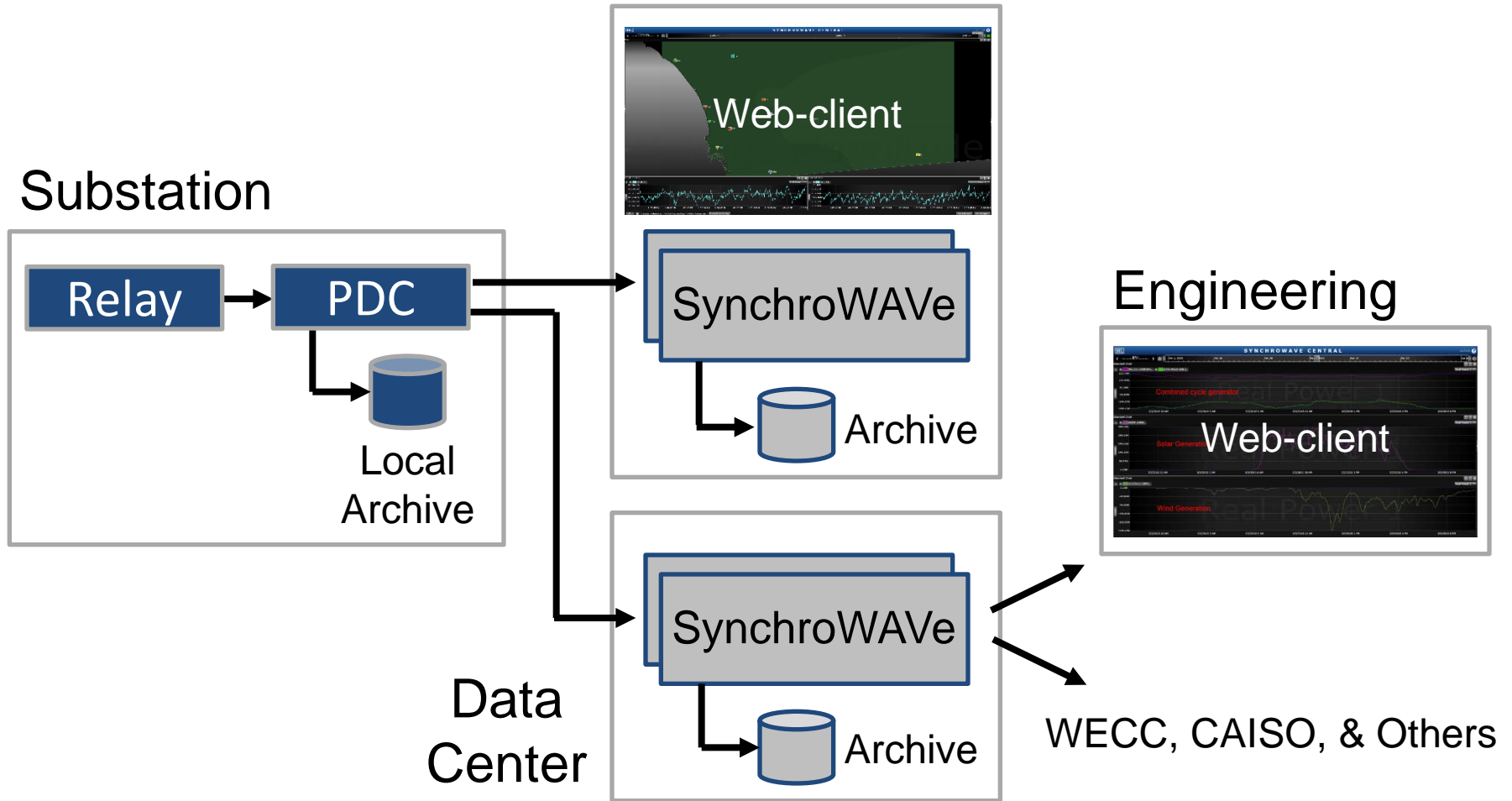- < 100ms average latency

Complete 230kV & 500kV Coverage

Current Architecture

Operations

Engineering

Substation

| Relay | → | PDC |

Local Archive

Serial

Data Center

PDC → SynchroWAVe → WECC & CAISO

Archive

Future Architecture

Operations

Substation

Engineering

Relay → PDC

PDC → Local Archive

Web-client

SynchroWAVe → Archive

Web-client

Data Center

SynchroWAVe → Archive

WECC, CAISO, & Others

Challenges Facing SDG&E

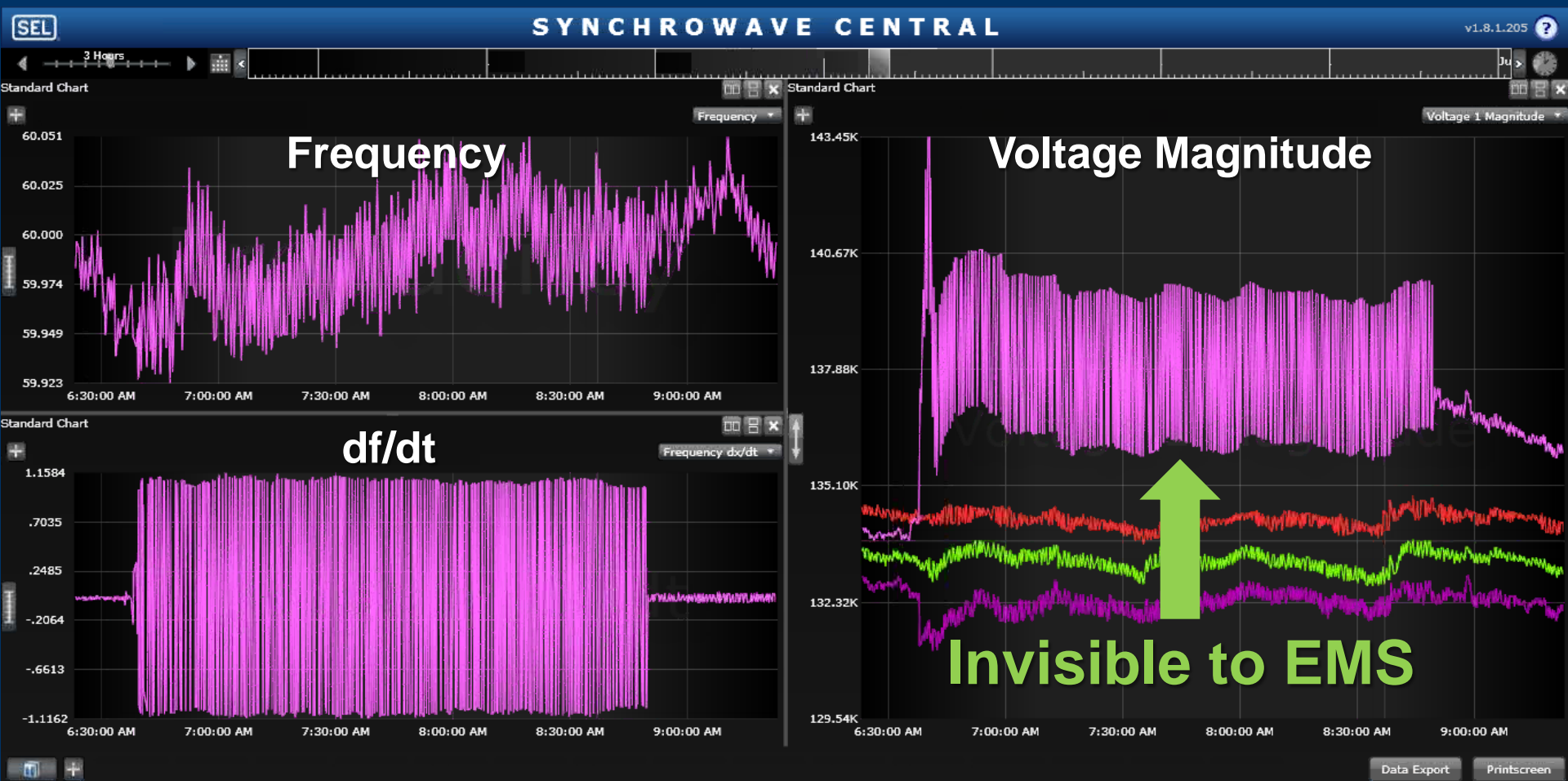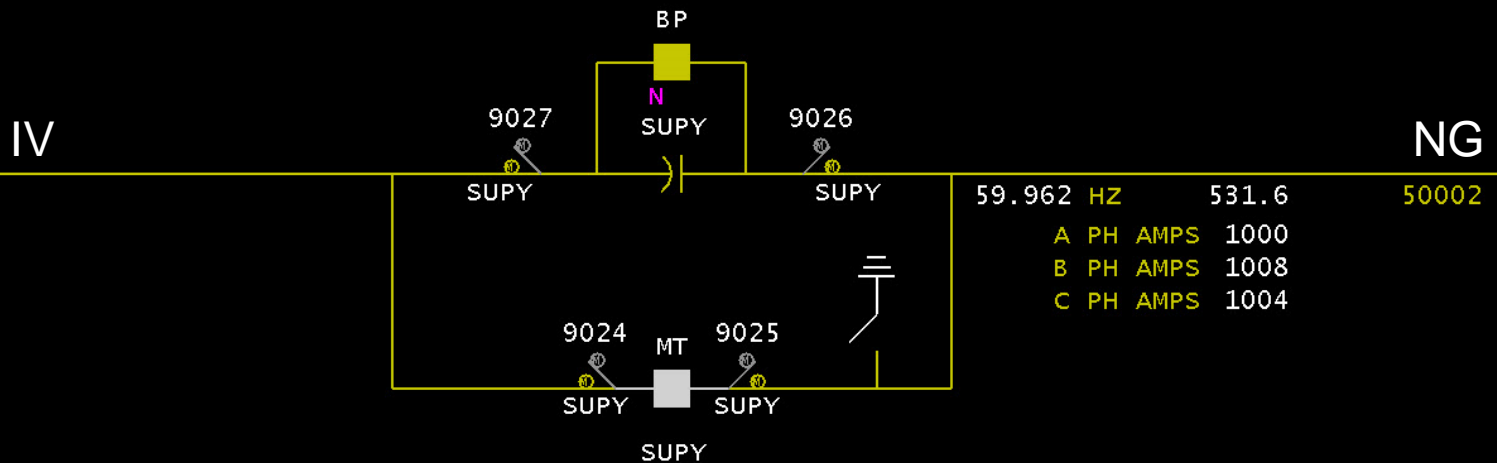# Effect of Renewables on Grid Operation
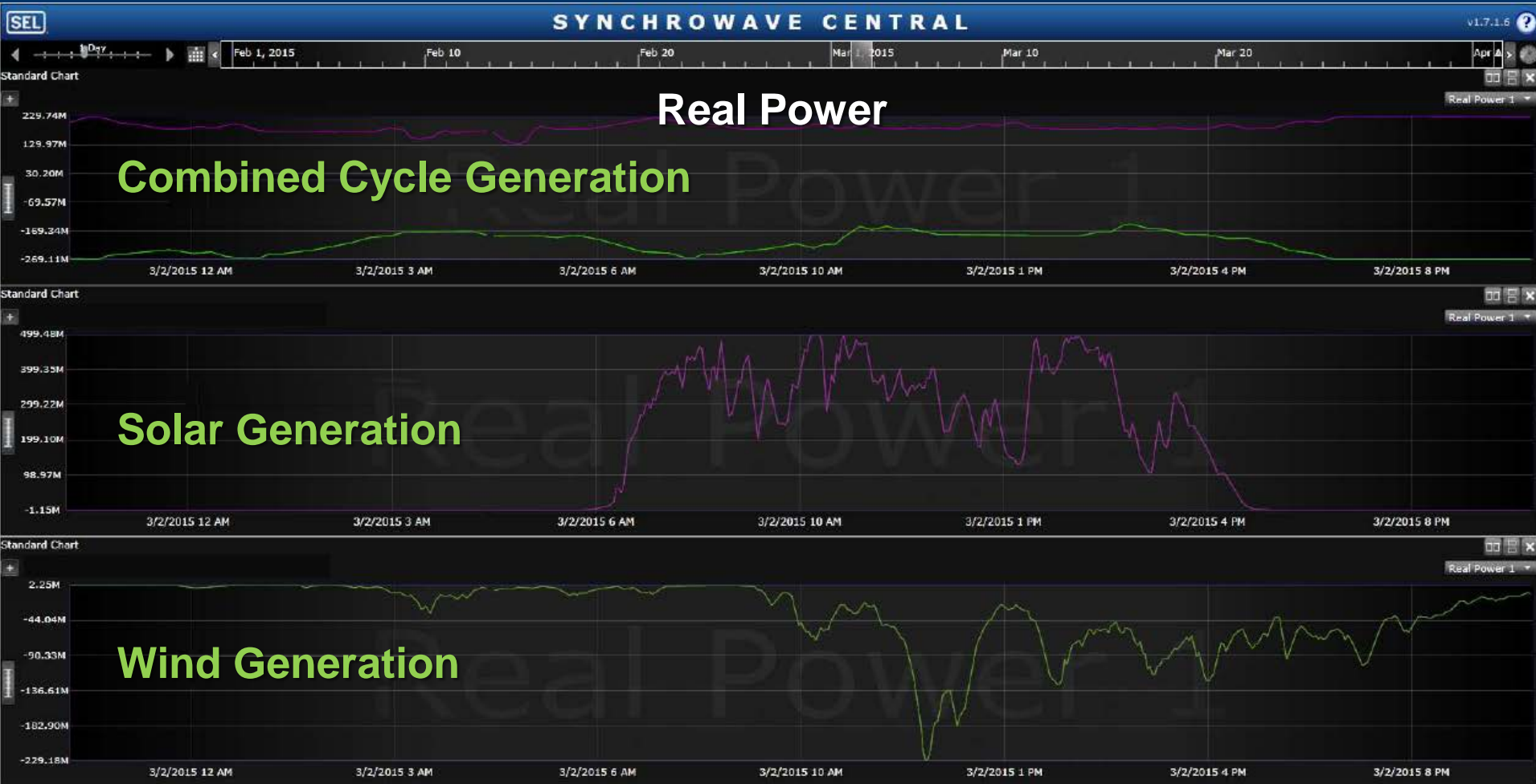
Detected Oscillation - Generator
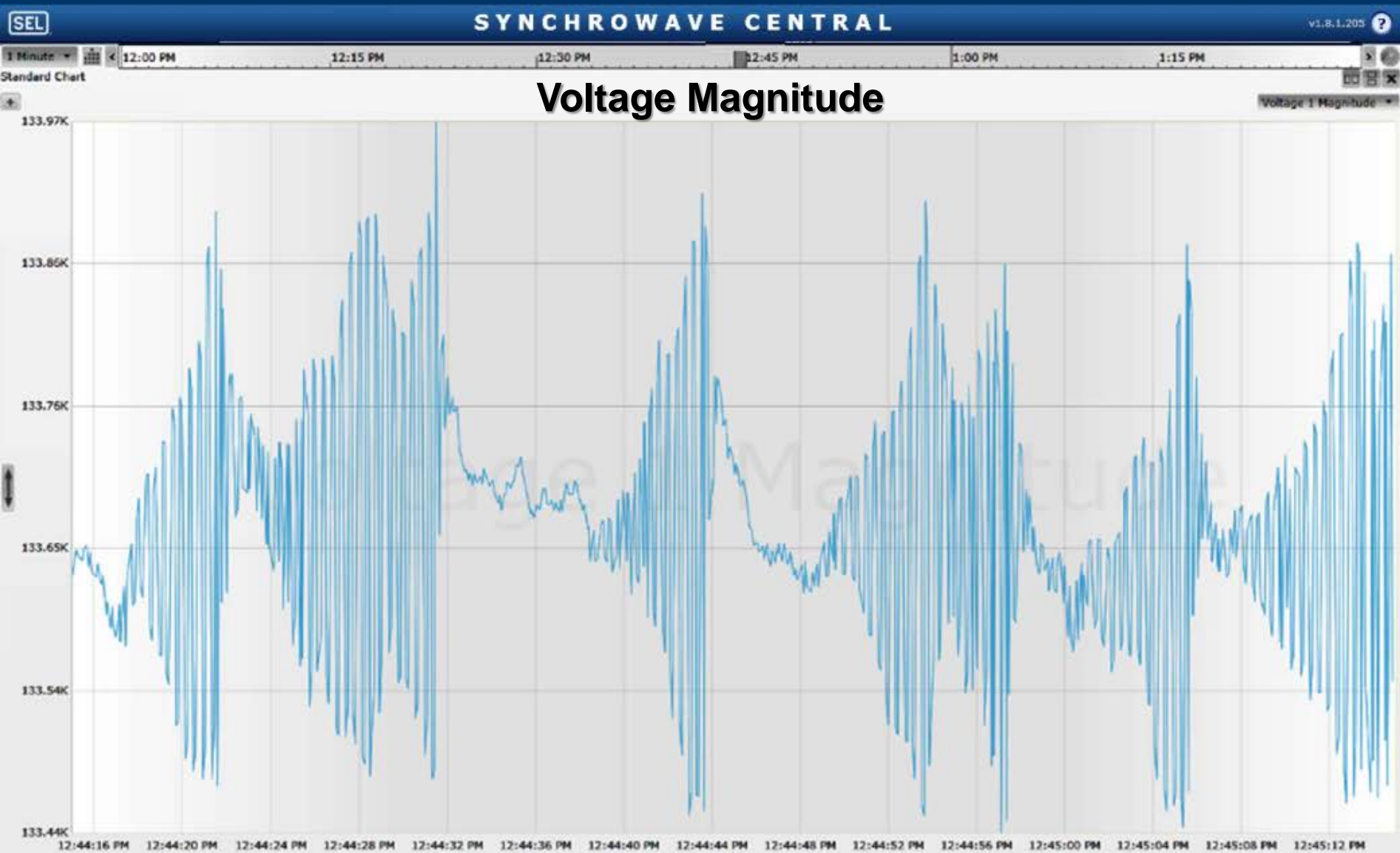
Detected Oscillation

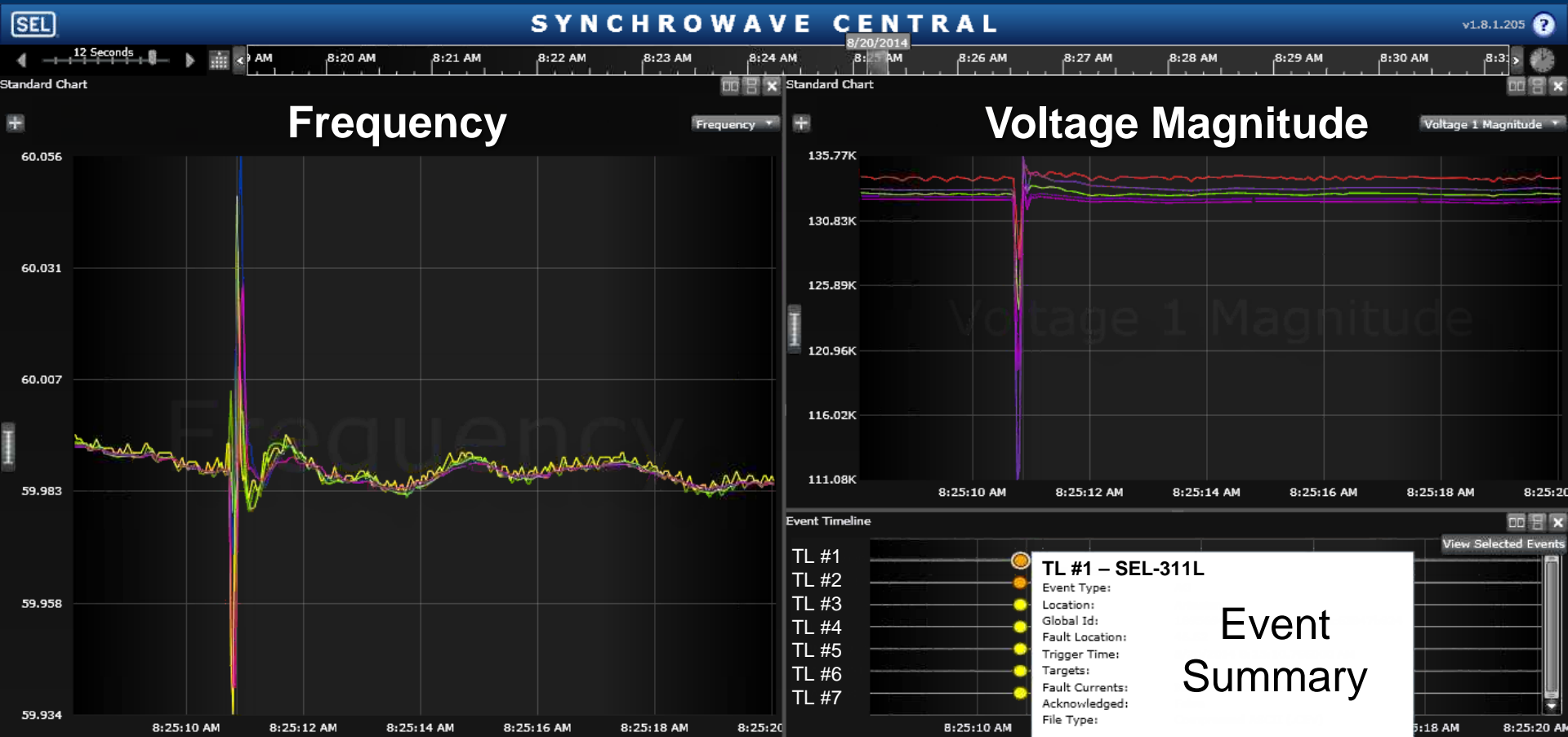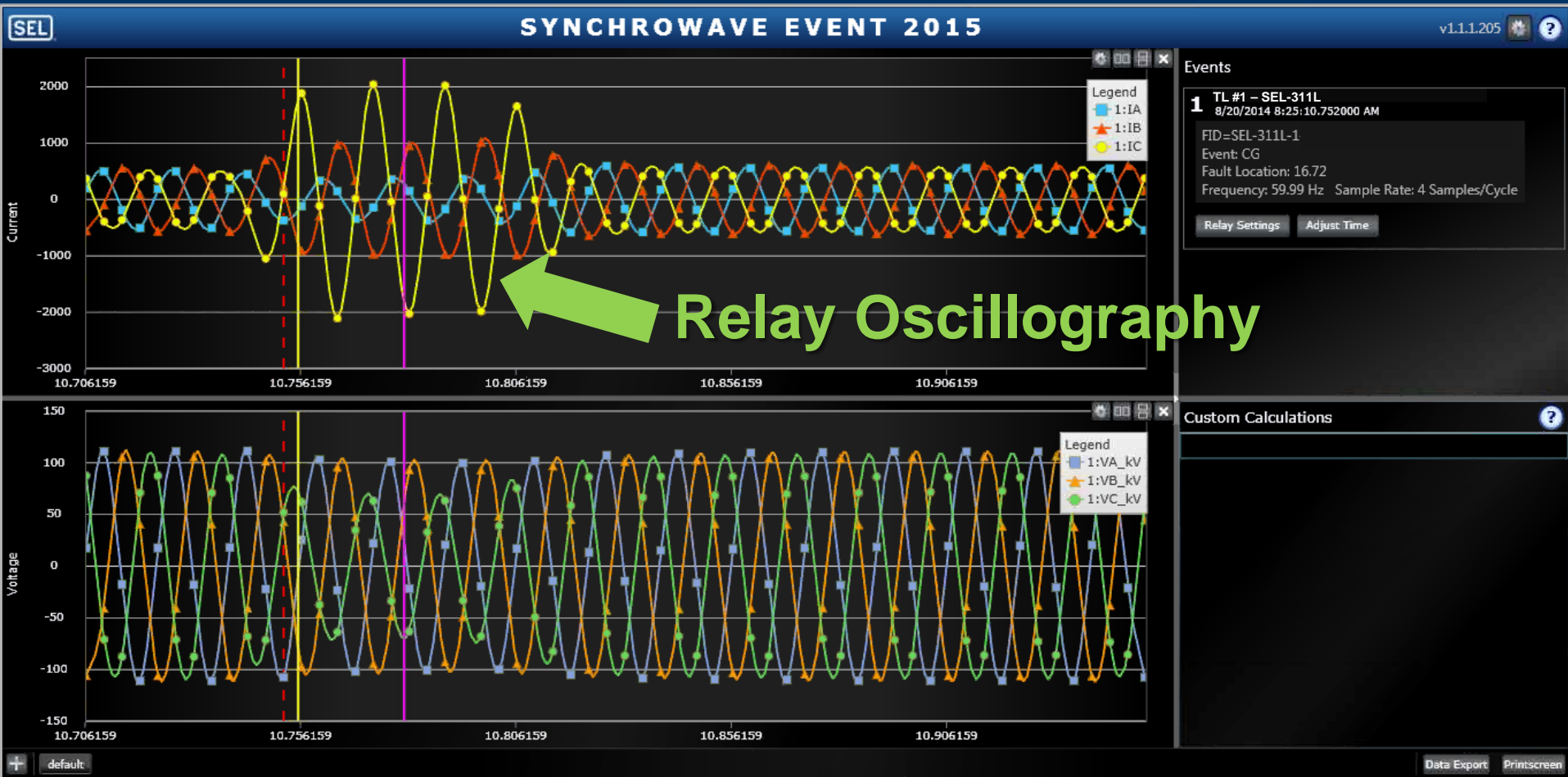# Phase Angle Measurement Across Inter-tie Breakers

Correlate Relay Event Data
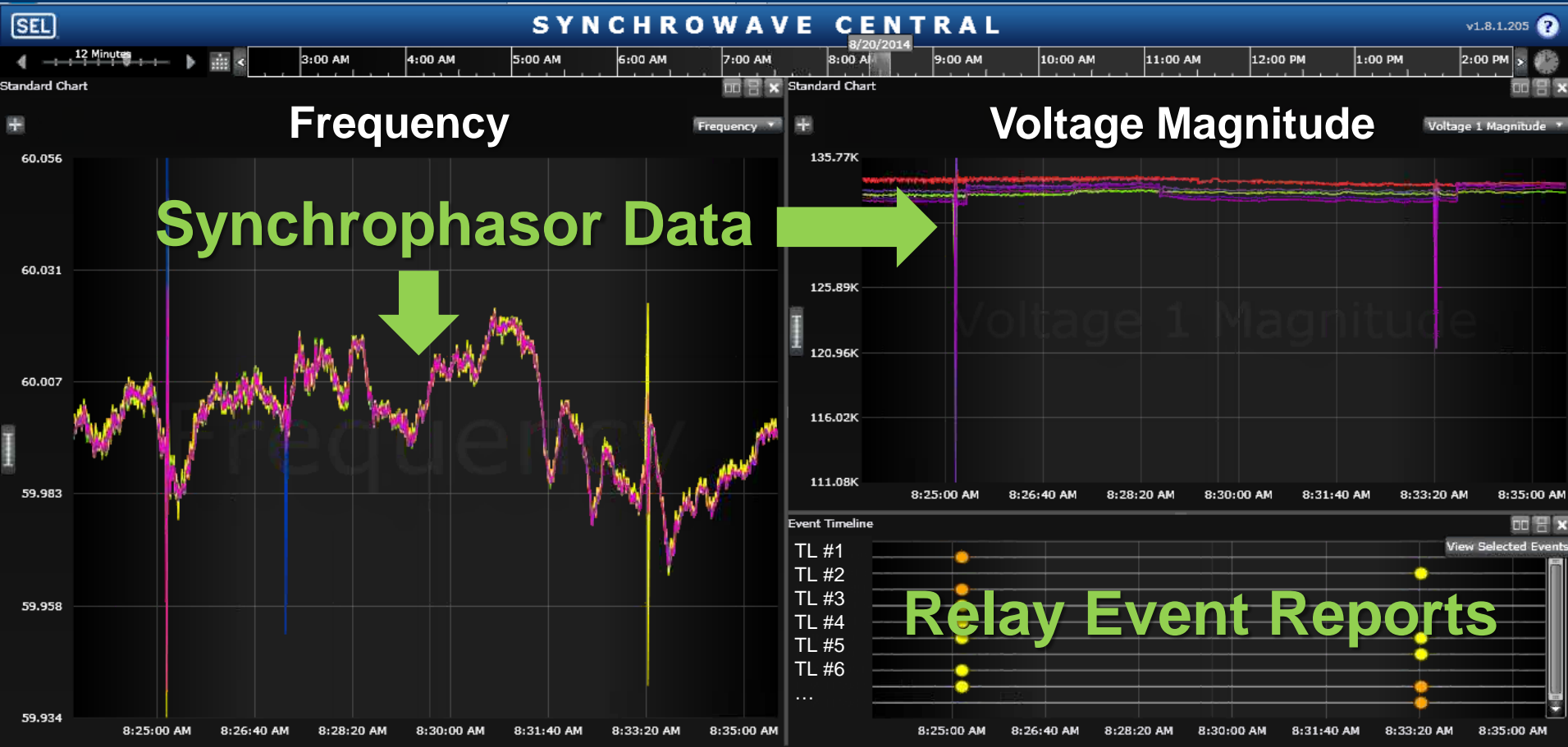
Correlate Relay Event Data
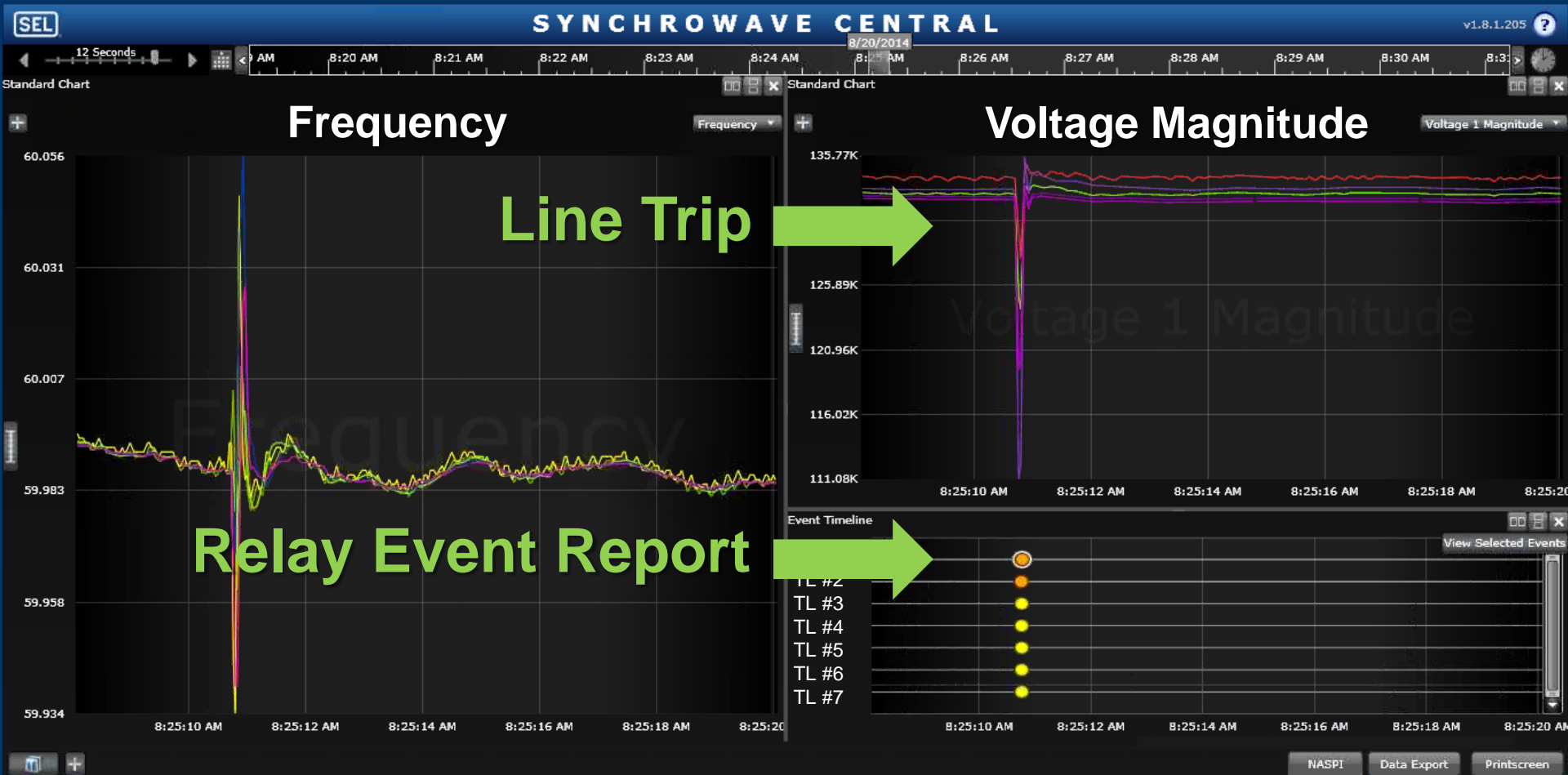
Event Summary for Operations

Integrated Event Analysis

Event Report Integration Architecture

Operations

Engineering

Substation

Relay → PDC

Local Archive

Web-client

Web-client

PDC → SynchroWAVe

TEAM

Data Center

Event Report Archive

Archive
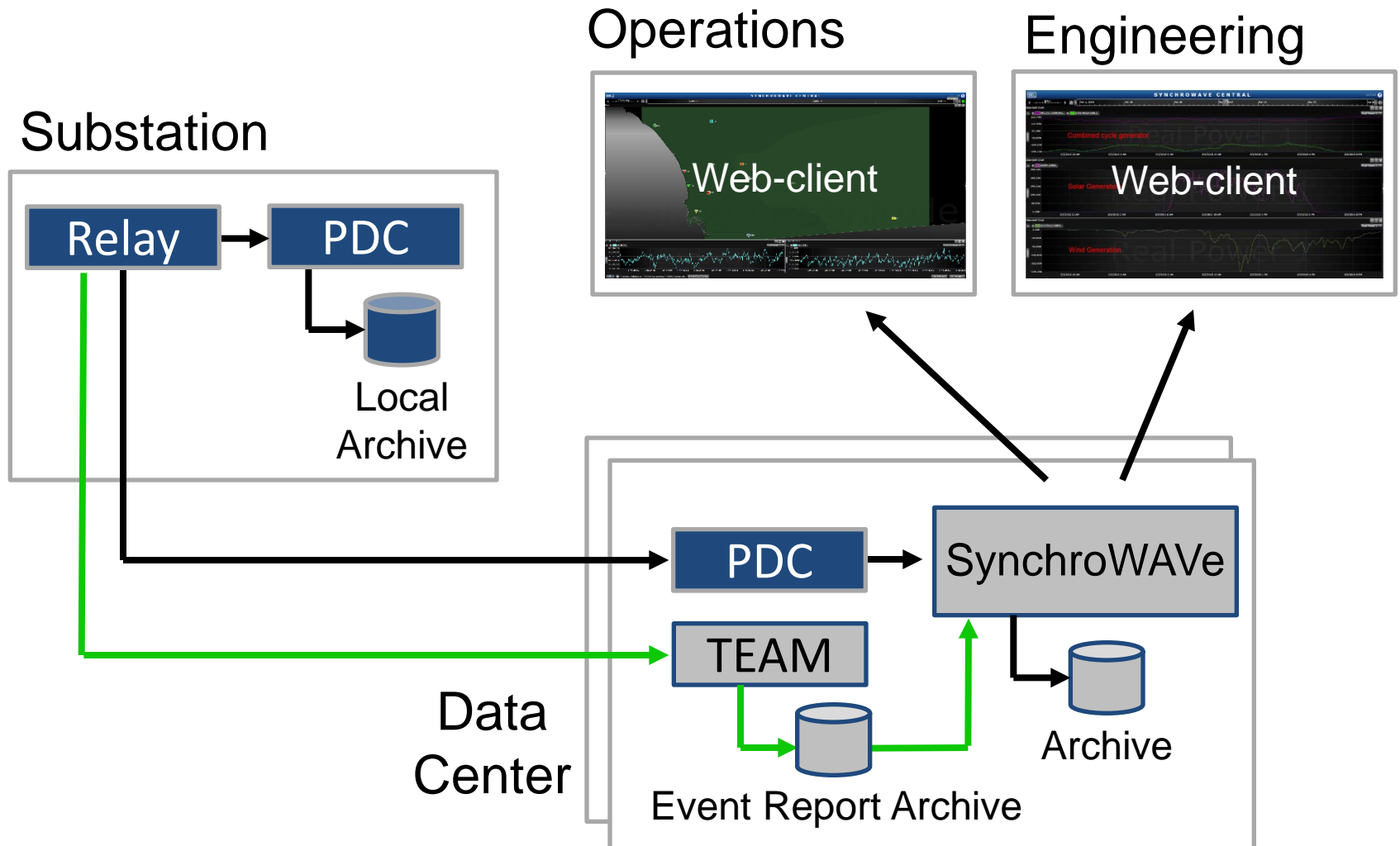
Next Steps for Project

1. Develop operational procedures for specific use cases

2. Work with SEL to further develop operations applications

3. Integrate V&R application for enhanced voltage stability

4. Develop Ethernet communication network

Thank you!