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OSIsoft. USERS CONFERENCE 2011

# The PI System based MODICOSEN

## (Dynamic Monitoring & Control of the National Power System)

# at CFE, Mexico

Presented by **Arturo Gonzalez, Comision Federal de Electricidad (CFE)**
**Centro Nacional de Control de la Energía (CENACE)**

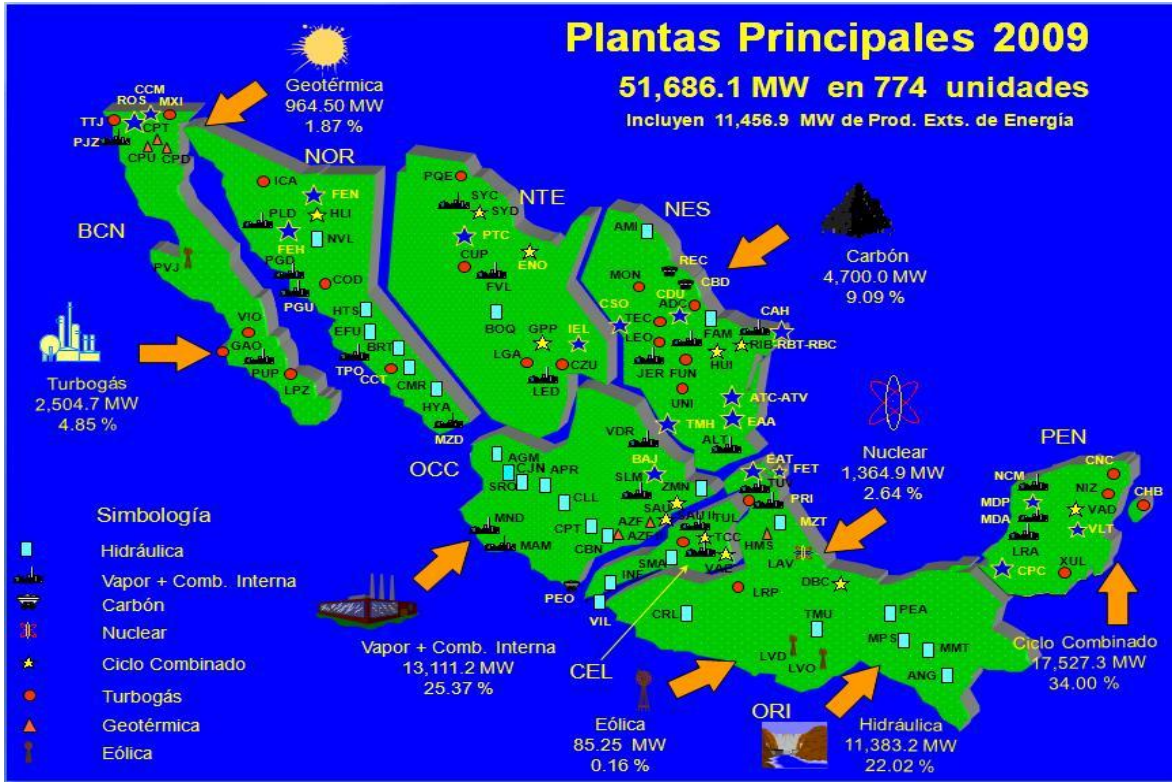
# Agenda

- Who is CFE CENACE ?
- Grid Stability Issues
- Proposed Solution
- Benefits
- Next Steps
- Q & A

# CENACE (National Energy Control Center) Overview

- CFE around 70K employees, and CENACE approx. 1,200
  - 1 National Center
  - 8 Control Areas
  - 32 Control Subareas
- Total installed capacity 51 GW
- More than 700 Generators
- Max. instantaneous demand

  35,434 MW



# 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:

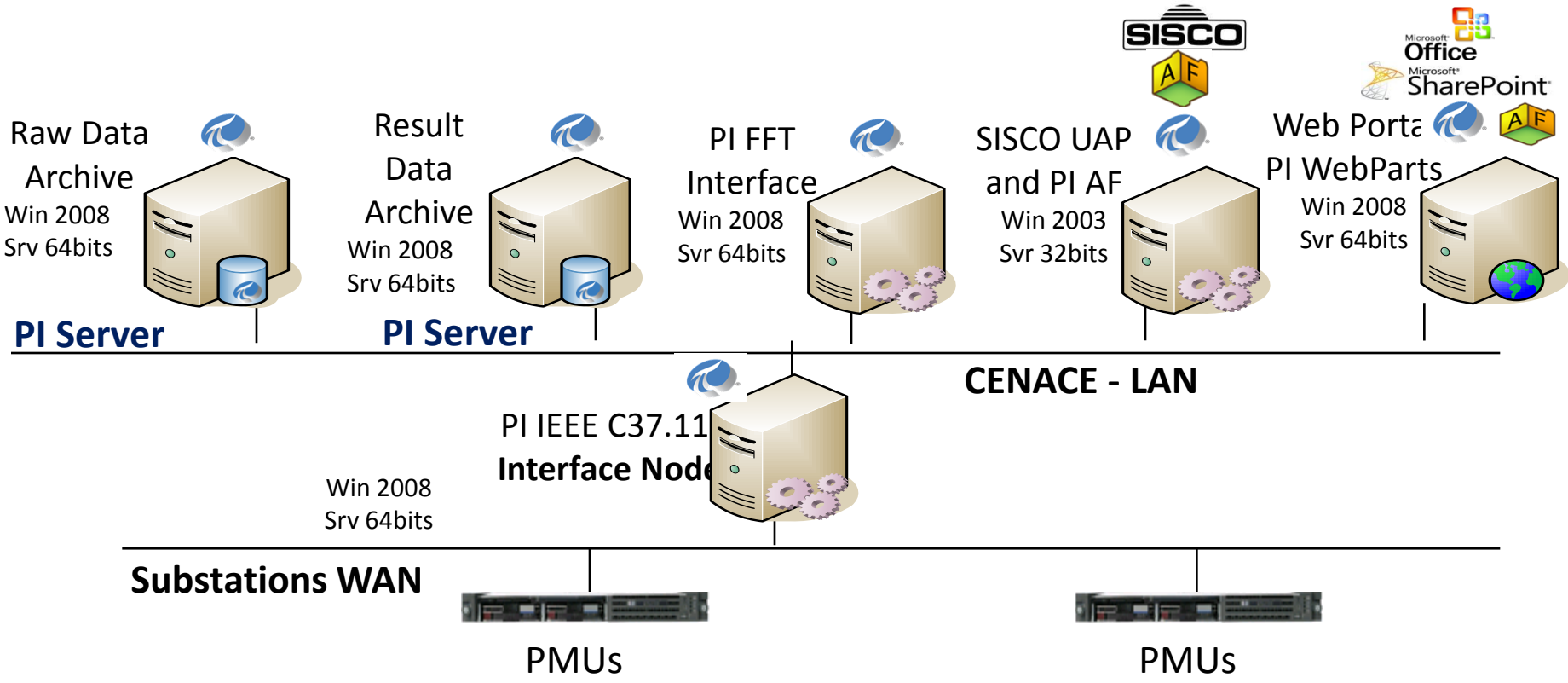
***MODICOSEN*** (Dynamic Monitoring & Control of the National Power System):

- 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

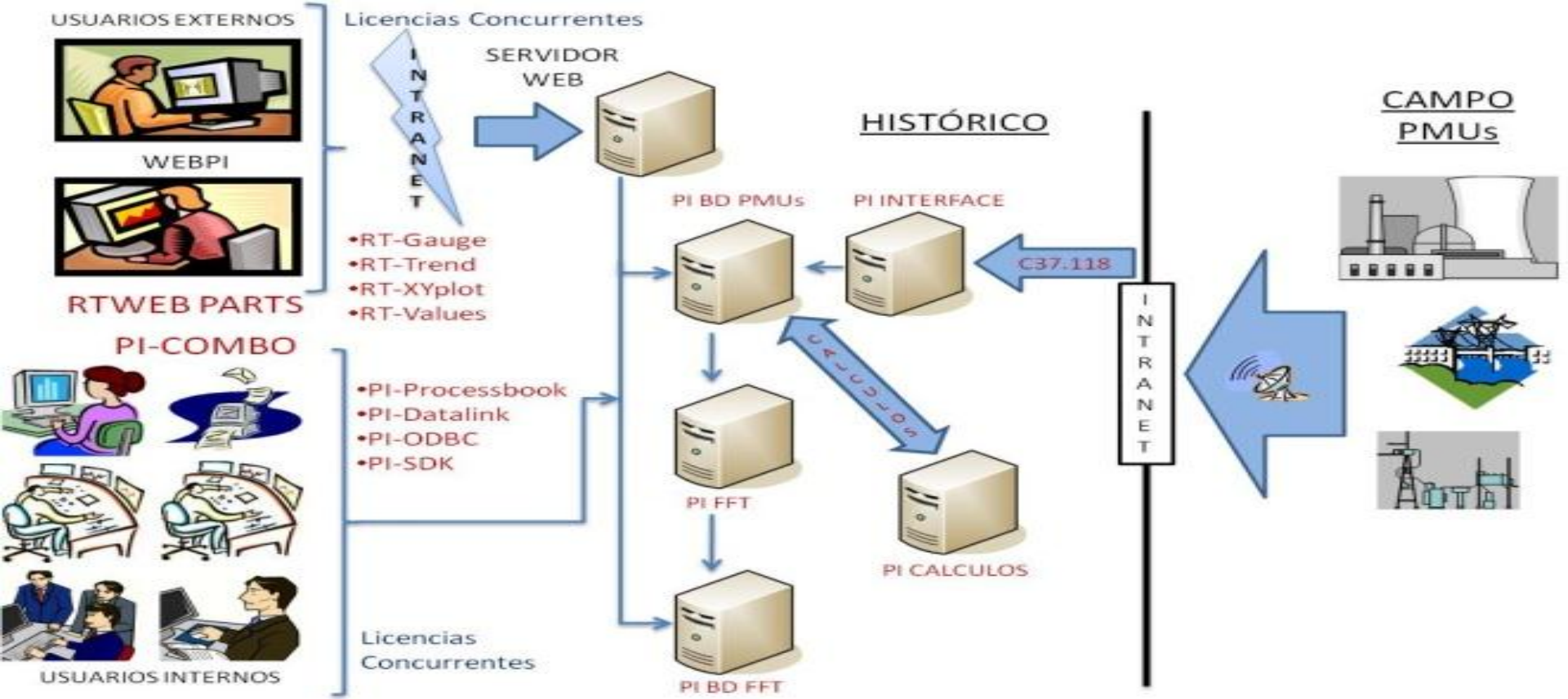
# Sistema de Monitoreo Dinámico y Control del Sistema Eléctrico Nacional MODICOSEN

- 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
- Apply OSIsoft PI System platform and 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

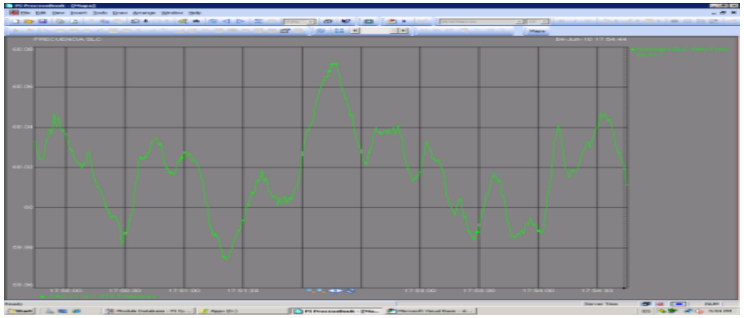


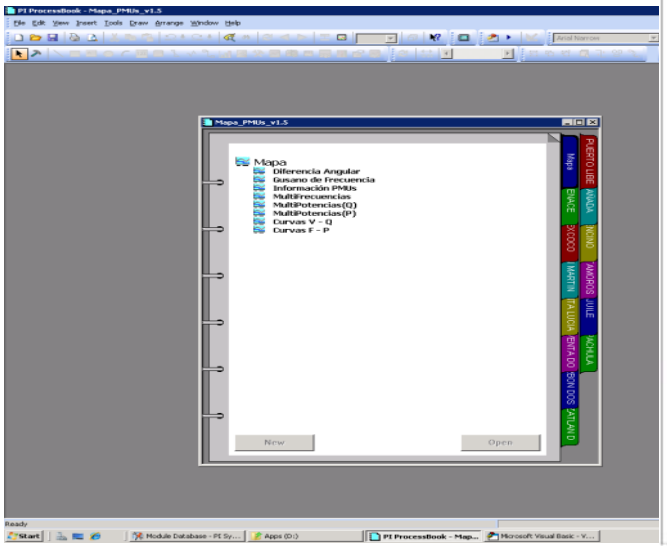
# MODICOSEN System Components

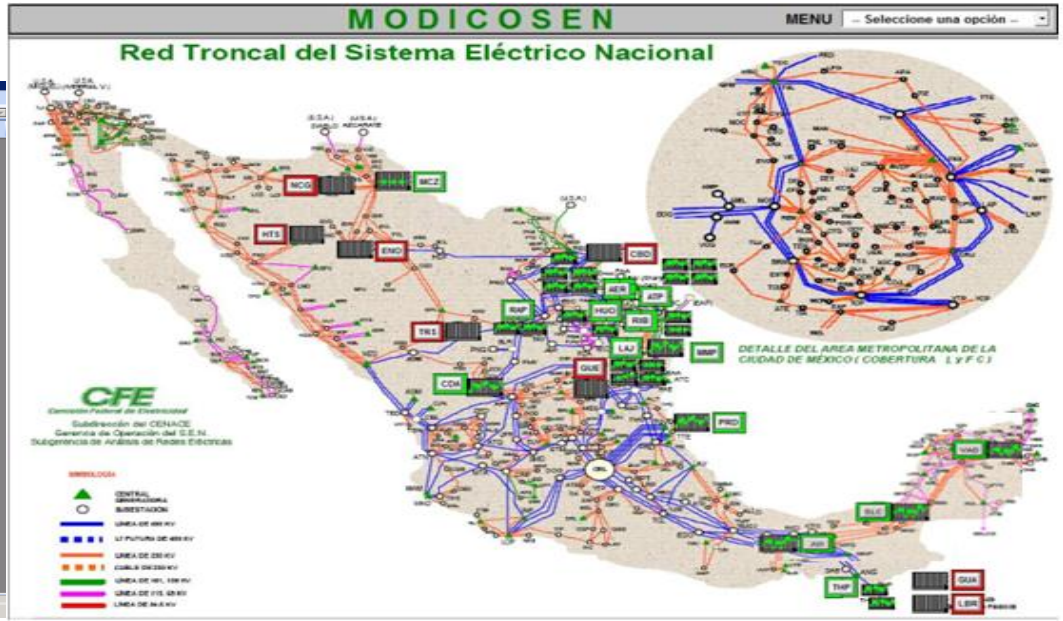


# MODICOSEN Visualization

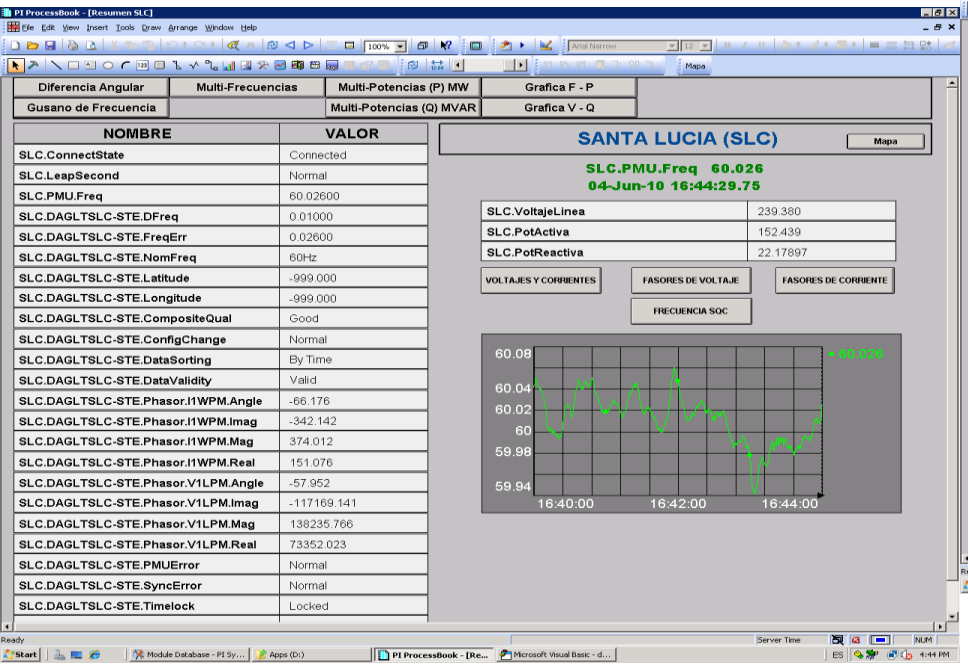
- PMU Monitoring
  - PI ProcessBook 3.2.0.0
  - 25 PMUs
  - Connection Status
  - Status Updates



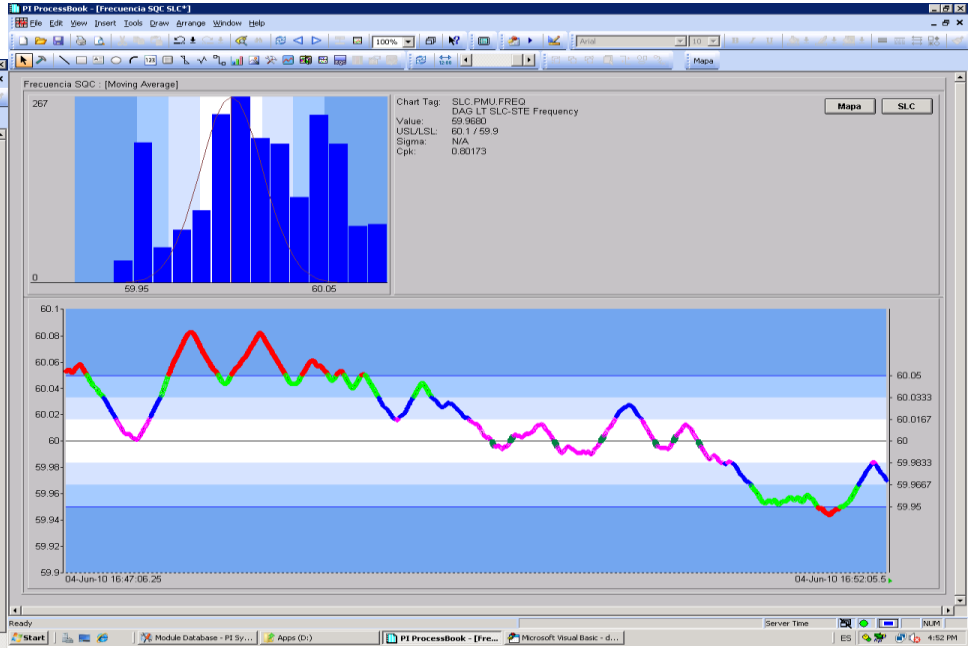


# MODICOSEN Visualization

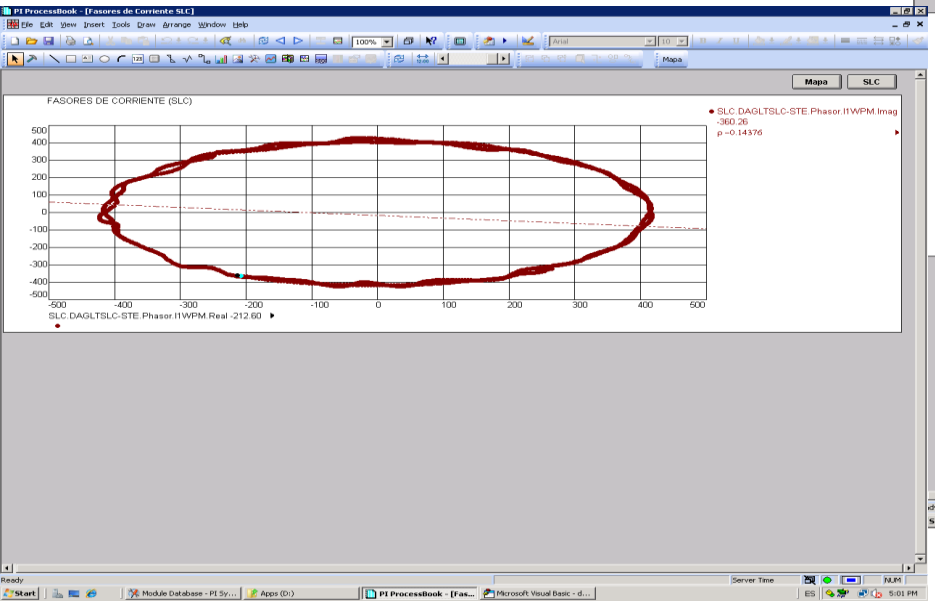



- PMUs Raw Data Displays

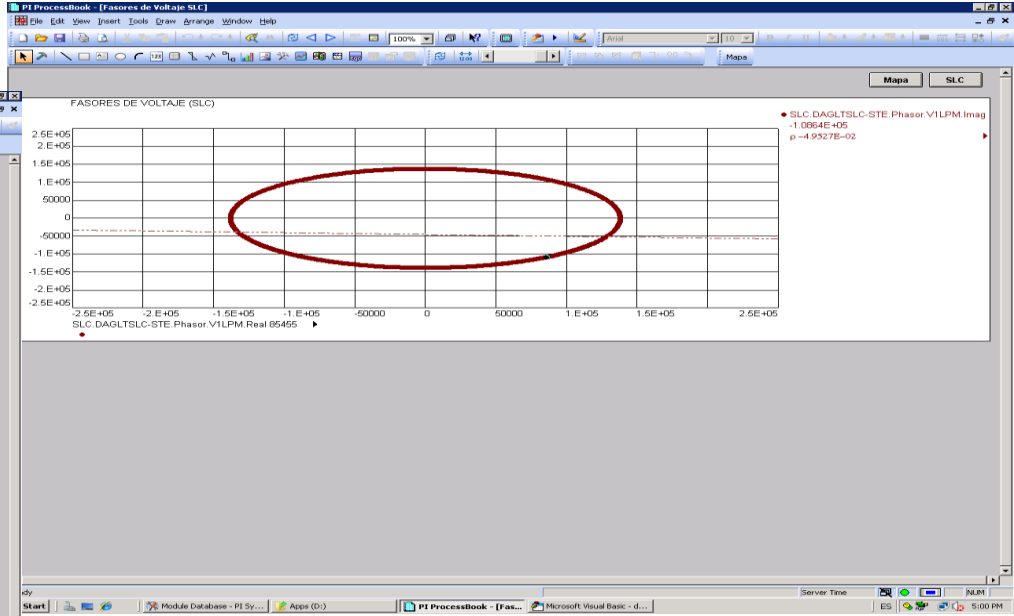



- PMUs Data Analysis Frequency using PI SQC (Statistical Quality Control)

# MODICOSEN Visualization

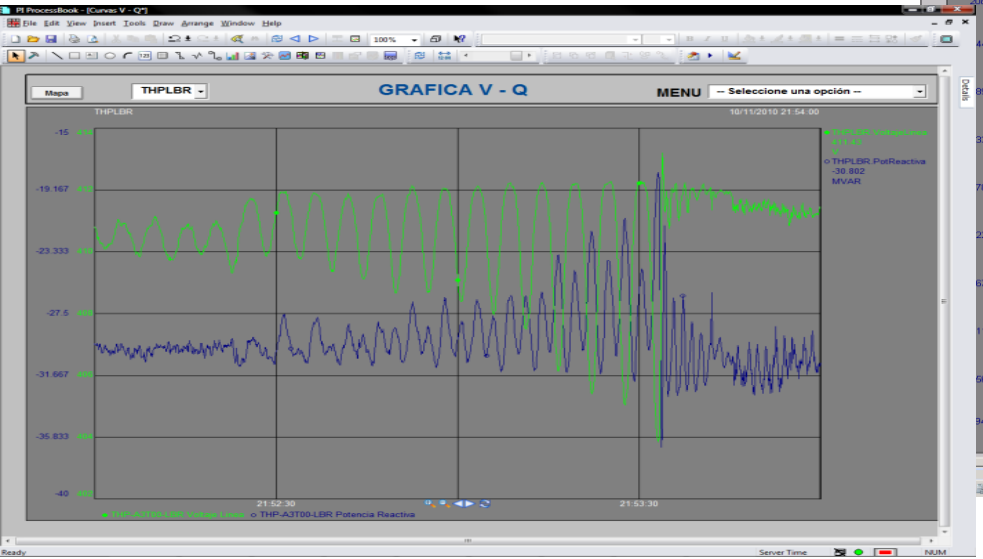



- Voltage Phasors Real & Imag Parts

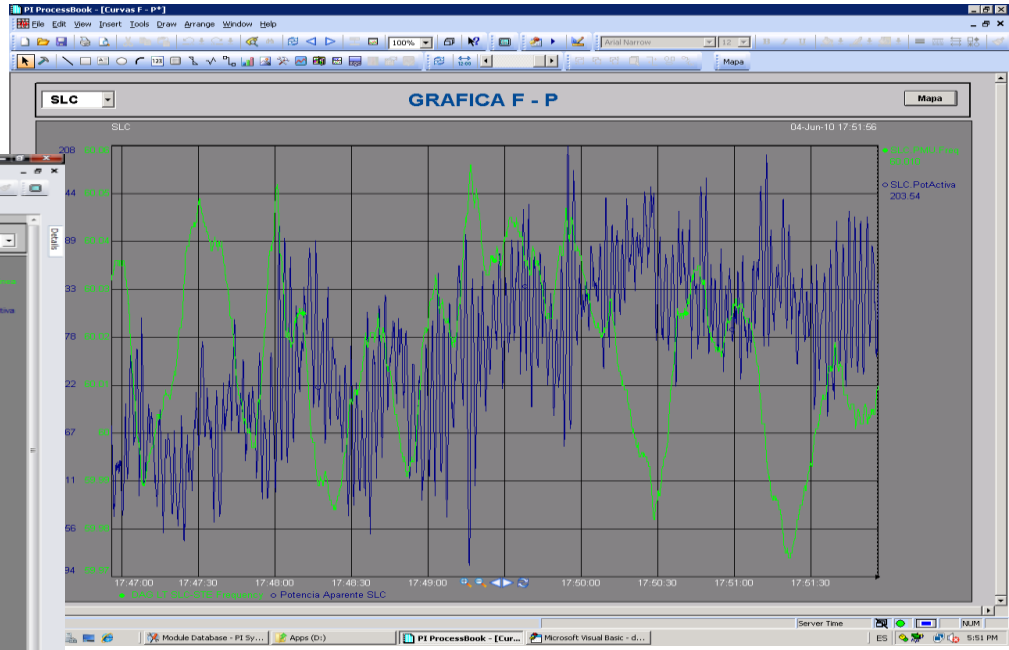



- Current Phasors  Real & Imag Parts

# MODICOSEN Visualization

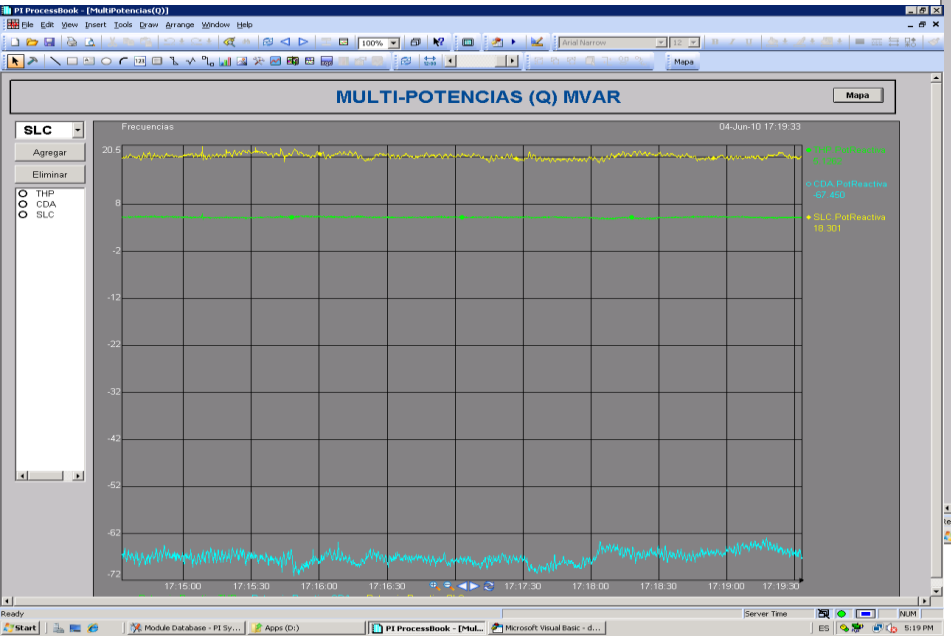



- Voltage and Reactive Power

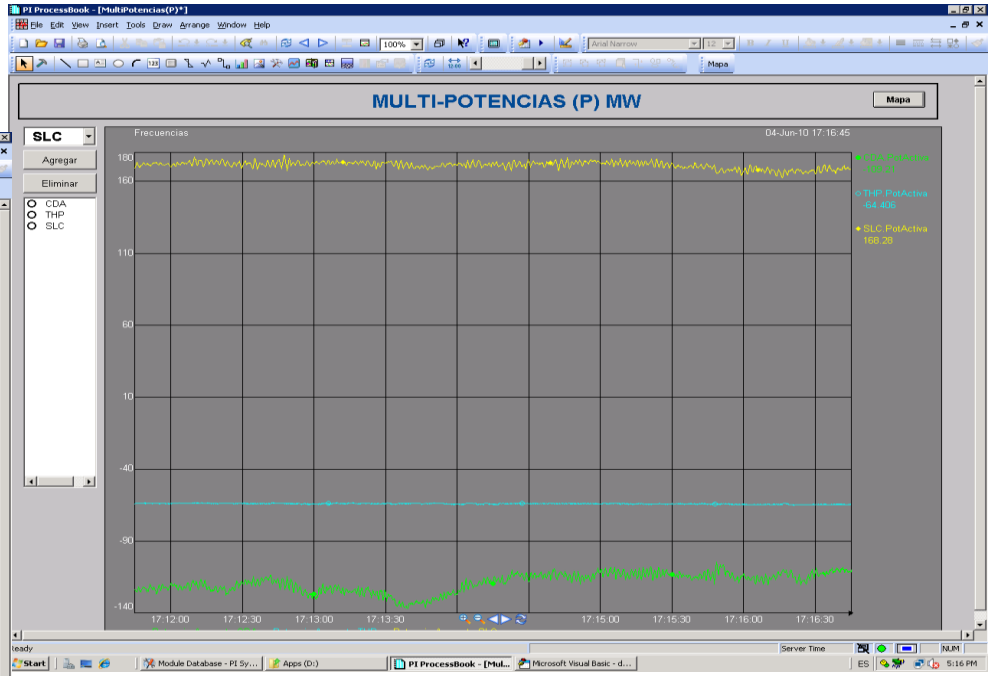



- Frequency and Real Power

# MODICOSEN Visualization

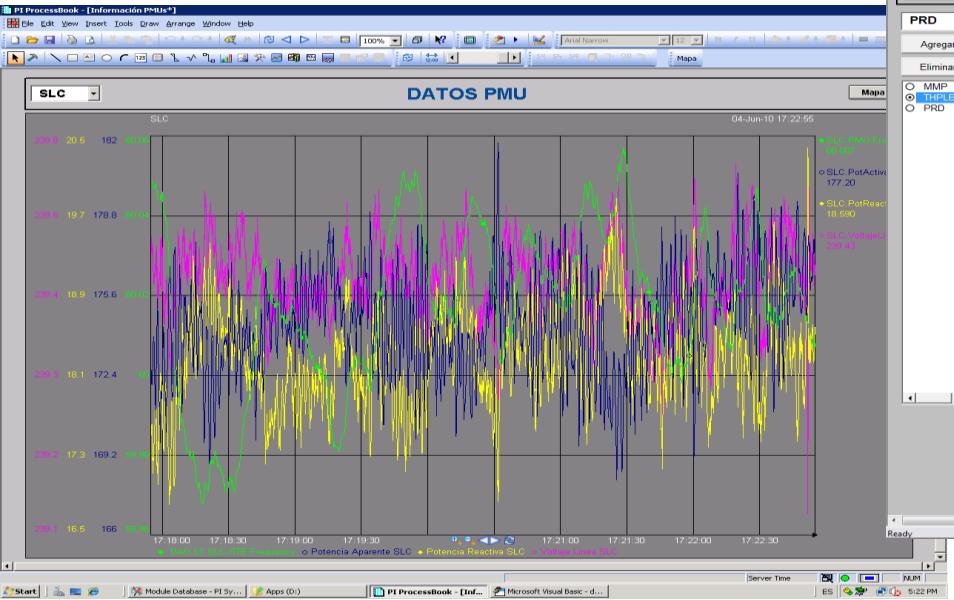



- Configurable MVARs Trending

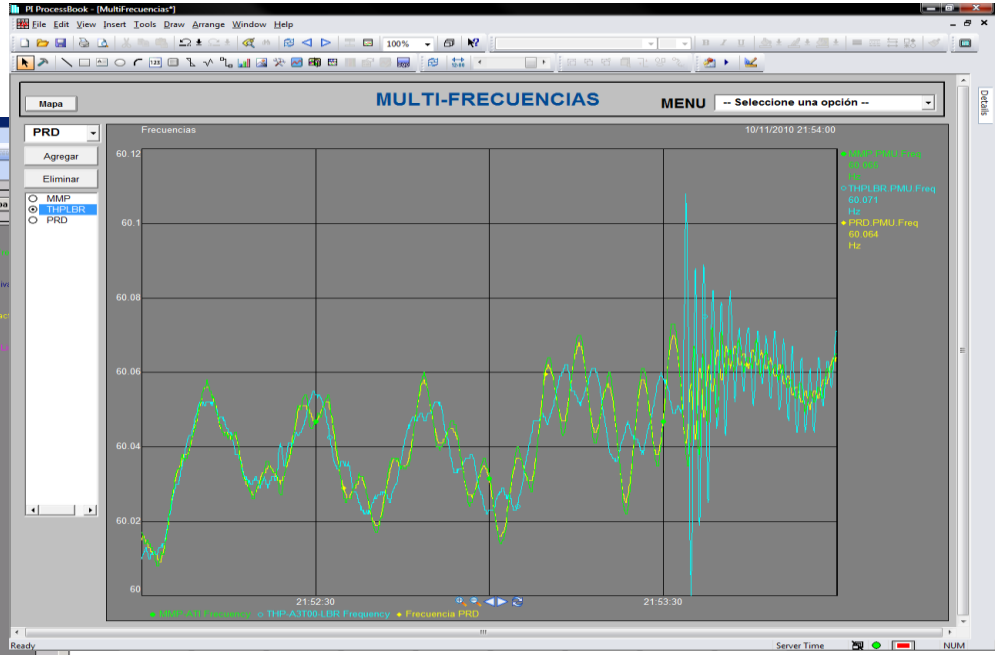



- Configurable MWs Trending

# MODICOSEN Visualization

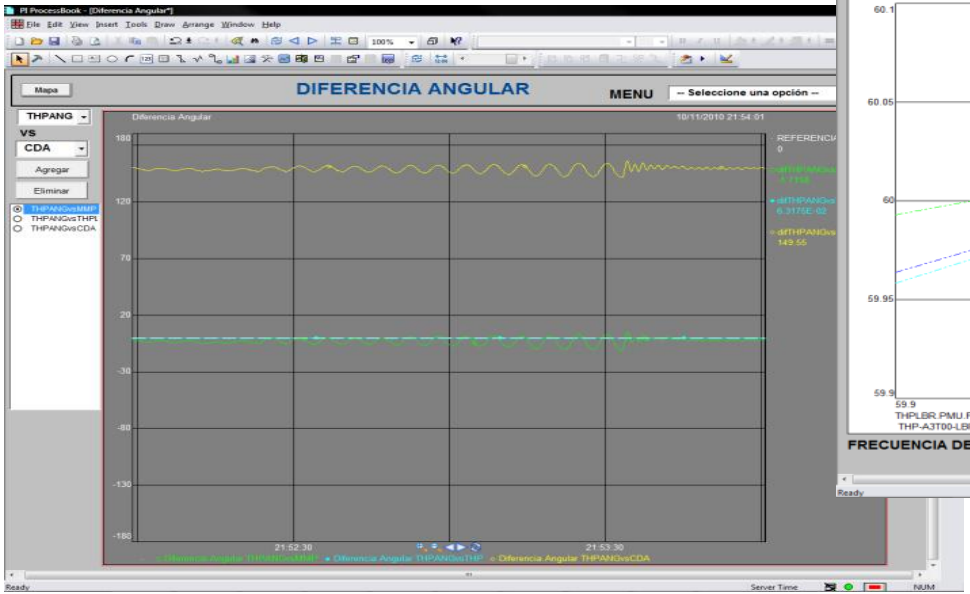



- Configurable Raw PMUs Data

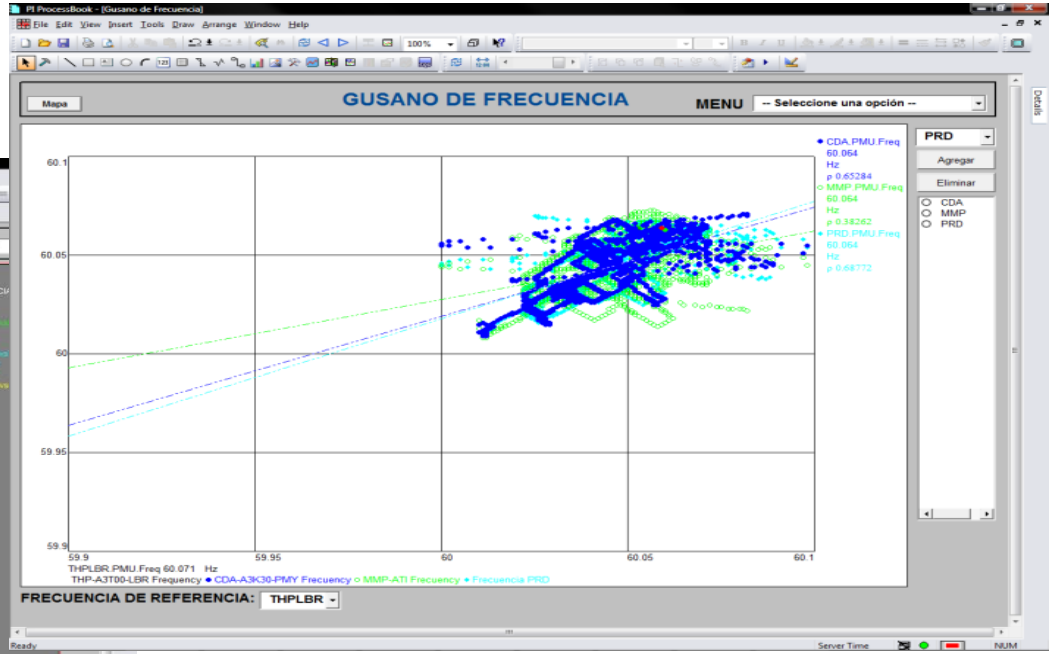



- Configurable Frequencies

# MODICOSEN Visualization

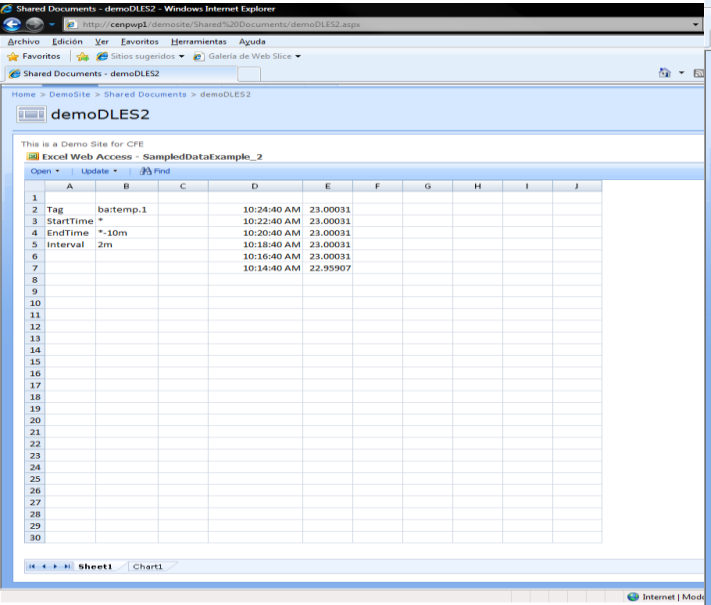


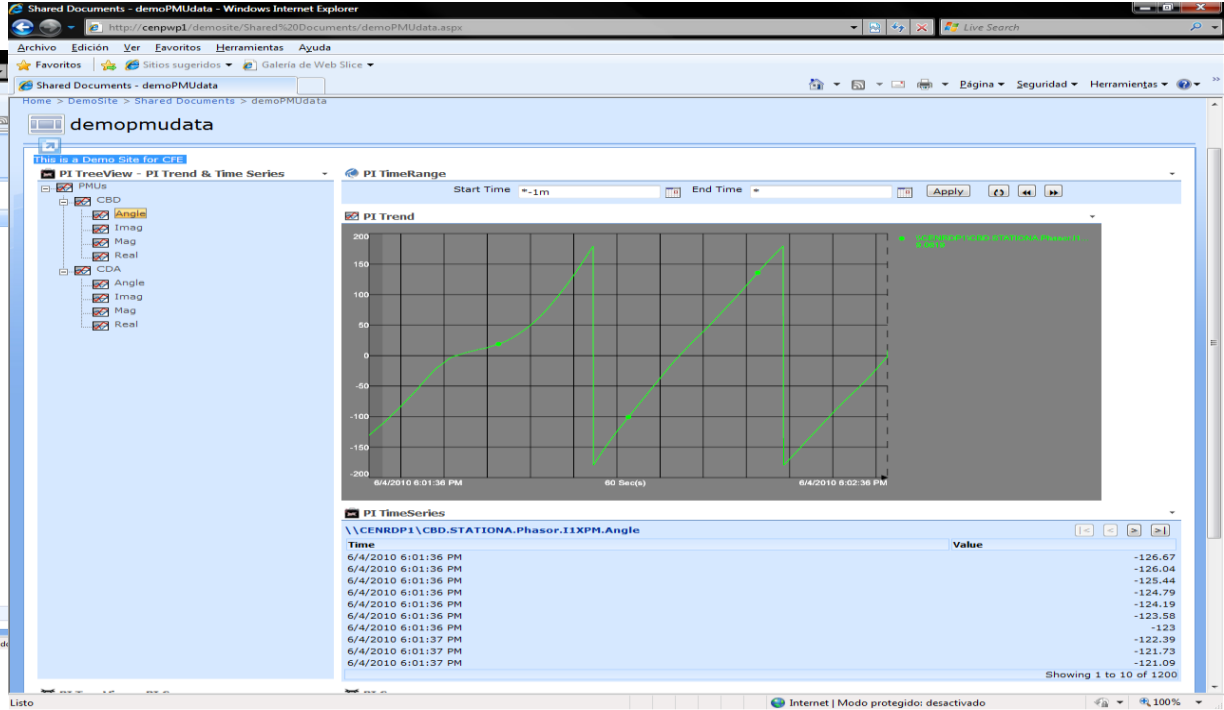

- Configurable Angle Differences Chart




- Configurable Frequency Worm Chart

# MODICOSEN Web-based Visualization

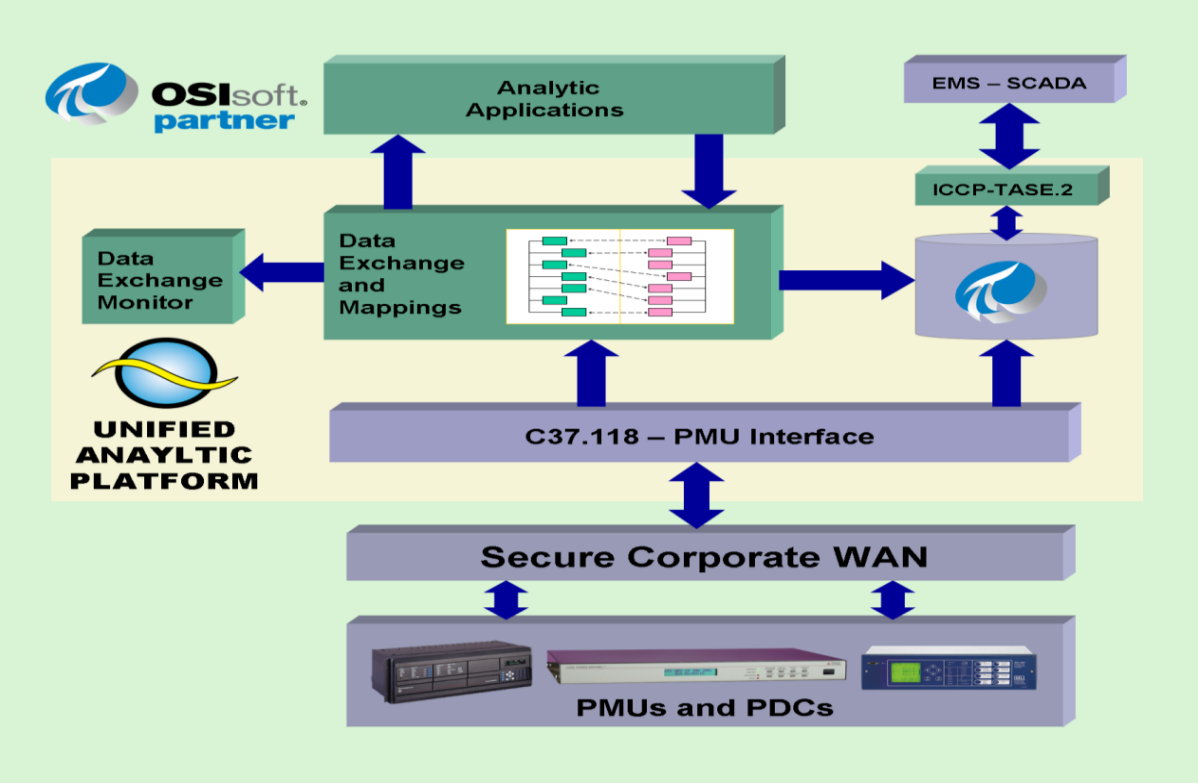



- PI DataLink Excel Services
- PI WebParts

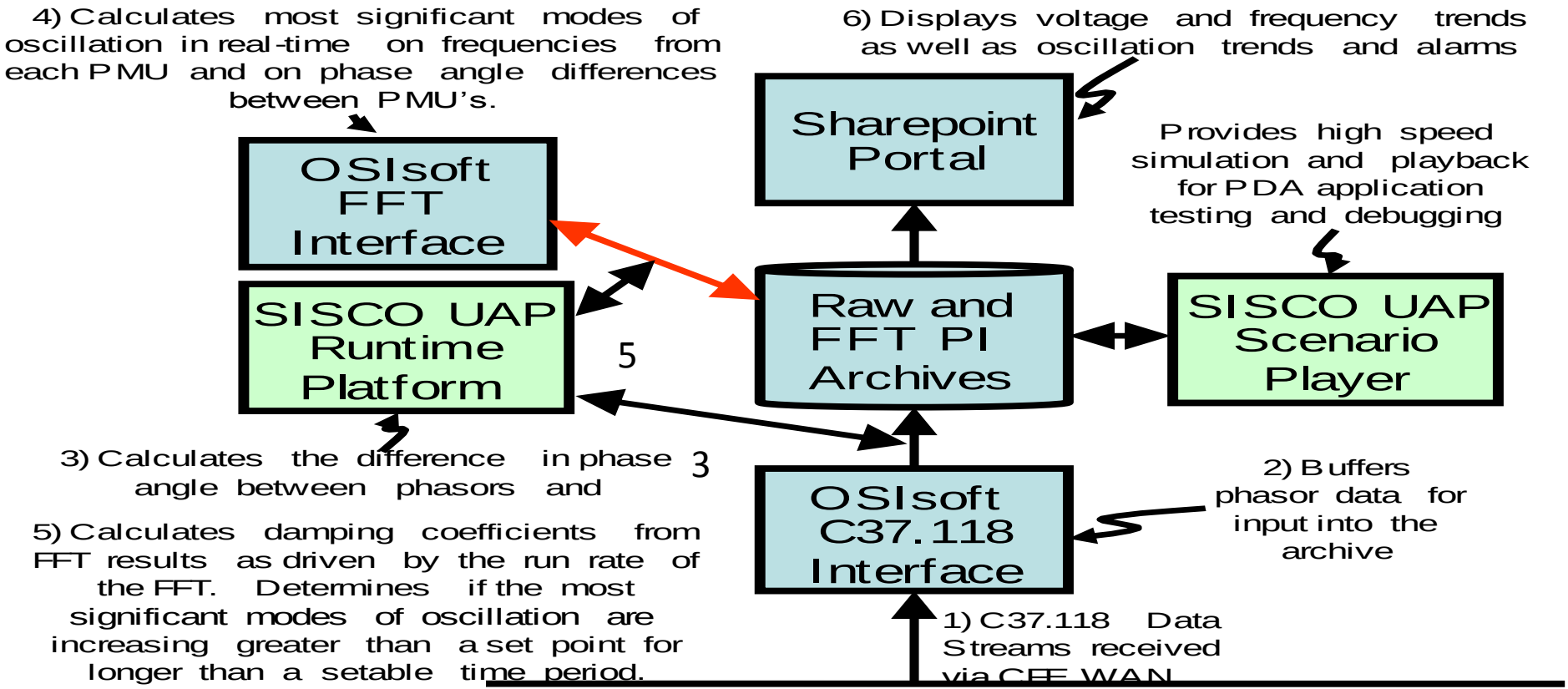
# MODICOSEN Analytics – UAP (Unified Analytic Platform)

- Real-Time Calculations performed using SISCO Unified Analytic Platform



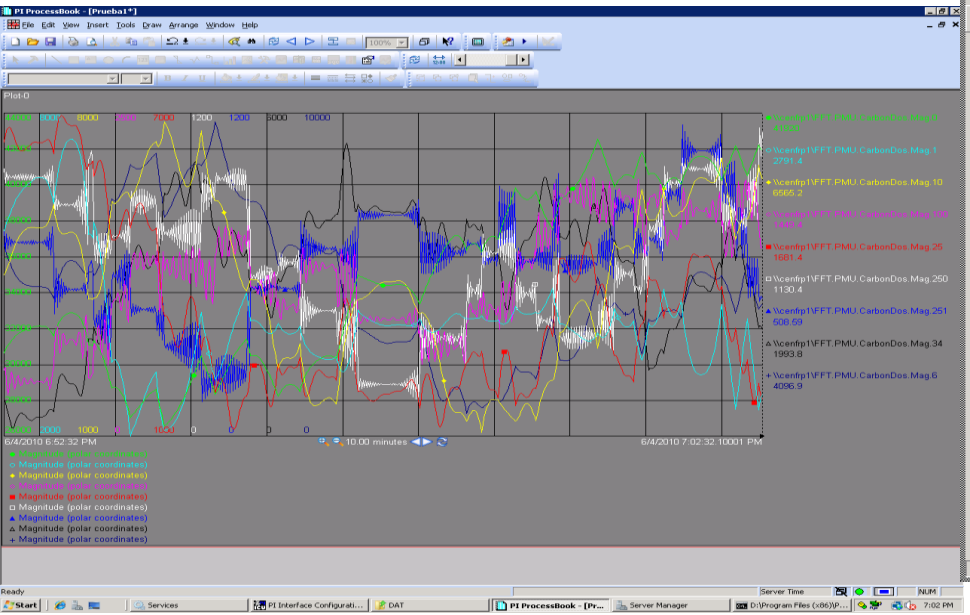

- Angle Differences, 20 times per second
- Oscillation Detection and Alarming, 5 times per second
- Damping Coefficient of Significant Harmonics, 5 times per second

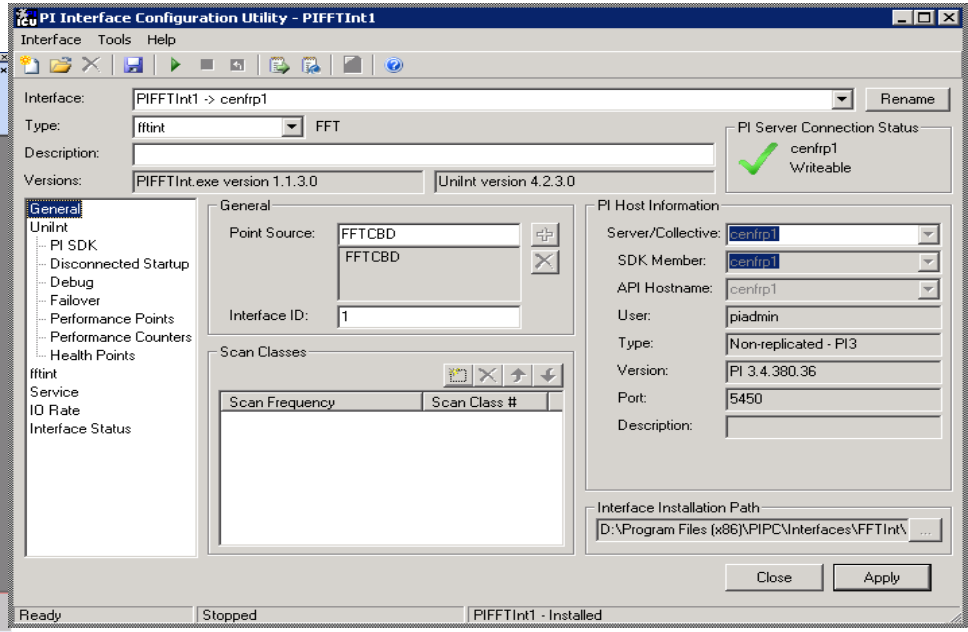
# MODICOSEN Analytics – PDA (Phasor Data Analyzer)



# MODICOSEN Analytics

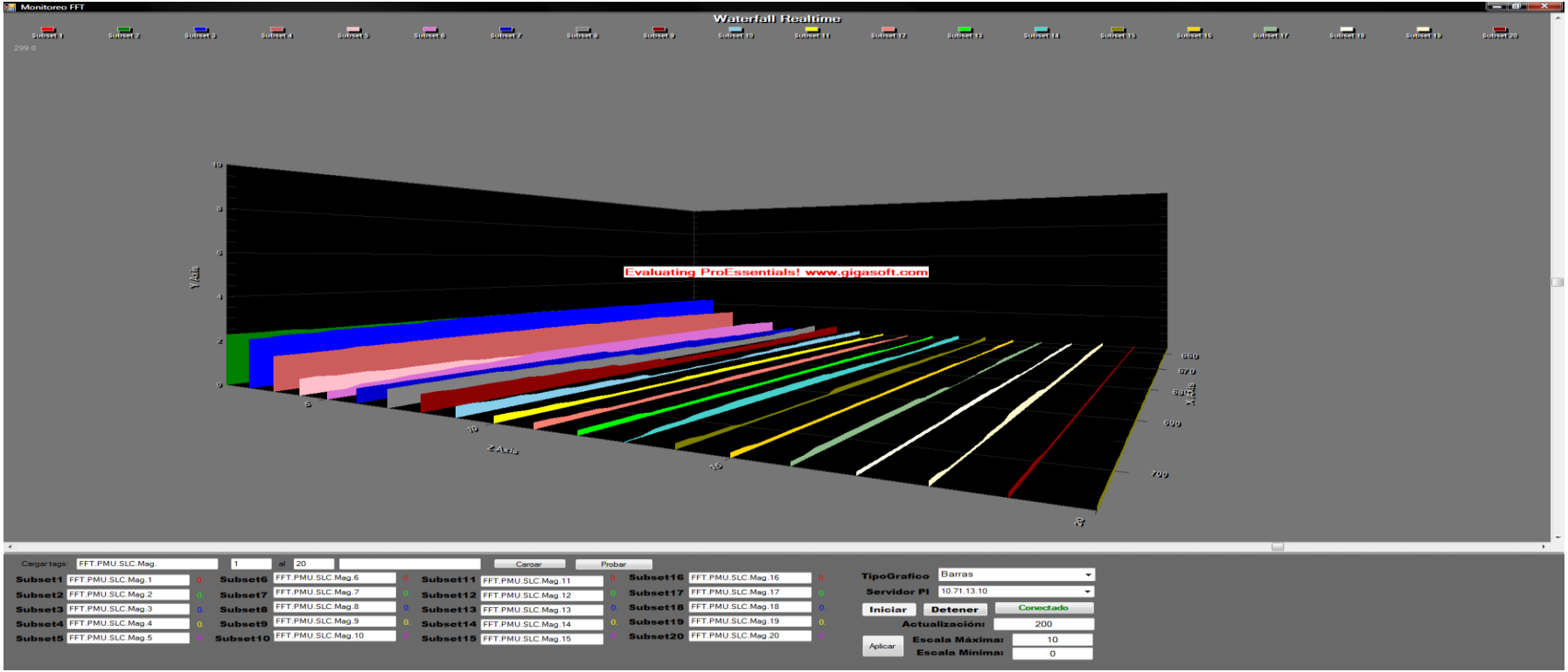
- OSIsoft PI FFT Interface (Fast Fourier Transform)
  - Calculates the modes of oscillation (Harmonics Content)
  - Polar & Rectangular Coordinates



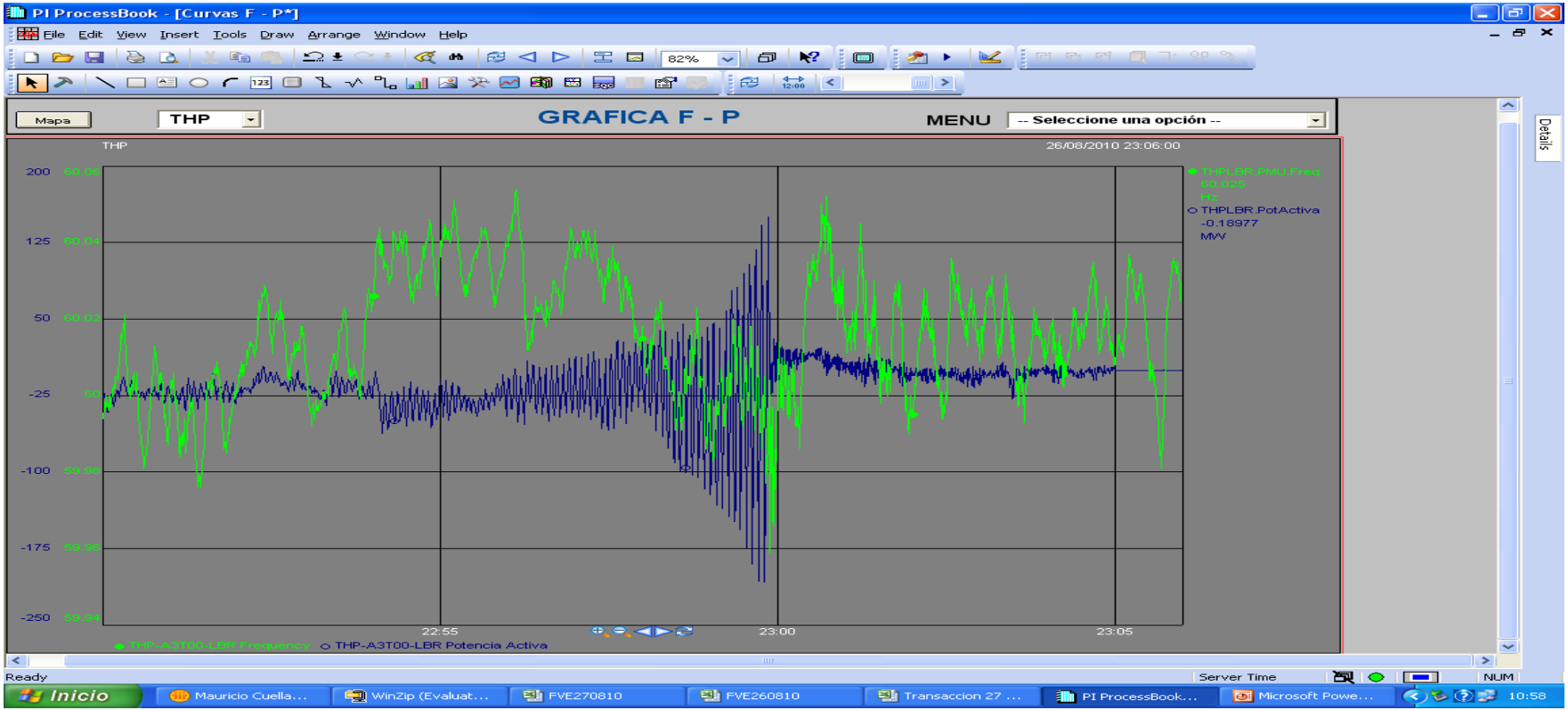
# MODICOSEN Analytics

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



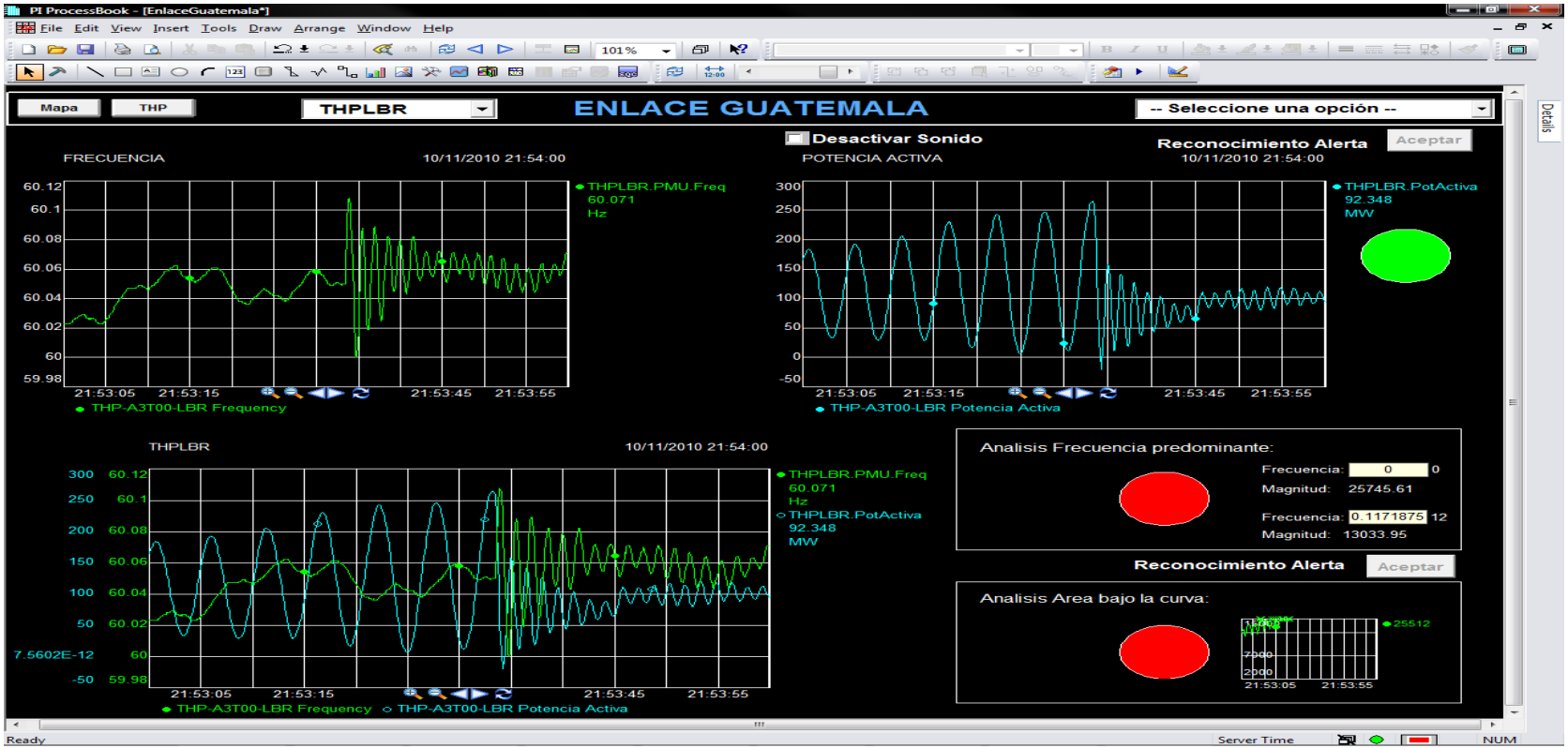
# MODICOSEN Analytics

- Mexico – Guatemala Tie Line Event



# MODICOSEN Analytics

- PI FFT Interface - Low Frequency Oscillations Detection and Alarming



# Intangible Benefits

- Improved response times for data analysis
- Greater flexibility in searching
- Friendly tool (graphics and Excel)
- Democratization of information through Integration
- A single source of information
- Improved visualization “Look and Feel“
- Easy and fast to update the information

# Tangible Benefits

- 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 Report Generation is flexible and simple
- The Failure Analysis can be carried out in Real-time
- Monitoring the Network Stability in Real-time better than SCADA

# Next Steps

- Increase PMUs coverage and data acquisition
- Install more instances of PI C37.118 PMUs Interface
- Increase System Scalability
- Install PI Interface Node & PI Raw Data Server at each Substation Level
- Implement PI HA (High Availability) Architecture
- Expand MODICOSEN at each Regional Control Area Level

# MODICOSEN

## Questions & Answers

# Thank you

Turning **insight** into **action**.