



Real-time Grid Monitoring and Controls Using Phasor Data

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Agenda

- ❑ Who is CENACE ?
- ❑ Grid Stability Issues
- ❑ Proposed Solution
- ❑ Benefit
- ❑ Next Steps
- ❑ Q & A

CENACE (Centro Nacional de Control de Energía) National Energy Control Center Overview

CENACE Organization information:

- CFE has over 85,000 employees, including temporary and permanent
- CENACE has about 1,200 employees
 - CENAL (National Control Center)
 - 8 Control Areas
 - 34 Sub-Areas
- 779 Generation Units
- CFE Total Capacity:
52,945 MW
- Peak Demand:
34,315 MW_(02/23/2011)
35,870 MW_(24/08/2010)



Grid Stability Issues

- ❑ In the past, it has been difficult to prevent grid stability issues from occurring
- ❑ It has not been possible to monitor Phase Angles in Real Time
- ❑ No visibility on Network Stability
- ❑ Fault analysis and report generation have been difficult and labor intensive

Sistema de Monitoreo Dinámico y Control del Sistema Eléctrico Nacional

MODICOSEN

Proposed Solution:

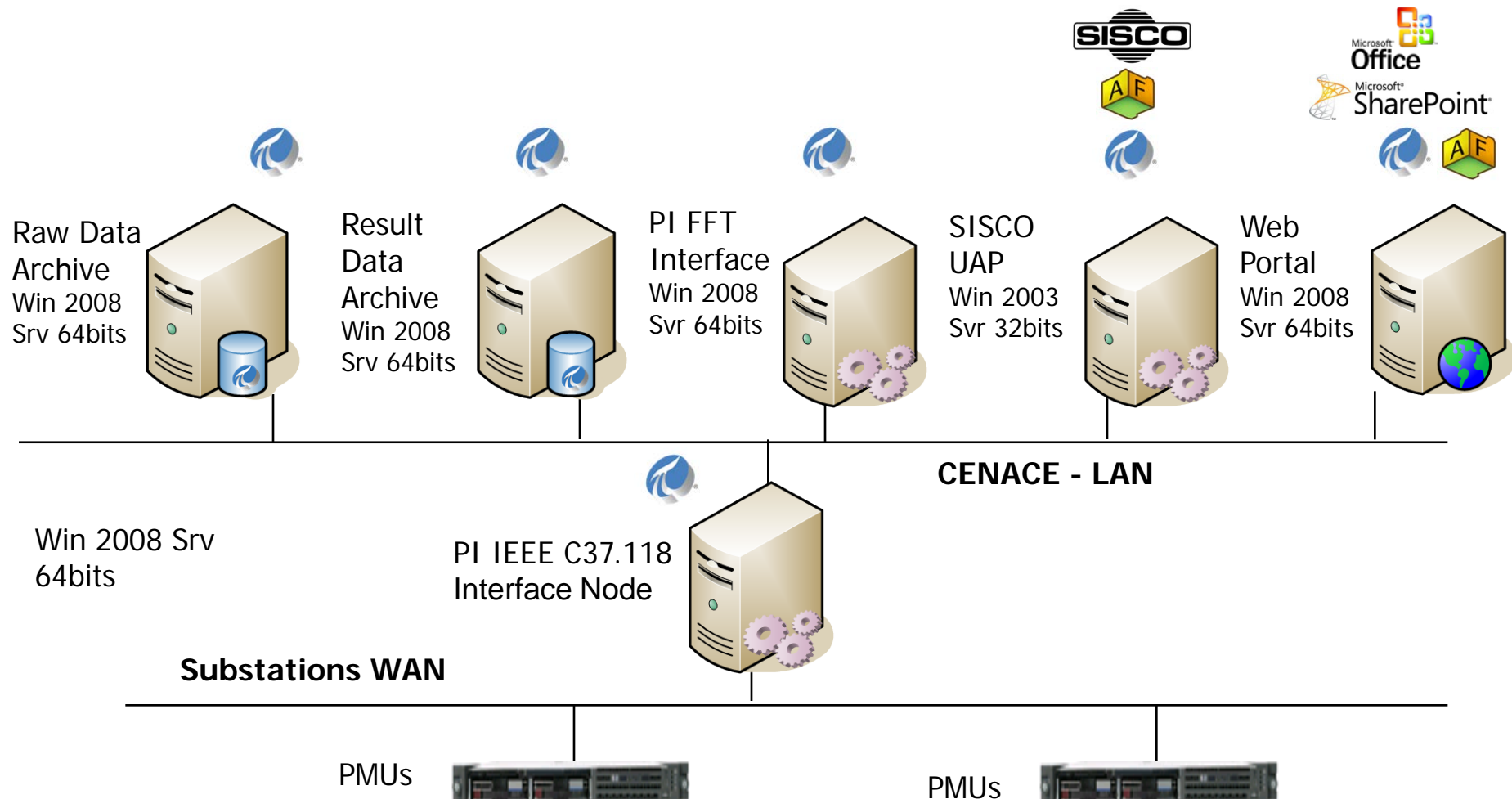
- ❑ *MODICOSEN* (Dynamic Monitoring & Control of the National Power System):
 - ✓ Provide the means for **Real-Time Monitoring, Analysis, and Archiving** for Synchrophasor measurements from PMUs
 - ✓ Present and visualize the dynamic behavior of the National Electrical Power system in a much faster real-time way, much better than what a SCADA system does

Sistema de Monitoreo Dinámico y Control del Sistema Eléctrico Nacional

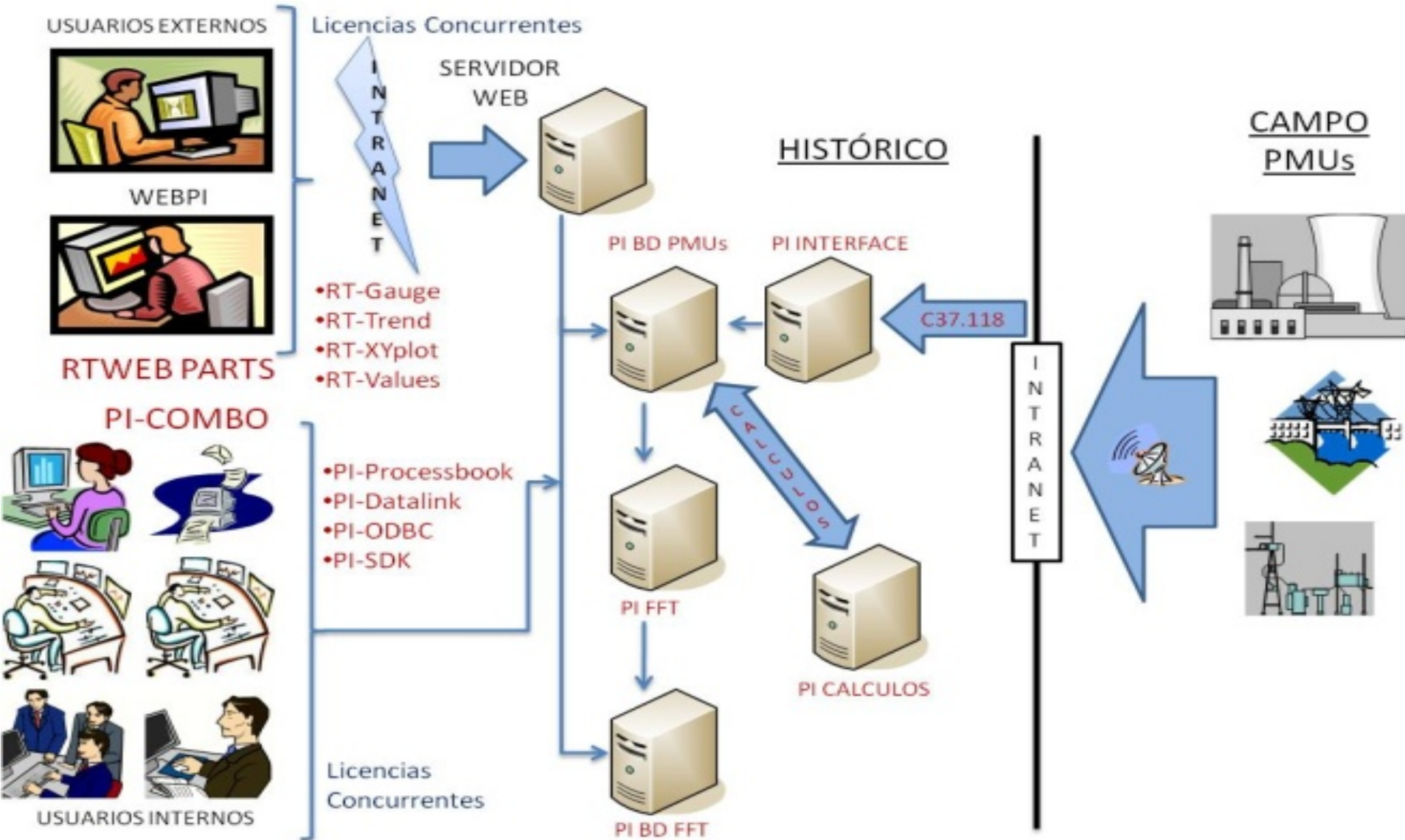
MODICOSEN

- ❑ WAMS (Wide Area Measurement System) designed to monitor the National Electrical Power System
- ❑ Prevent Future Blackouts by enabling a timely response to emerging network instabilities
- ❑ Analysis and Real Time Visualization of measurements of Voltage & Current synchrophasors, Angle Differences, and the Damping Coefficient calculations for inter-area regional low frequency oscillations
- ❑ Enhance the existing national electrical infrastructure to improve stability analysis, generate timely alarm notifications, and help identify differences in the network settings that will improve stability

MODICOSEN System Components

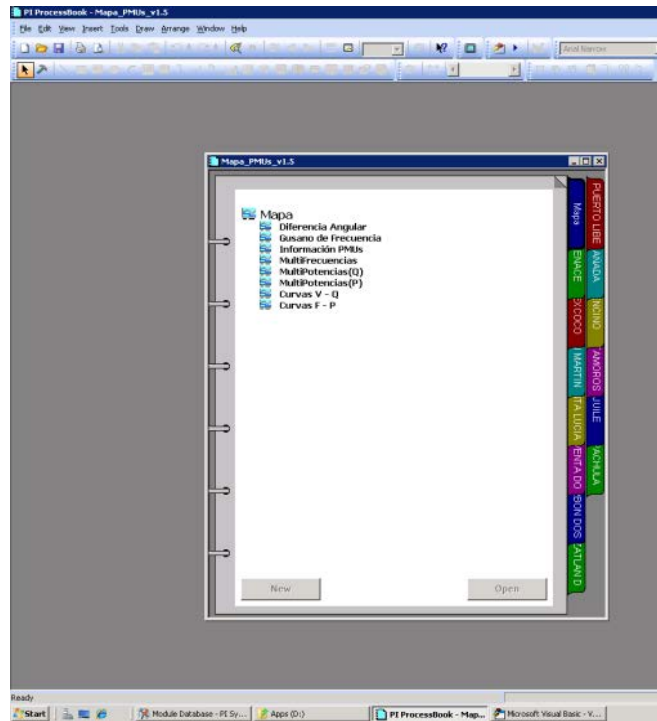
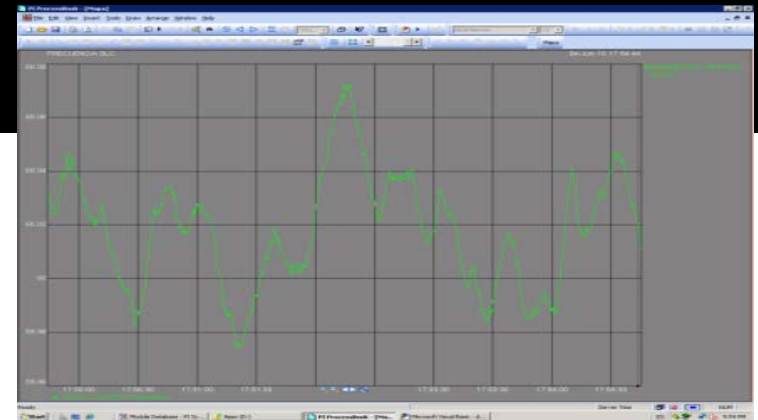


MODICOSEN System Components

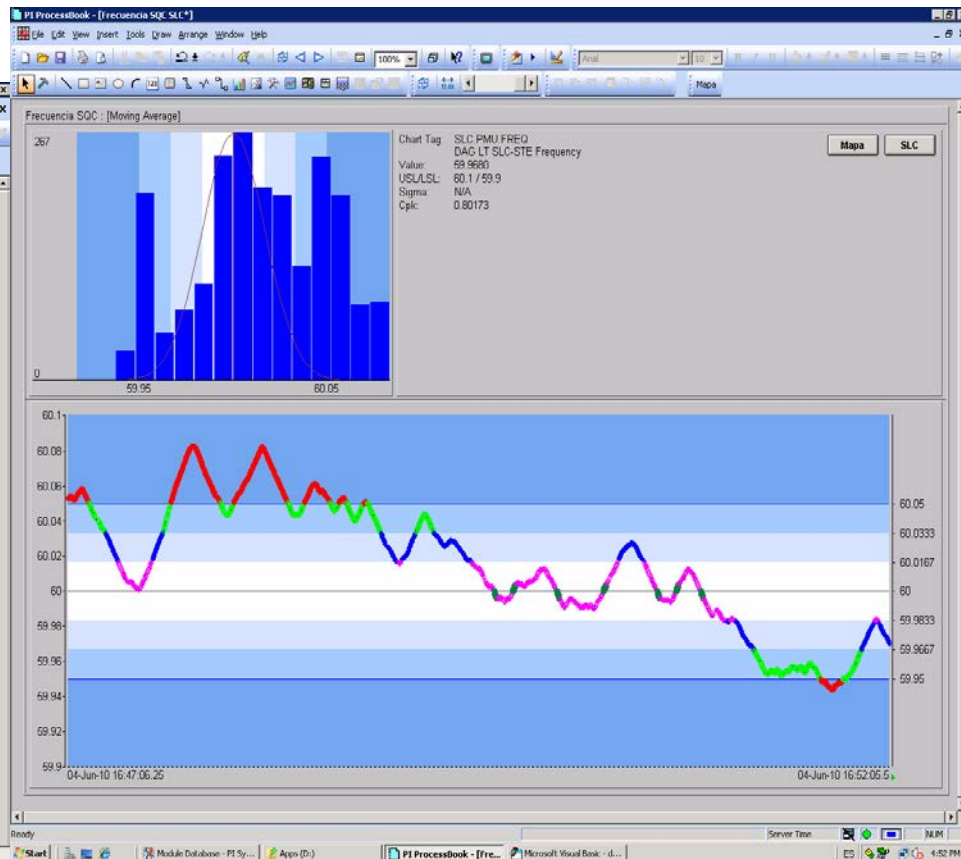
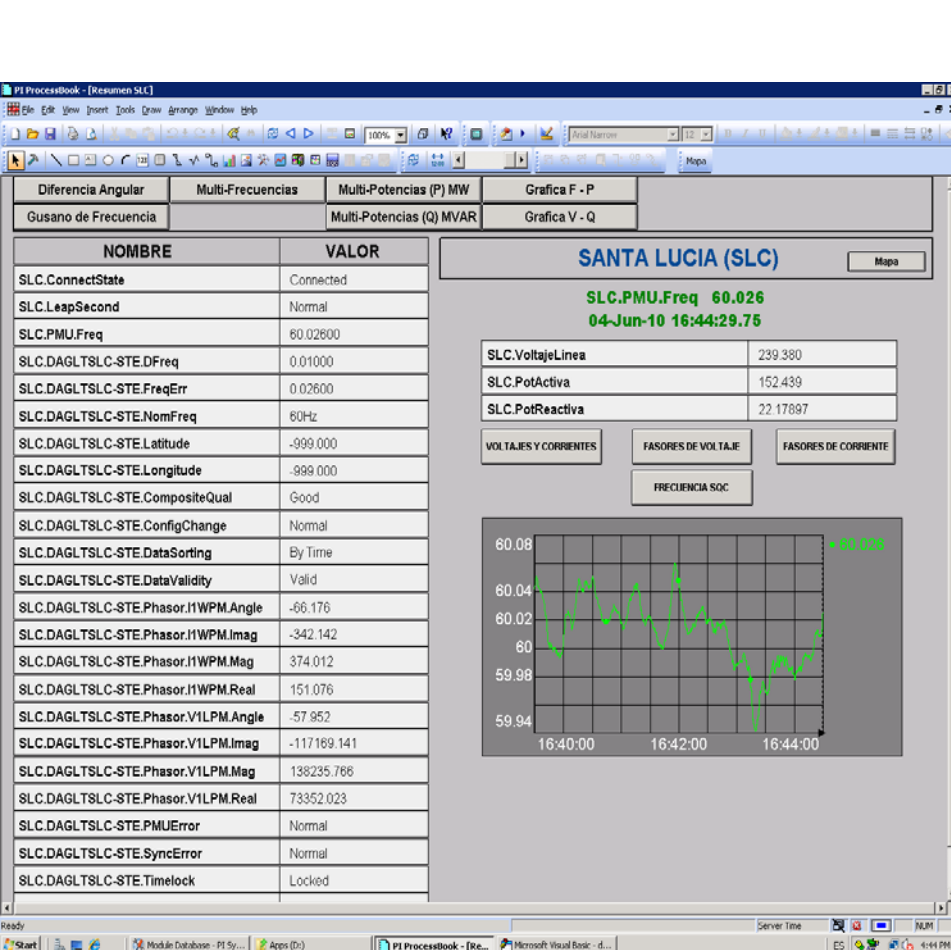


MODICOSEN Visualization

- PMU Device Monitoring
 - 25 PMUs
 - Connection Status
 - Status Updates



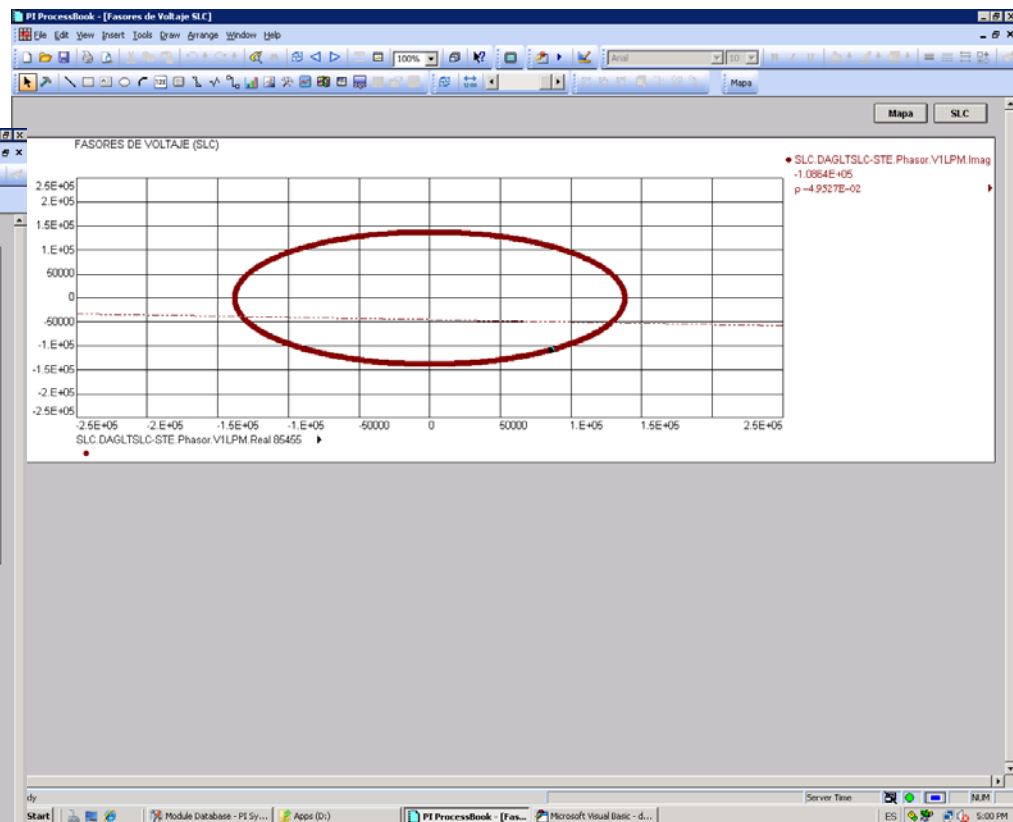
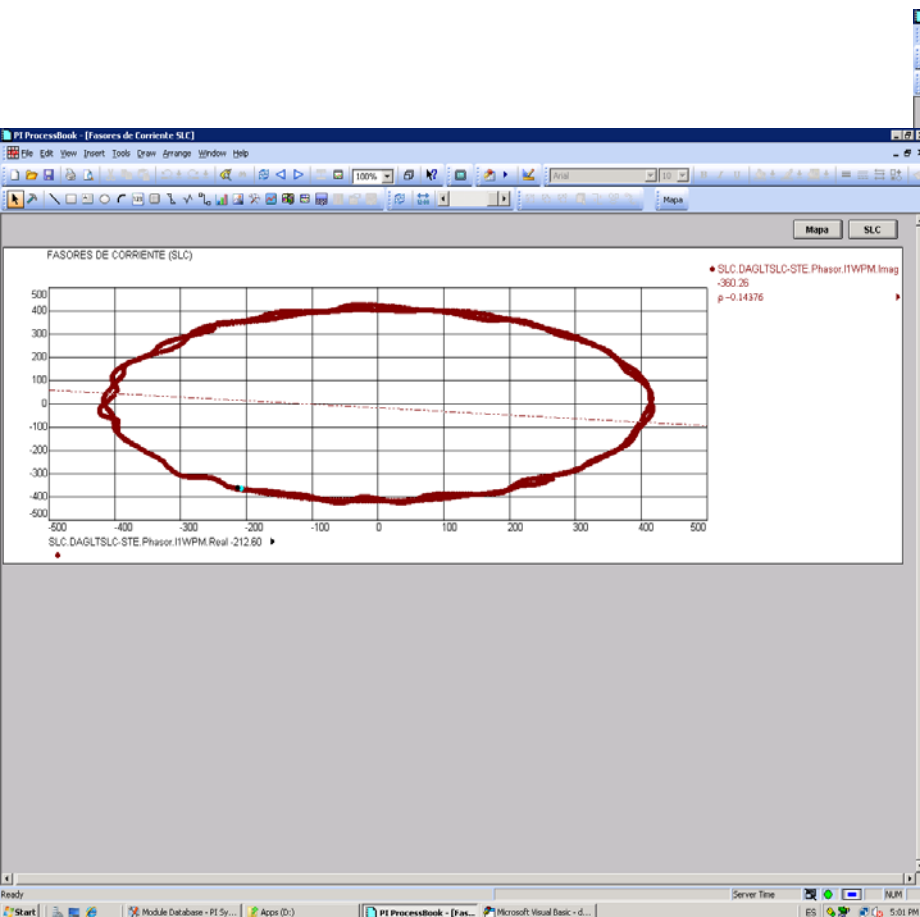
MODICOSEN Visualization



- PMUs Data Analysis Frequency using SQC (Statistical Quality Control)

- PMUs Raw Data Displays

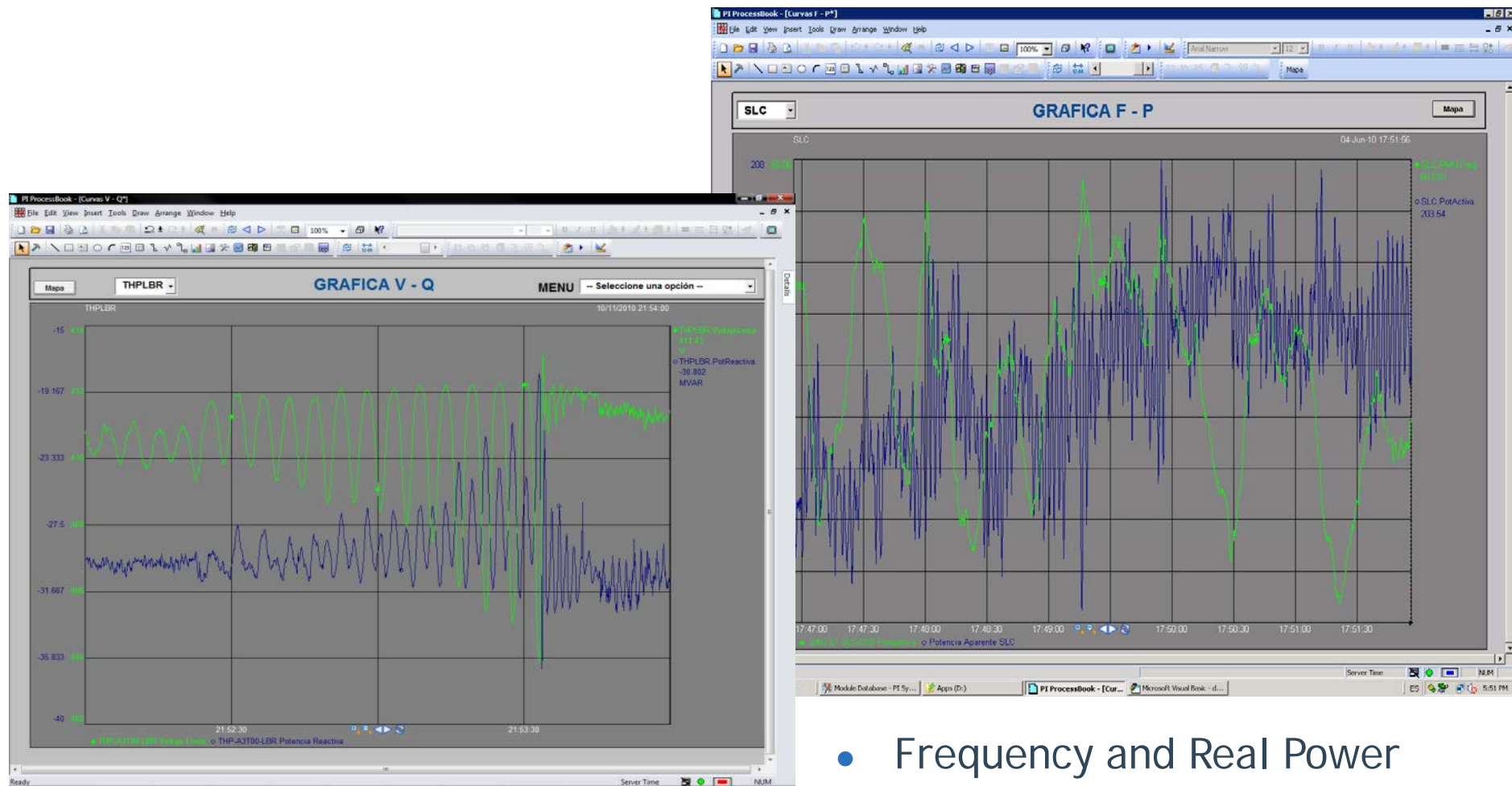
MODICOSEN Visualization



- Voltage Phasors
Real & Imag Parts

- Current Phasors
Real & Imag Parts

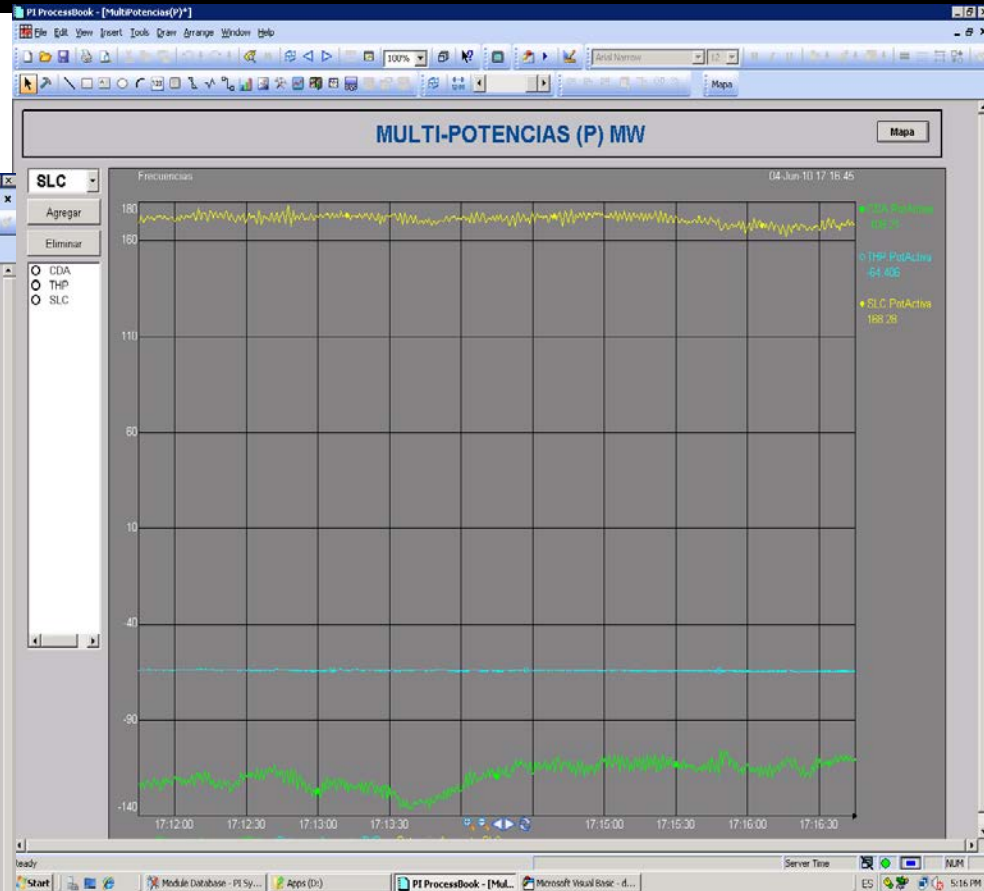
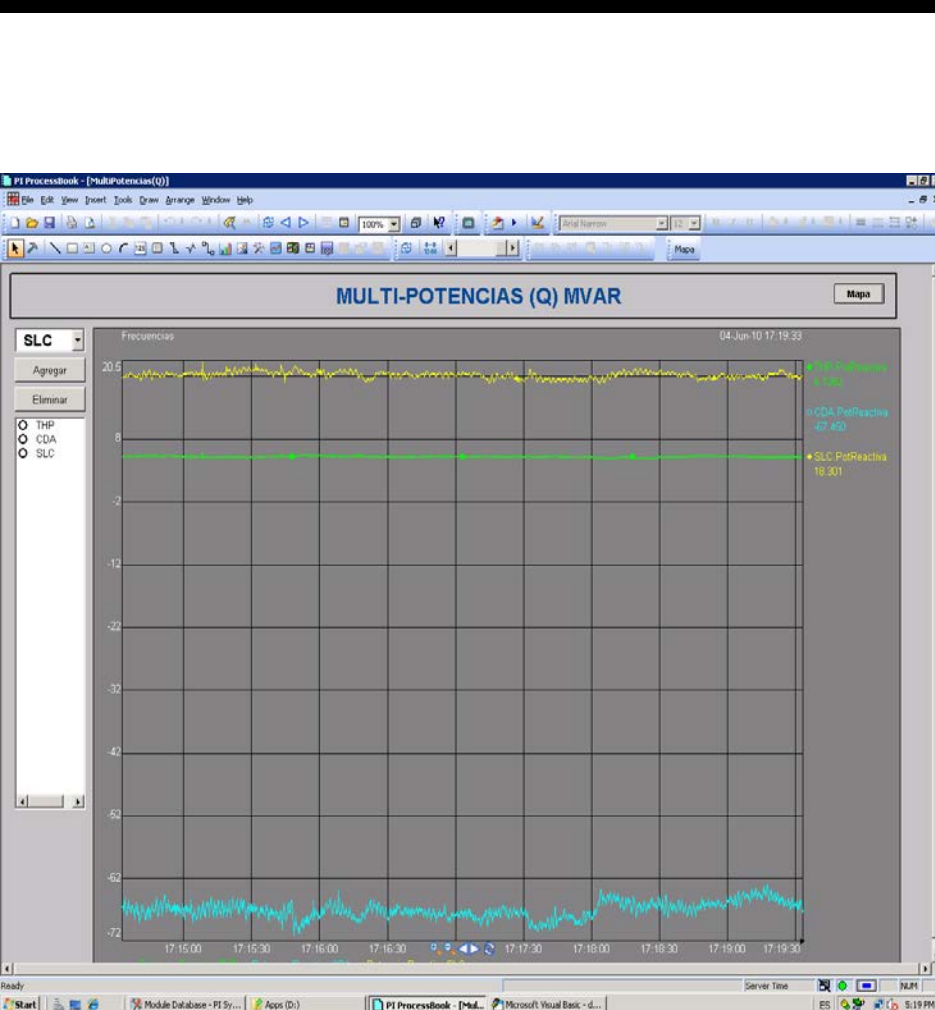
MODICOSEN Visualization



- Voltage and Reactive Power

- Frequency and Real Power

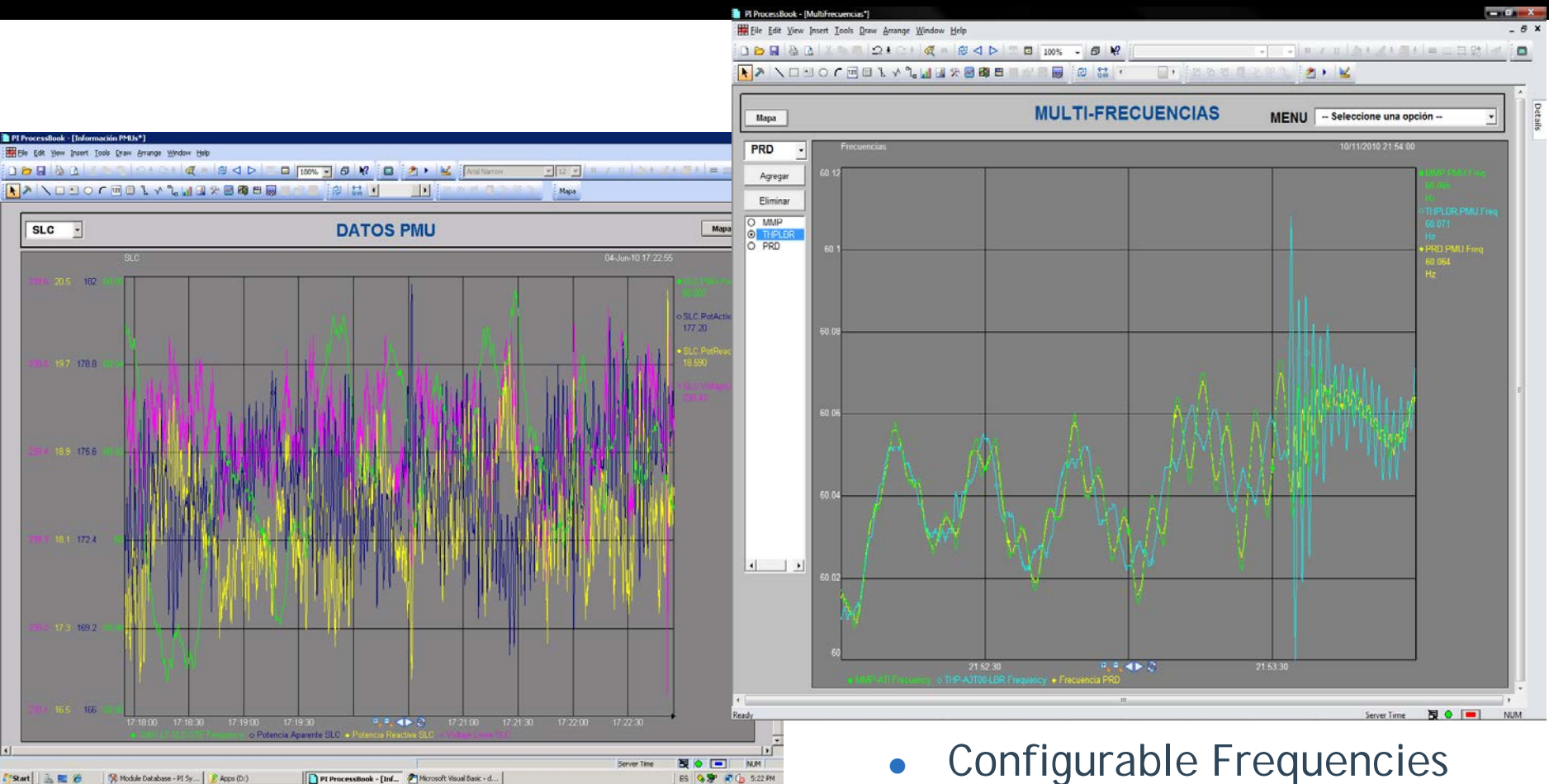
MODICOSEN Visualization



- Configurable MWs Trending

- Configurable MVARs Trending

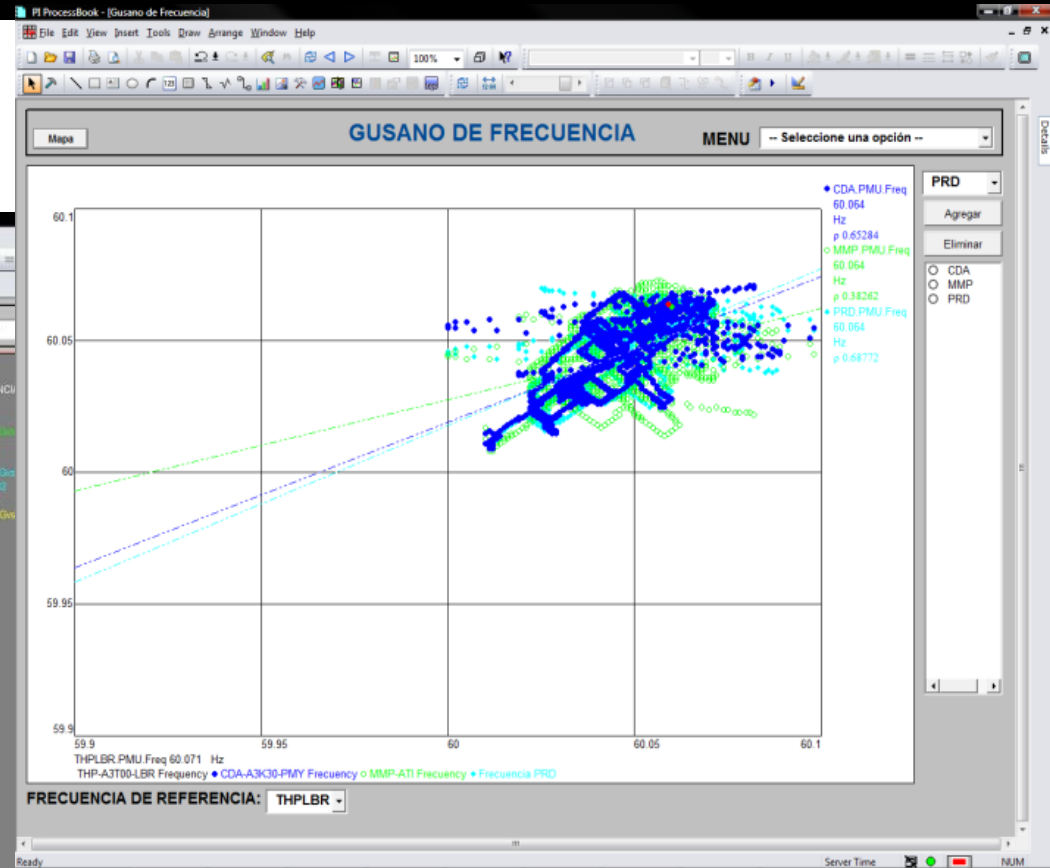
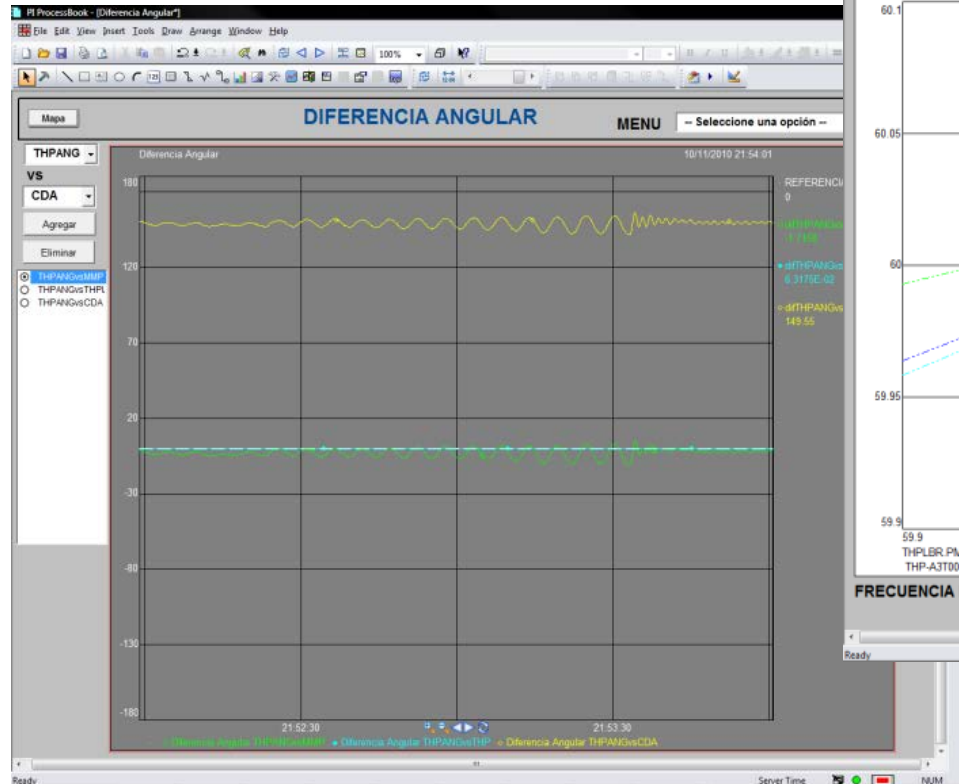
MODICOSEN Visualization



- Configurable Raw PMUs Data

- Configurable Frequencies

MODICOSEN Visualization

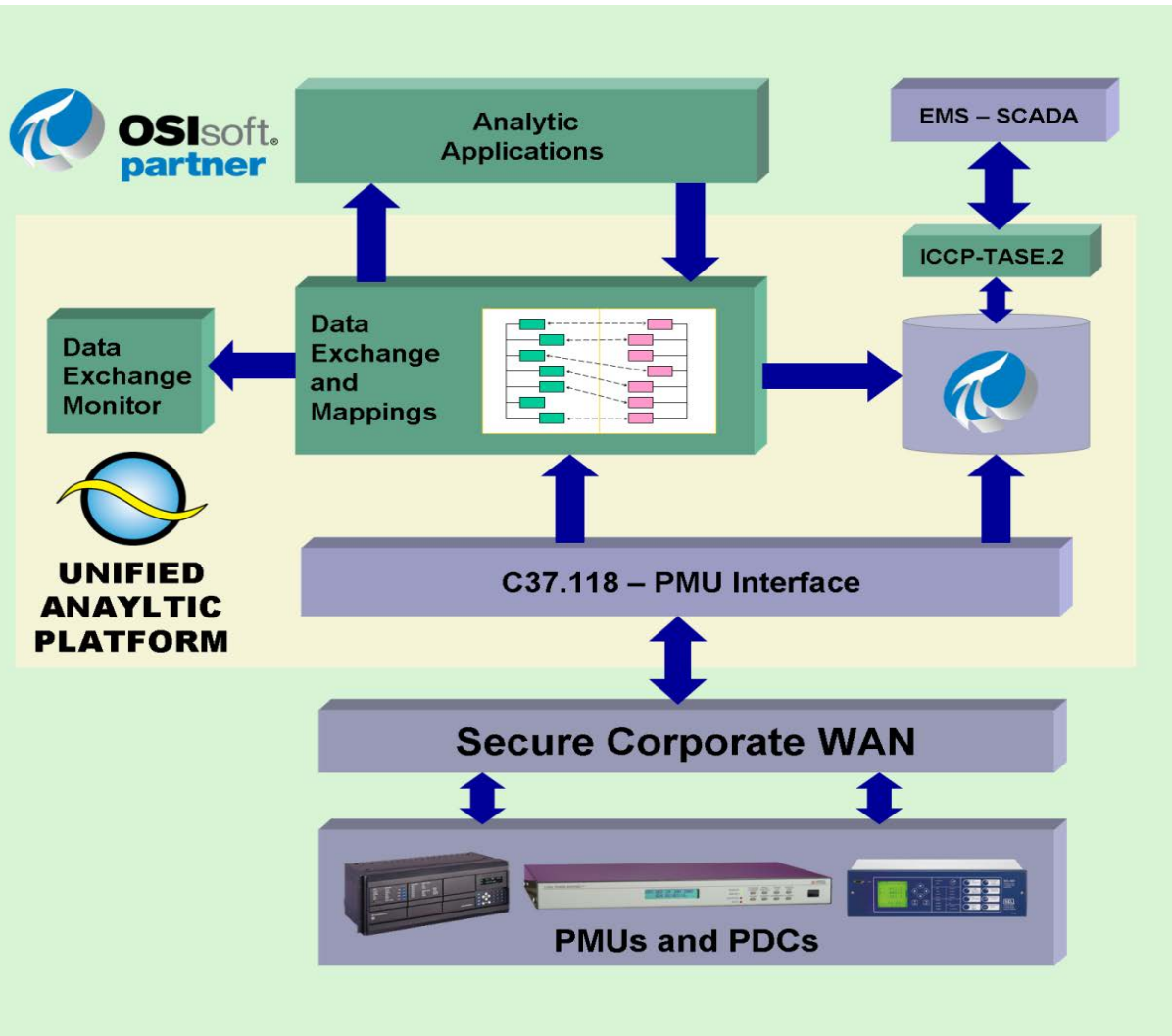


Configurable Frequency Worm Chart

- Configurable Angle Differences Chart

MODICOSEN Analytics - UAP (Unified Analytic Platform)

- Real-Time Calculations performed using SISCO Unified Analytic Platform



- Angle Differences. 20 times per second
- Oscillation Detection and Alarming. 5 times per second
- Damping Coefficient of Significant Harmonics. 5 times per second

MODICOSEN Analytics - PDA (Phasor Data Analyzer)

4) Calculates most significant modes of oscillation in real-time on frequencies from each PMU and on phase angle differences between PMU's.

OSIsoft
FFT
Interface

SISCO UAP
Runtime
Platform 5

3) Calculates the difference in phase angle between phasors and 3

5) Calculates damping coefficients from FFT results as driven by the run rate of the FFT. Determines if the most significant modes of oscillation are increasing greater than a set point for longer than a setable time period.

6) Displays voltage and frequency trends as well as oscillation trends and alarms

Sharepoint
Portal

Provides high speed simulation and playback for PDA application testing and debugging

Raw and
FFT PI
Archives

SISCO UAP
Scenario
Player

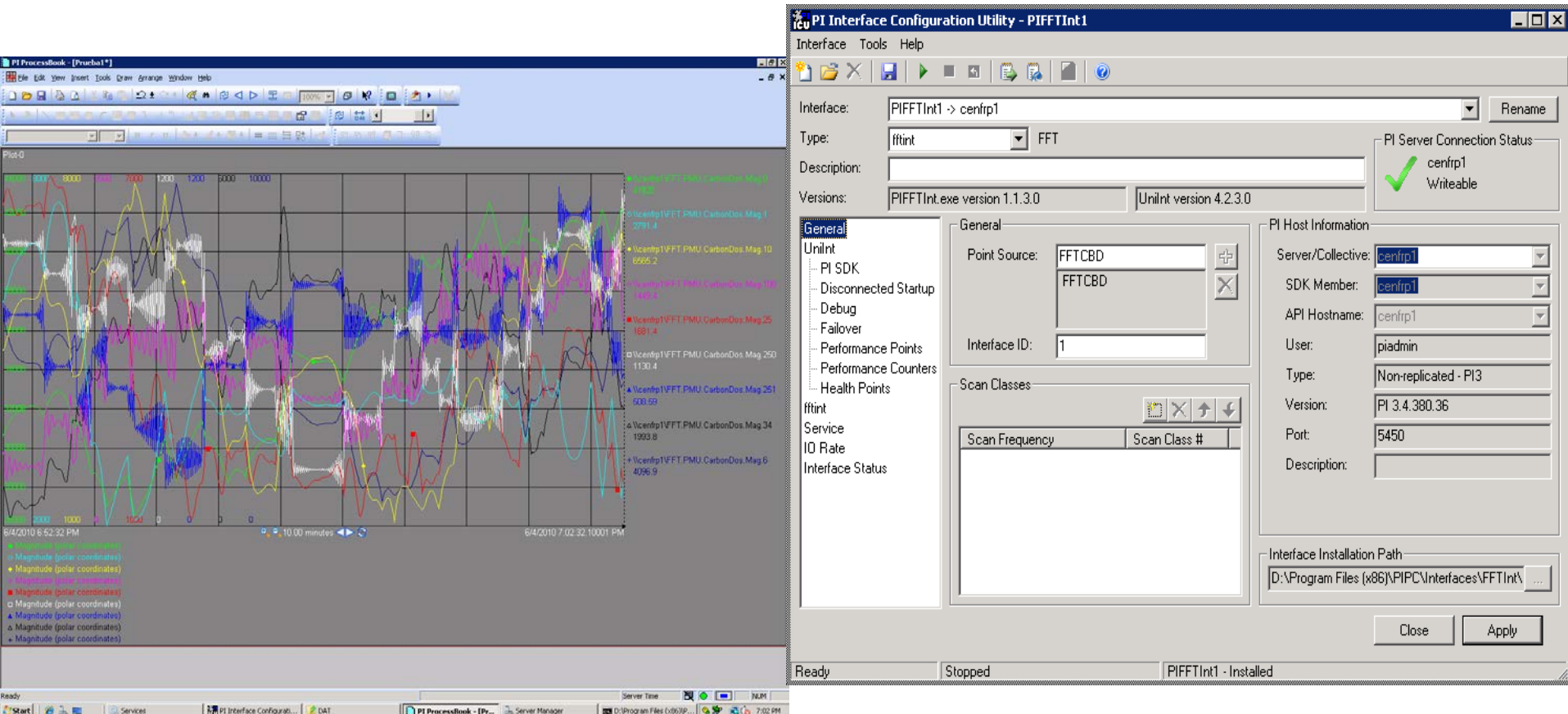
OSIsoft
C37.118
Interface

2) Buffers phasor data for input into the archive

1) C37.118 Data Streams received via CFE WAN

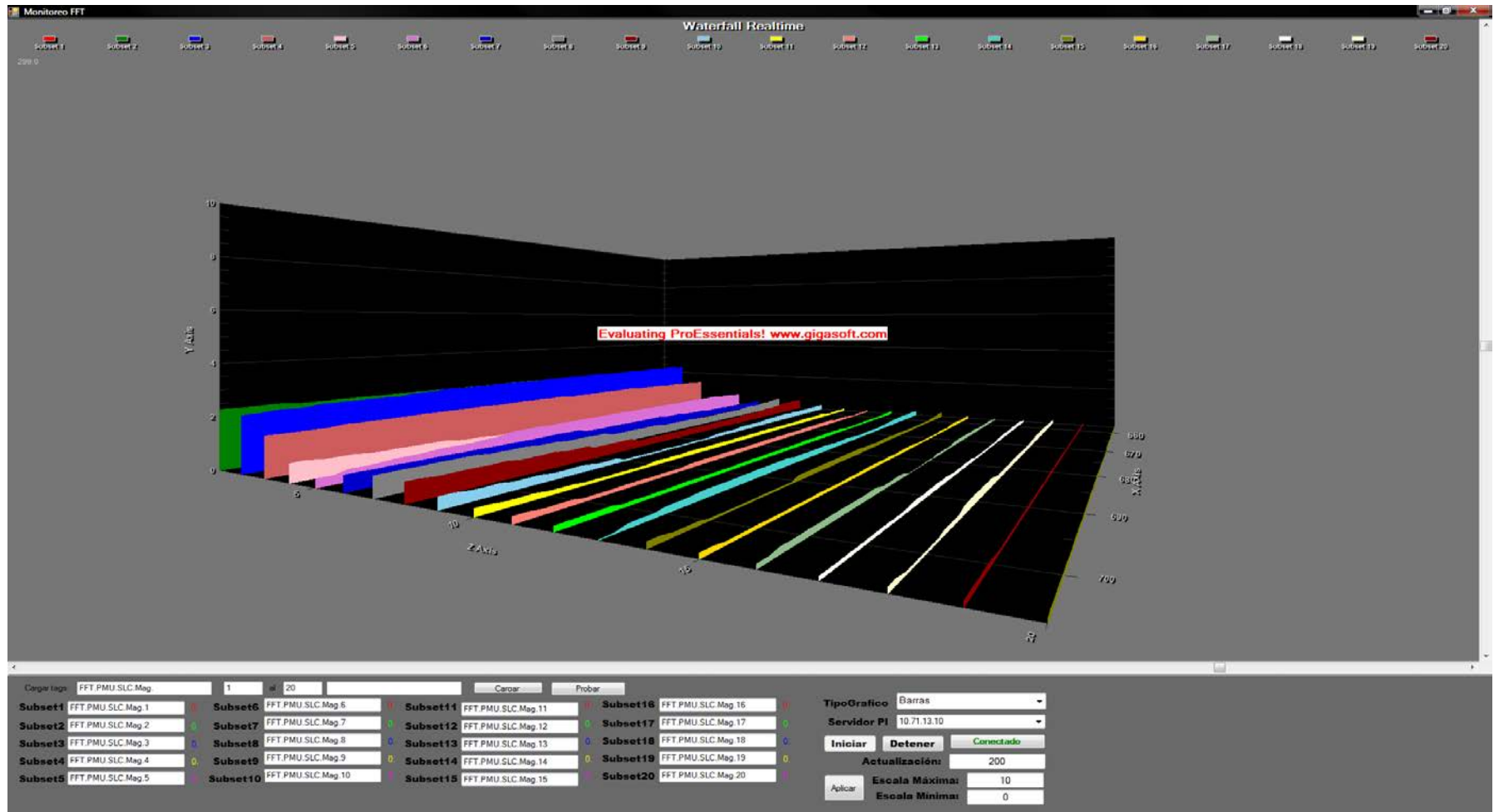
MODICOSEN Analytics

- OSIsoft PI FFT Interface (Fast Fourier Transform)
 - Calculates the modes of oscillation (Harmonics Content)
 - Polar & Rectangular Coordinates



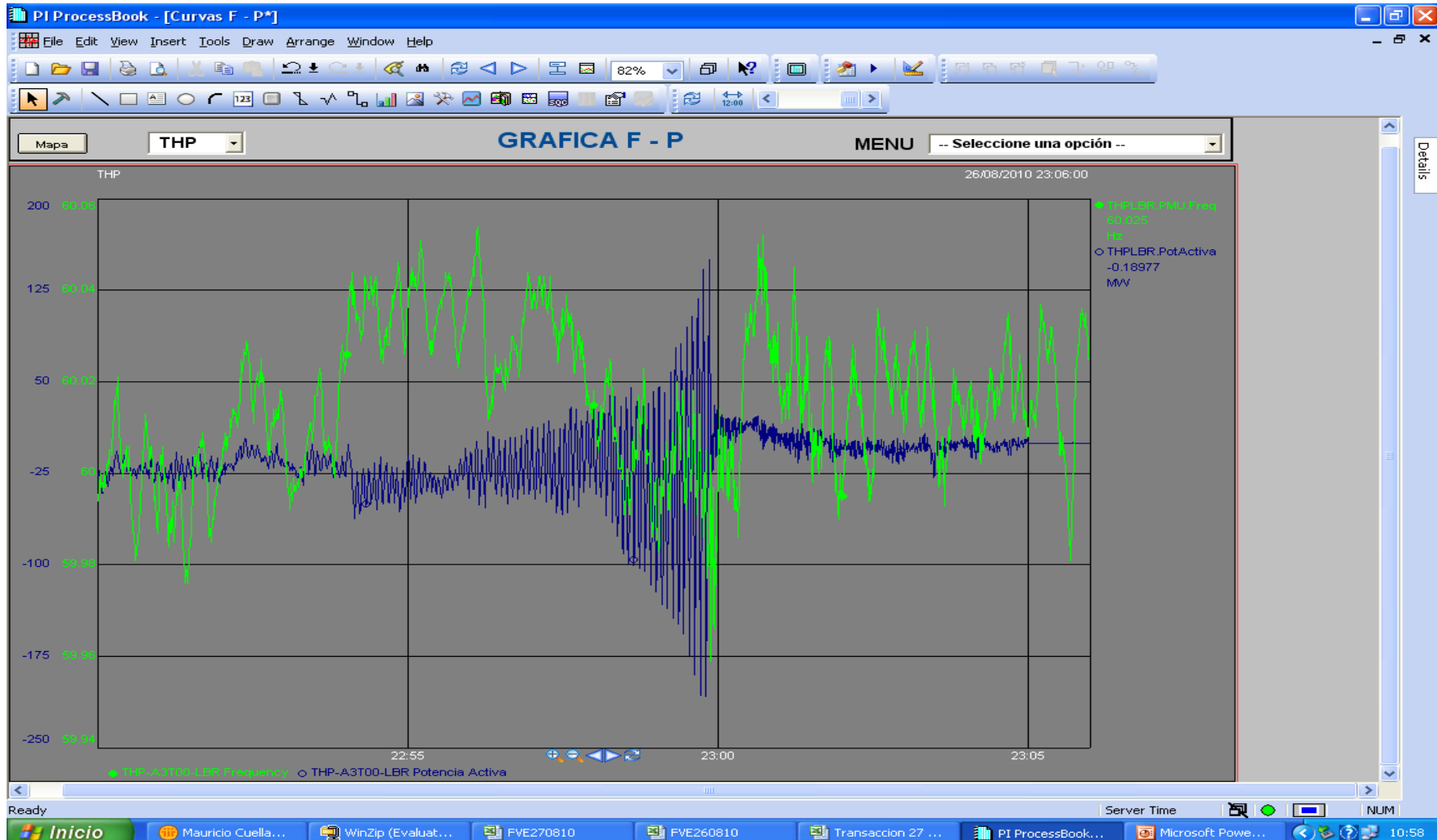
MODICOSEN Analytics

- OSIsoft PI FFT Interface (Real Time Water Fall Chart)



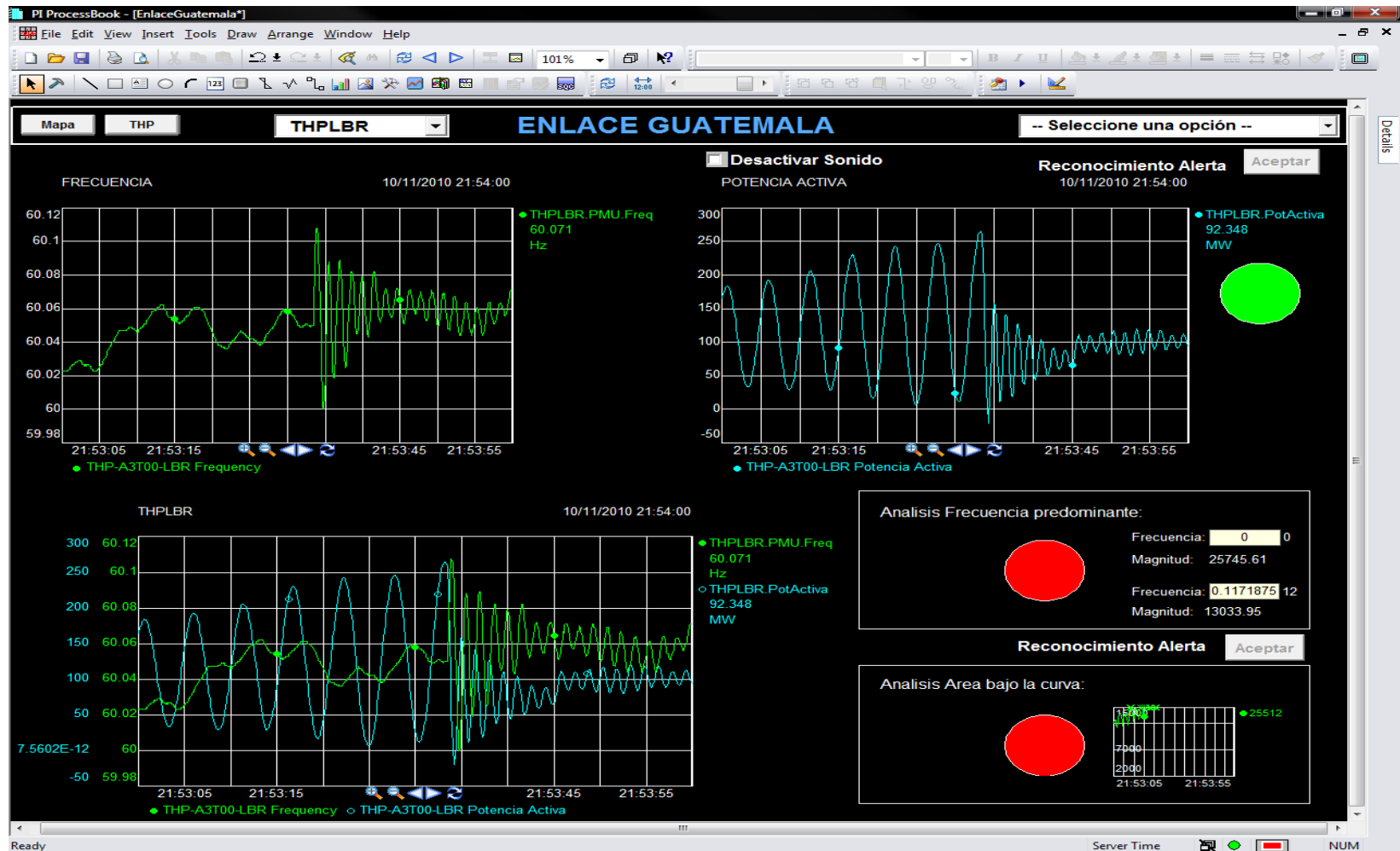
MODICOSEN Analytics

- Mexico - Guatemala Tie Line Event



MODICOSEN Analytics

- FFT Interface - Low Frequency Oscillations Detection and Alarming



Benefits

- ❑ Improved response times for data analysis
- ❑ Greater flexibility in searching, visualization and reporting
- ❑ Democratization of information through Integration
- ❑ A single source of information
- ❑ Improved “Look and Feel” visualization
- ❑ Operators can foresee instabilities in different areas of the electrical system to implement corrective or preventive actions
- ❑ Monitoring Phase Angle 20 times per second (50ms)
- ❑ The Failure Analysis can be carried out in Real Time
- ❑ Monitoring the Network Stability in Real Time better than SCADA

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Thank You