Introduction to PQView and PQWeb

Wieslaw Jerry Olechiw
Vice President of Sales – Dranetz
General Manager - Electrotek Concepts

Who Uses PQView Today?

United States/Canada

- American Electric Power
- Alabama Power Company
- Baltimore Gas and Electric
- CMS Energy
- CPS Energy San Antonio
- Con Edison New York
- Detroit Edison Company
- Dominion Virginia Power
- Duke Energy Corporation
- EnerNex Corporation
- Entergy Services
- EPRI
- FirstEnergy
- Georgia Power Company
- Hawaiian Electric Company
- Hydro One Networks
- Hydro Ottawa
- Maui Electric Company
- NIST
- Nebraska Public Power District
- Northeast Utilities
- Public Service Electric and Gas Company
  Public Service of New Hampshire
- Salt River Project
- San Diego Gas and Electric
- Southern California Edison
- Southern Company
- Tennessee Valley Authority
- United Illuminating Company
- Wisconsin Public Service
- Wireless from AT&T

Asia-Pacific

- Ausgrid Sydney
- Companhia de Electricidade de Macau (CEM)
- Guangdong Power Grid
- Guangxi Power Grid Company
- Hebei Electric Power Company
- Henan Power Company
- North China Power Grid
- Orion New Zealand
- Provincial Electricity Authority
- Shandong Provincial Electrical Power Corporation
- Shanghai Municipal Electric Power Company
- Shanghai Jiu Long Electric Power Science & Technology Company
- Shanxi Power Company
- Yunnan Power Grid Corporation
- Transpower New Zealand

Latin America

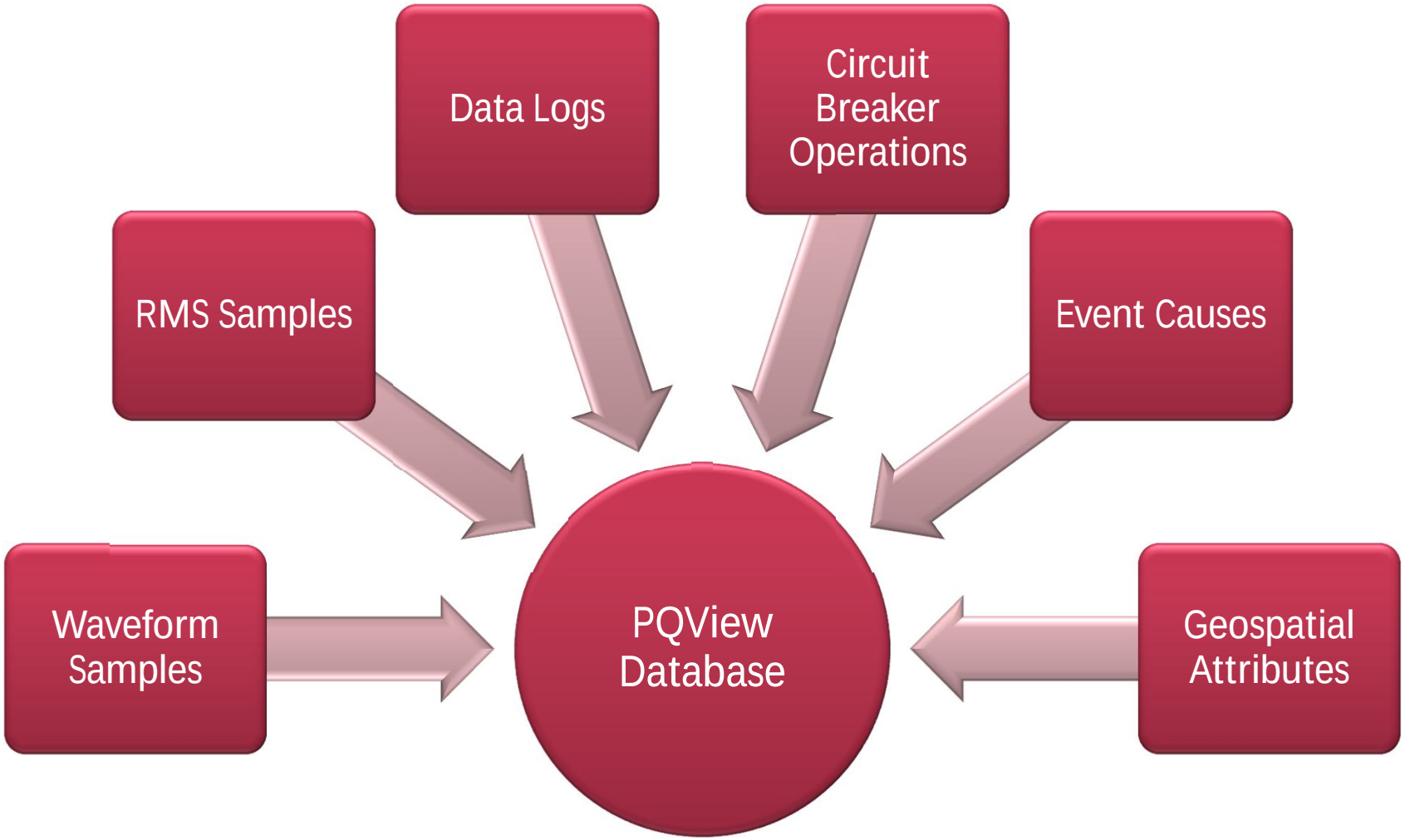
- Central Hidroeléctrica de Caldas
- Operador Nacional do Sistema Eléctrico

Europe

- Agder Energi Nett AS
- BKK Nett AS
- CEE Energiteknikk AS
- Central Networks (E.ON)
- DEM Slovenia
- Elektro Slovenia
- Elektrobistand
- Hålogaland Kraft AS
- Helgelandskraft AS
- Hydro Aluminium AS
- Hrvatska Elektroprivreda (HEP)
- Istad Nett AS
- Lyse Nett AS
- Nordmøre Energiverk AS
- Notodden Energi AS
- PSE-Operator
- Rødøy-Lurøy Kraftverk AS
- SFE Nett AS
- Skagerak Nett AS
- SINTEF
- Statnett
- StatoilHydro
- Sunnfjord Energi AS
- Sweco Grøner AS
- Tafjord Kraftnett AS
- Tussa Nett AS

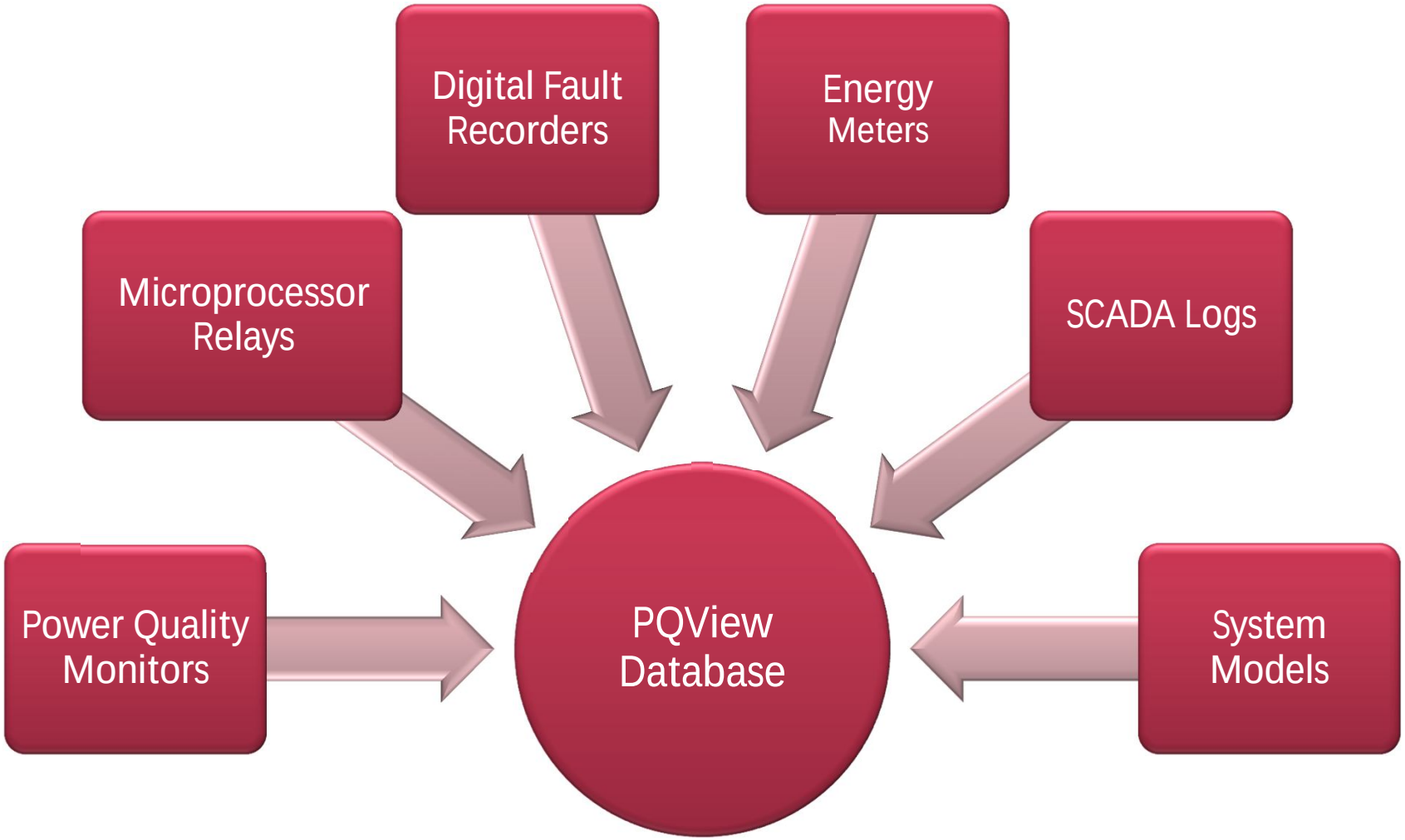
ELECTROTEK CONCEPTS

What data is stored in a PQView Database?



ELECTROTEK CONCEPTS

What are the data sources for a PQView Database?

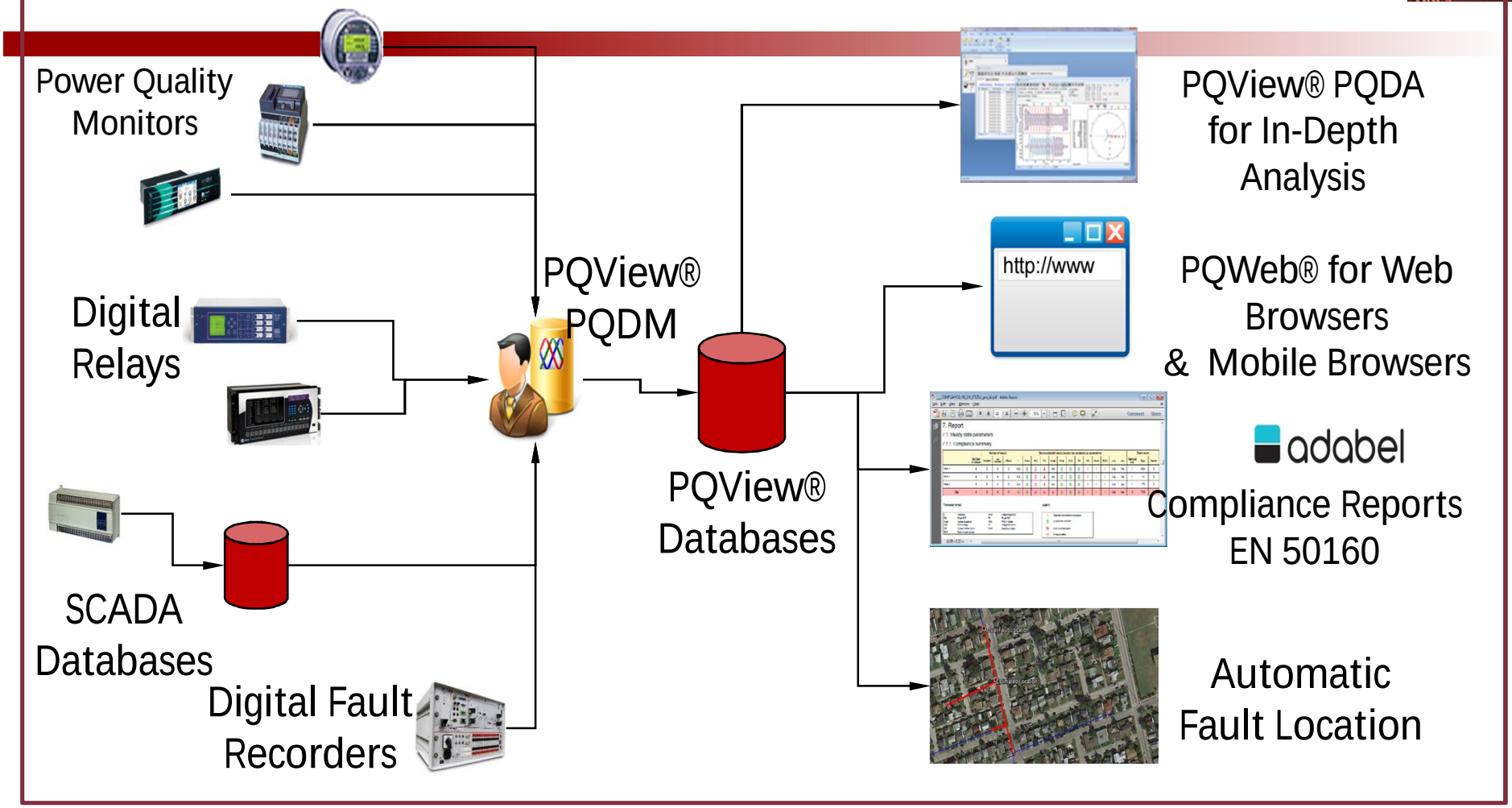


What analysis functions are offered by PQView?

ELECTROTEK CONCEPTS

Companies that Produce Power System Sensors or Software Integrated by PQView Users Today

- Advantech®
- Arbiter® Systems
- Cooper Power Systems® CYME
- Dranetz®
- Edison Electric Institute®
- EDMI
- Electro Industries®
- Electrotek Concepts®
- E-MAX Instruments
- Fluke®/Reliable Power Meters
- General Electric®
- GL Industrial Group/Stoner Software® SynerGEE® Electric
- Gossen Metrawatt
- GridSense
- Grounded Power
- HIOKI®
- Landis+Gyr®
- Linbo
- OSIsoft®
- Power Monitors, Inc.® (PMI)
- PSL Power Standards Labs®
- Qualitrol®/LEM Instruments
- SATEC
- Schneider Electric®/Power Measurement®
- Schweitzer Engineering Laboratories® (SEL)
- Siemens®
- SoftSwitching Technologies®
- Unipower®
- Utility Systems Inc. (USI)



Schweitzer Engineering Laboratories

- Data Handler for Schweitzer Engineering Laboratories Reports:

The data handler can now import SEL event reports (EVE files), compressed event reports (CEV files), and load profile reports (LDP files).

Additionally, the PQView installation program installs example SEL files and an example configuration file demonstrating how to import SEL text reports.

IEEE COMTRADE Files

SEL Relays

SEL 5045 acSELerator Team Software

GE Relays

GE EnerVista

Qualitrol Relays

BEN32 Master Station Software

Other Relays

Softstuf Wavewin Data Collection

SUBNET Solutions SubSTATION Server

COMTRADE Folders

PQView PQ Data Manager

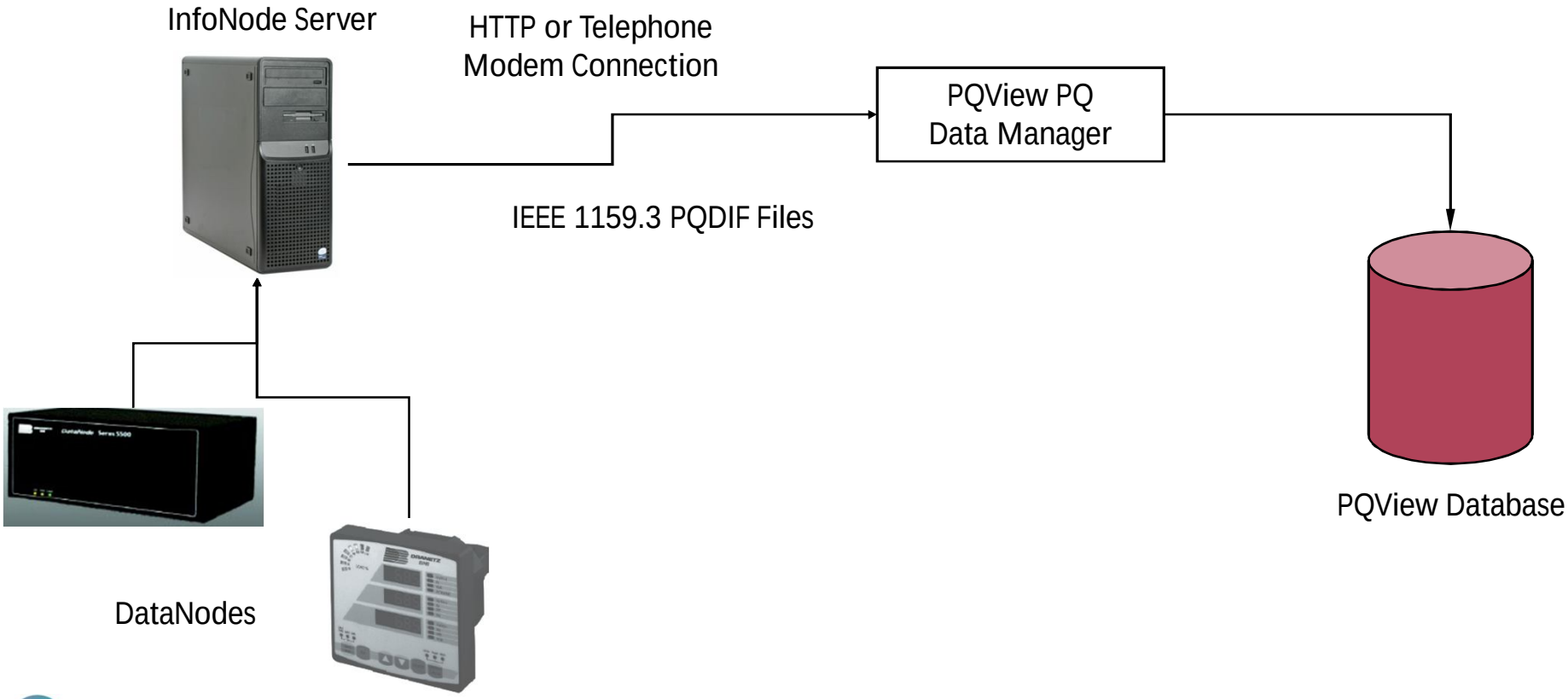
PQView Database

ELECTROTEK CONCEPTS

Signature System®/Encore Series

DRANETZ
THE STANDARD FOR ENERGY & POWER MEASUREMENT

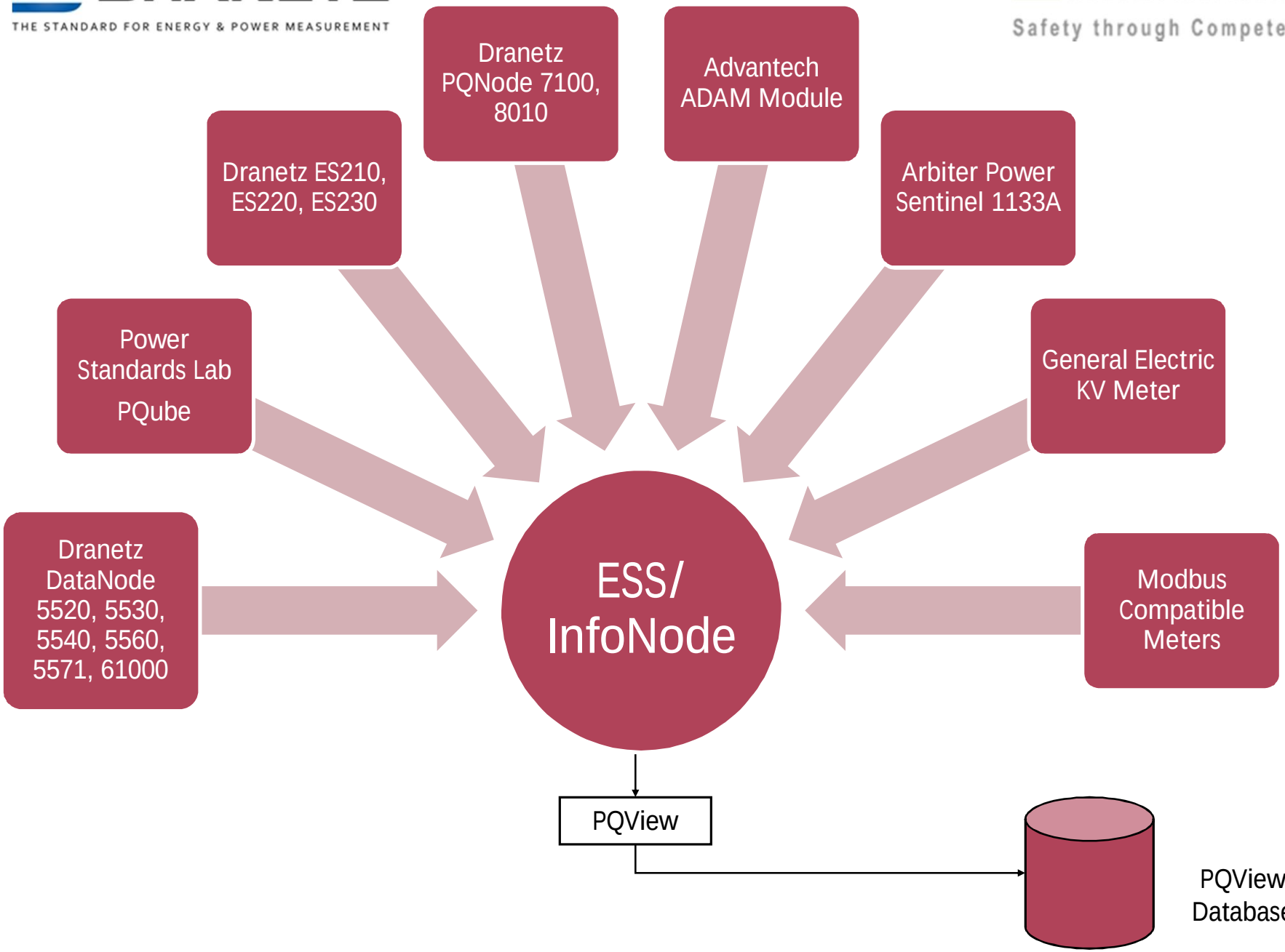
GOSSEN METRAWATT
Safety through Competence



ELECTROTEK CONCEPTS

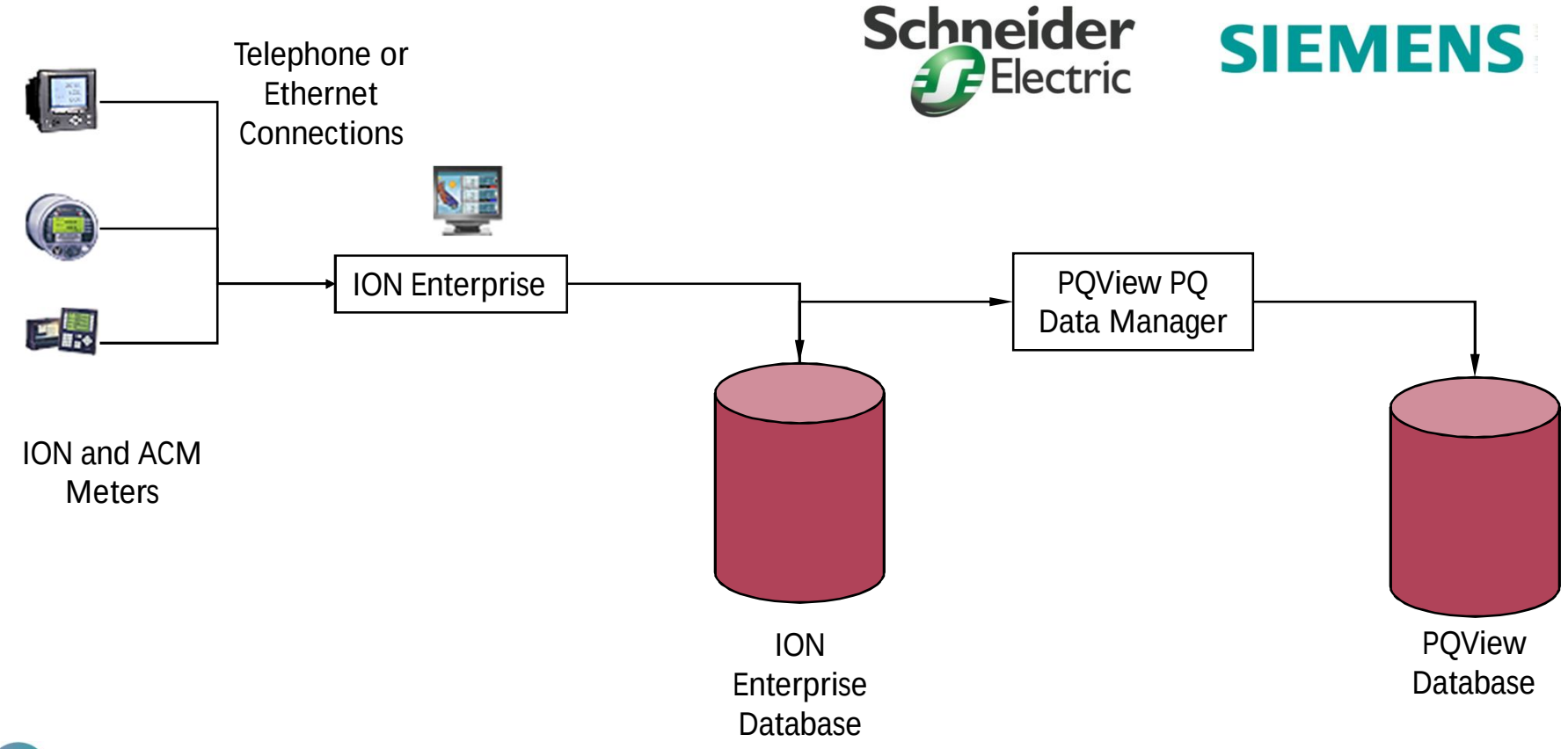
DRANETZ
THE STANDARD FOR ENERGY & POWER MEASUREMENT

GOSSEN METRAWATT
Safety through Competence



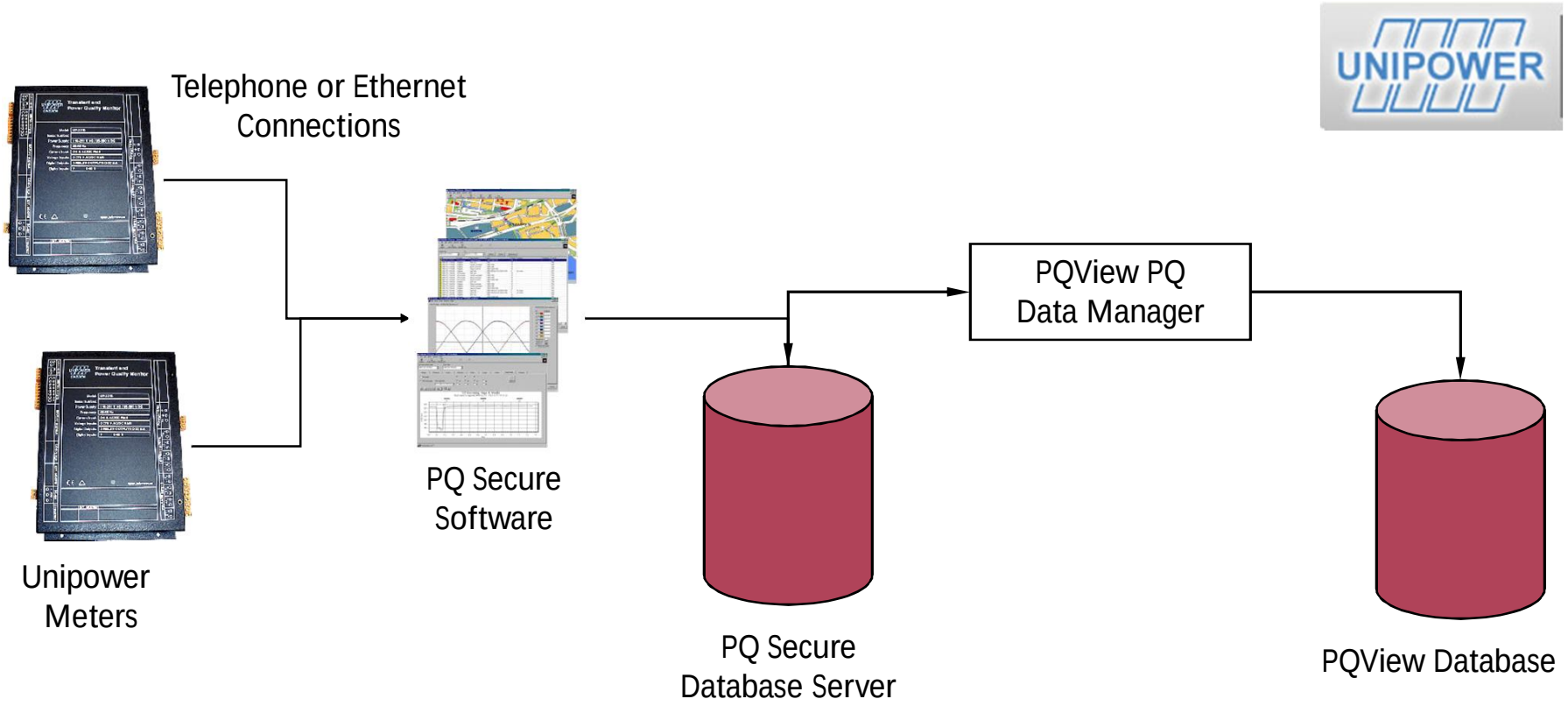
PQView Integration with ION Enterprise® or WinPM.Net Database

- Requires installation of optional ION Enterprise Database Data Handler



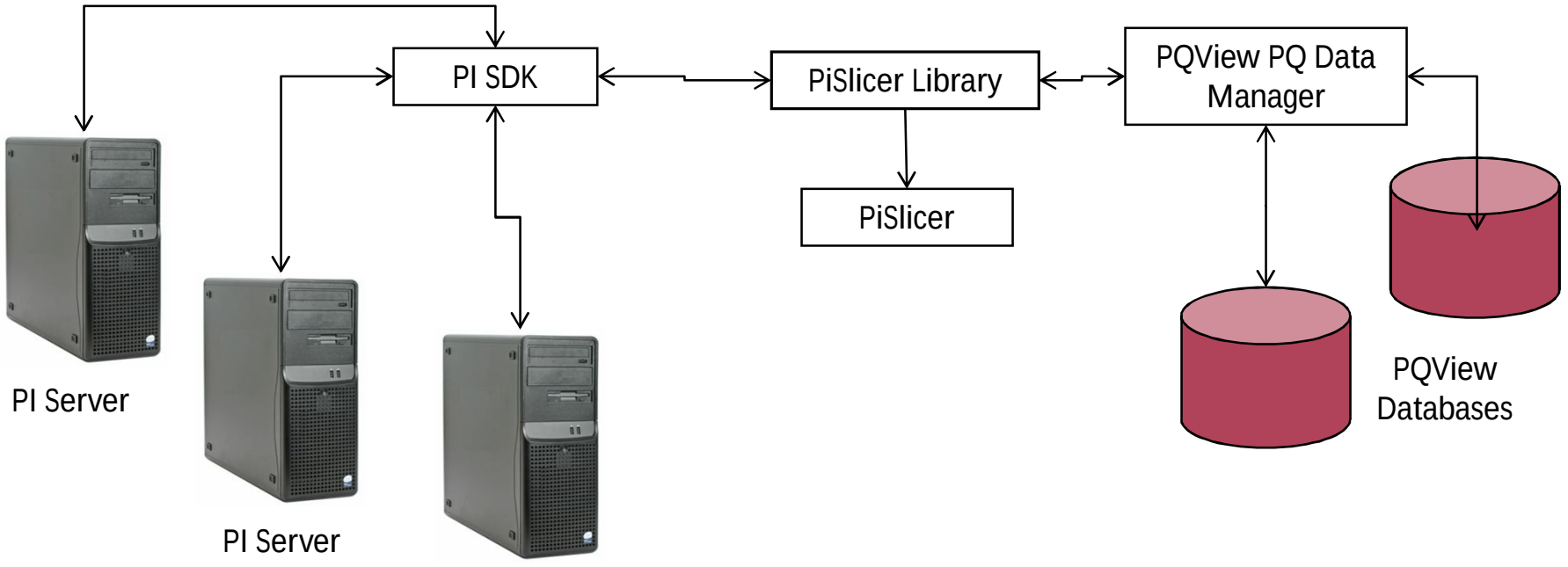
PQView Integration with Unipower PQSecure Database

- Requires installation of optional PQ Secure Database Data



OSIsoft PI System

- Requires installation of optional OSIsoft PI SDK and Electrotek PiSlicer Library



PQView Integration with Dranetz Portable Monitors

Power Xplorer

Power Guide

Power Visa

Energy Platform EP-1

PQView PQ Data Manager

DDB Files

PQView Database

DRANETZ
THE STANDARD FOR ENERGY & POWER MEASUREMENT

ELECTROTEK CONCEPTS

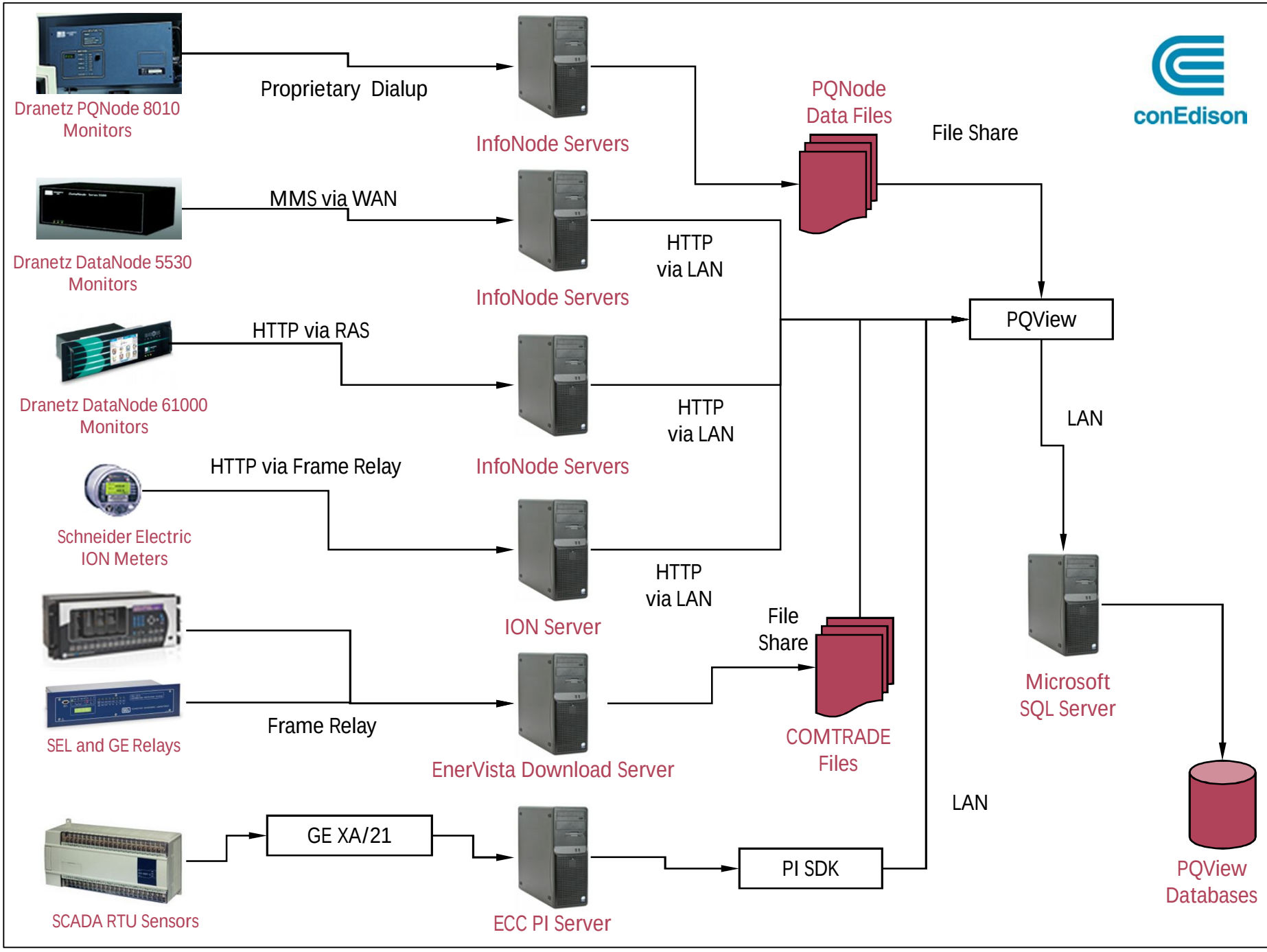
More Data Sources

- Cooper Power Systems CYME
- Dranetz® PES Databases
- Electro Industries/General Electric Communicator Log EPM Files
- Fluke®/Reliable Power Meters (RPM) Omega and Scenario Databases
- GL Industrial Group/Stoner Software® SynerGEE
- Gossen Metrawatt Portable Monitors
- GridSense PowerView
- GroundedPower Text Files
- HIOKI® Text Files
- Landis+Gyr® Text Files
- PQView Text File Formats
- PQView Databases
- SATEC PAS Databases
- Siemens® SICARO PQ Manager Text Files
- SoftSwitching Technologies® I-Grid® Web Site

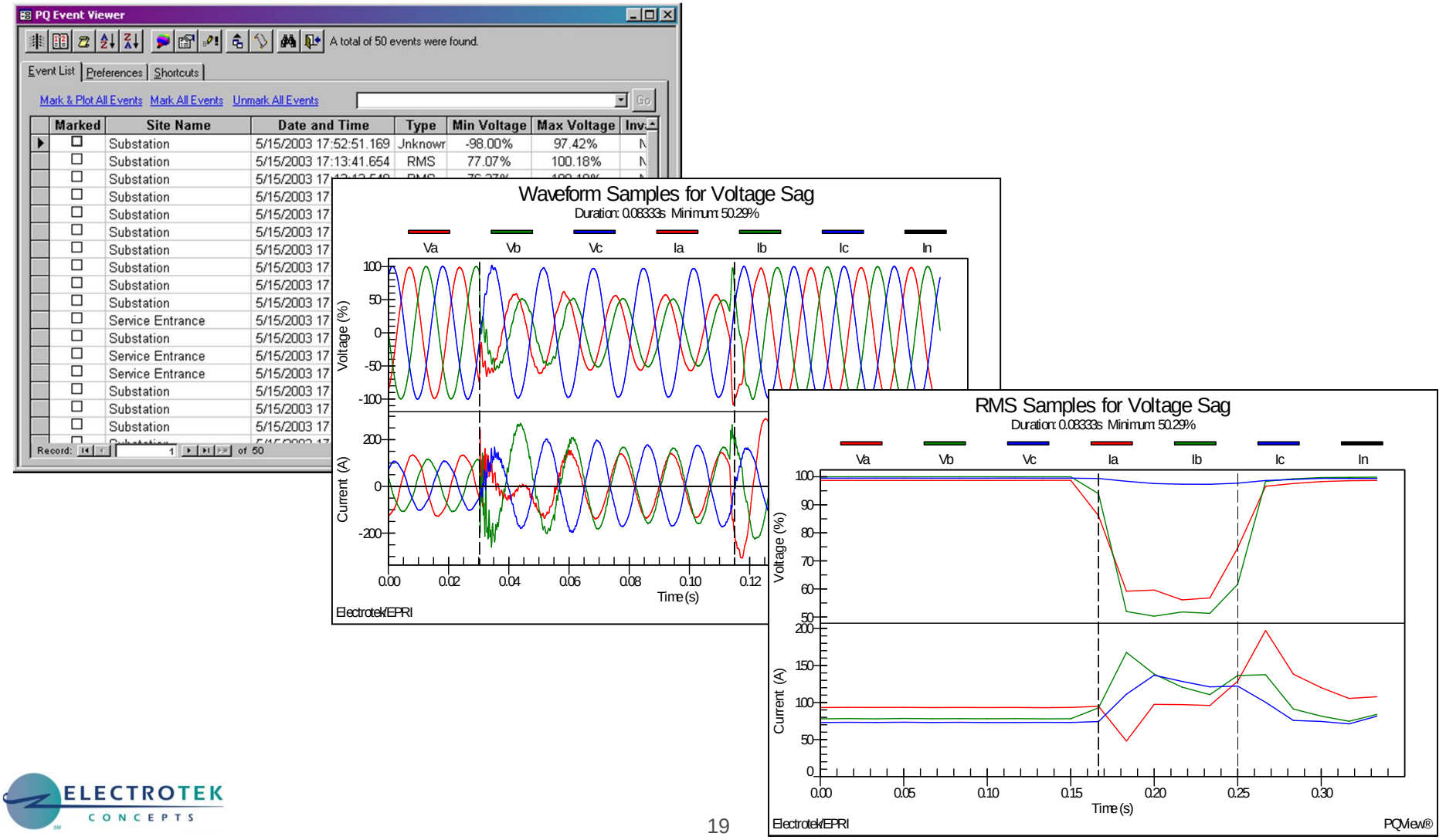
www.pqview.com/data-sources/

Custom Data Sources

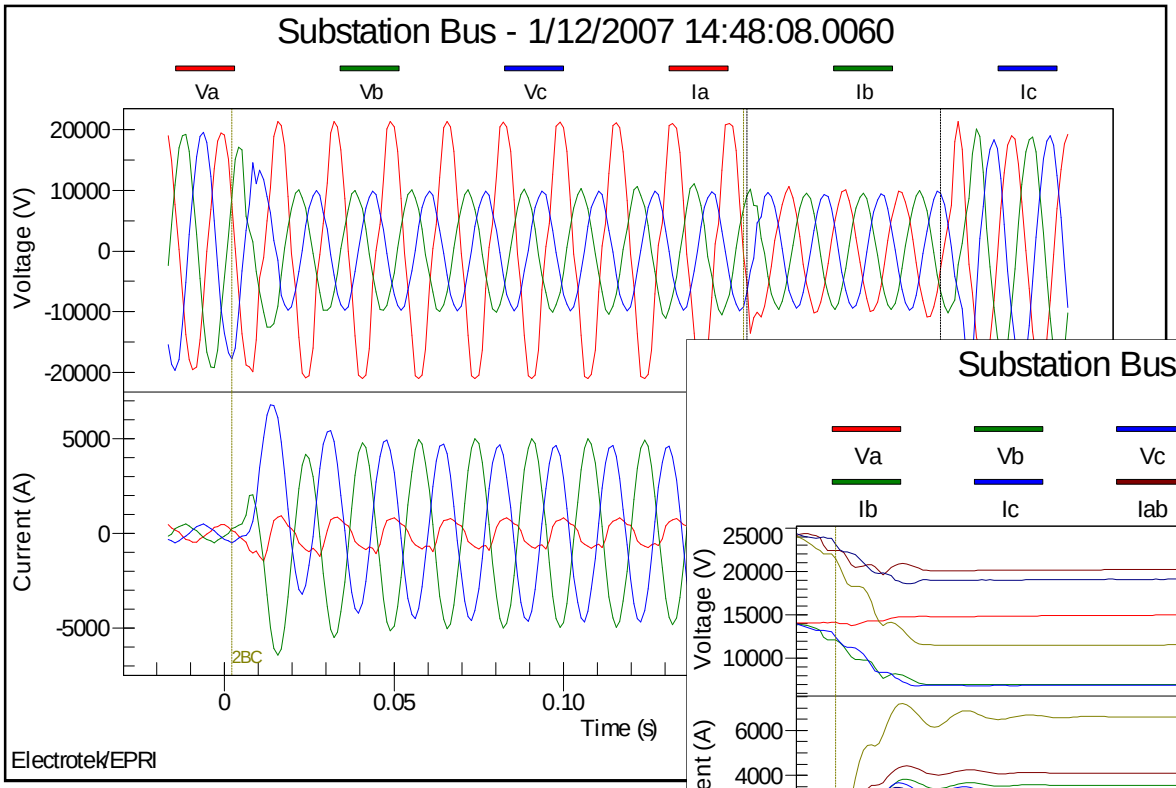
- Alabama Power Company SCADA Database
- Con Edison AMR Databases
- Ergon Energy Australia AMR Database
- Progress Energy Feeder Management System Database
- Provincial Electric Authority (PEA) Thailand AMR Database
- Companhia de Electricidade de Macau (CEM) EDMI Meters

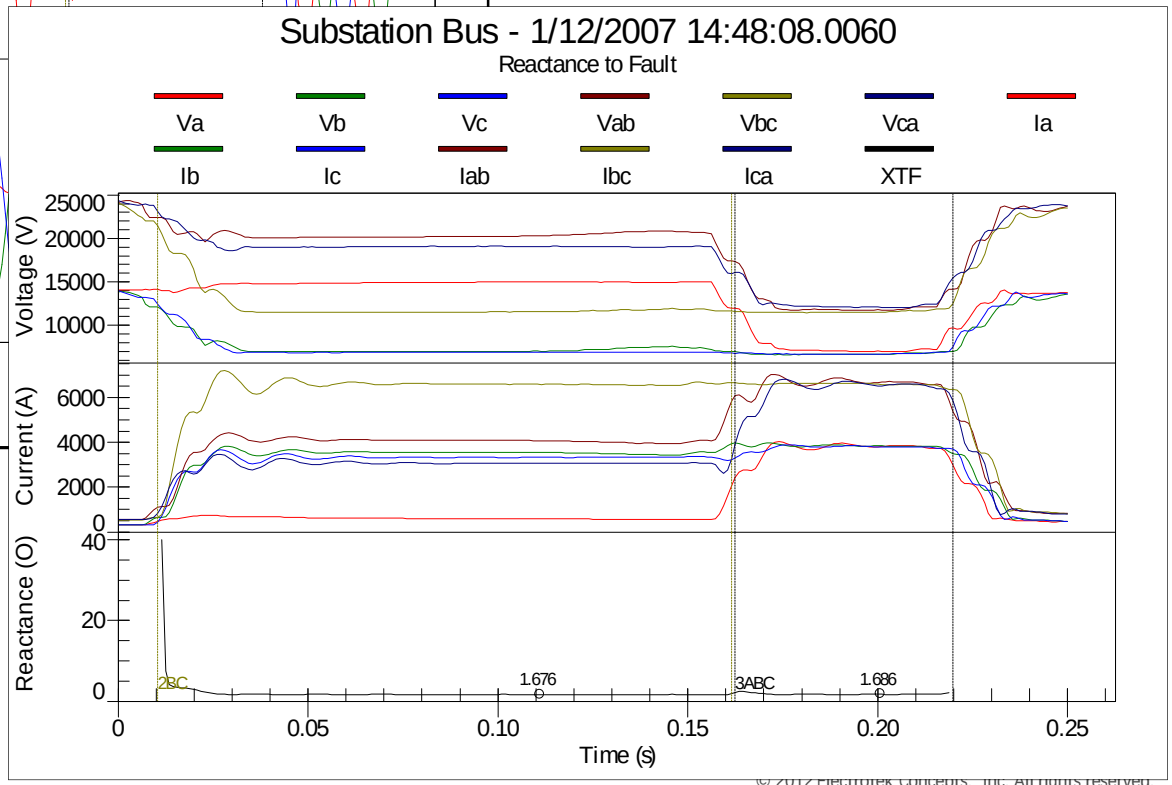

Dranetz PQNode 8010 Monitors
Proprietary Dialup
InfoNode Servers
PQNode Data Files
File Share
conEdison
Dranetz DataNode 5530 Monitors
MMS via WAN
InfoNode Servers
HTTP via LAN
PQView
Dranetz DataNode 61000 Monitors
HTTP via RAS
InfoNode Servers
HTTP via LAN
LAN
Schneider Electric ION Meters
HTTP via Frame Relay
ION Server
HTTP via LAN
File Share
Microsoft SQL Server
SEL and GE Relays
Frame Relay
EnerVista Download Server
COMTRADE Files
LAN
PQView Databases
SCADA RTU Sensors
GE XA/21
ECC PI Server
PI SDK

PQView Event Analysis

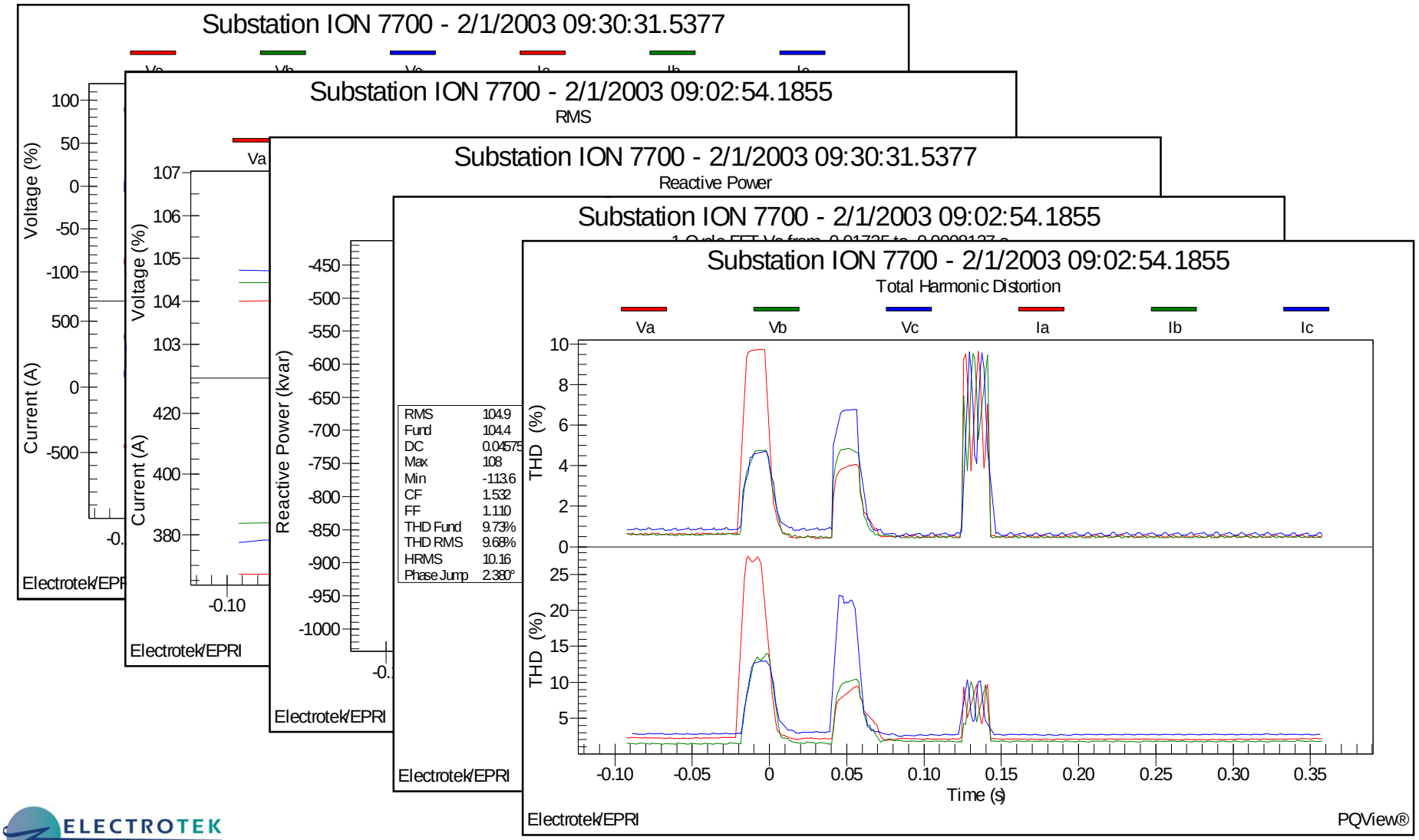


Examples of PQView Event Derivations





Examples of PQView Event Derivations

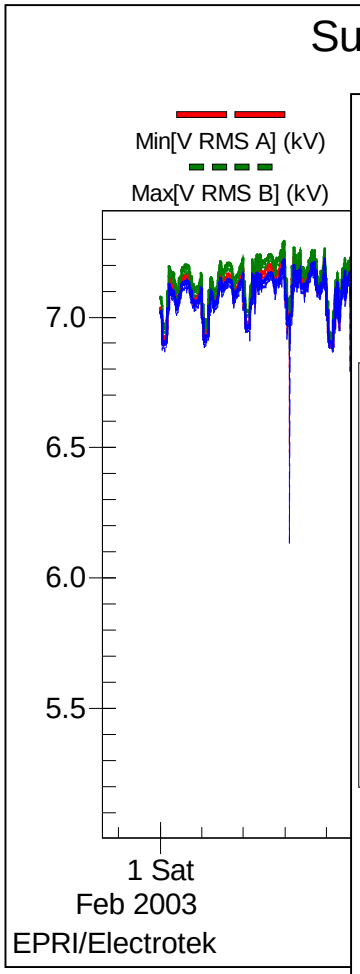


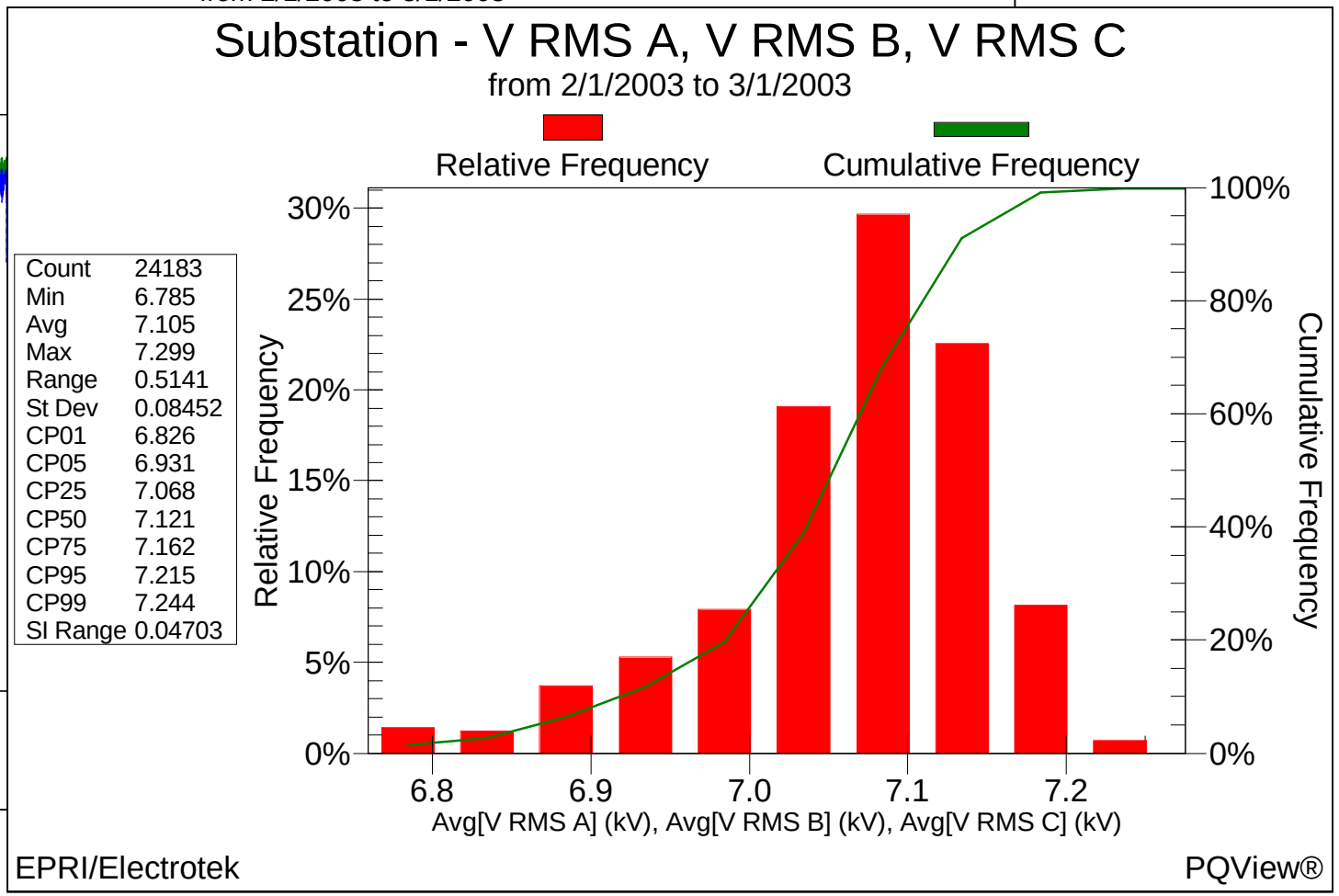
Derivations from Waveform and RMS Samples

- Reactance-to-Fault
- Radial Fault Location
- Spectrum Charts
  - 1, 2, 3, 4, 5, 6, 10, and 12 Cycle Windows
- Phasors and Harmonic Phasors
- High-Pass Filter and Low-Pass Filter
- First Derivative , Second Derivative, Third Derivative, and Squared Value·Time
- Mean Values and RMS Values
- Load Resistance, Load Reactance, Load Impedance, and Load Impedance Angle
- Real Power, Reactive Power, Apparent Power, and Energy
- Delta Real Power, Reactive Power, Apparent Power, and Energy
- Characteristic Voltage
- Waveform Transformation
- Missing Voltage and Delta Current from First Cycle or from Ideal Waveform
- Symmetrical Components
- Delta Symmetrical Components
- Three-Phase Diode Rectifier Output
- Line Frequency during Event
- Total Harmonic Distortion (THD)
- DC Component, Fundamental Component, and Harmonic Trends during Event
- Links to Map Viewer and Trend Viewer
- IEEE P1159.2 RMS Characteristics
- IEEE P1159.2 Point-in Wave Characteristics
- IEEE P1159.2 Missing Voltage Characteristics
- Dranetz Event Characteristics
- Digital Status Changes
- Operations Summary

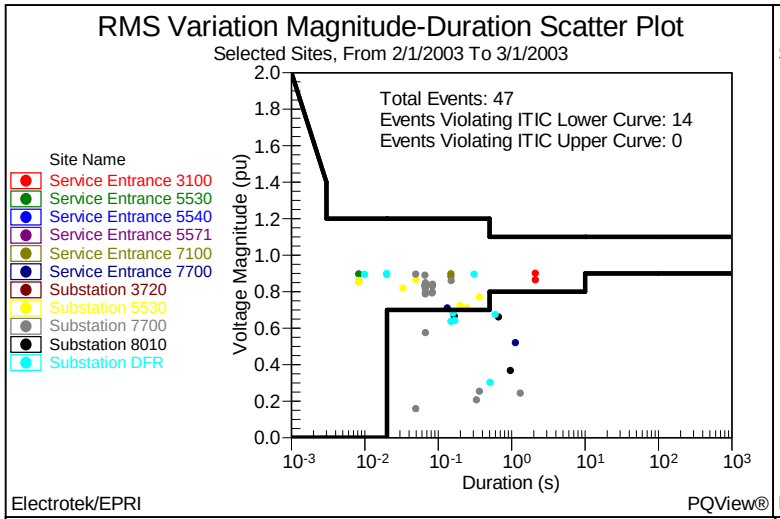
ELECTROTEK CONCEPTS

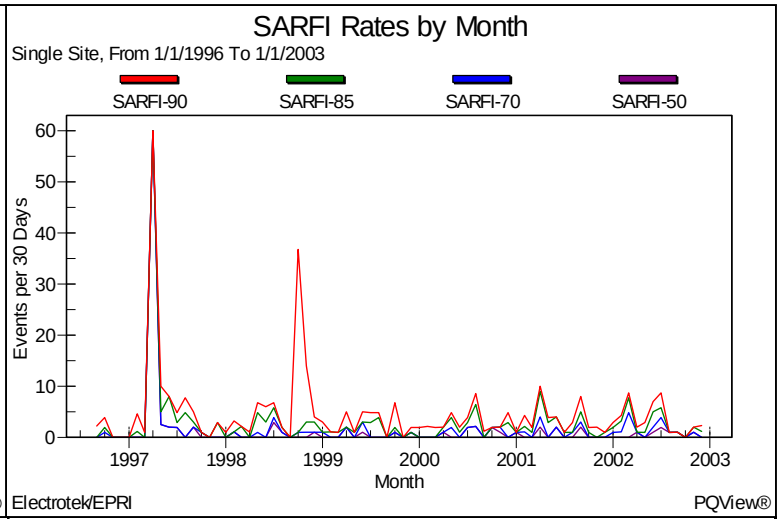
Analysis of Data Logs

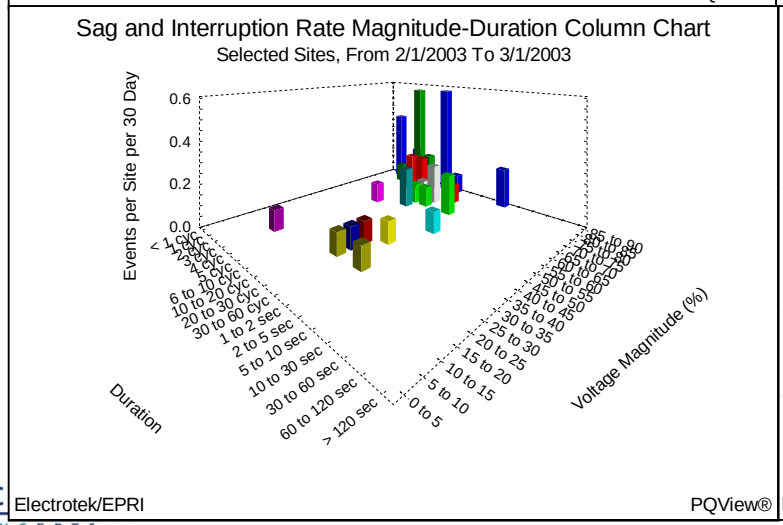


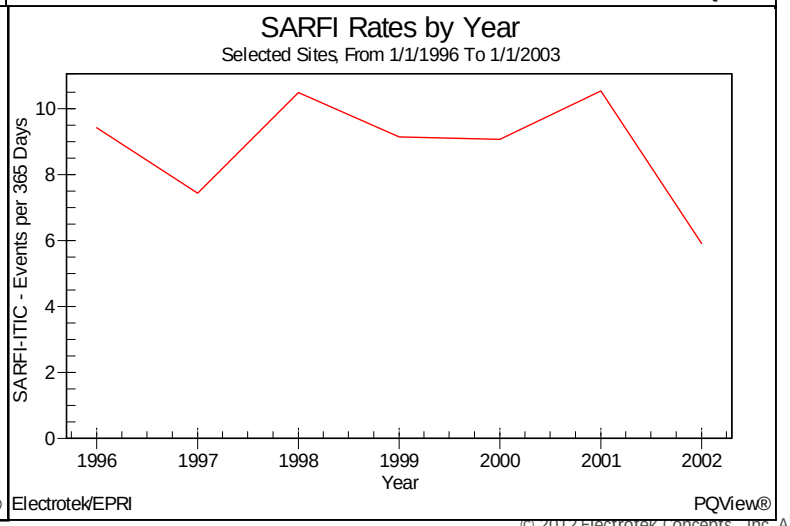


RMS Voltage Variation Analysis

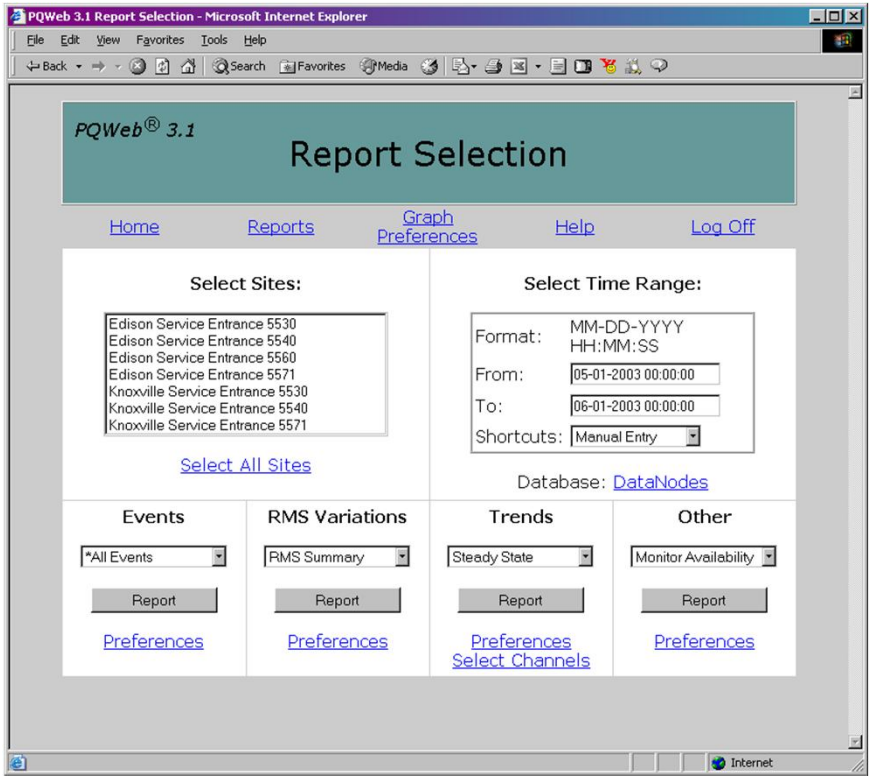


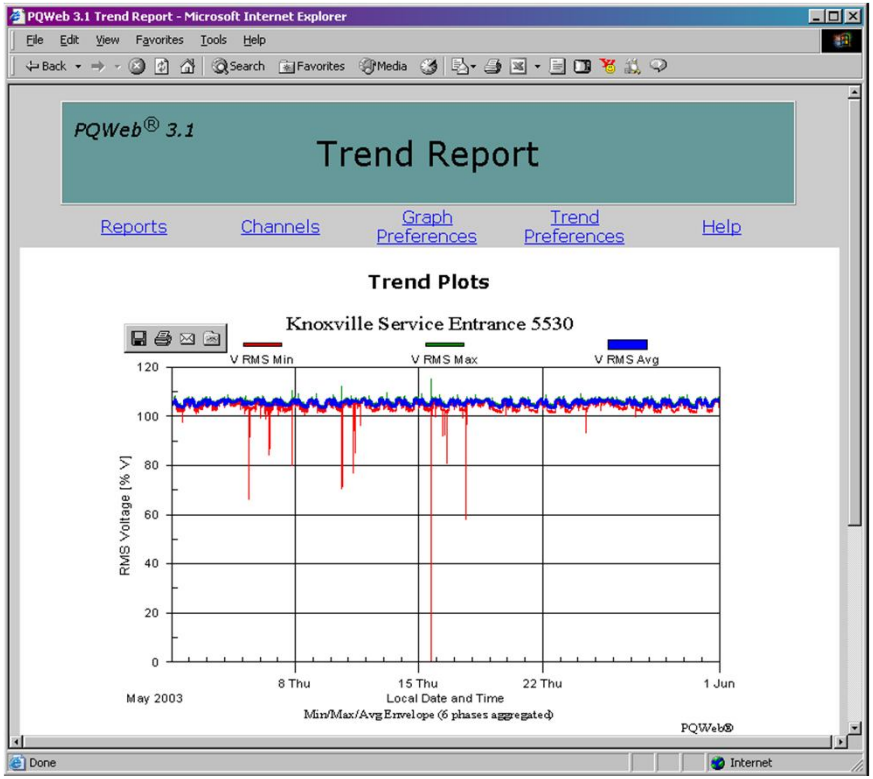




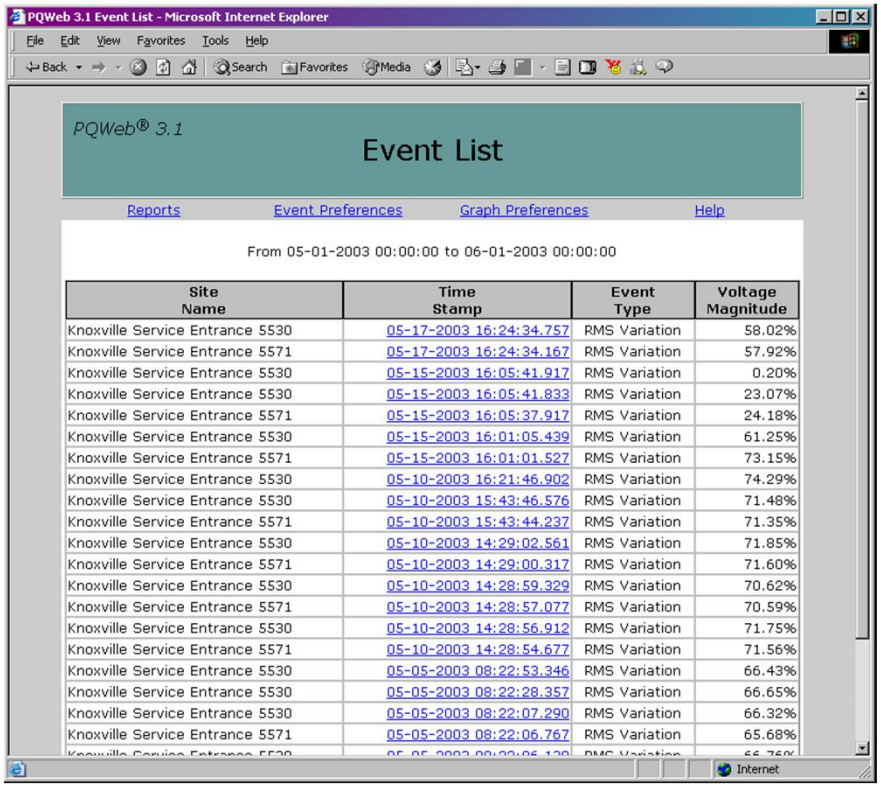


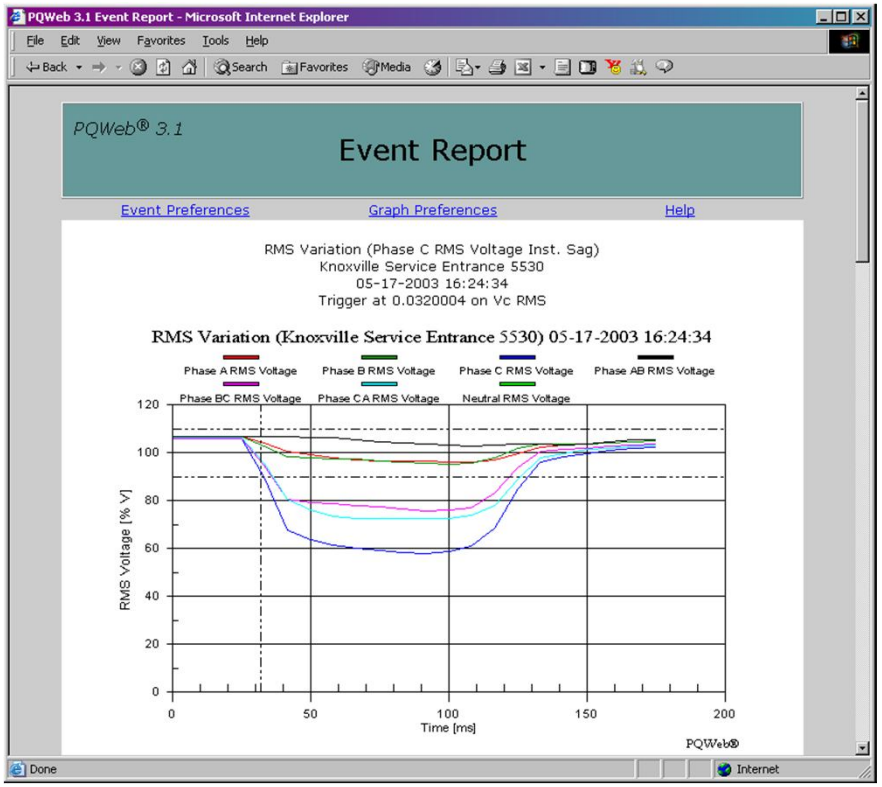
PQWeb Analysis via Internet



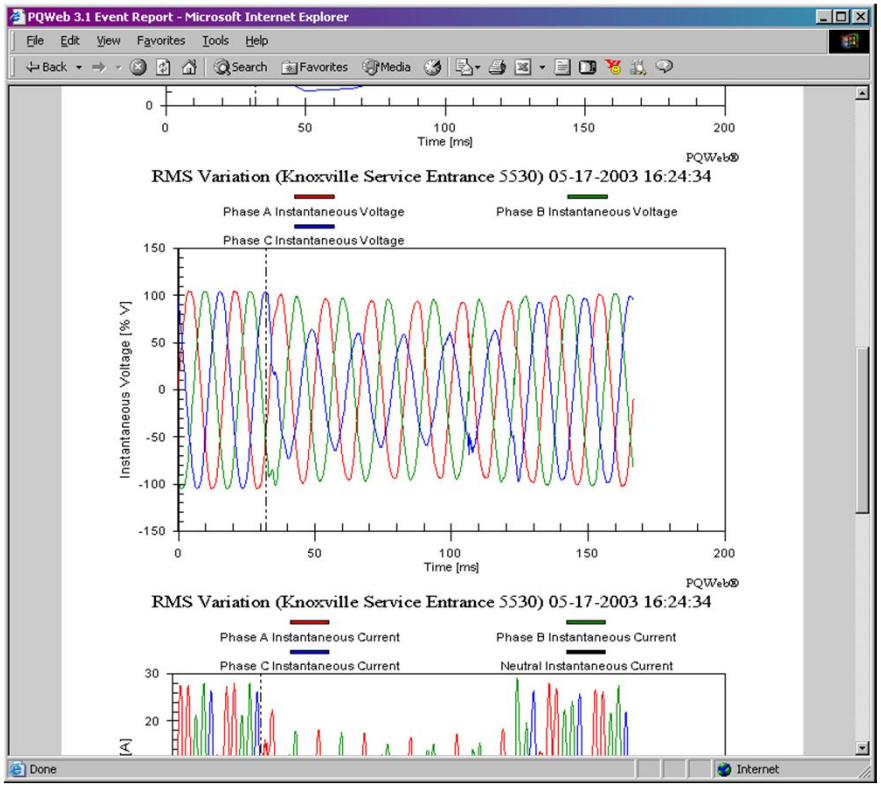


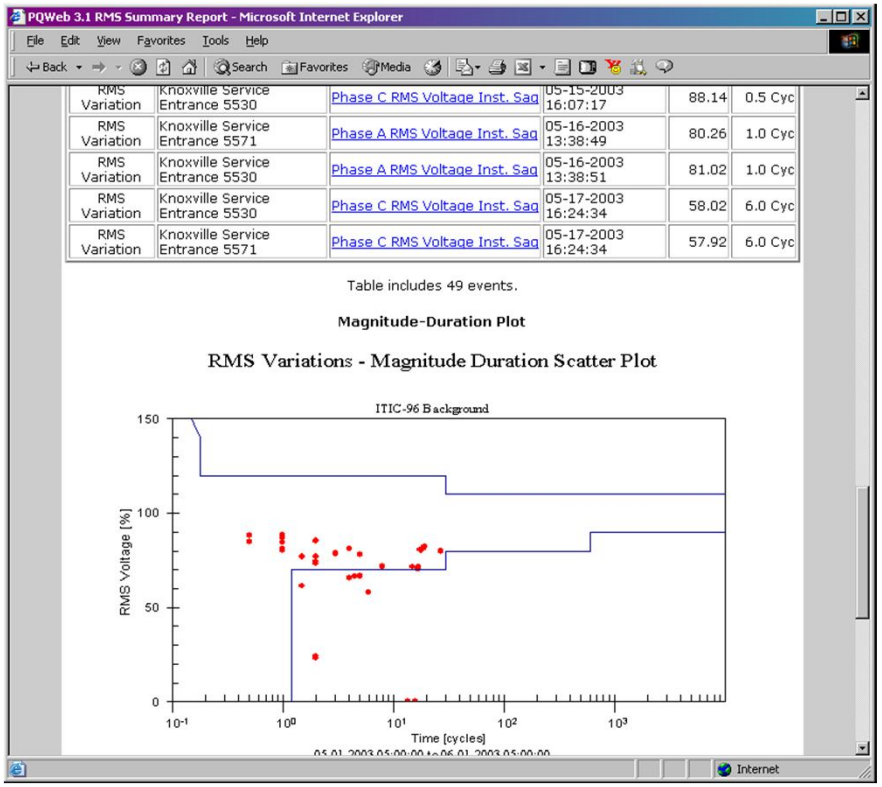
PQWeb Analysis via Internet



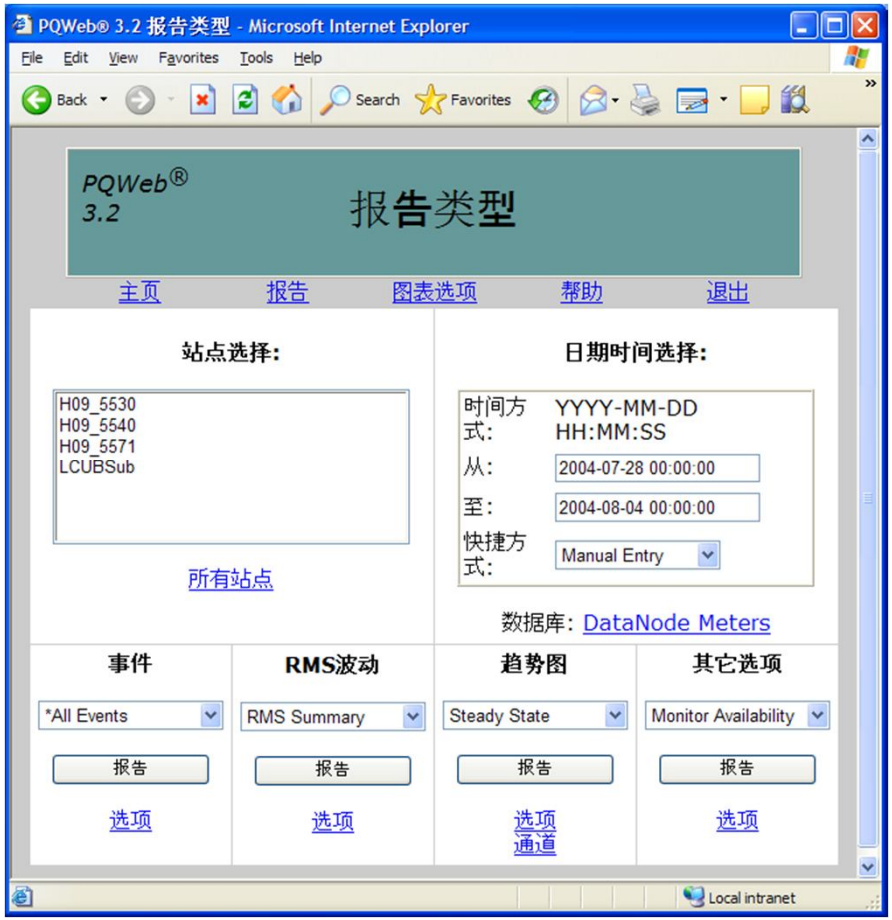


PQWeb Analysis via Internet





PQView Application Study
Guangdong Power, Guangzhou, China

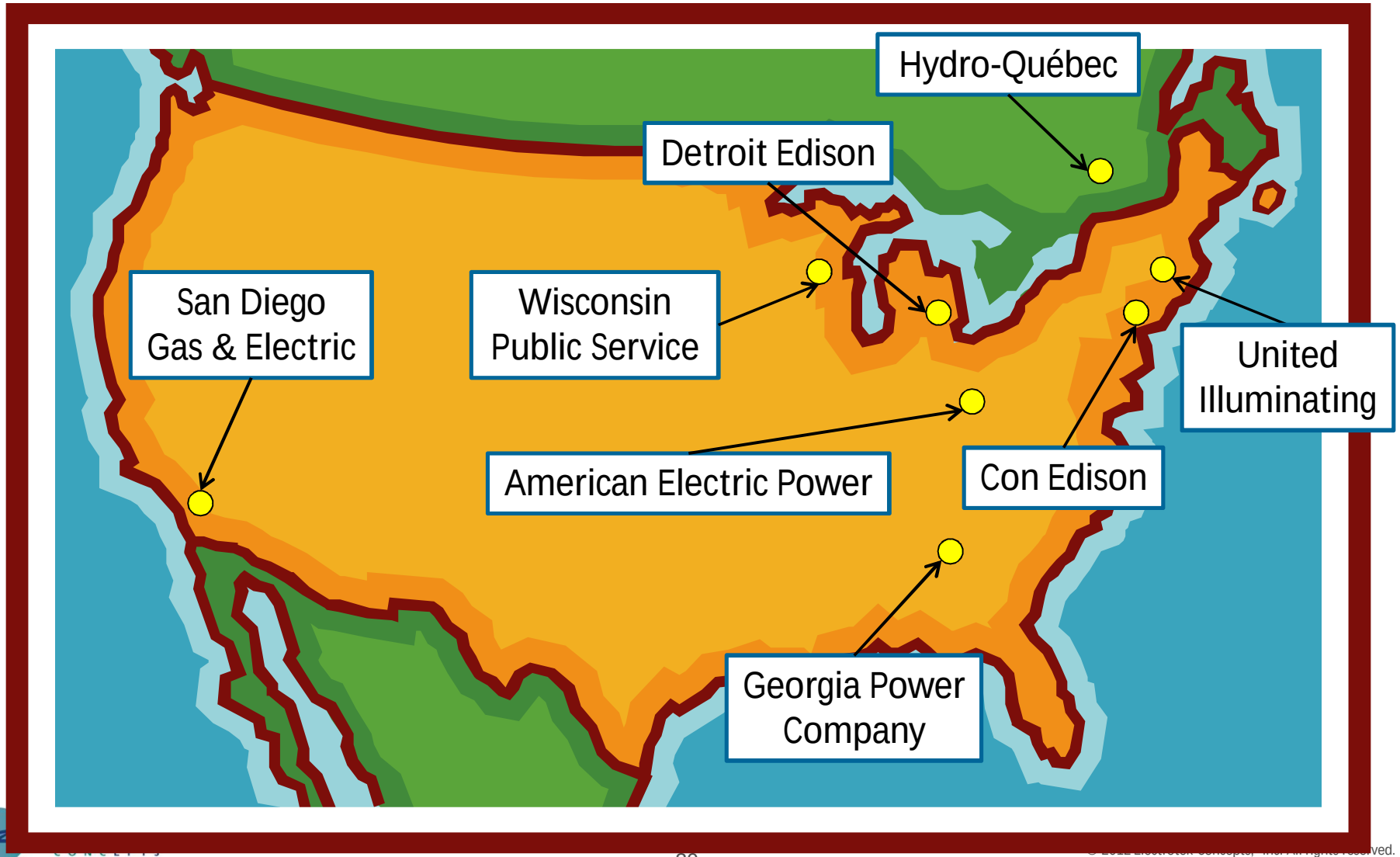


- Provides transmission service for 38GW of load to Guangdong Province in Southeast China
- Monitors network with Dranetz-BMI DataNodes and Power Measurement ION meters
- Measurements available on intranet with Chinese user interface
- Measurements record DC transmission line performance during monopole ground return mode

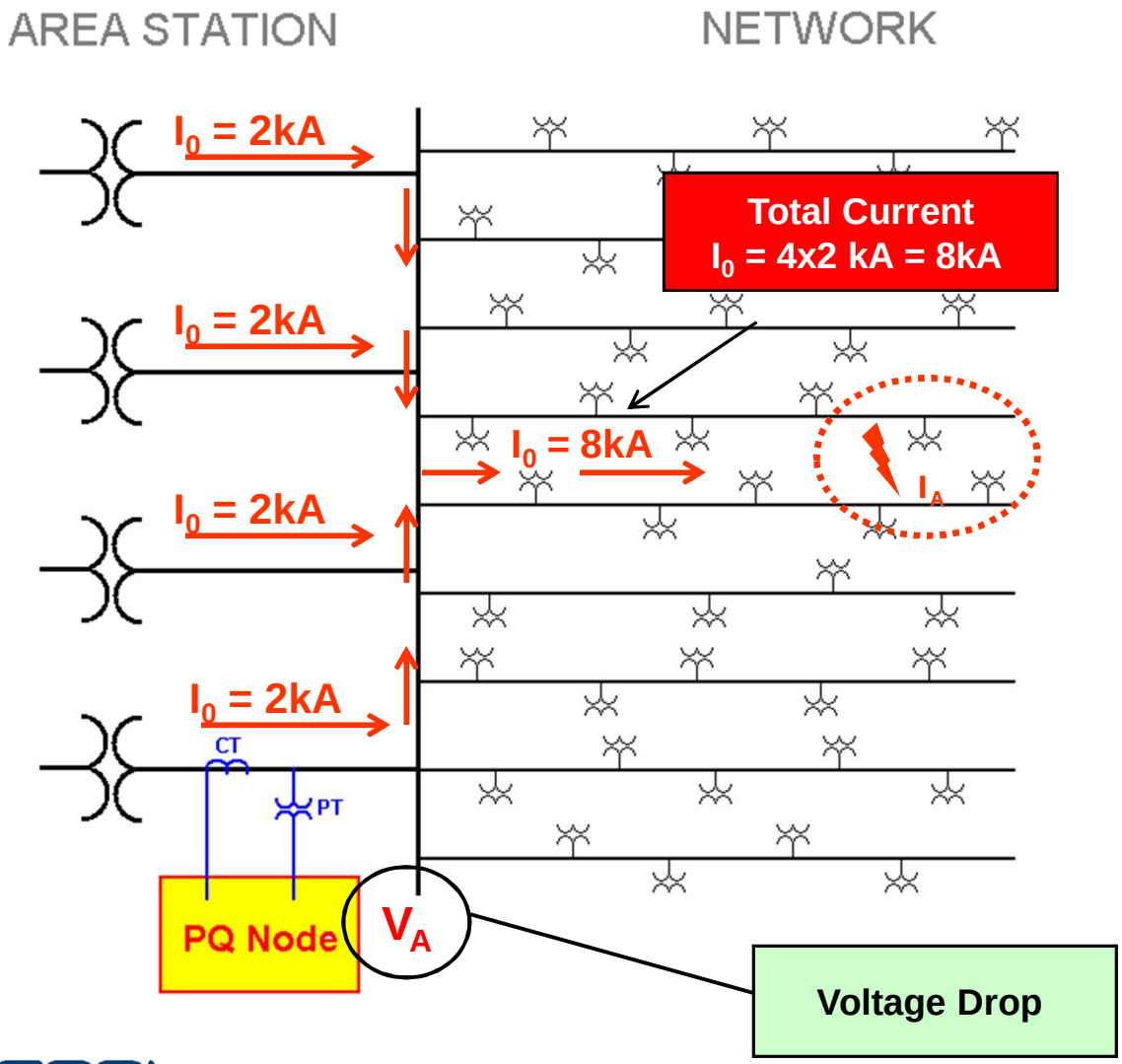
PQView Application Examples

- **Fault Location**
- System Performance
- Integration of Power System Measurements with GIS
- Standards Compliance

Fault Location Systems with PQView



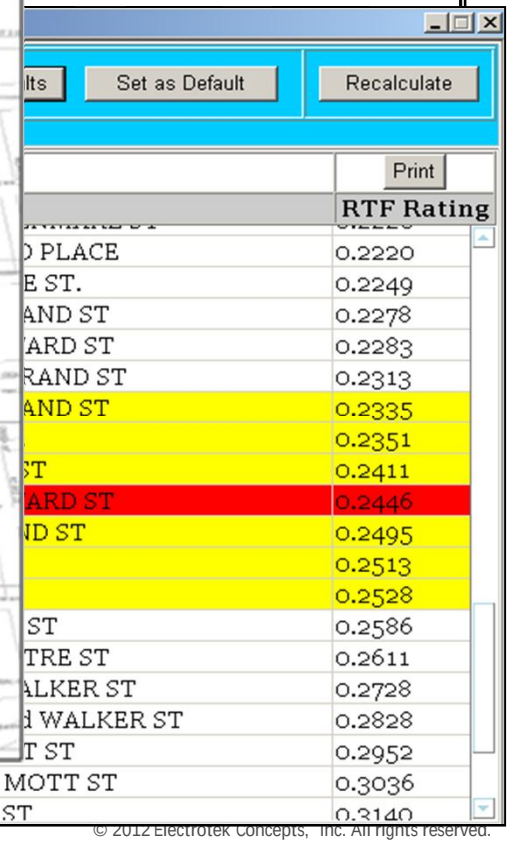
Example Single-Phase Fault



Fault Locating Process at Con Edison

Feeder Trips due to Fault → **PQ Meter Captures Waveforms** → **PQView Calculates Reactance** → **Match Reactance To Feeder Model**

o Two-Phase

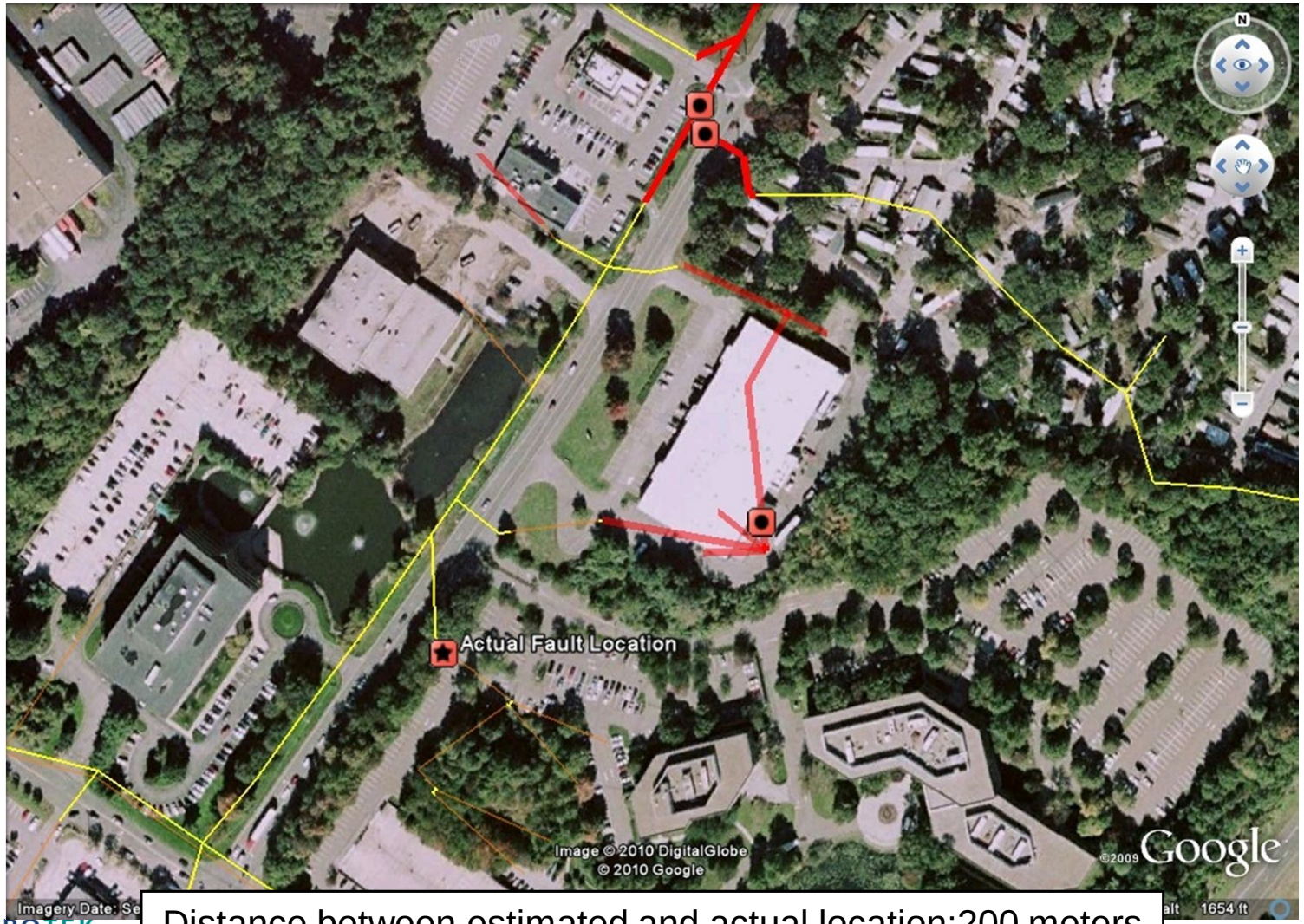


Summary of Estimated Fault Location versus Actual Fault Location for Faults in Manhattan

- On average, use of the Reactance-to-Fault for fault location saves one hour per feeder restoration job because it saves use of capacitive discharge thumpers and DC hi-pot
- Recent Results:

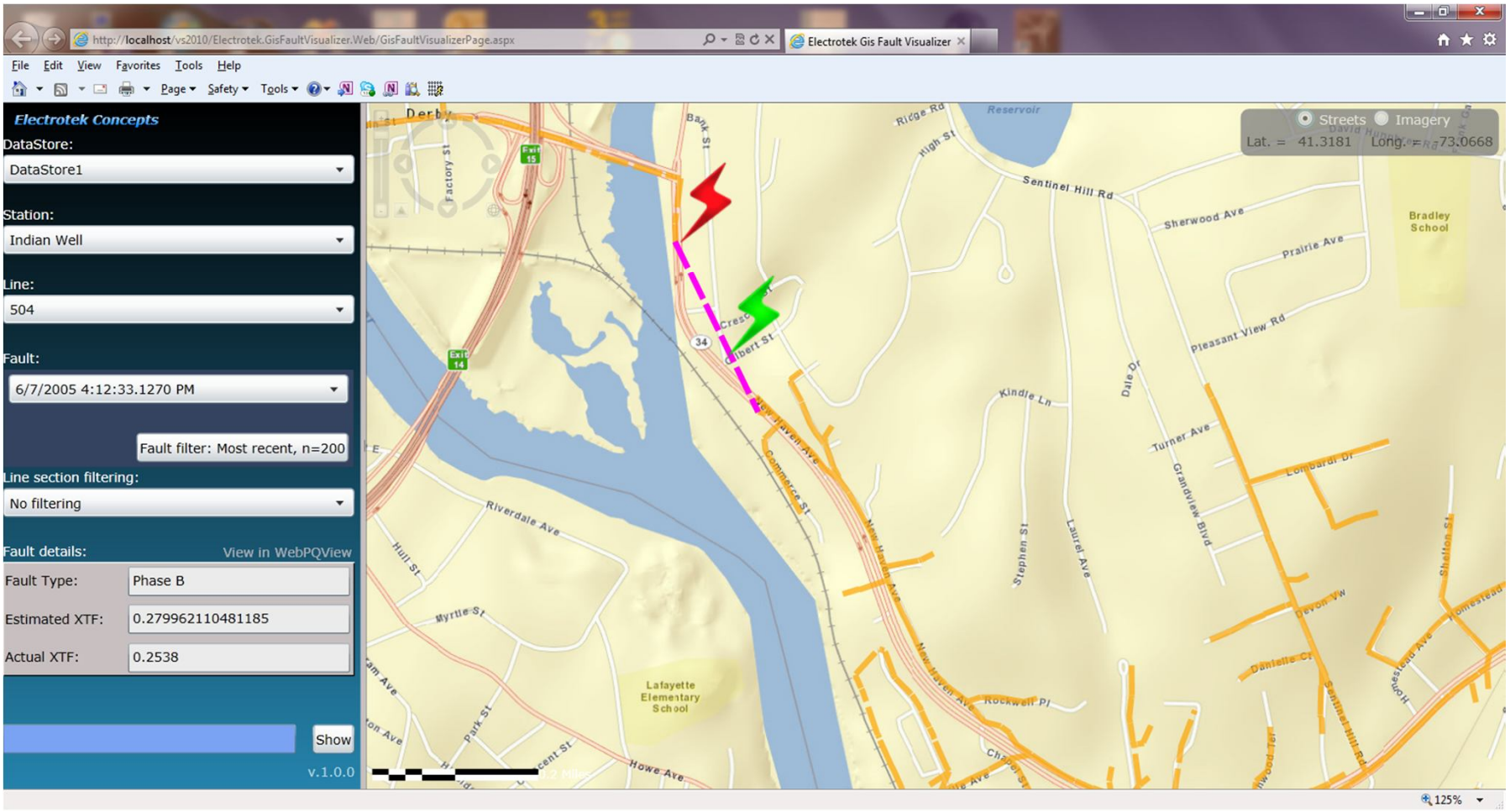
Year	0-1 MH	1-3 MH	3-5 MH	5-10 MH	> 10 MH
2009	64%	24%	5%	2%	6%
2010	67%	14%	5%	3%	11%
2011	64%	20%	8%	3%	5%
Summer 2012	76%	14%	4%	4%	1%

One-Line Diagram with Aerial Map of Estimated and Actual Location



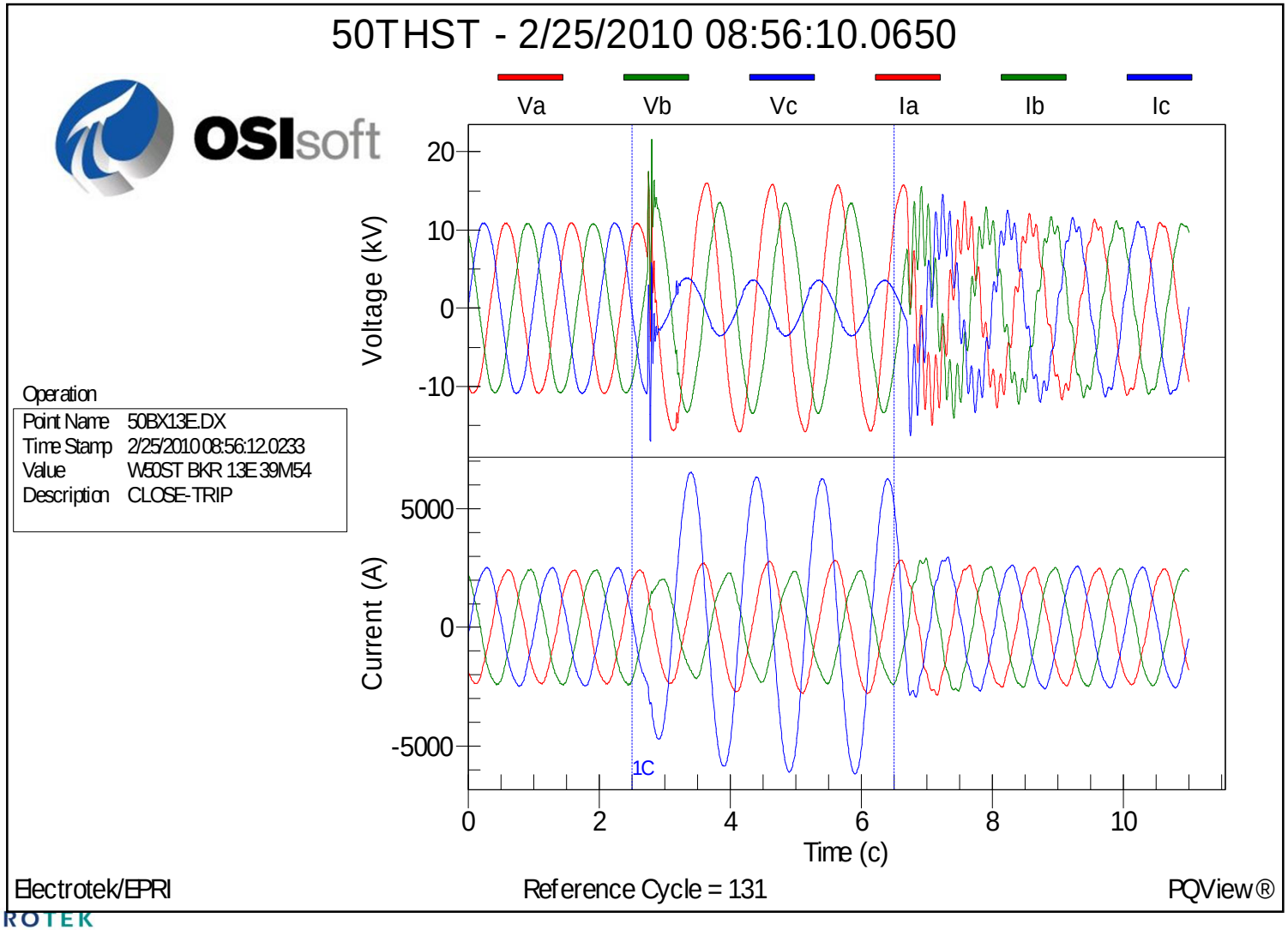
Distance between estimated and actual location:200 meters

Fault Location View with Street View

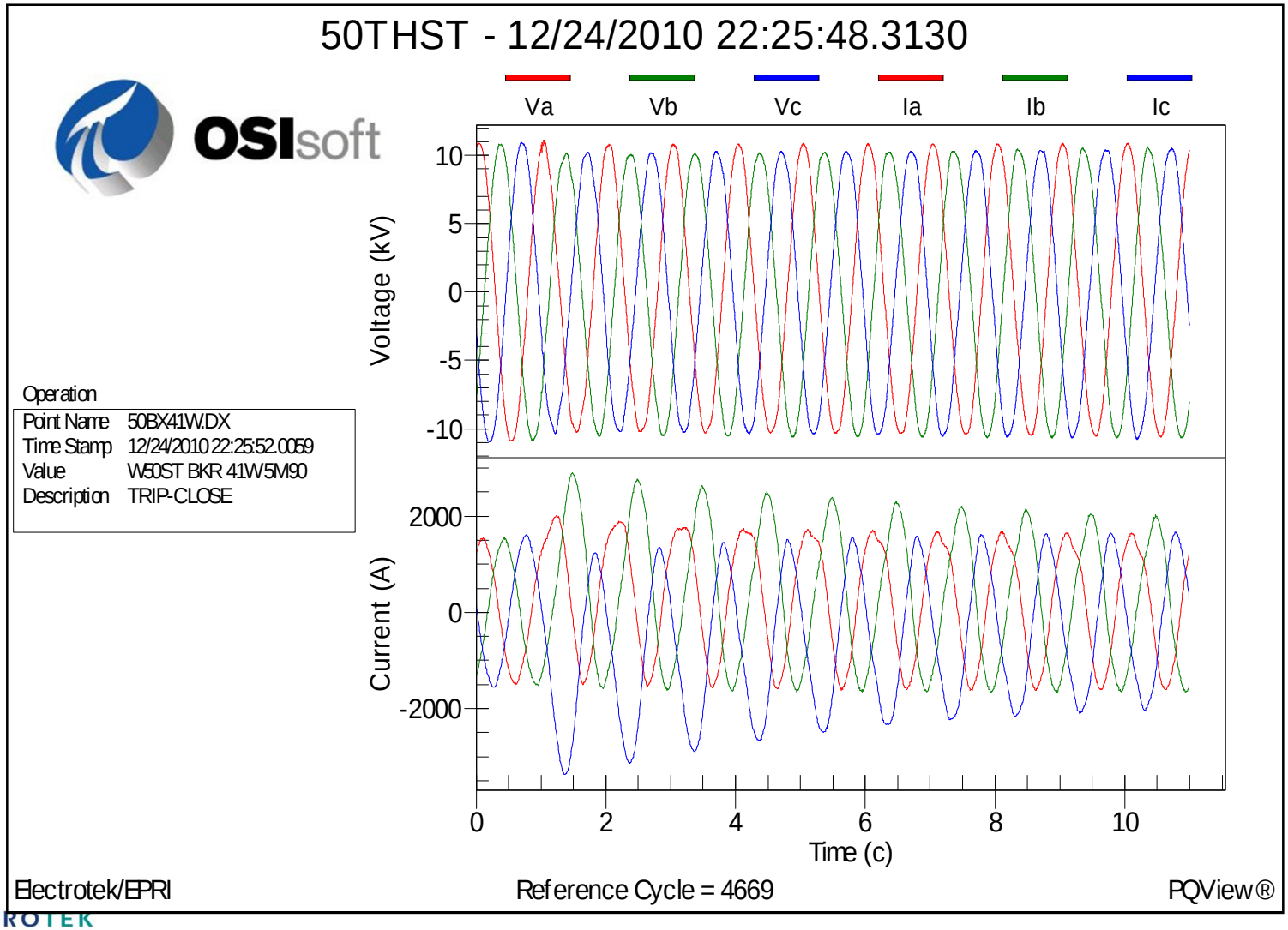


Demo

Example Correlation of Feeder Fault Event with PI Event from SCADA Operation

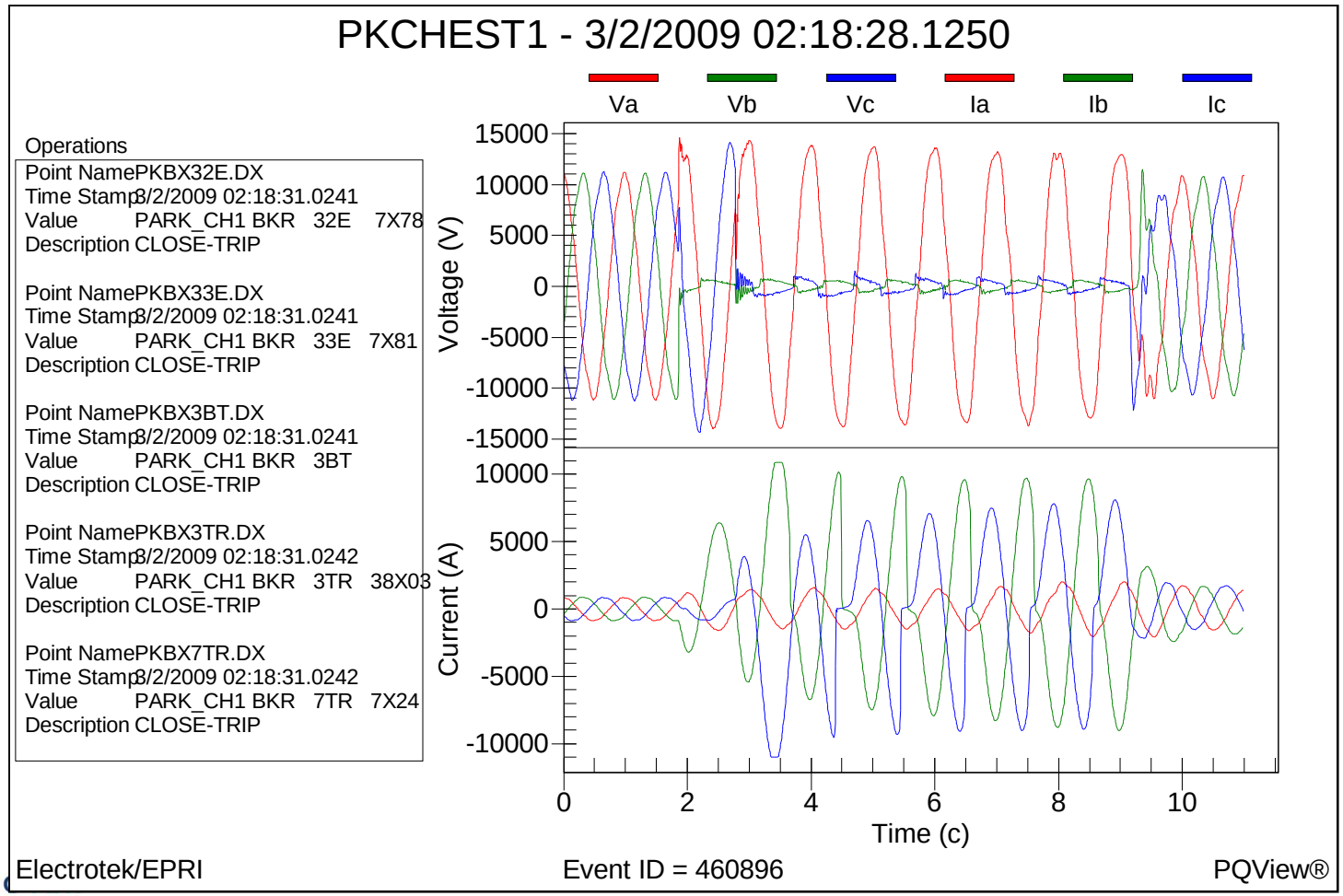


Example Correlation of Feeder Reclose Event with PI Event from SCADA Operation

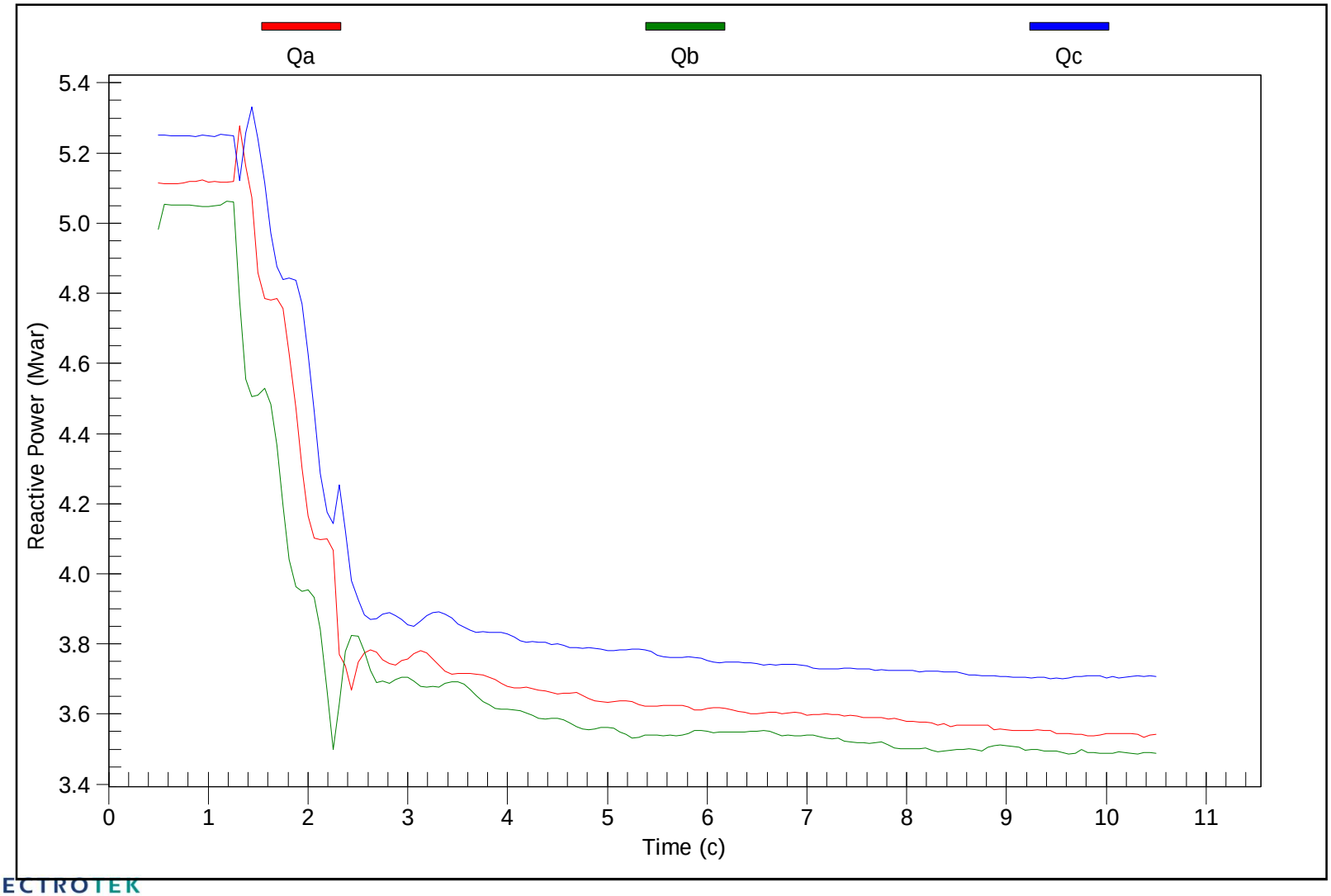


Con Edison PQMS Module:
Correlation of Fault Events with SCADA Events

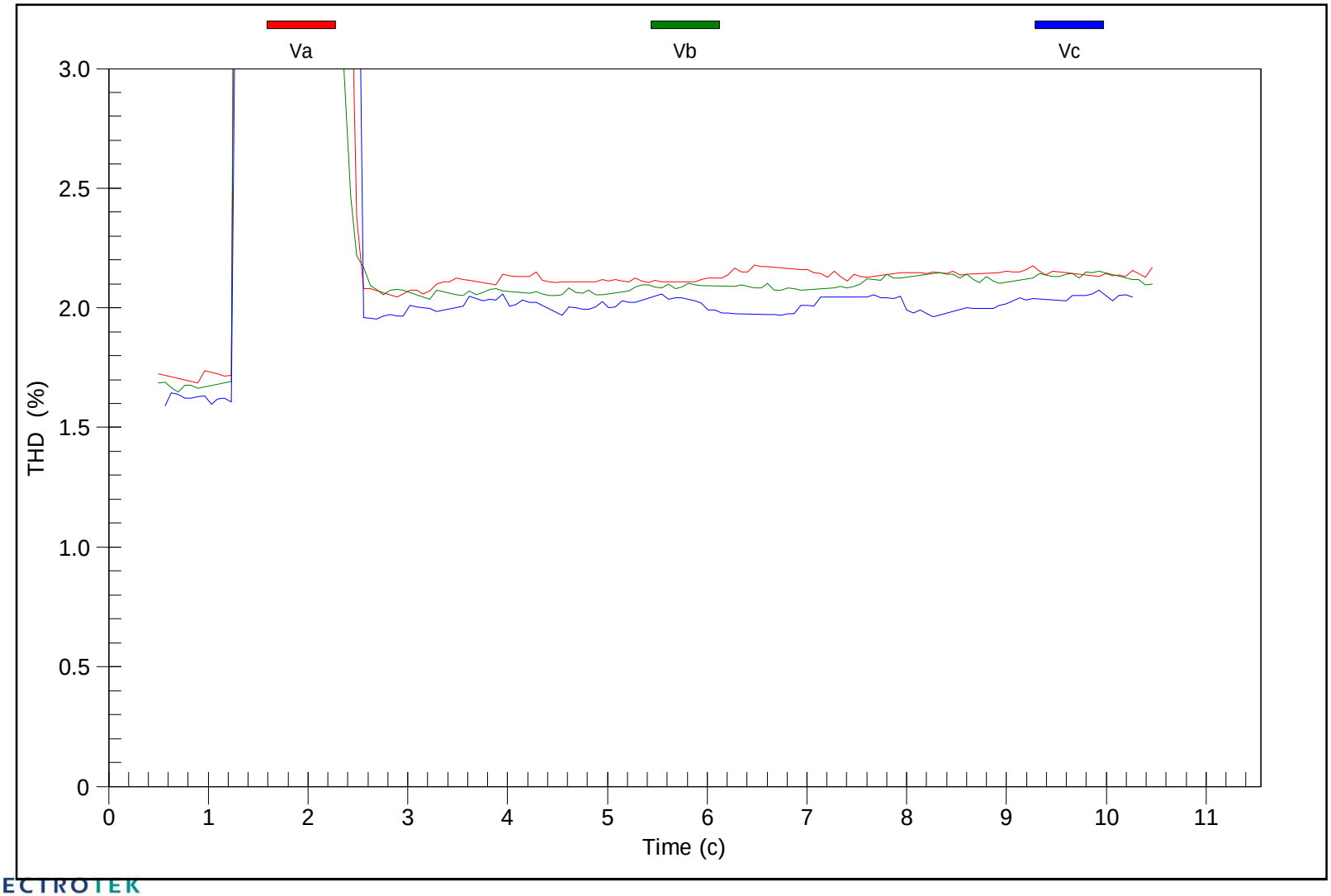
Multiple Breaker Trips due to Substation Fault



Reactive Power Change

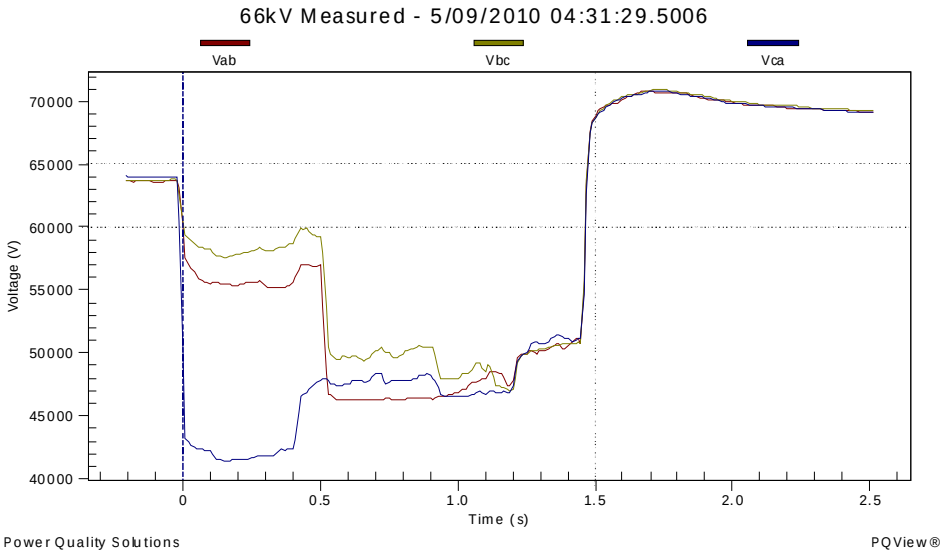


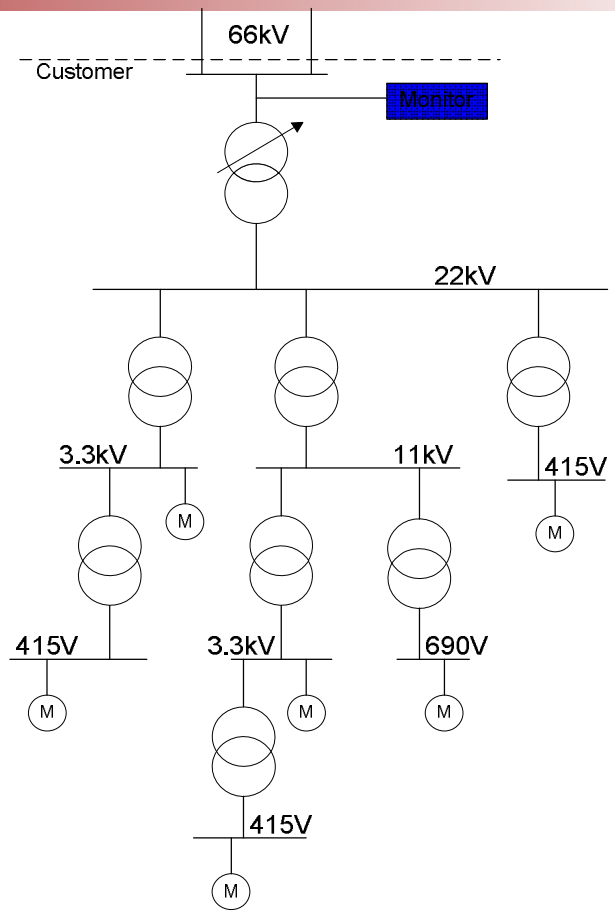
Voltage THD Change



Examples – Voltage Disturbances-3

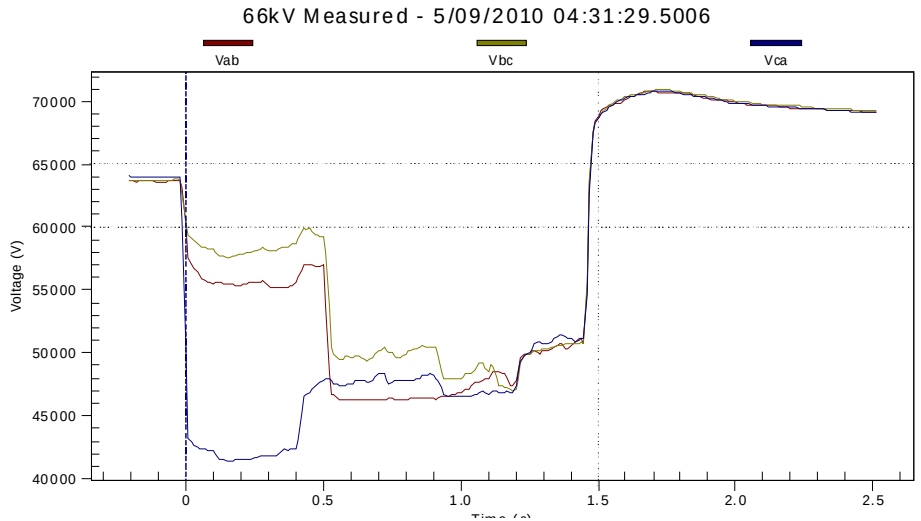
Transformed waveforms

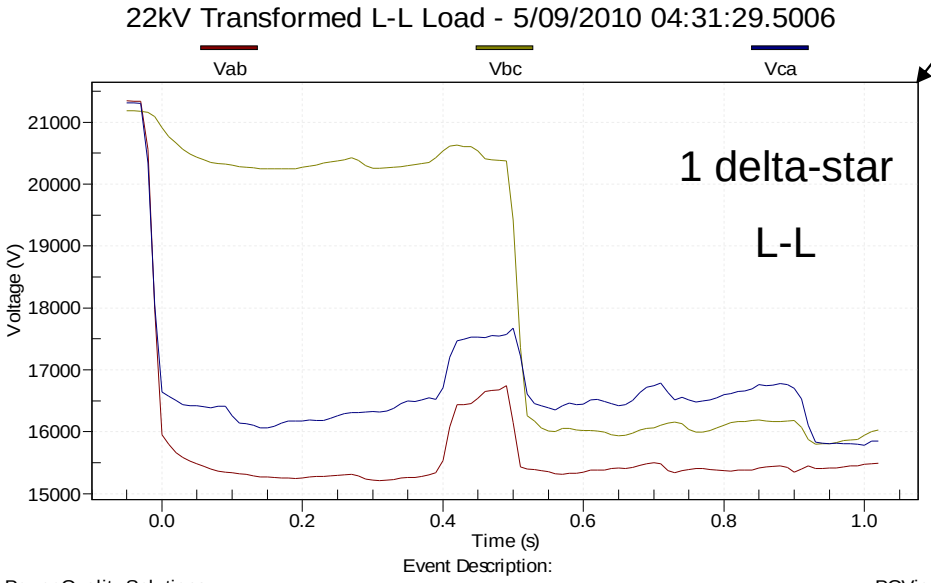


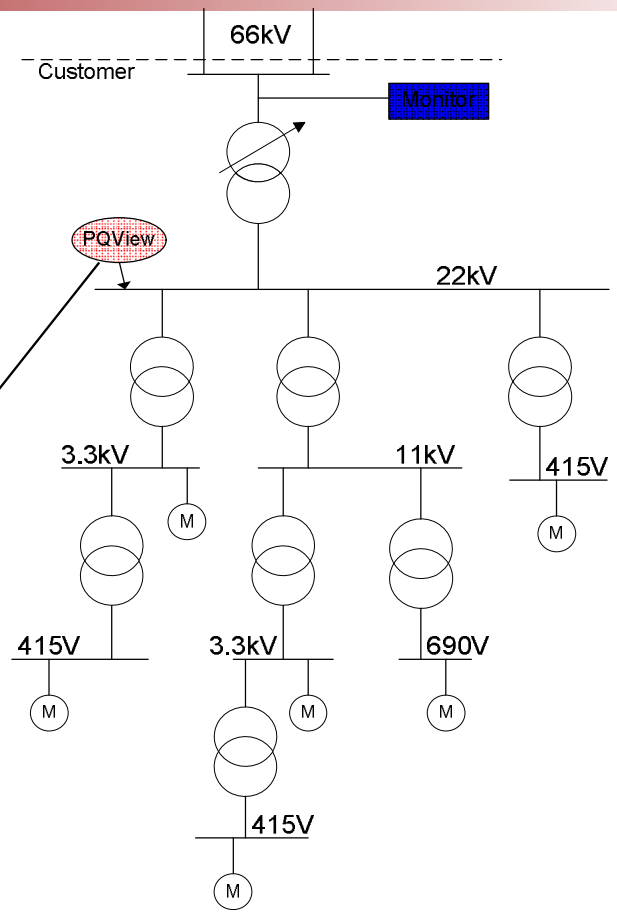


Examples – Voltage Disturbances-3

Transformed waveforms

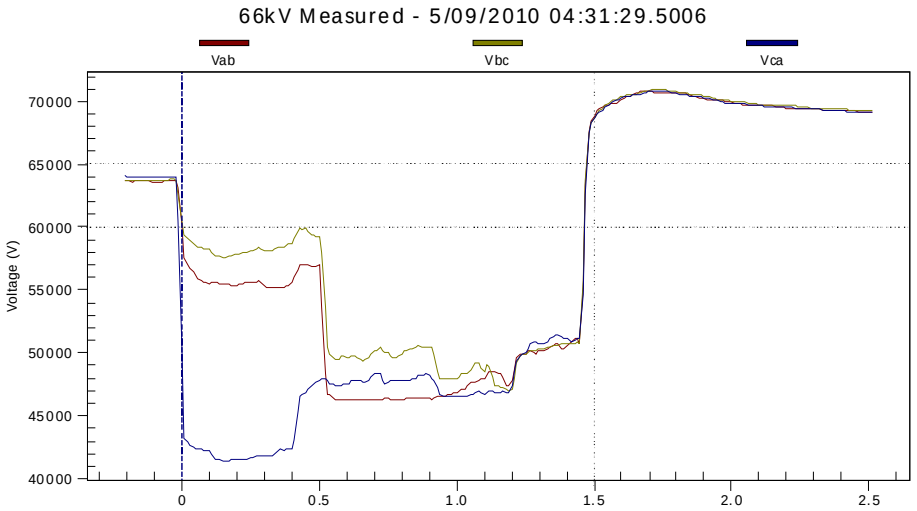


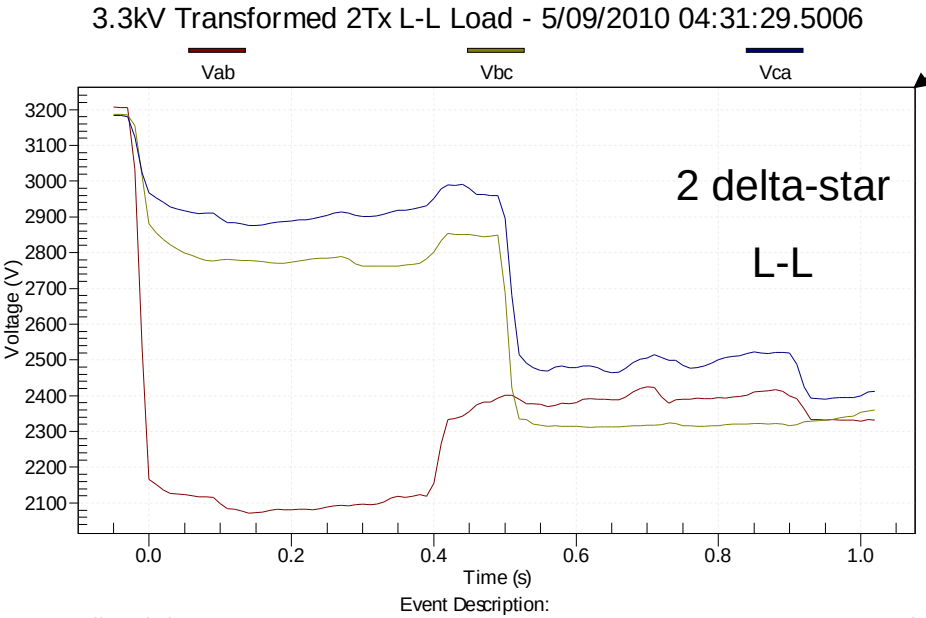


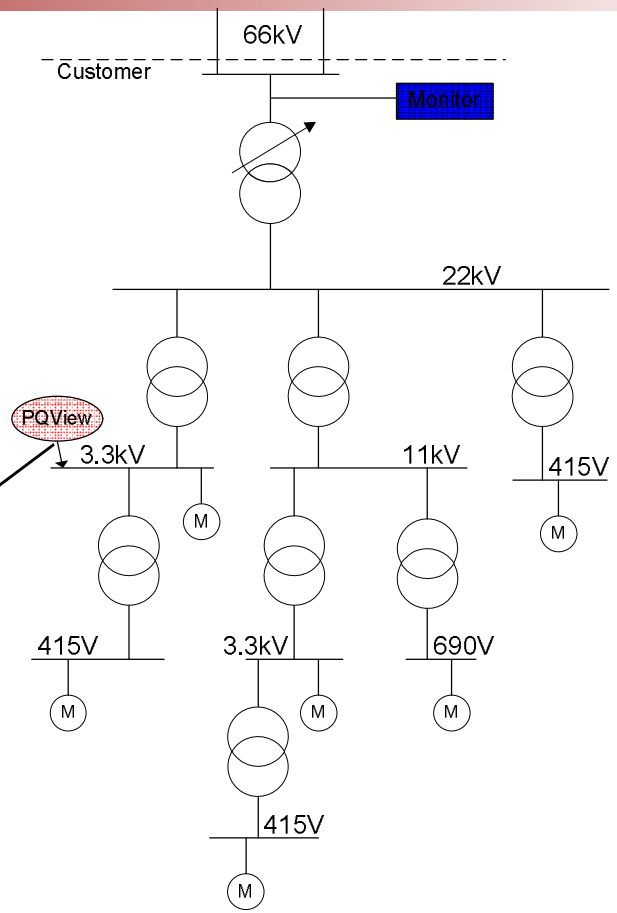


Examples – Voltage Disturbances-3

Transformed waveforms

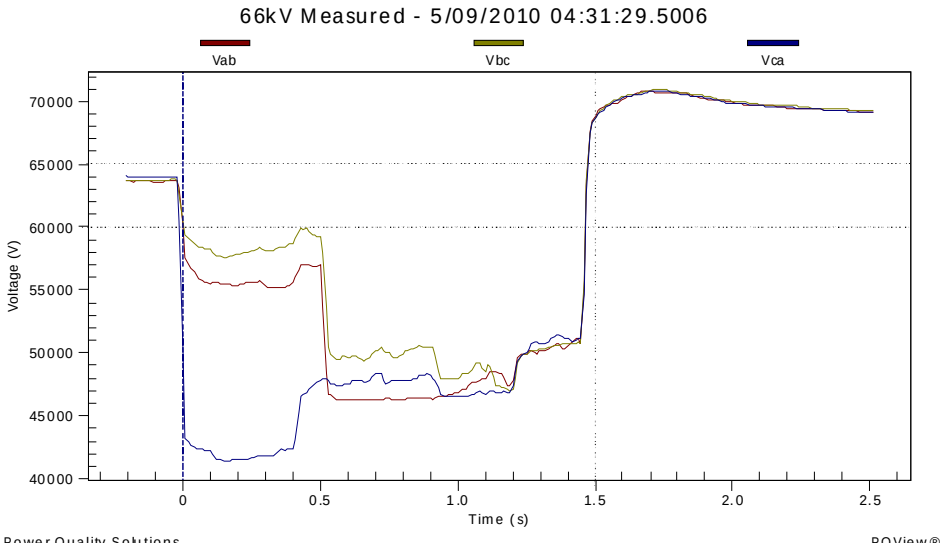


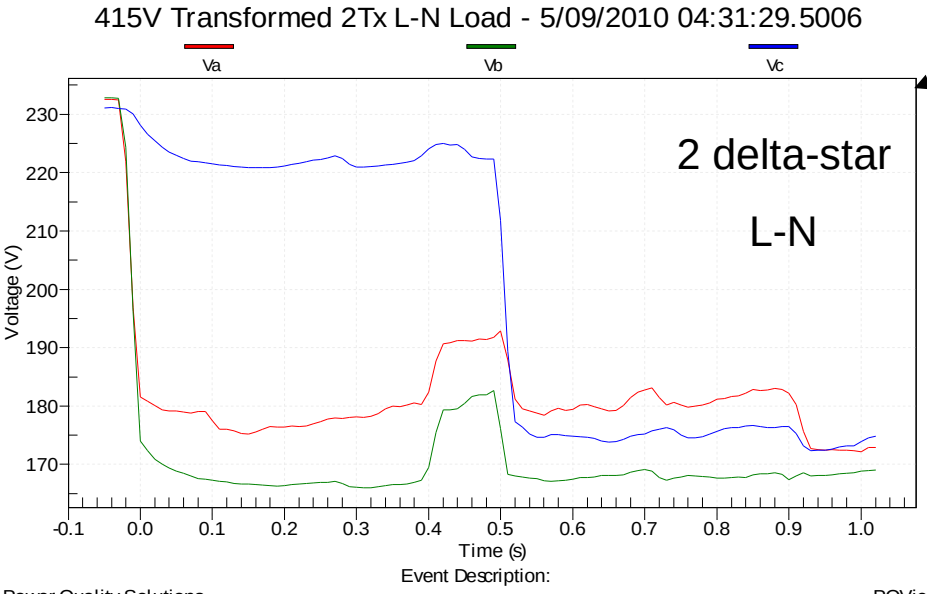


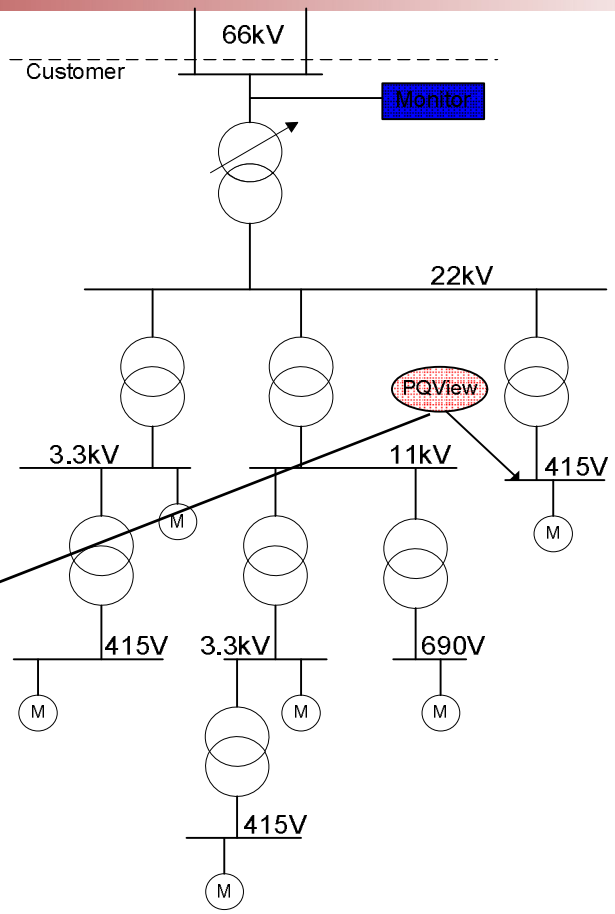


2. Examples – Voltage Disturbances-3

Transformed waveforms



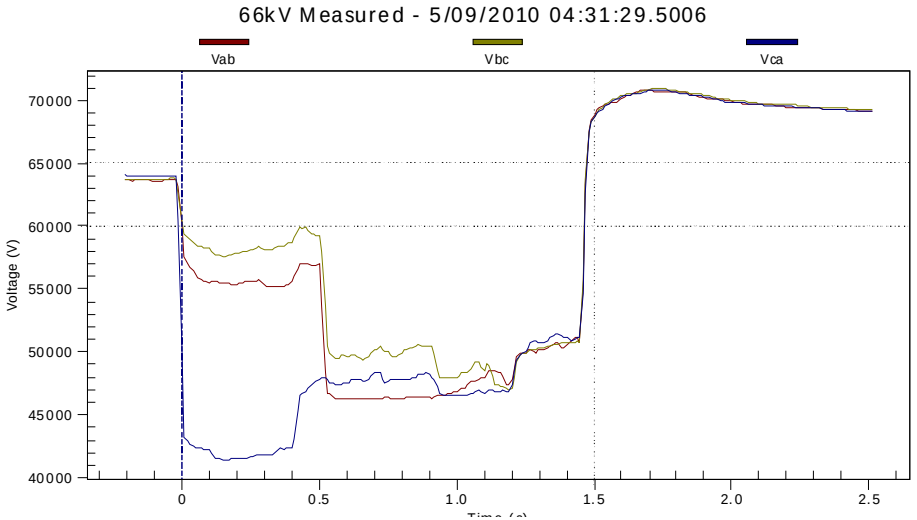




Event Description:

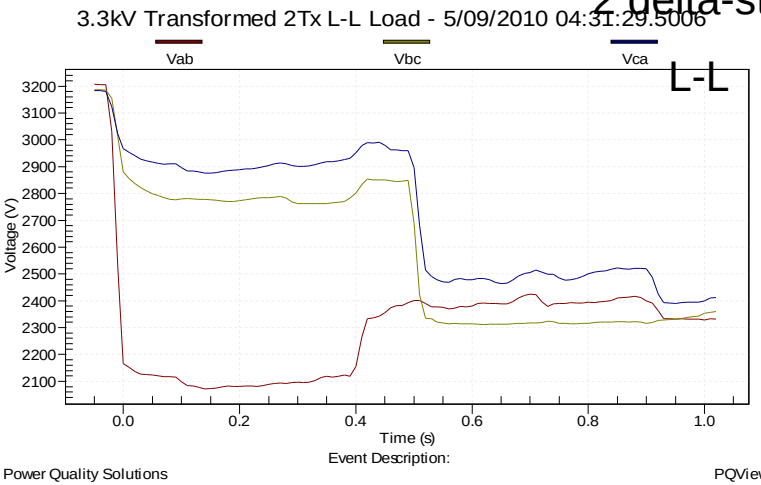
Examples – Voltage Disturbances-3

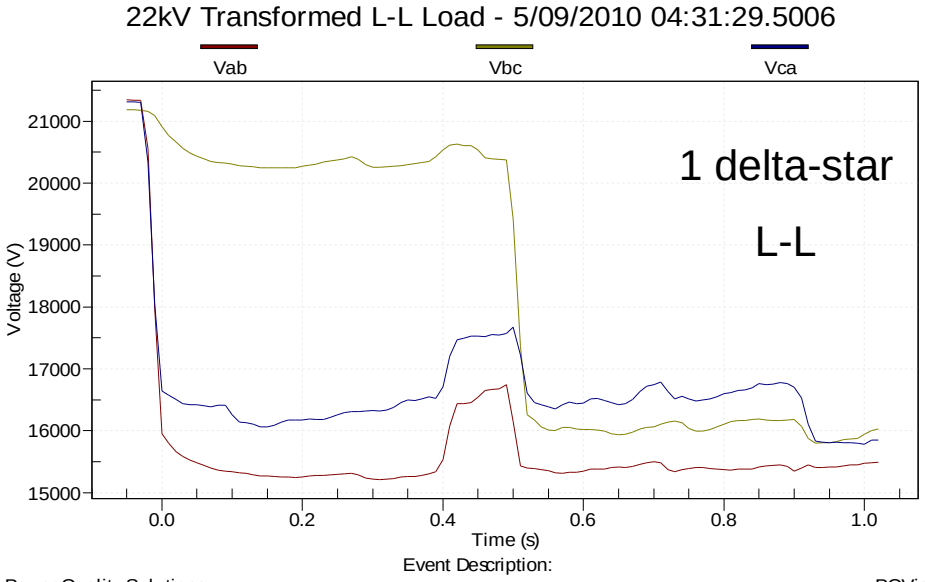
Transformed waveforms



2 delta-star

L-L



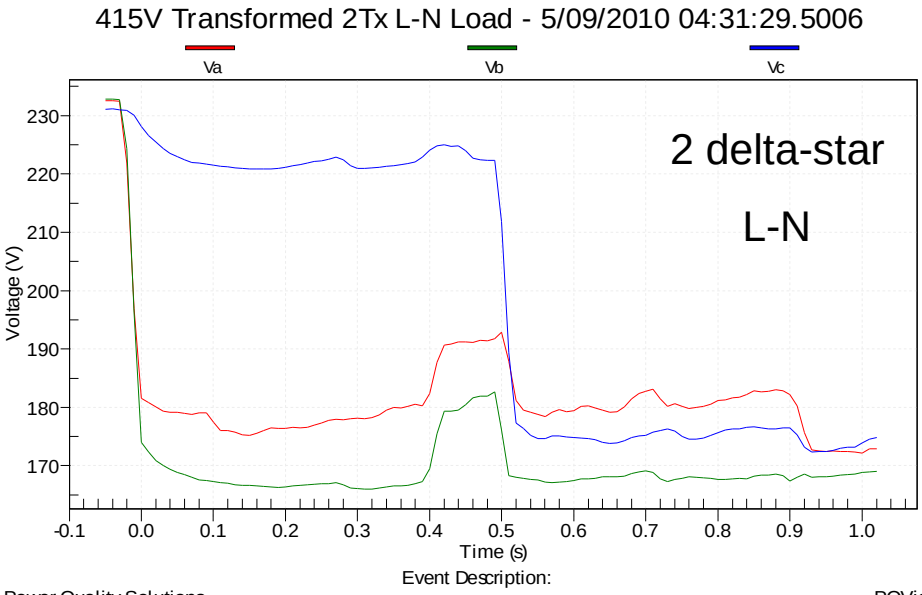


1 delta-star

L-L

Power Quality Solutions

PQView®



2 delta-star

L-N

Power Quality Solutions

PQView®

adabel

Power monitoring solutions

www.adabel.com

Automatic Reporting System (ARS) for PQView

Why ARS?
Motivation

- Users have many specific requirements for power quality reports.

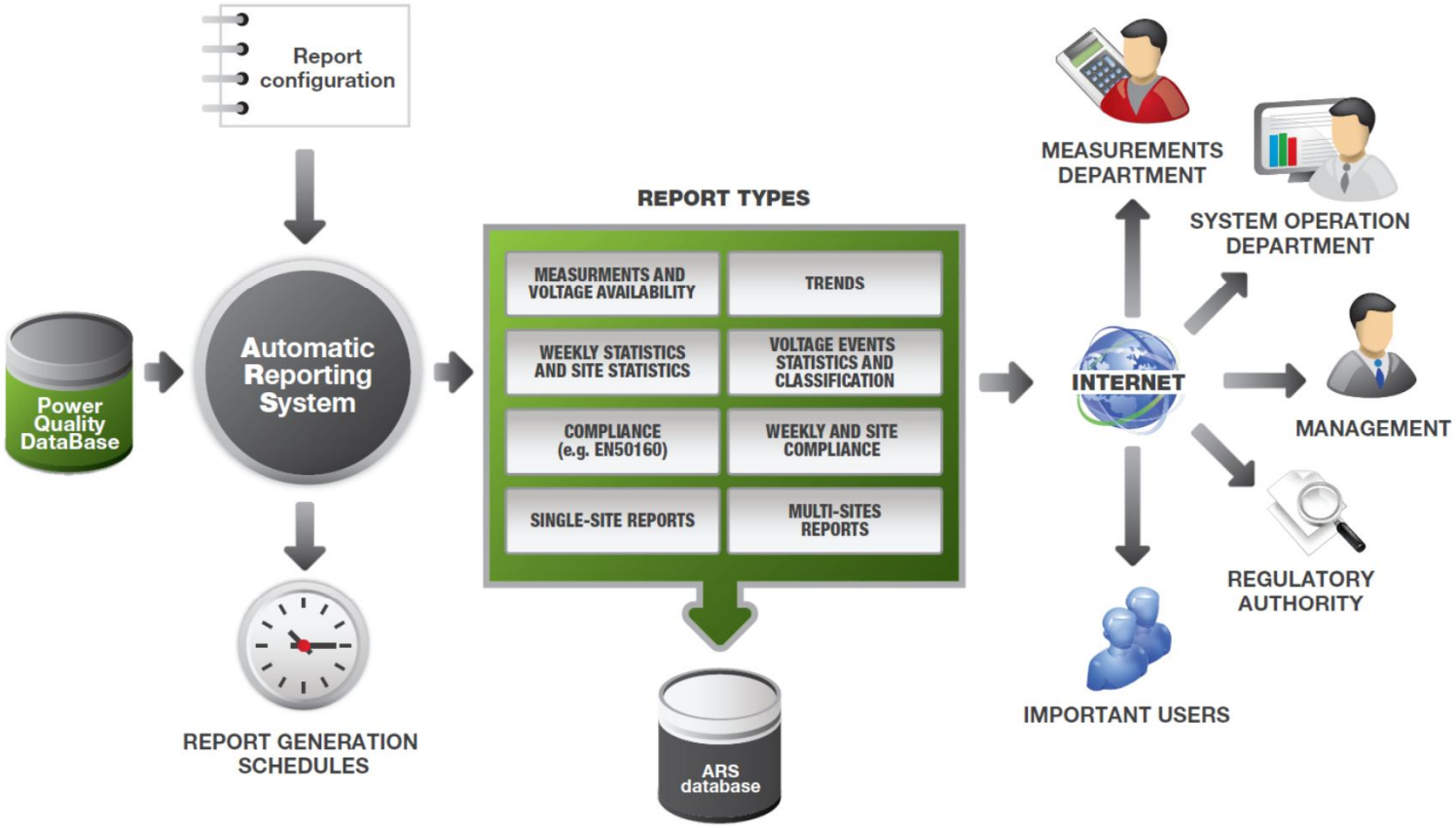
- PQView provides powerfull tools to analyse data and to create complex reports, but:
  - That task is often complicated
  - It is time consuming.
  - Requires lots of manual work

- Report format that will satisfy all existing and future requirements is impossible.

adabel

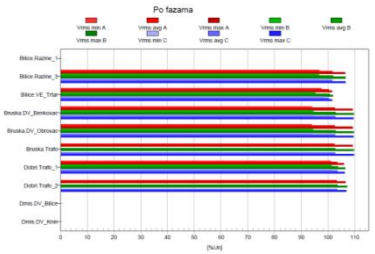
Automatic reporting system - overview

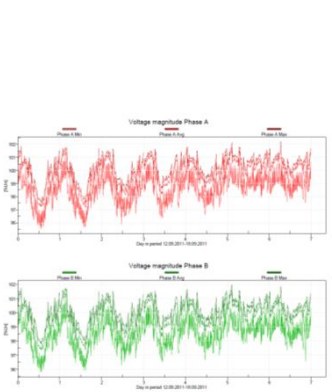
- ARS uses PQView databases as data sources
- Automatically creates customized power quality or other types of reports (submetering…)

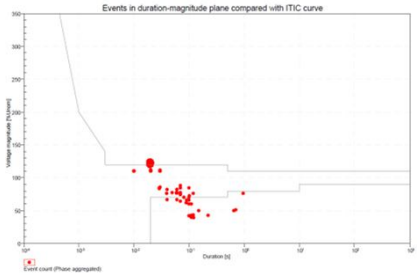


Automatic reporting system: Main goals

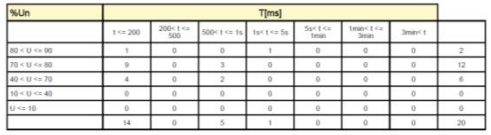
- Modular - many different report components are available as plug-ins:
  - tables
  - trends
  - statistical analysis
  - histograms...







- User defines report template:
  - components (pages)
  - databases / sites
  - time interval (last year, last month...)
  - parameters and custom settings

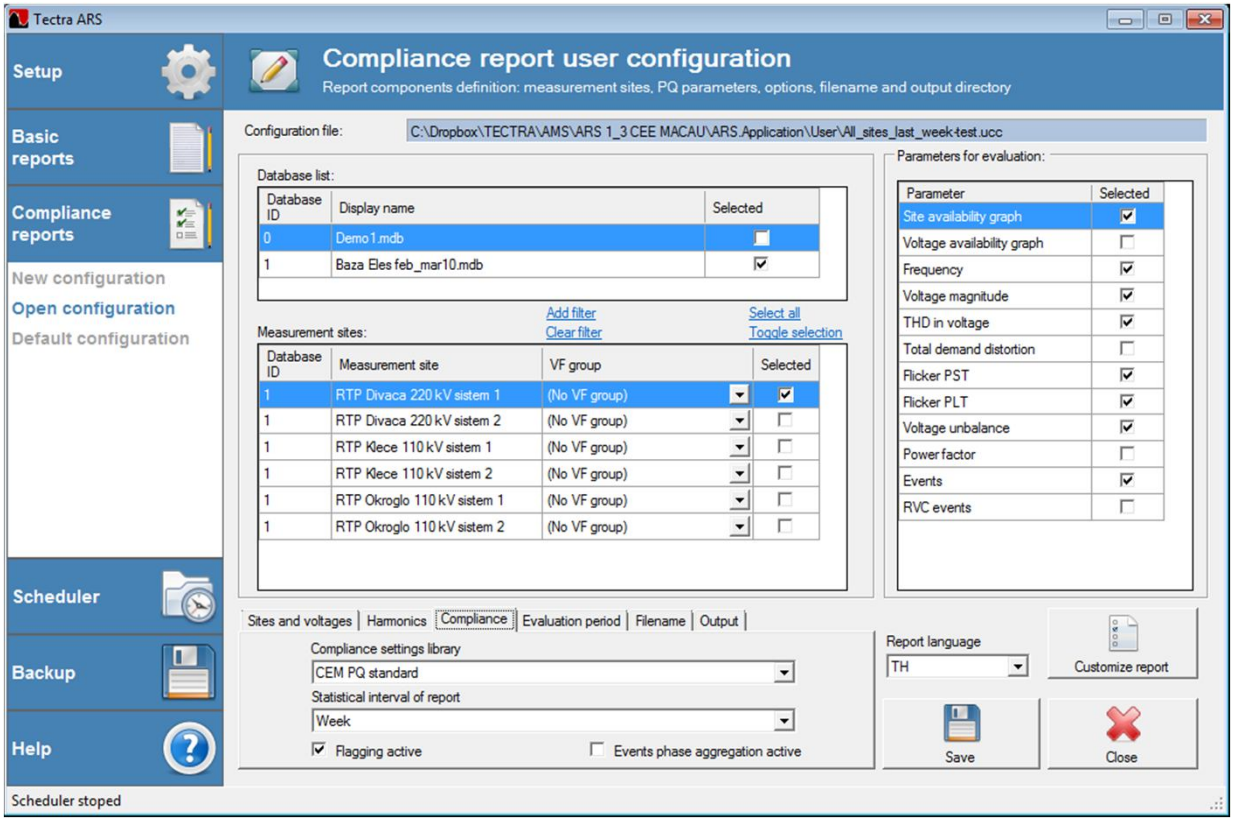


- Mechanism for **automatic report** generation creates actual report documents from templates without user intervention.

Reports are available as

- PDF
- Word
- HTML files

Easy usage – simple user interface



- "Complex" part of setup is done only once
  - Databases
  - Sites and virtual feeders
  - Compliance criteria
  - Report visual template

- Report templates setup is very easy – point and click

ARS
Automatic reporting system – key features

- **Automatic report generation** – ARS simplifies otherwise complicated and time-consuming process of creating complex reports.

- Reports for **one measurement site**, or **multi-site** (comparative) reports are available. Even multiple databases can be used in single report

- **Reports: statistic-basic, compliance** (using standardized or custom compliance limits), **custom**

adabel

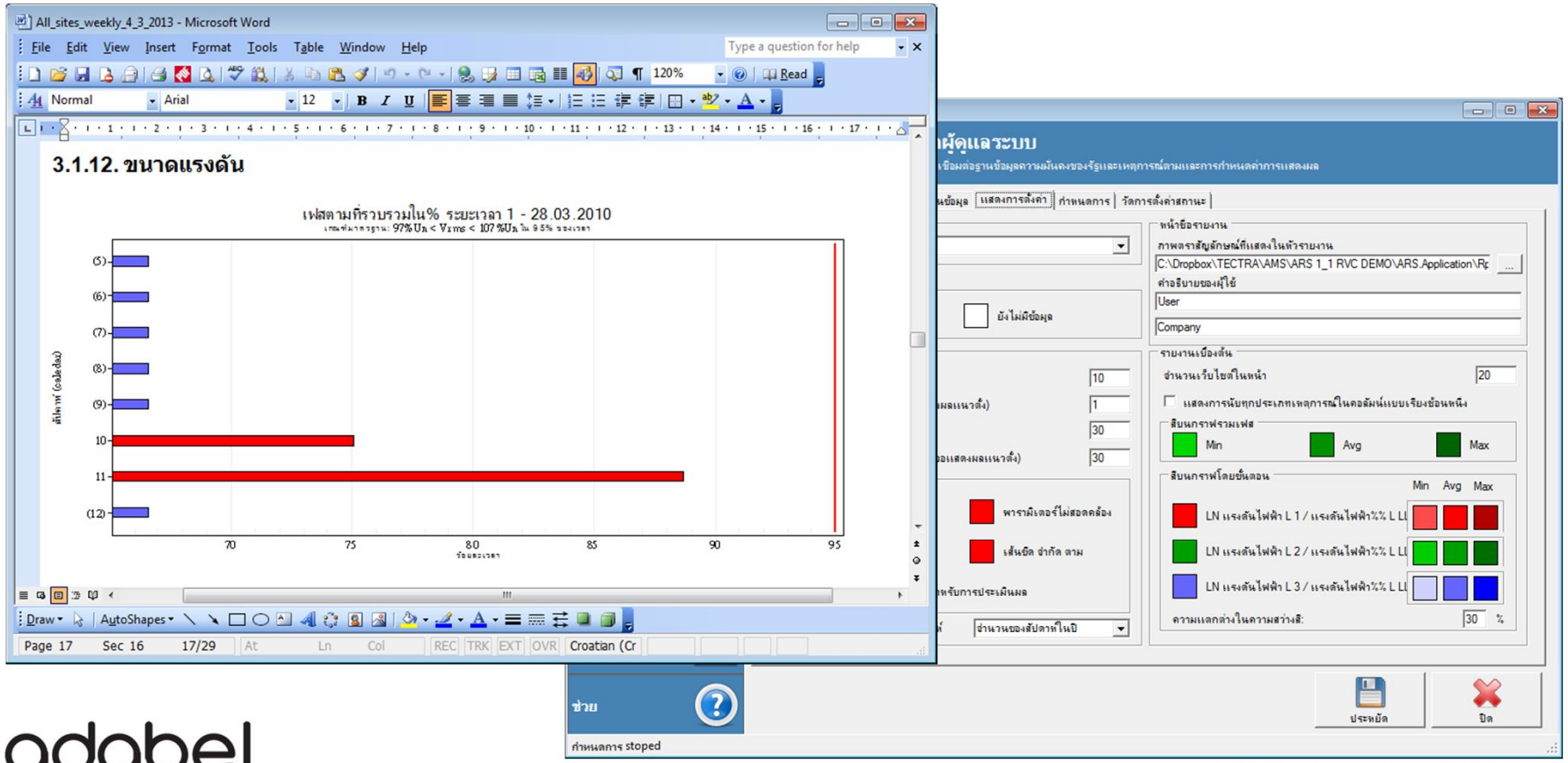
ARS
Automatic reporting system – key features

- **Large level of customization** is offered: users can customize various report parameters to their needs:
  - Components – plugin modules
  - Display formats, colors
  - report template designs
  - Language
- **Report creation scheduler:** user can define number of automatic report generation schedules.
- Created reports are **automatically** archived and can be sent via **e-mail** to defined recipients.

adabel

ARS
Automatic reporting system – key features

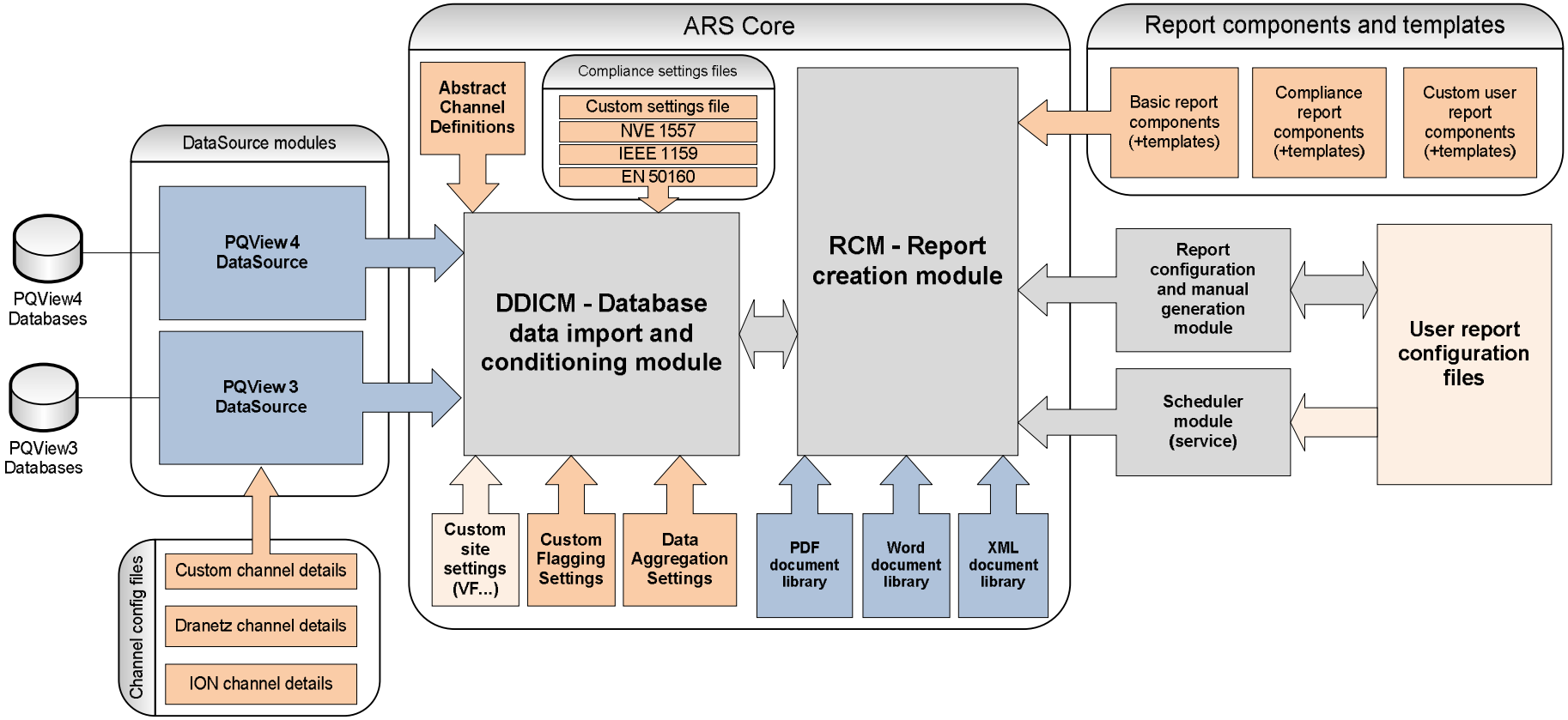
– **Easy software localization** – translation of user interface and report templates to different languages is very easy



adabel

Automatic reporting system – architecture

– **Modular structure** – software can be upgraded with new modules for creating custom user-defined reports.



adabel

Data source flexibility

Support for various PQ monitor dana format

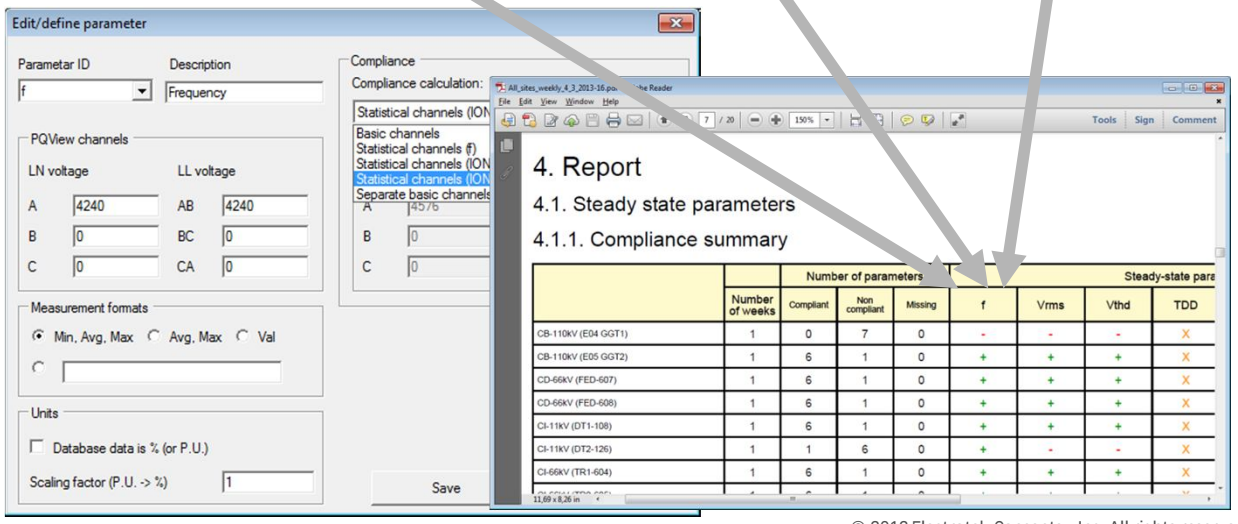
- Different instruments can store information in different formats
  - Trend data
  - Compliance counters
- PQView **channel map files** can be defined for different instrument types in ARS:
  - PQView channels
  - Record format
- Unified reports can be created using data from different instrument types

Frequency compliance measurements?

Counters of **compliant** 10 **second** intervals

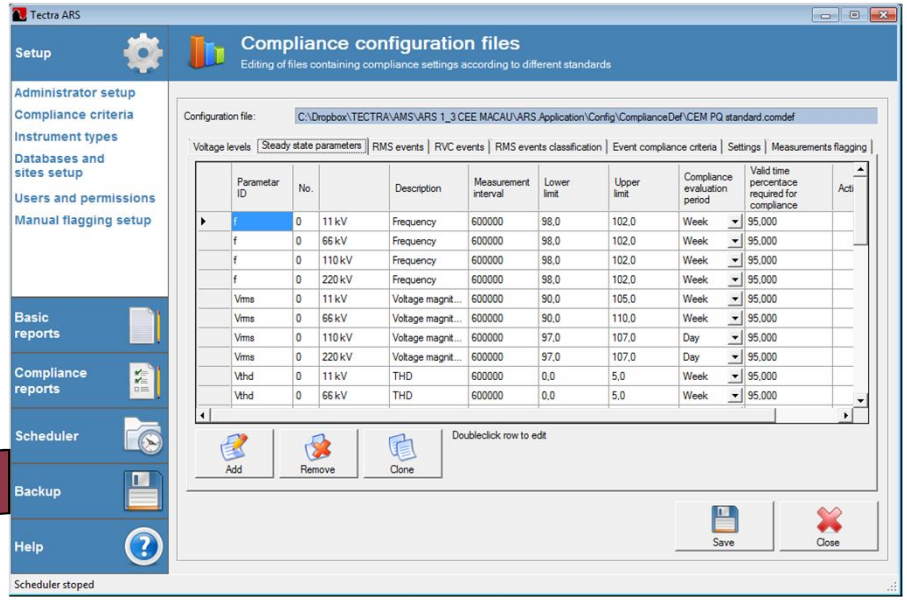
Counters of ***non*** **compliant** 10 **second** intervals

10 **minute** min/average/max trends



Compliance criteria
Support for various compliance requirements

- **ARS supports unlimited number of different compliance criteria sets.**
- **Predefined compliance criteria files are available at ARS:**
  - EN 50160
  - NVE 1557
  - IEEE 519
  - IEEE 1559
  - IEC 61000-3-7
- **Custom compliance criteria files can be defined**
  - Internal utility regulation
  - Contracts
  - National and regional standards
- **Compliance of**
  - Steady state parameters



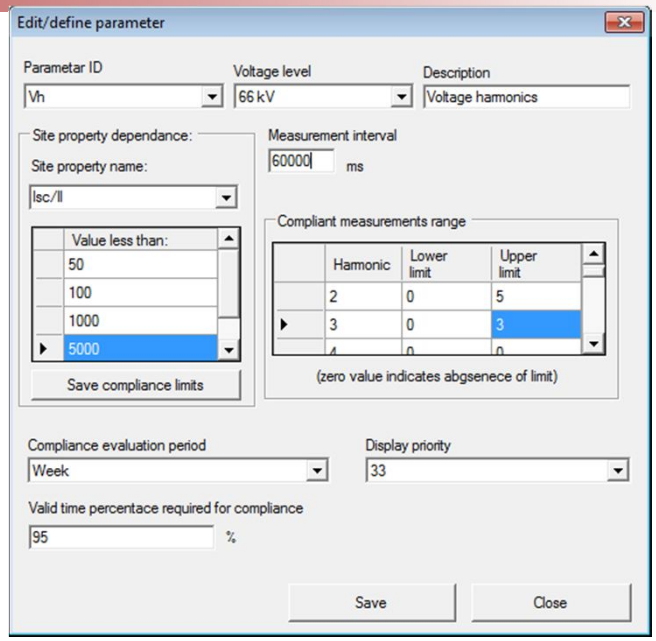
Parameter	Symbol	Recording interval*	Evaluation period	Compliance limits		Compliance time
				Lower	Upper	
11 kV Voltage level						
Frequency	f	10 min	Week	98%fn	102%fn	95%
Voltage magnitude	Vrms	10 min	Week	90%Un	105%Un	95%
THD in voltage	Vthd	10 min	Week		5%Un	95%
Total demand distortion	TDD	10 min	Week		5%	95%
Flicker PST	Pst	10 min	Week		1	95%
Flicker PLT	Plt	2 hour	Week		0.8	95%
Voltage unbalance	Vunb	10 min	Week		2%Un	95%
Power factor	PF	10 min	Week	0.85	1	95%
110 kV Voltage level						
Frequency	f	10 min	Week	98%fn	102%fn	95%
Voltage magnitude	Vrms	10 min	Week	97%Un	107%Un	95%
THD in voltage	Vthd	10 min	Week		2.5%Un	95%
Total demand distortion	TDD	10 min	Week		100%	95%
Flicker PST	Pst	10 min	Week		0.8	95%
Flicker PLT	Plt	2 hour	Week		0.6	95%
Voltage unbalance	Vunb	10 min	Week		2%Un	95%
Power factor	PF	10 min	Week	0.85	1	95%

adabel

changes

Compliance criteria
Steady-state measurements

- **Custom compliance criteria can be applied to any measured steady-state parameter:**
  - Valid range (90-110% Un)
  - Evaluation period (week, year…)
  - Compliance time (95%, 100%...)
- **Different criteria can be defined for single parameter**
  - Frequency should be 50±1Hz for 95% of a week
  - Frequency should be 50±7.5Hz for 100% of the time
- **Different criteria can be defined for different voltage levels**
- **Different criteria can be defined for various site properties**
  - Short circuit ratio
  - Location (rural / urban)
  - Generation / transmission / distribution
  - …



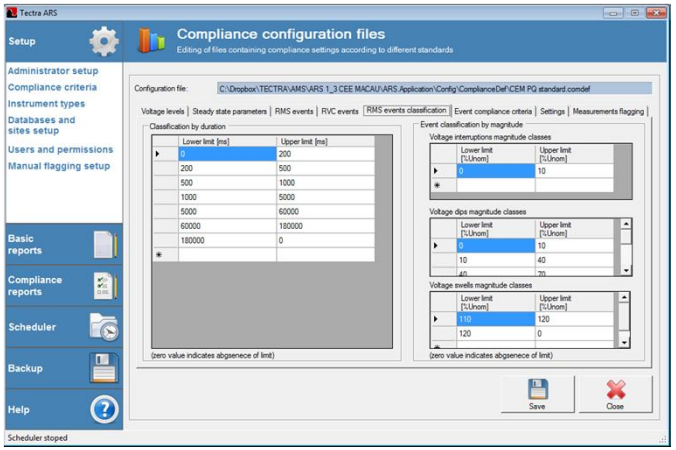
4.1.2 Current Distortion Limits (230V to 66kV)

I_{sc}/I_L	Total Demand Distortion (TDD %)
*<20	5.0
20-50	8.0
50-100	12.0
100-1000	15.0
>1000	20.0

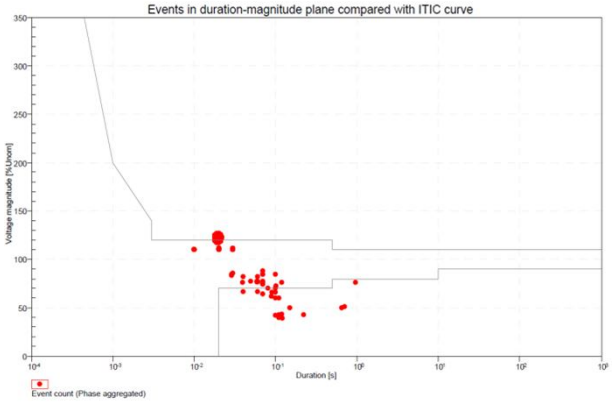
Current distortions that result in a dc offset are not allowed.
*** All power generation equipment is limited to these values of current distortion, regardless of actual I_{SC}/I_L.**

Compliance criteria
Events

- **ARS offers many event classifications like:**
  - Specification of event types by magnitude and duration – Long and short interruptions
  - UNIPEDE DISDIP tables (custom limits)
- **Different event severity criteria are available**
  - CBEMA
  - ITIC
  - SEMI47
  - User defined sensitivity curves
- **Different compliance criteria can be applied to event count in some period (year,month...)**
  - Total count of events
  - **SARFI:** CBEMA, ITIC, 70, 80, 90 ...
  - **...ices**: long interruption count duration, CAIDI,



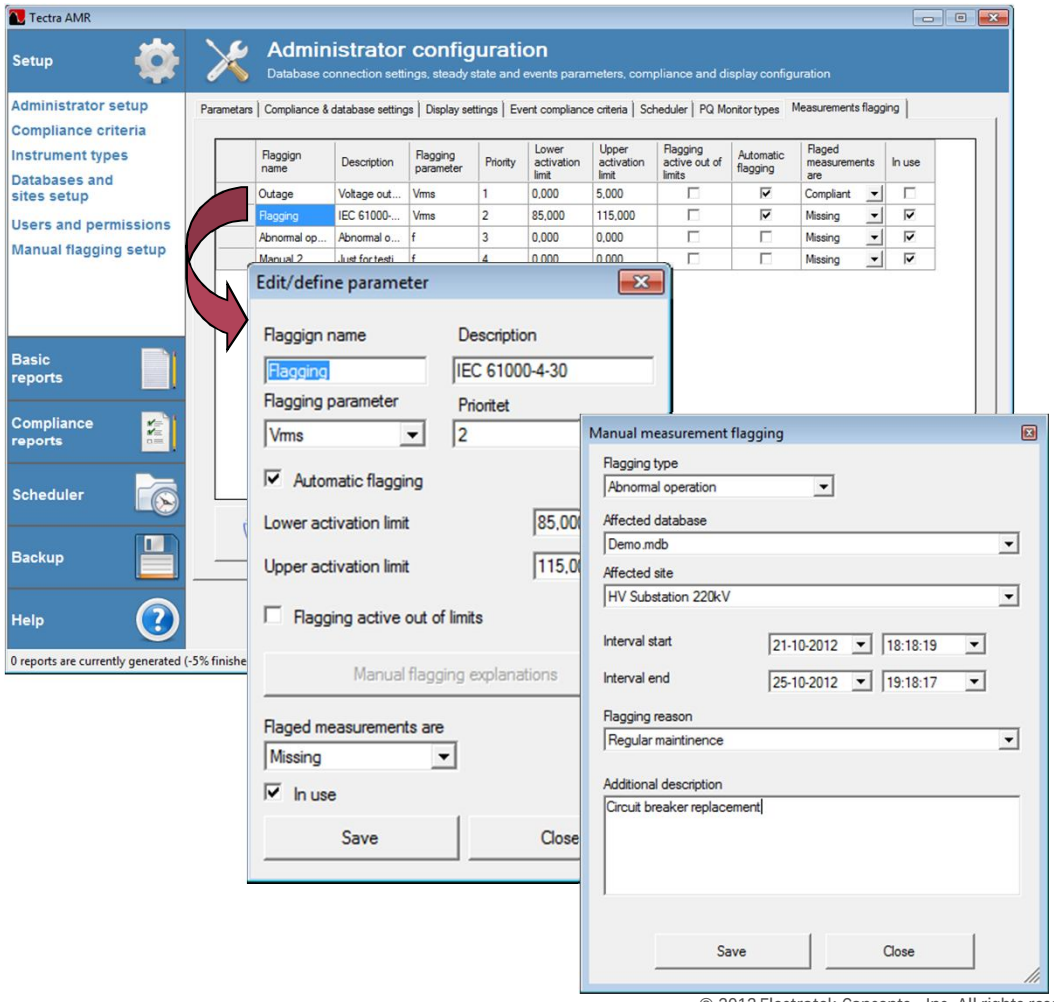
%Un	T[ms]							
	t <= 200	200< t <= 500	500< t <= 1s	1s< t <= 5s	5s< t <= 1min	1min< t <= 3min	3min< t	
80 < U <= 90	1	0	0	1	0	0	0	2
70 < U <= 80	9	0	3	0	0	0	0	12
40 < U <= 70	4	0	2	0	0	0	0	6
10 < U <= 40	0	0	0	0	0	0	0	0
U <= 10	0	0	0	0	0	0	0	0
	14	0	5	1	0	0	0	20



Measurement flagging

Support for various measurement flagging types

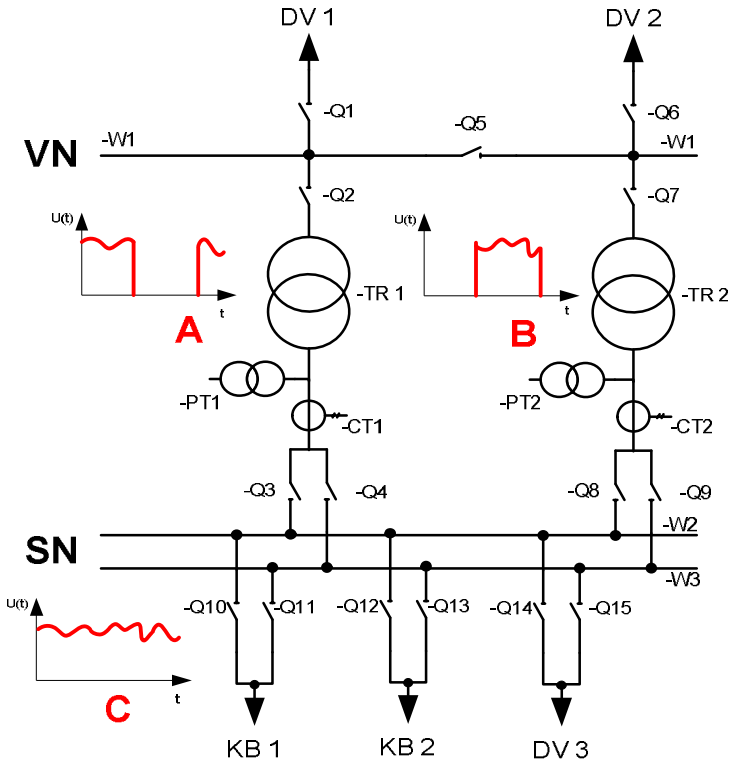
- **Flagging:** excluding of faulty measurements from compliance statistics
- **Automatic flagging** criteria are activated when choosed parameter value falls into choosen limits
- **Manual flagging** intervals are entered by user or can be imported from external data source (maintinence, storms, faults...)



Advanced algorithms

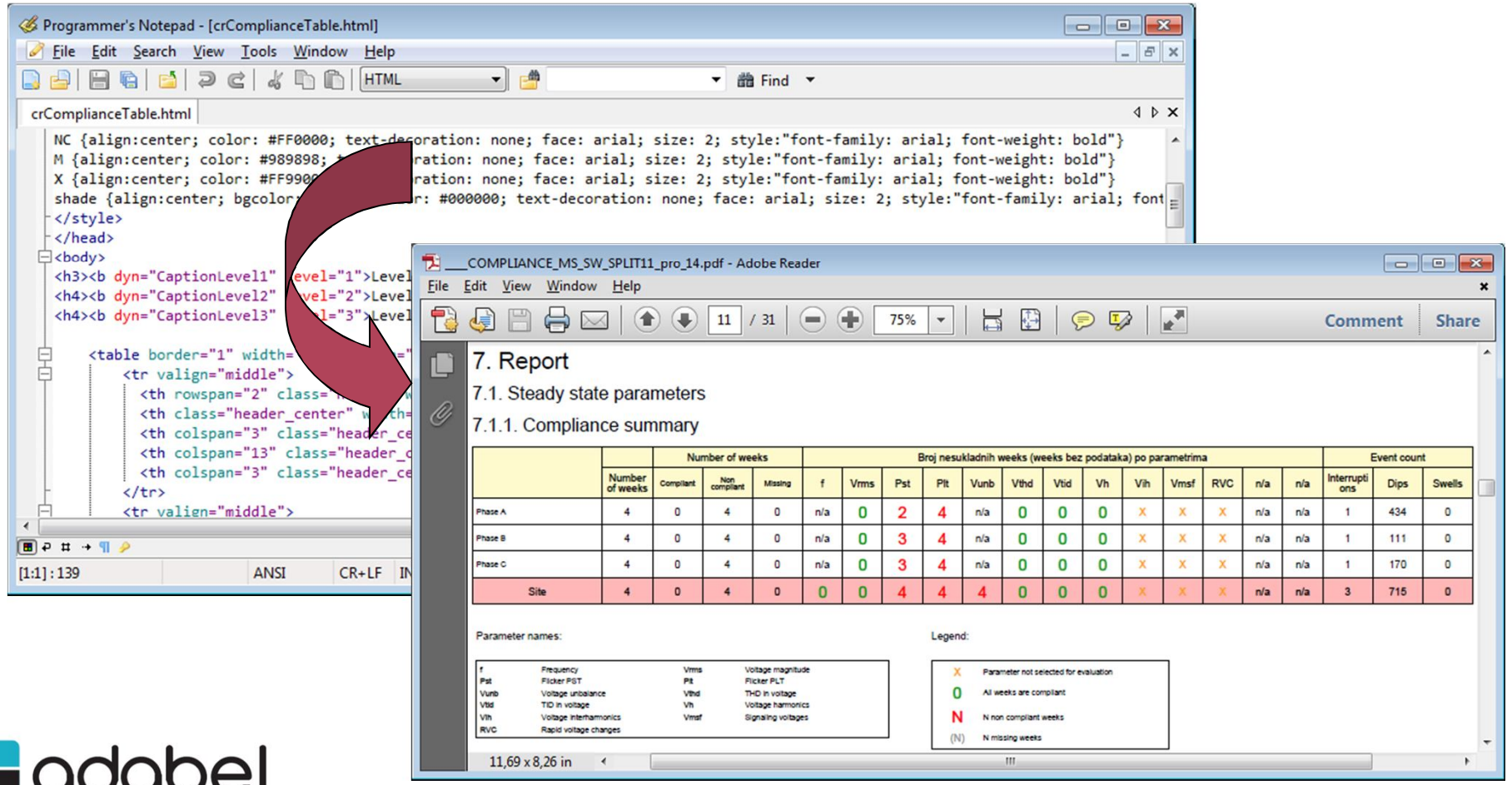
Example: “virtual feeder” - grouping multiple measurement sites into single virtual site

- **ARS allows to group two or more sites (instruments) into virtual feeder – virtual site**
- **Usually used when two parallel transformers power single bus**
  - One of transformers can be disconnected for some time
  - Voltage at the point of measurement is not compliant when transformer is off
  - Customers don’t expirience interruption – other transformer is powering them.
- **Virtual feeder algorithm automatically detects and calculates bus voltage**
- **Can be used for**
  - different instruments in same database,
  - different or identical instruments in separate databases

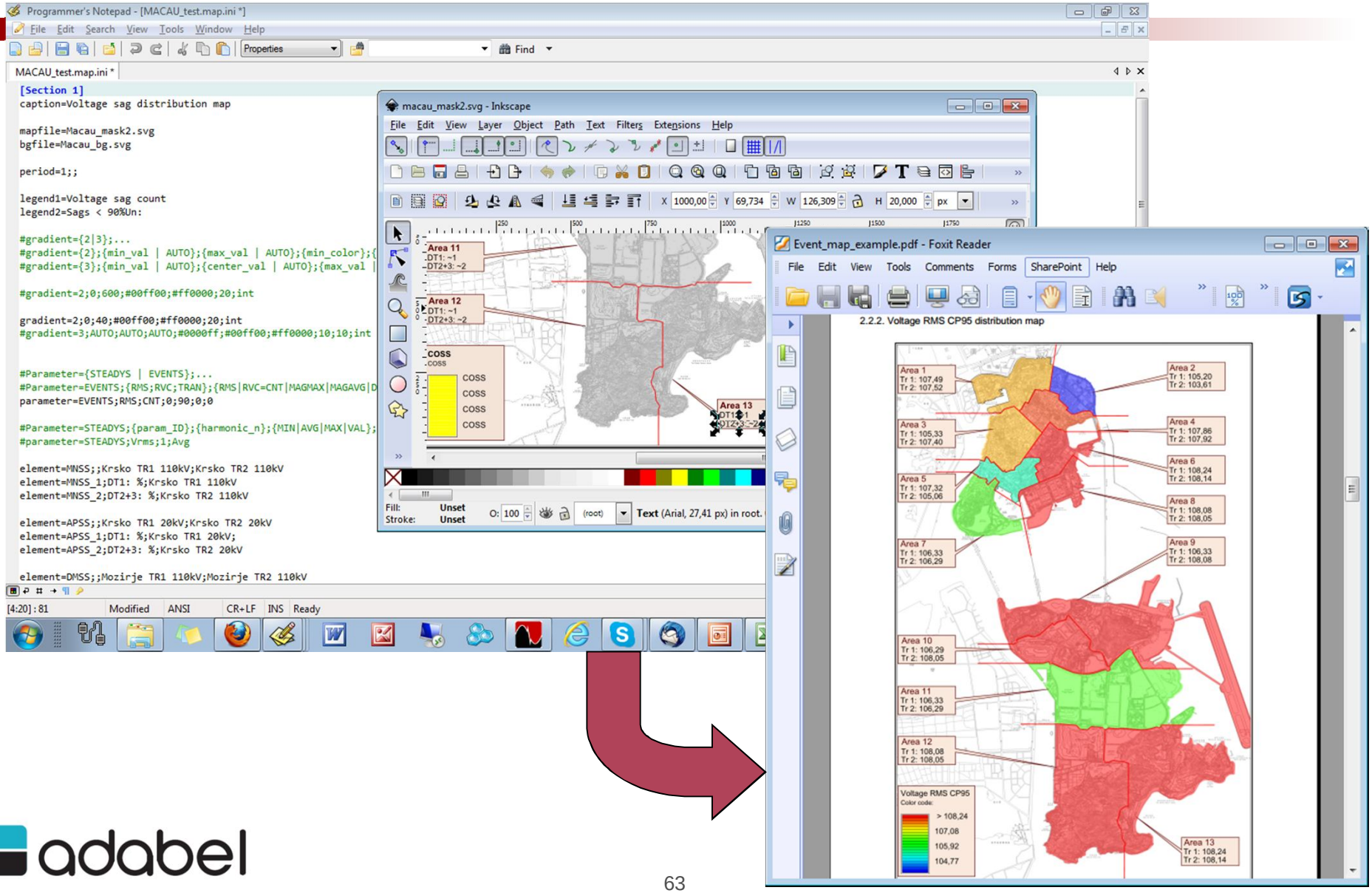


Visual structure of report templates

Report templates are stored in HTML format, and easily changed to satisfy user's visual requirements.



Visual structure of report templates



Summary

- PQView can import, manage and analyze data from a many different types of devices from many manufacturers using PQDIF, Comtrade, Modbus or proprietary data formats.
- PQView can be used to present PQ event information and reports from single sites to the complete system for short or very long durations.
- Advanced correlations and derivations can be to expand the information available.
- All departments within a utility organization.
- PQView is an integral part of developing a Smart Grid Program

Thank You