19th Annual PQSynergy™
International Conference and Exhibition 2019

Commercial Presentation

A Case of PQ Monitoring System of a Very Large Utility in New York City

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DRANETZ™
THE STANDARD FOR ENERGY & POWER MEASUREMENT

Mr. Chandler has more than 30 years experience in the Power Quality Industry. He has published more than 100 papers on the various aspects of Power Quality, conducted 100's of classes and seminars on Power Quality.

Power Quality Monitoring System at the Consolidated Edison Company of New York

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ELECTROTEK CONCEPTS

The Consolidated Edison Company of New York

- Provide electrical service to New York City and Westchester County
- 3.3 million electric customers
- System Peak Load: 13189 MW
- 62 Distribution Substations
- 83 Secondary Networks and Non-Network Load Pockets
- 2247 Distribution Feeders
- 87% of Distribution System is Underground

ELECTROTEK CONCEPTS

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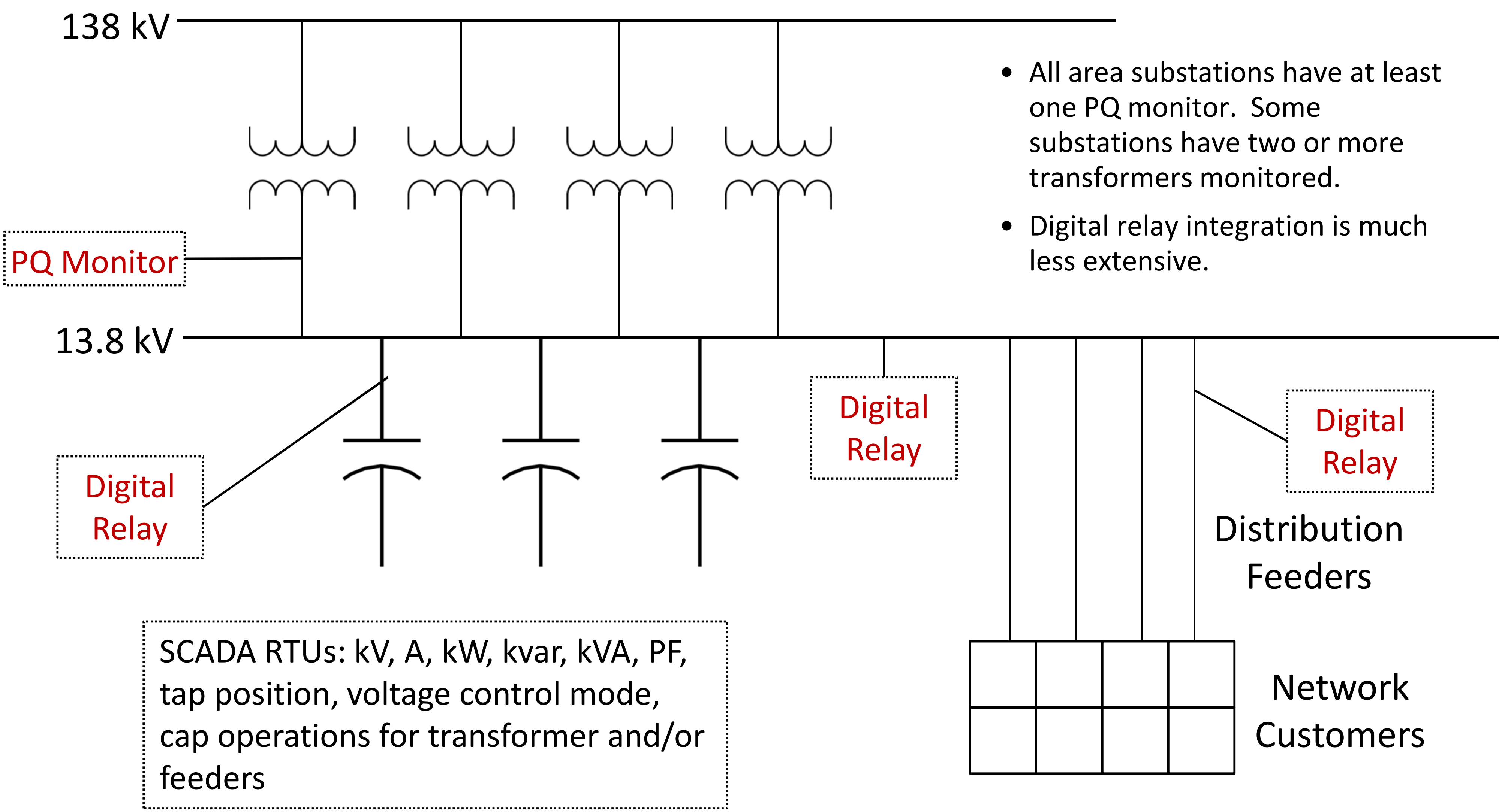
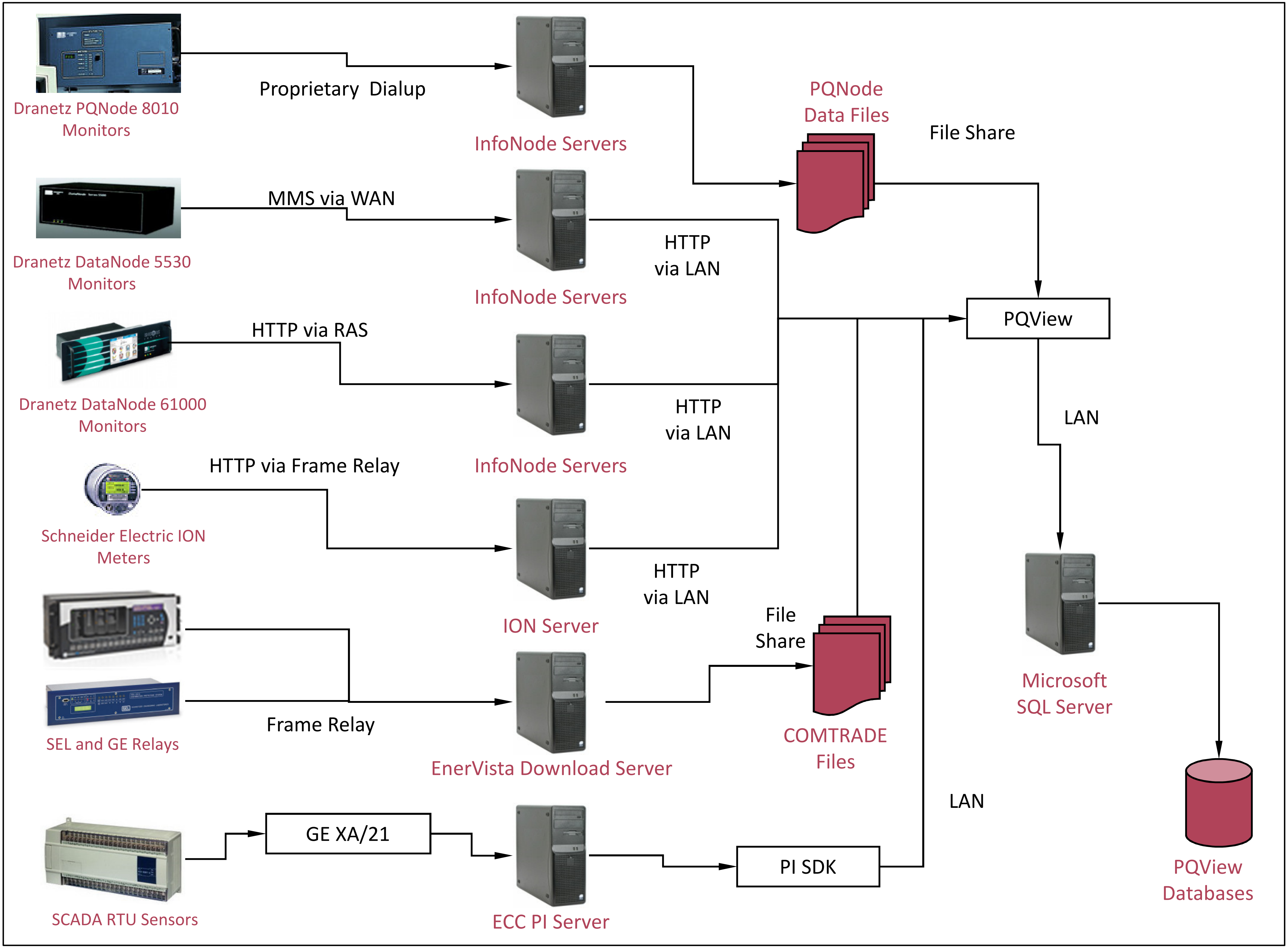
Power Quality Monitoring System (PQMS) at the Consolidated Edison Company of New York

- Data Integration and Basic Analysis
- Permanent Faults
- Inrush Events
- Second Faults
- Incipient Faults
- SCADA/PQ System Federation

Con Edison Area Substation Monitoring

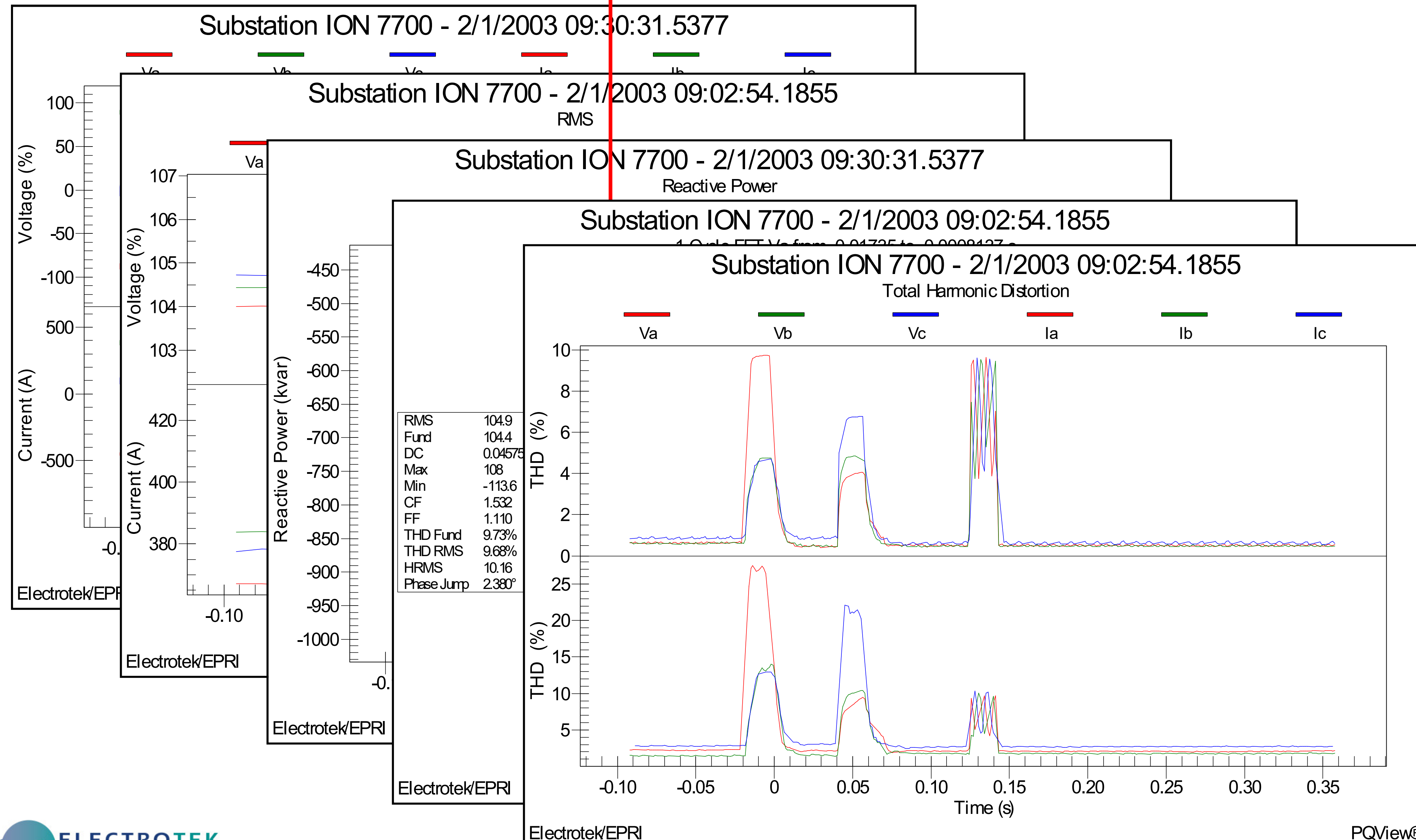
- All area substations have at least one PQ monitor. Some substations have two or more transformers monitored.
- Digital relay integration is much less extensive.





Dranetz PQNode 8010 Monitors
Proprietary Dialup
InfoNode Servers
PQNode Data Files
File Share
Dranetz DataNode 5530 Monitors
MMS via WAN
InfoNode Servers
HTTP via LAN
Dranetz DataNode 61000 Monitors
HTTP via RAS
PQView
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
SCADA RTU Sensors
GE XA/21
ECC PI Server
PI SDK
PQView Databases

Examples of Derivations Possible from Waveform Events using Con Edison PQMS



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

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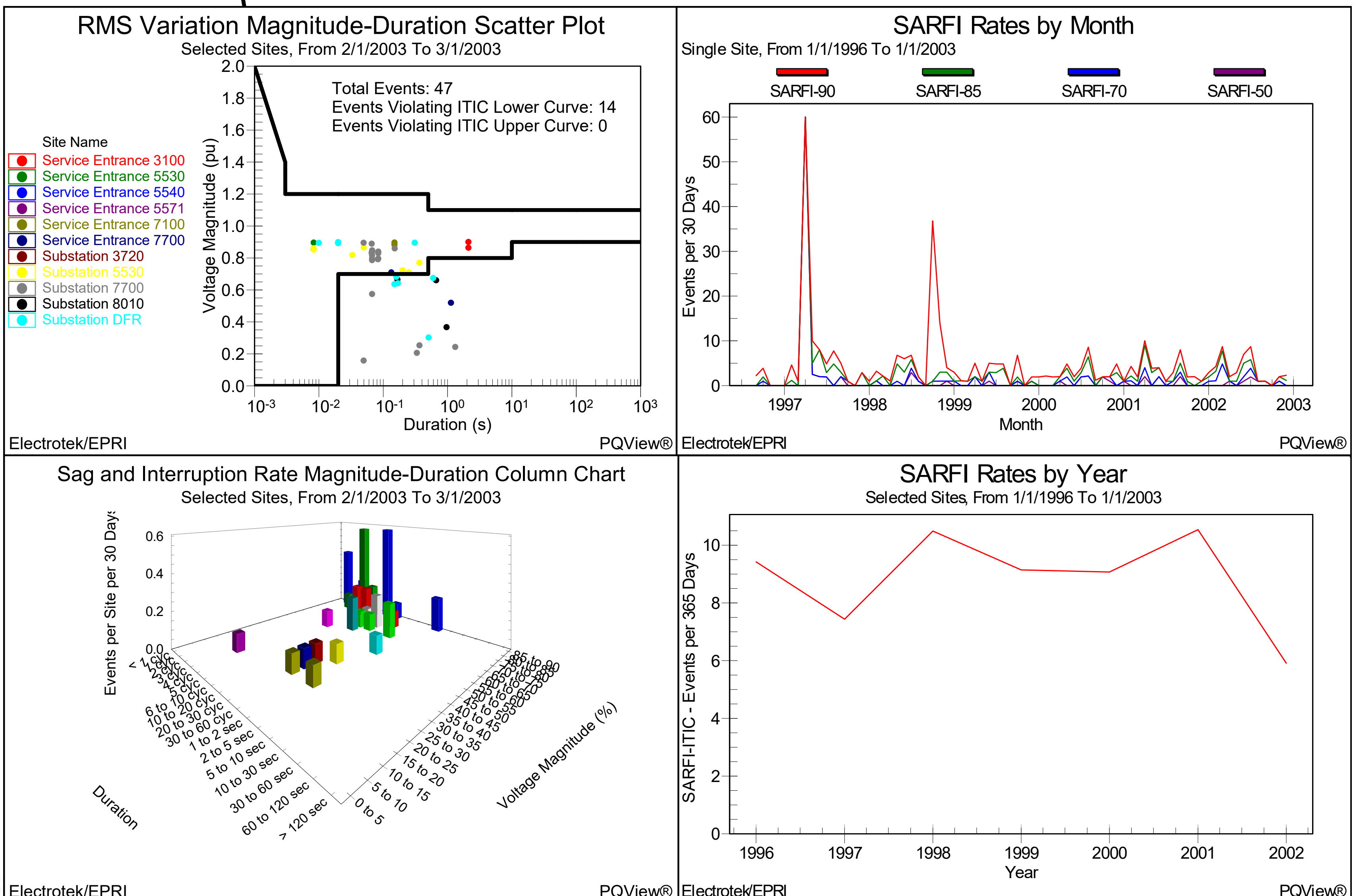
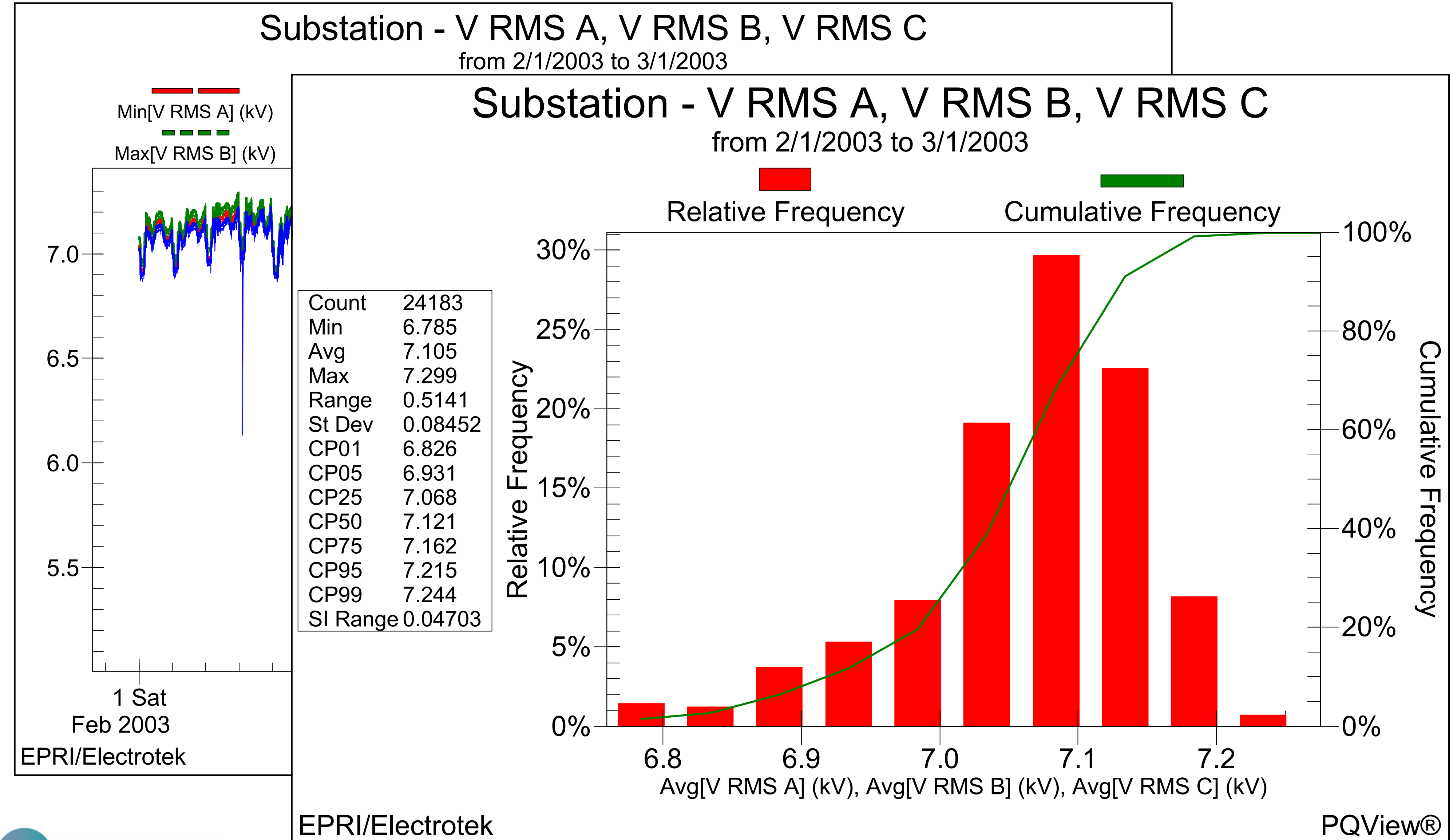
RMS Voltage Variation Analysis



Analysis of Data Logs



Count	24183
Min	6.785
Avg	7.105
Max	7.299
Range	0.5141
St Dev	0.08452
CP01	6.826
CP05	6.931
CP25	7.068
CP50	7.121
CP75	7.162
CP95	7.215
CP99	7.244
SI Range	0.04703

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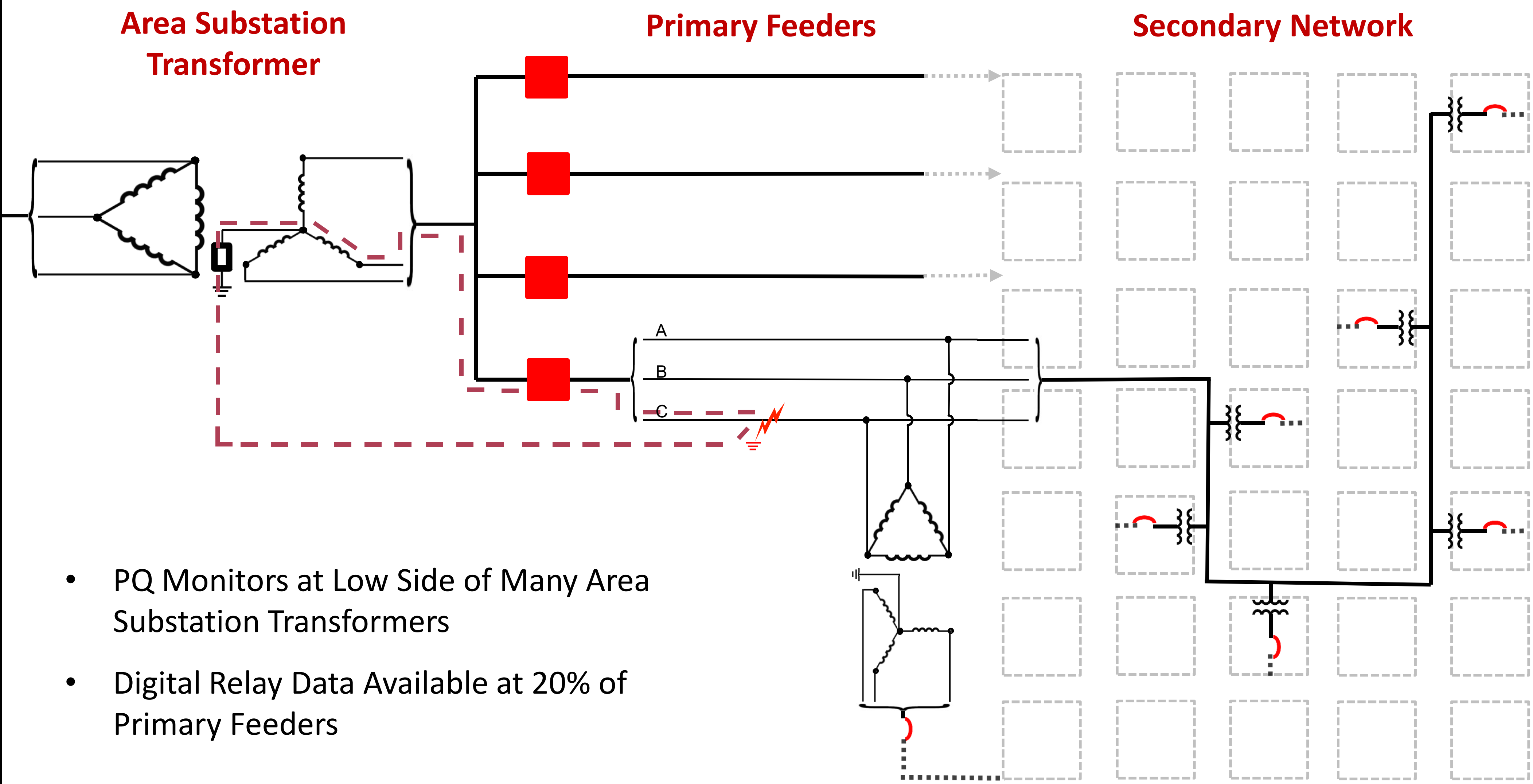
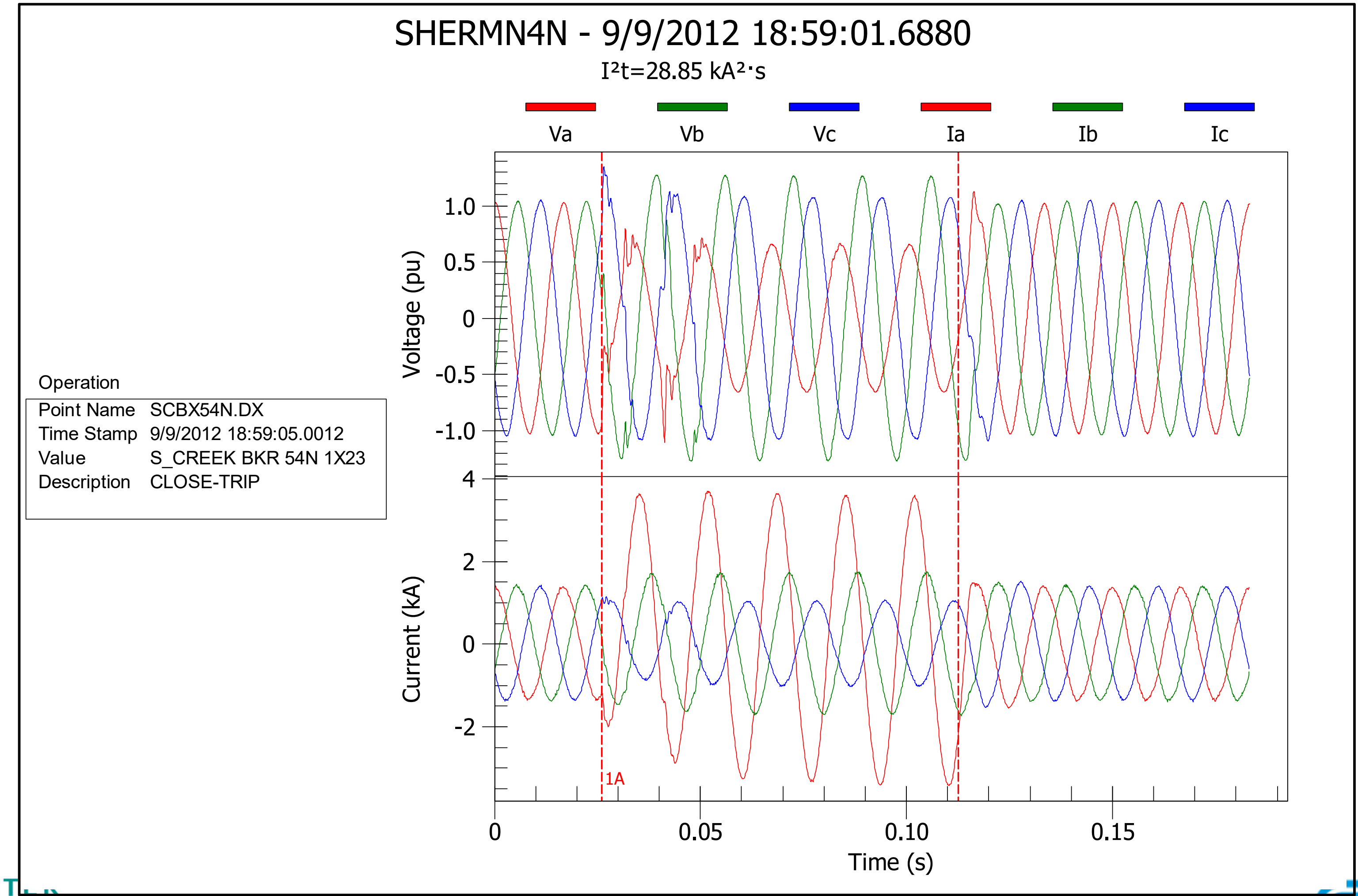
Single Line to Ground Fault



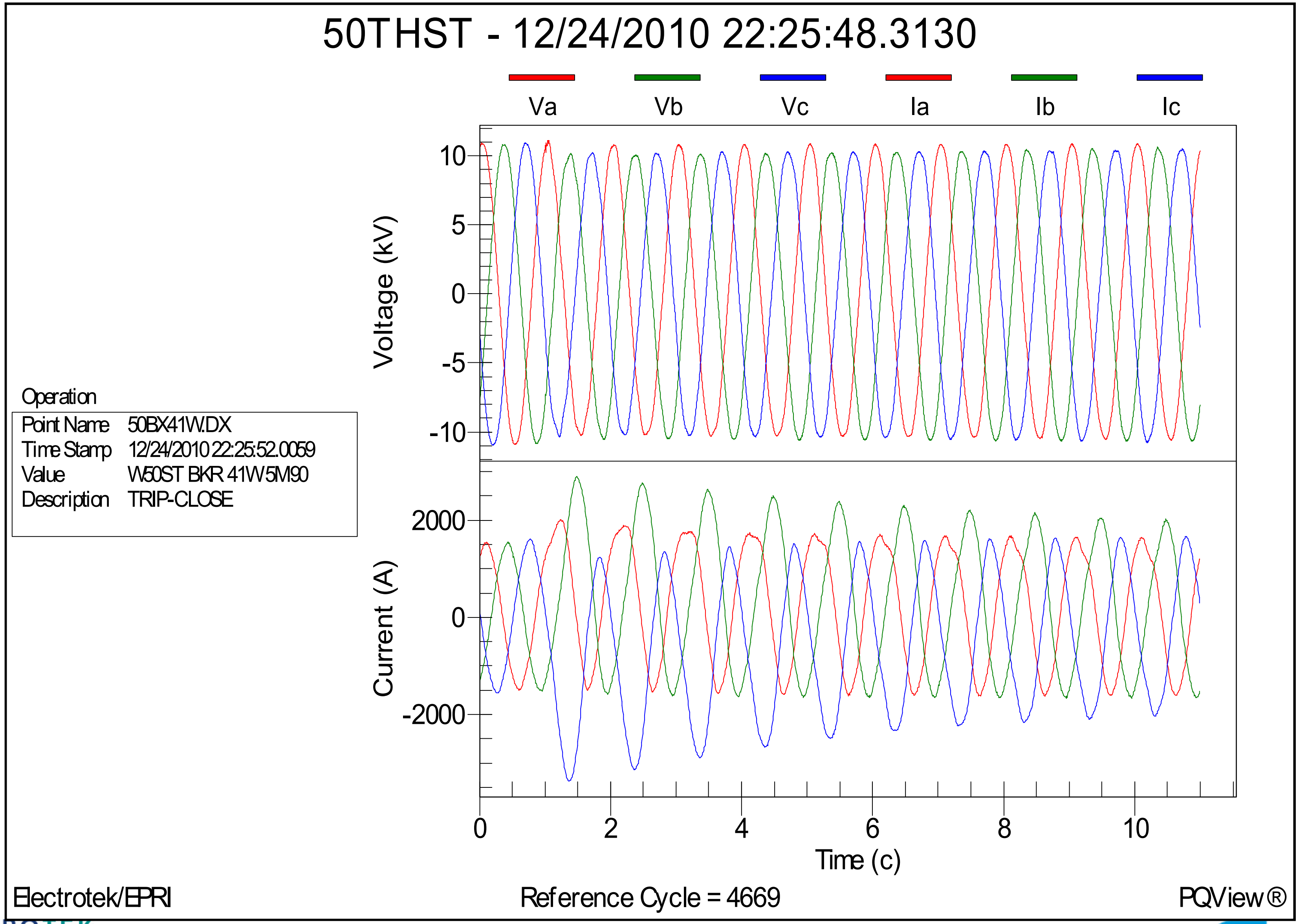
- PQ Monitors at Low Side of Many Area Substation Transformers
- Digital Relay Data Available at 20% of Primary Feeders

Example SLG Fault Recorded by PQ Monitor at Area Substation

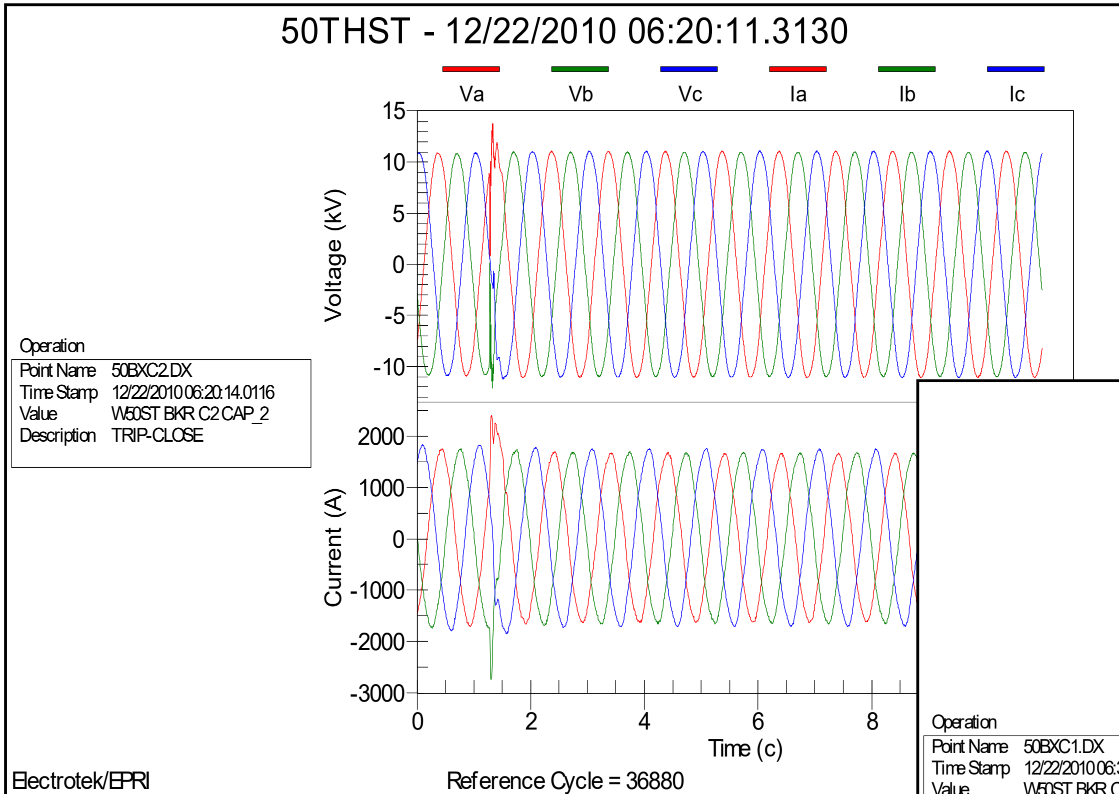
- Fault type and fault start/stop detection algorithm based on waveforms, phasors, zero-sequence, negative-sequence, and spectral content.

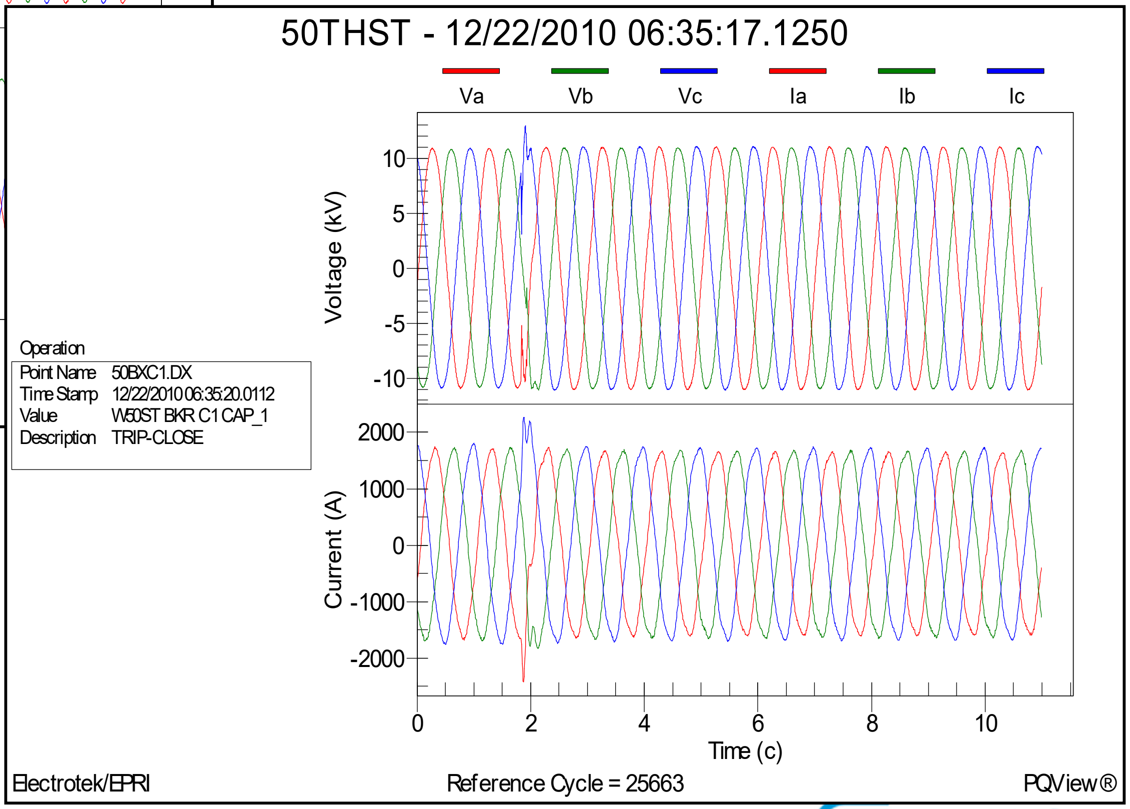


Example Correlation of Feeder Reclose Event with PI Event from SCADA Operation



Example Correlations of Capacitor Energizing Event with PI Event from SCADA Operation





Event Categorization

Permanent Faults

- Single-Phase: A, B, C
- Two-Phase: AB, BC, CA
- Three Phase Faults: ABC

Subcycle Faults

- Single-Phase: A, B, C
- Two-Phase: AB, BC, CA
- Three Phase Faults: ABC

Feeder Inrush

- A, B, C, AB, BC, CA, ABC

Overcurrent

- Zero-Sequence: I0
- Negative-Sequence: I2
  - "Second Fault"
- Phase: IA IB, IC

Voltage Sag

- A, B, C, AB, BC, CA

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Automatic E-Mail Notifications

- Inrush Events

From: PQView Infonode RTF <pqview@coned.com> Sent: Sun 9/21/2014 2:00

To: hofmannp; washingtonw; dl-RTFInrushManhattan

Subject: Inrush Event Notification: Parkview TR4

This email has been sent to you by rule from PQVIEW Substation_Nodes

Site Name	Local Time	Hyperlinks	Fault Type	RMS Dur	Time Offset(s)	XTF (Ω)	Va (V)	Vb (V)	Vc (V)	Ia (A)	Ib (A)	Ic (A)	I0 (A)	k1	Relay Channels	Operations			
Parkview TR4	9/21/2014 13:58:08.4410	Waveforms One-Line	Inrush 2CA		0.05279		7389	7636	7319	**1050**	1048	**1405**	2	2.500		2014-09-21 13:58:12	PABX13A.DX	PARKVIEW BKR 13A (44M04)	TRIP-CLOSE

- Fault Events

From: PQView Infonode RTF <pqview@coned.com> Sent: Fri 9/5/2014 10:58

To: dl-RTFNotificationManhattan

Subject: Fault Notification: Parkview TR4

This email has been sent to you by rule from PQVIEW Substation_Nodes

Site Name	Local Time	Hyperlinks	Fault Type	RMS Dur	Time Offset(s)	XTF (Ω)	Va (V)	Vb (V)	Vc (V)	Ia (A)	Ib (A)	Ic (A)	I0 (A)	k1	Relay Channels	Operations			
Parkview TR4	9/5/2014 22:56:02.6500	Waveforms One-Line	1C	5.496 c	0.09163	0.5893	10325	8605	4052	1223	1102	**3327**	**913**	2.500		2014-09-05 22:56:04	PABX42B.DX	PARKVIEW BKR 42B (44M24)	CLOSE-TRIP

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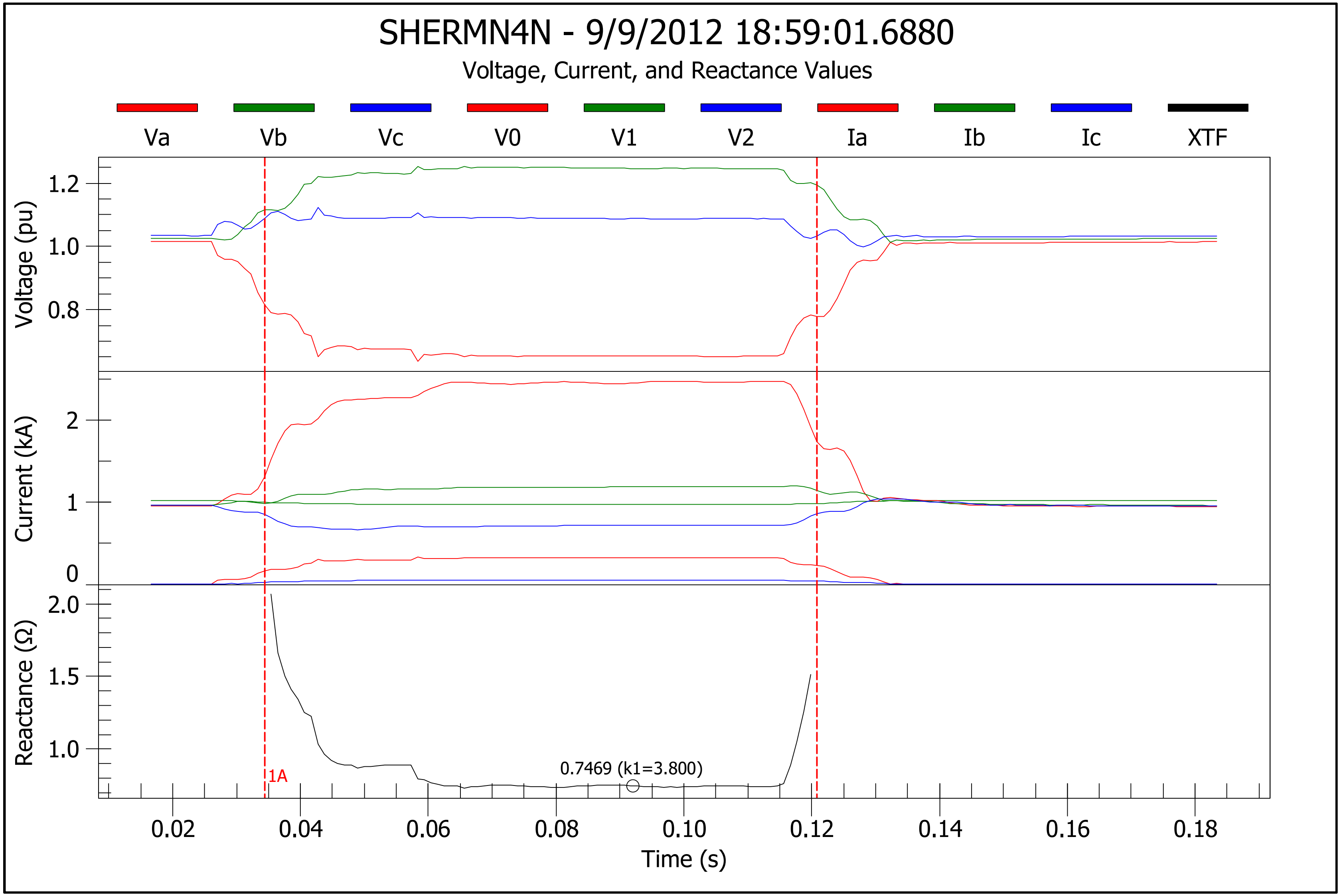
Reactance-to-Fault Calculations for PQ Measurement at Area Substation



Predicted Location of Fault by Matching Measured Reactance to Reactance of Circuit Model

RTFDetail - Windows Internet Explorer

PQ View XTF	Banks	Feeder Factor	XTF	Accuracy
0.7469	4	1.2	0.2241	5.00 %

Defaults | Set as Default | Recalculate

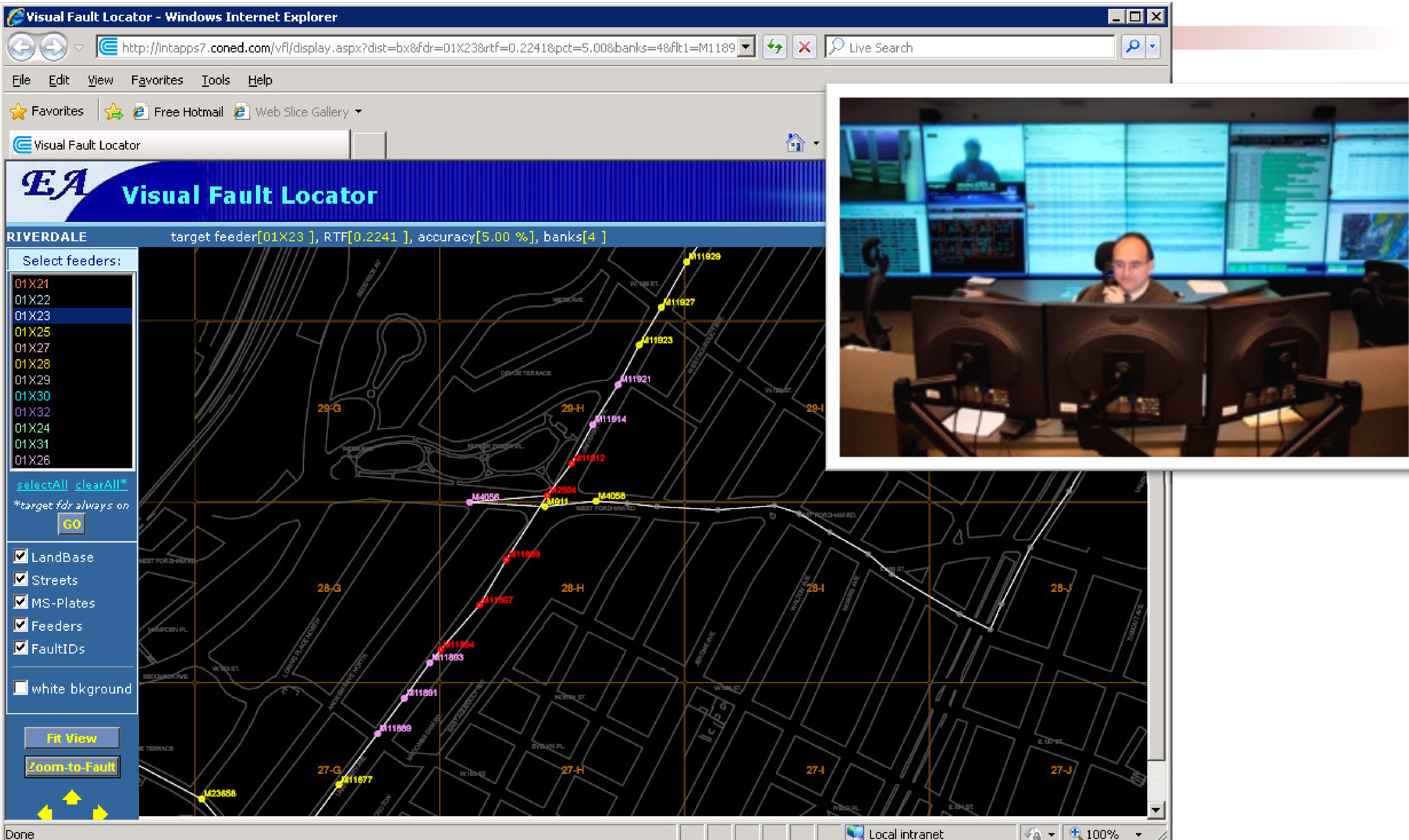
9/9/2012 6:59:01 PM Single-Phase Fault on Phase A — SABIND, RTF User

Feeder
01M02
01M03
01M04
01M06
01M07
01M14
01M18
01M50
01M51
01M54
01X22
01X23
01X26
01X28
01X29
01X32

Feeder : 01X23 Network : Riverdale — Print

	Structure	Location	Resistance	Reactance
26	M23658		0.0975	0.1479
27	M23659		0.1027	0.1574
28	M11873		0.107	0.1654
29	M11874		0.1116	0.1741
30	M11877		0.1169	0.1843
31	M11889		0.1223	0.1925
32	M11891		0.126	0.1982
33	M11893		0.1299	0.2041
34	M11894		0.1316	0.207
35	M11897		0.1366	0.2165
36	M11899		0.1408	0.2244
37	M2504		0.1465	0.2352
38	M11912		0.1507	0.2416
39	M11914		0.1538	0.2476
40	M4056		0.179	0.2514
41	M11921		0.1571	0.2538
42	M11923		0.1604	0.26
43	M11927		0.1634	0.2658
44	M911		0.1922	0.2659

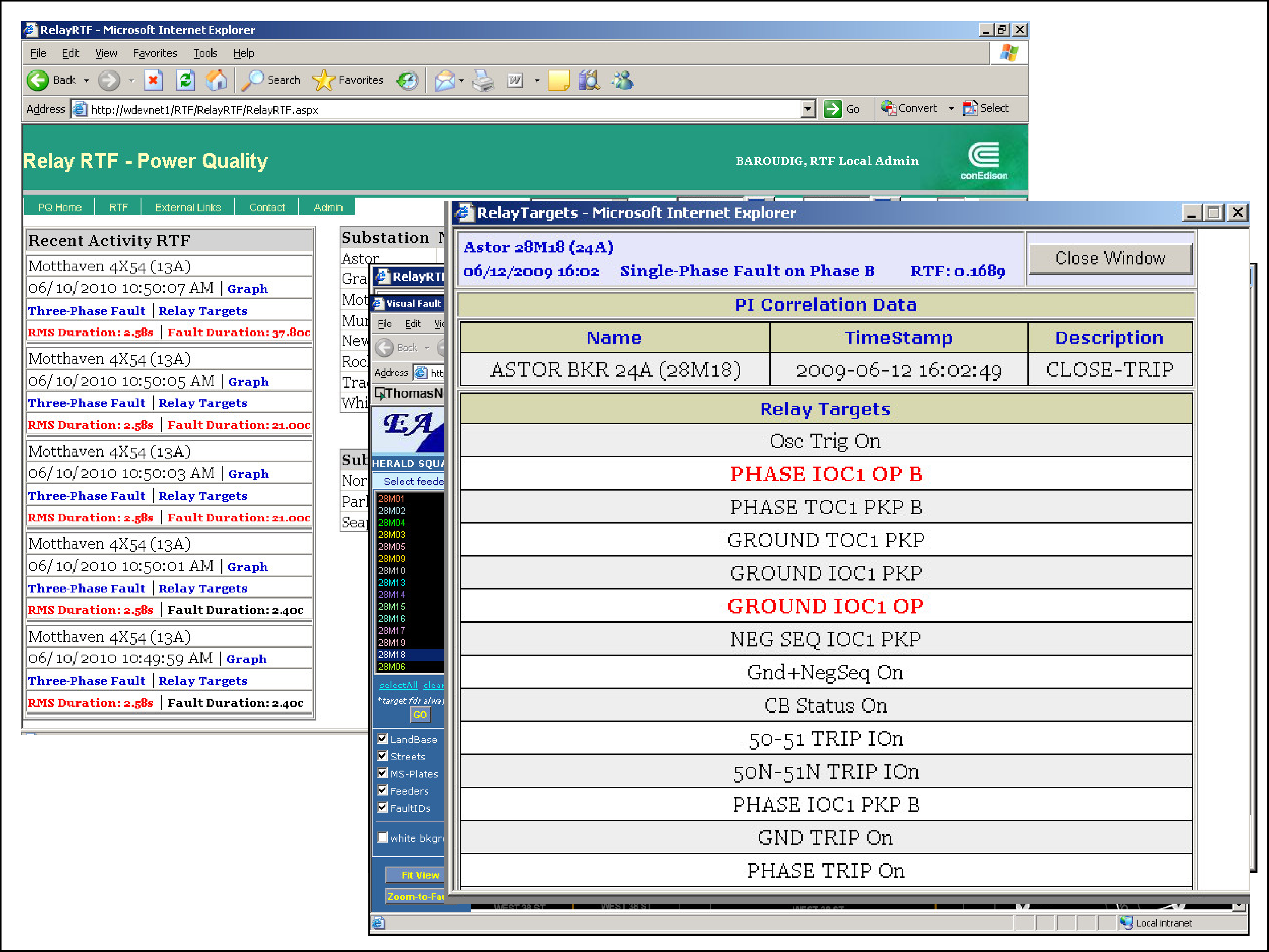
Visualized Location of Fault



Distribution Fault Location Results

- On average, use of the reactance-to-fault method for fault location saves one hour per feeder restoration job
- Mitigates use of capacitive discharge thumpers and DC high voltage (hi-pot) testing

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%


RelayRTF - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://wdevnet1/RTF/RelayRTF/RelayRTF.aspx
Go Convert Select
Relay RTF - Power Quality
BAROUDIG, RTF Local Admin
conEdison
PQ Home RTF External Links Contact Admin
Recent Activity RTF
Motthaven 4X54 (13A)
06/10/2010 10:50:07 AM | Graph
Three-Phase Fault | Relay Targets
RMS Duration: 2.58s | Fault Duration: 37.80c
Motthaven 4X54 (13A)
06/10/2010 10:50:05 AM | Graph
Three-Phase Fault | Relay Targets
RMS Duration: 2.58s | Fault Duration: 21.00c
Motthaven 4X54 (13A)
06/10/2010 10:50:03 AM | Graph
Three-Phase Fault | Relay Targets
RMS Duration: 2.58s | Fault Duration: 21.00c
Motthaven 4X54 (13A)
06/10/2010 10:50:01 AM | Graph
Three-Phase Fault | Relay Targets
RMS Duration: 2.58s | Fault Duration: 2.40c
Motthaven 4X54 (13A)
06/10/2010 10:49:59 AM | Graph
Three-Phase Fault | Relay Targets
RMS Duration: 2.58s | Fault Duration: 2.40c
Substation
Astor
RelayRTI
Visual Fault
HERALD SQUA
Select feede
28M01
28M02
28M04
28M03
28M05
28M09
28M10
28M13
28M14
28M15
28M16
28M17
28M19
28M18
28M06
selectAll
LandBase
Streets
MS-Plates
Feeders
FaultIDs
white bkgr
Fit View
RelayTargets - Microsoft Internet Explorer
Astor 28M18 (24A)
06/12/2009 16:02 Single-Phase Fault on Phase B RTF: 0.1689
Close Window
PI Correlation Data
Name
TimeStamp
Description
ASTOR BKR 24A (28M18)
2009-06-12 16:02:49
CLOSE-TRIP
Relay Targets
Osc Trig On
PHASE IOC1 OP B
PHASE TOC1 PKP B
GROUND TOC1 PKP
GROUND IOC1 PKP
GROUND IOC1 OP
NEG SEQ IOC1 PKP
Gnd+NegSeq On
CB Status On
50-51 TRIP IOn
50N-51N TRIP IOn
PHASE IOC1 PKP B
GND TRIP On
PHASE TRIP On
Local intranet

Transmission Feeder Trip - Email Notification

Overcurrent at R28-Ramapo 345kV - Message (HTML)

File Edit View Insert Format Tools Actions Help

Reply | Reply to All | Forward

You forwarded this message on 7/31/2009 11:32 AM.

From: PQView Test [PQ] Sent: Thu 7/30/2009 6:46 PM
To: dl-DFR
Cc:
Subject: Overcurrent at R28-Ramapo 345kV

Overcurrent Notification

Site Name	R28-Ramapo 345kV
Time Stamp	7/30/2009 18:34:15.0353

Station / Timestamp

Analog Channel Summary

Channel	Units	RMS Min	RMS Max	Duration
Line #77 Ph. 1 Volts	V	186150	207513	
Line #77 Ph. 2 Volts	V	165672	207971	
Line #77 Ph. 3 Volts	V	170466	211135	
Line #77 Ph. 1 Amps	A	926.7	1130	
Line #77 Ph. 2 Amps	A	981.9	1421	
Line #77 Ph. 3 Amps	A	912.2	1143	
Line #77 Neut. Amps	A	36.93	300.6	
Spare	V	0.01234	0.07213	
Y94 Ph. 1-N Volts	V	197438	220198	
Y94 Ph. 2-N Volts	V	165328	208533	
Y94 Ph. 3-N Volts	V	182037	227124	
Y94 Ph. 1 Amps	A	344.7	725.9	
Y94 Ph. 2 Amps	A	280.6	**1564**	1.108 s
Y94 Ph. 3 Amps	A	327.5	1316	
Y94 Neut. Amps	A	12.95	762.6	
5018 Ph. 1-N Volts	V	272650	306713	
5018 Ph. 2-N Volts	V	266868	305564	

All Channels
Min/Max RMS Values

Transmission Feeder Trip - Email Notification

Overcurrent at R28-Ramapo 345kV - Message (HTML)

File Edit View Insert Format Tools Actions Help

Reply | Reply to All | Forward

You forwarded this message on 7/31/2009 11:32 AM.

From: PQView Test [PQ]

Sent: Thu 7/30/2009 6:46 PM

To: dl-DFR

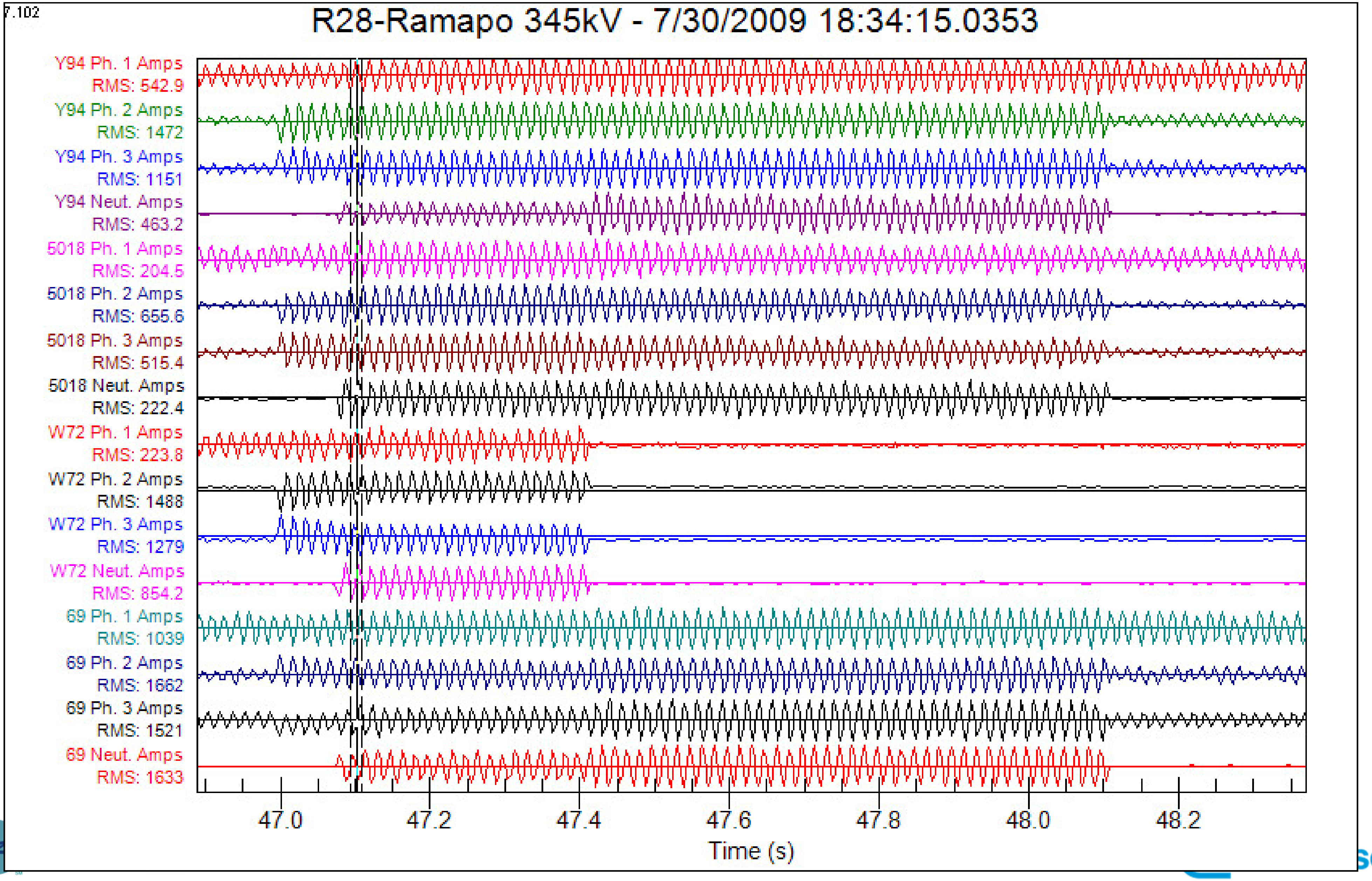
Cc:

Subject: Overcurrent at R28-Ramapo 345kV

Y94 Ph. 3-N Volts	V	182037	227124	
Y94 Ph. 1 Amps	A	344.7	725.9	
Y94 Ph. 2 Amps	A	280.6	**1564**	1.108 s
Y94 Ph. 3 Amps	A	327.5	1316	
Y94 Neut. Amps	A	12.95	762.6	
5018 Ph. 1-N Volts	V	272650	306713	
5018 Ph. 2-N Volts	V	266868	305564	
5018 Ph. 3-N Volts	V	275698	309680	
5018 Ph. 1 Amps	A	113.8	234.7	
5018 Ph. 2 Amps	A	105.7	676.2	
5018 Ph. 3 Amps	A	108.3	551	
5018 Neut. Amps	A	6.478	229.5	
W72 Ph. 1 Amps	A	12.96	271.4	
W72 Ph. 2 Amps	A	11.15	**1662**	7.500 c
W72 Ph. 3 Amps	A	13.38	**1535**	1 c
W72 Neut. Amps	A	18.75	893.1	
69 Ph. 1 Amps	A	742.9	1106	
69 Ph. 2 Amps	A	774.2	**2140**	1.125 s
69 Ph. 3 Amps	A	759.2	**1991**	1.025 s
69 Neut. Amps	A	11.17	**2095**	1.033 s
Bnk Neut. Amps	A	5.590	105.6	
Analog Channel 33 - Suggest Va	V	0.009061	0.05339	
Analog Channel 34 - Suggest Vb	V	0.005938	0.05304	
Analog Channel 35 - Suggest Vc	V	0.007906	0.06134	
Analog Channel 36 - Suggest Ia	A	0.01068	0.05751	

W72 Trip Out

Transmission Feeder Trip Notification with Maximum RMS Values



Fault Location Projects using the Same Power Quality Monitoring System at Con Edison (PQView)

Company	Voltage (kV)	Initiated	Sensors	Circuit Models	SCADA Integration	Status
Con Edison Network Feeders	13, 27, 33	2005	PQ Monitors and Relays	Proprietary	OSIsoft PI System	Production
San Diego Gas & Electric	12	2006	PQ Monitors	SynerGEE		Pilot Completed
Wisconsin Public Service	25	2008	PQ Monitors	SynerGEE		Pilot Completed
United Illuminating Company	4.16, 13.2	2008	PQ Monitors	CYMDIST		Production
DTE Energy (Detroit Edison)	40	2009	PQ Monitors	Custom	OSIsoft PI System	Production
Georgia Power Network	12.47, 25	2019	Relays	CYMDIST		Preproduction
American Electric Power	13.2	2011	PQ Monitors	CYMDIST		Pilot Completed
Hydro-Québec	25	2012	PQ Monitors	CYMDIST		Pilot
Alabama Power Company	13.2	2012	PQ Monitors	CYMDIST	Oracle SOE	Preproduction
Hydro Ottawa	13.2	2013	PQ Monitors	CYMDIST	OSIsoft PI System	Pilot
Con Edison Overhead	4.16	2013	PQ Monitors	Proprietary		Pilot
Tennessee Valley Authority	161	2013	DFRs	CAPE		Pilot
National Grid	13 kV	2015	Recloser Controllers	CYMDIST		Prepilot
British Columbia Hydro	MV	2015	PQ Monitors and Relays	CYMDIST	OSIsoft PI System	Prepilot
Jamaica Public Service	MV	2015	PQ Monitors	CYMDIST		Prepilot

What are the Other Data Sources for the Power Quality Monitoring Systems at Con Edison (PQView)?

- IEEE® PQDIF
- IEEE® COMTRADE
- MODBUS®
- Advantech®
- Arbiter® Systems
- BTECH®
- Cooper CYMDIST
- Dranetz®
- EDMI
- Electro Industries®
- ENTSO-E Loads
- Environment Canada
- Fluke®/RPM
- GE®
- Gossen Metrawatt
- I-Grid®
- GridSense
- HIOKI
- OSIsoft® PI System
- Power Monitors
- PSL PQube®
- Qualitrol® /LEM
- SATEC
- Schneider Electric®
- Schweitzer Engineering Laboratories®
- Siemens®
- SynerGEE® Electric
- TECTRA ALFA
- Unipower®
- Duke Energy Carolinas Oracle FMS

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- Data Integration and Basic Analysis
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- **Inrush Events**
- Second Faults
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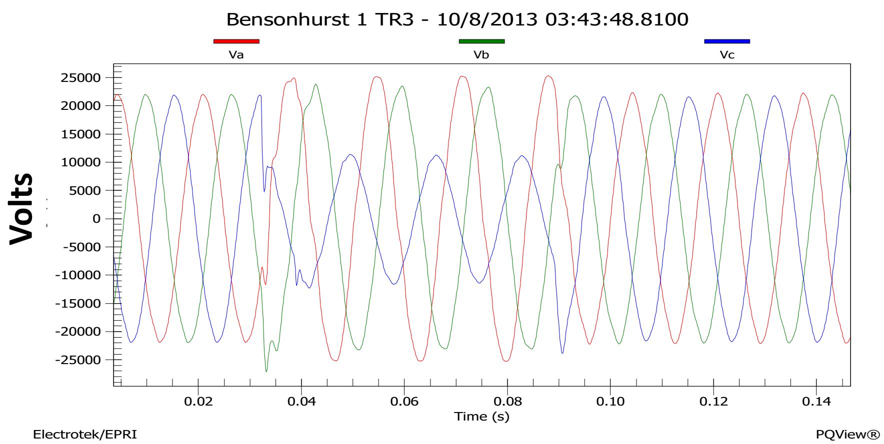
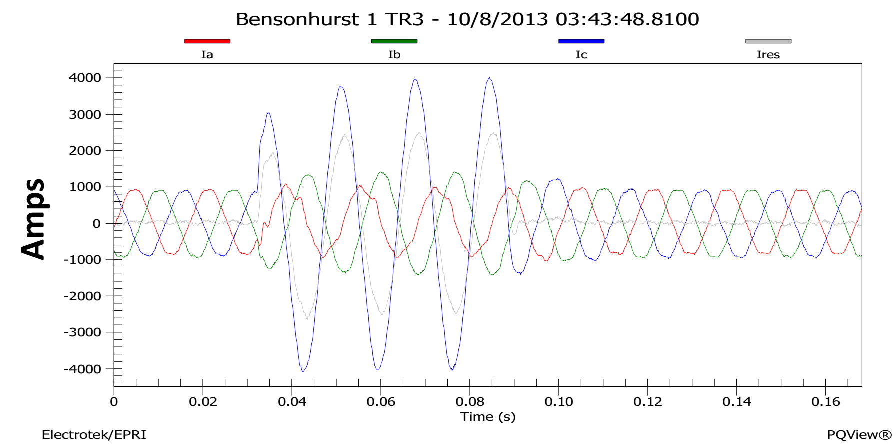
CIOA Events

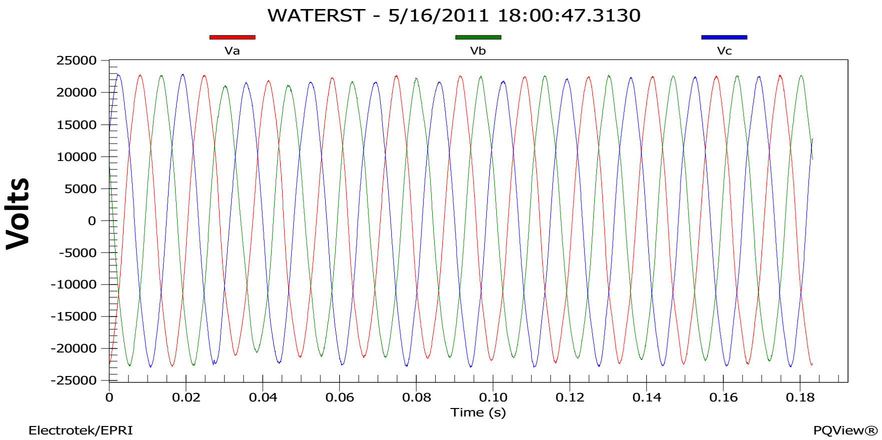
- A “cut-in open-auto” event (CIOA) describes a feeder trip immediately upon re-energization
- A CIOA could be caused by a fault or by inrush current
- Relays at area substations detect an overcurrent condition on the feeder and trip the breaker – even though there is no fault
- If there is no fault, the feeder can be re-energized quickly
- Con Edison needed automation to distinguish between fault events and inrush events reliably

Cut-In Open-Autos: Fault versus Inrush

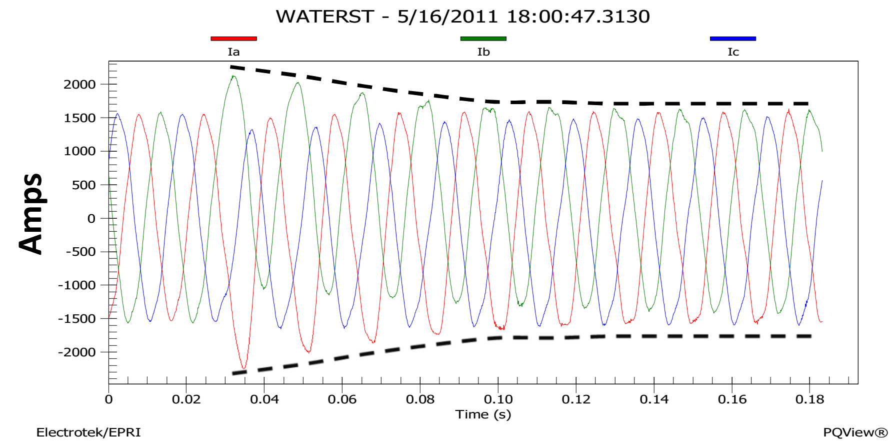


FAULT

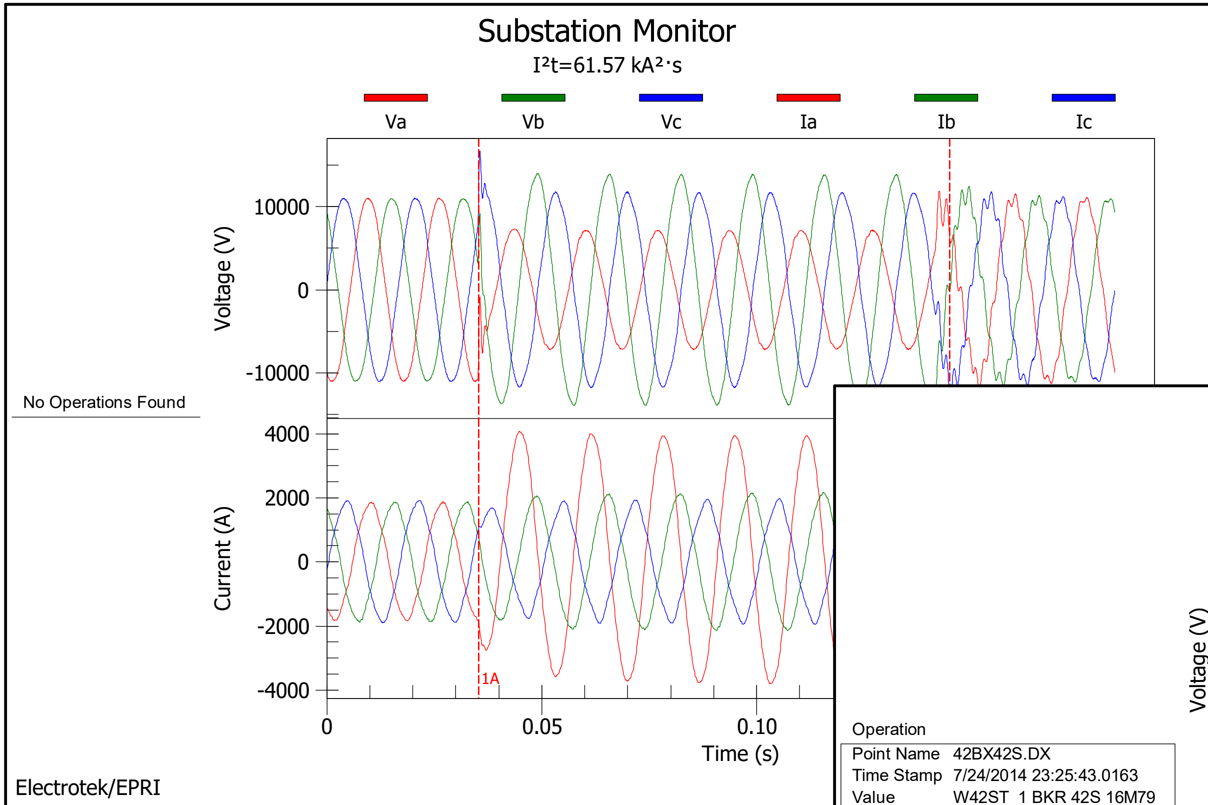


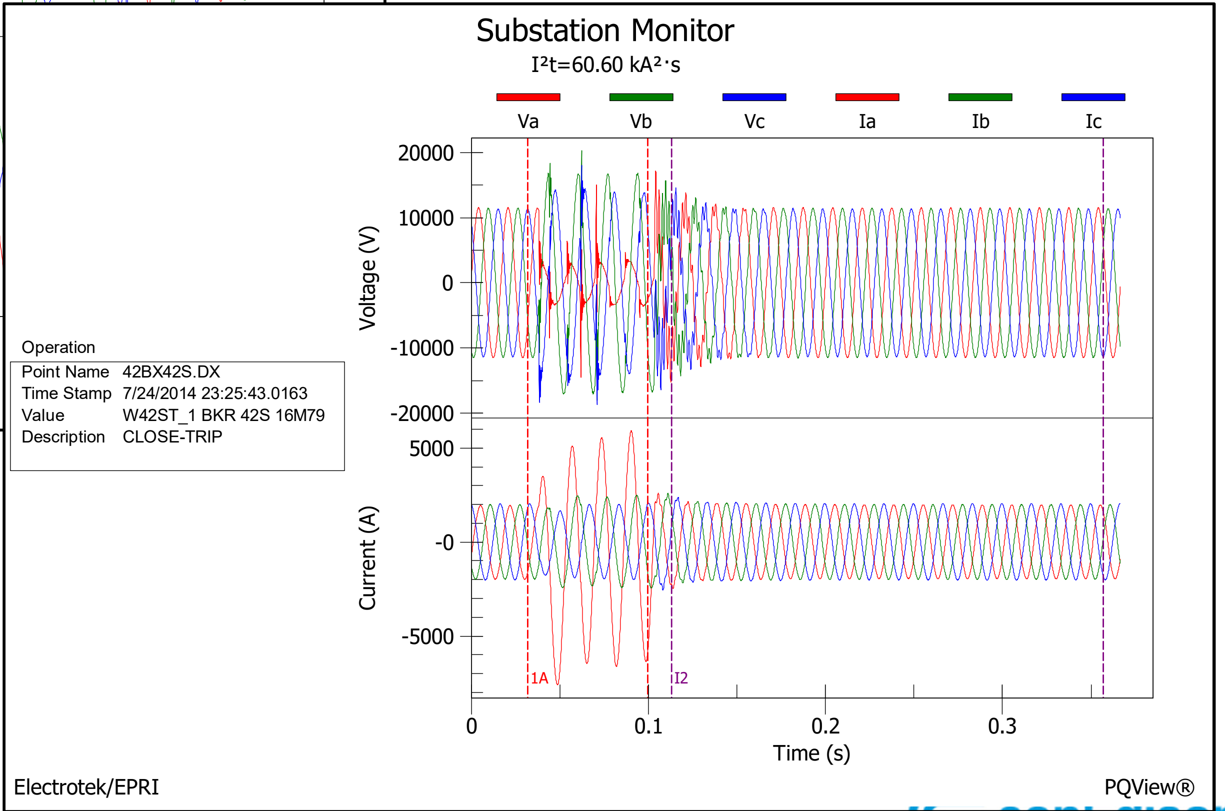


INRUSH



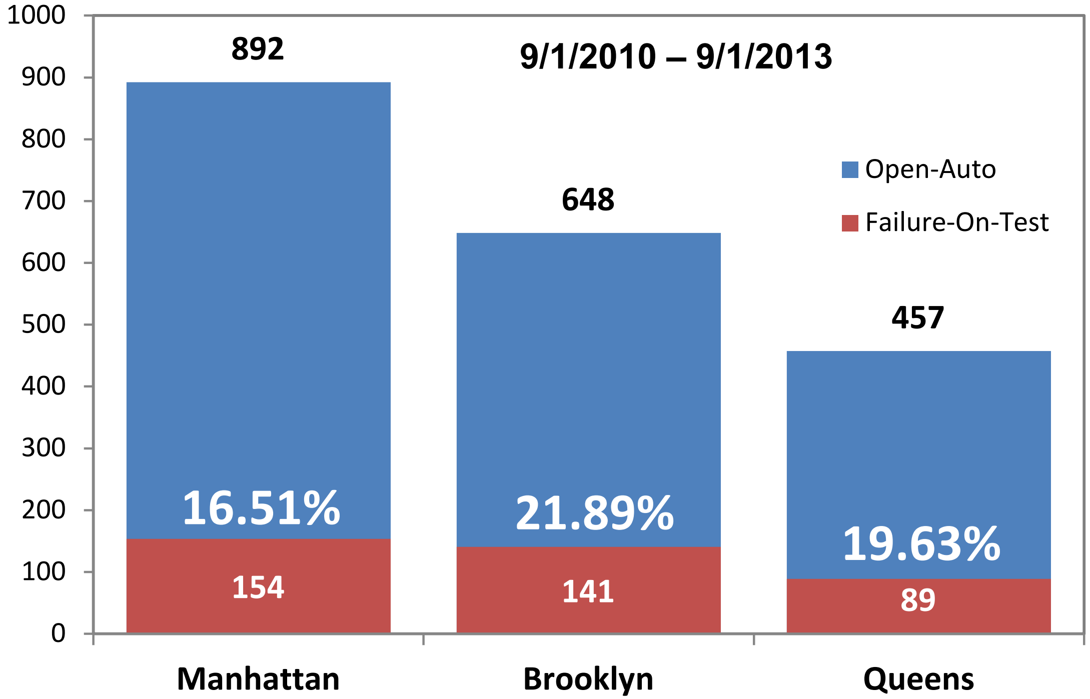
New Steps for Con Edison PQMS Module
I^2T Calculation and Analysis





"Second Faults"

- After a feeder is repaired a high voltage (hi-pot) test is performed
- Between 9/1/2010 – 9/1/2013 Manhattan, Brooklyn & Queens had 384 failed-on-test occurrences (FOTs)



9/1/2010 – 9/1/2013		
	Brooklyn	Queens
Total FOTs analyzed	114	65
Failed on the rise	88	40
Failed ammeter clear	19	21
Failed at test voltage	7	4
FOTs that failed on rise or ammeter clear	**94%**	**94%**

ELECTROTEK CONCEPTS

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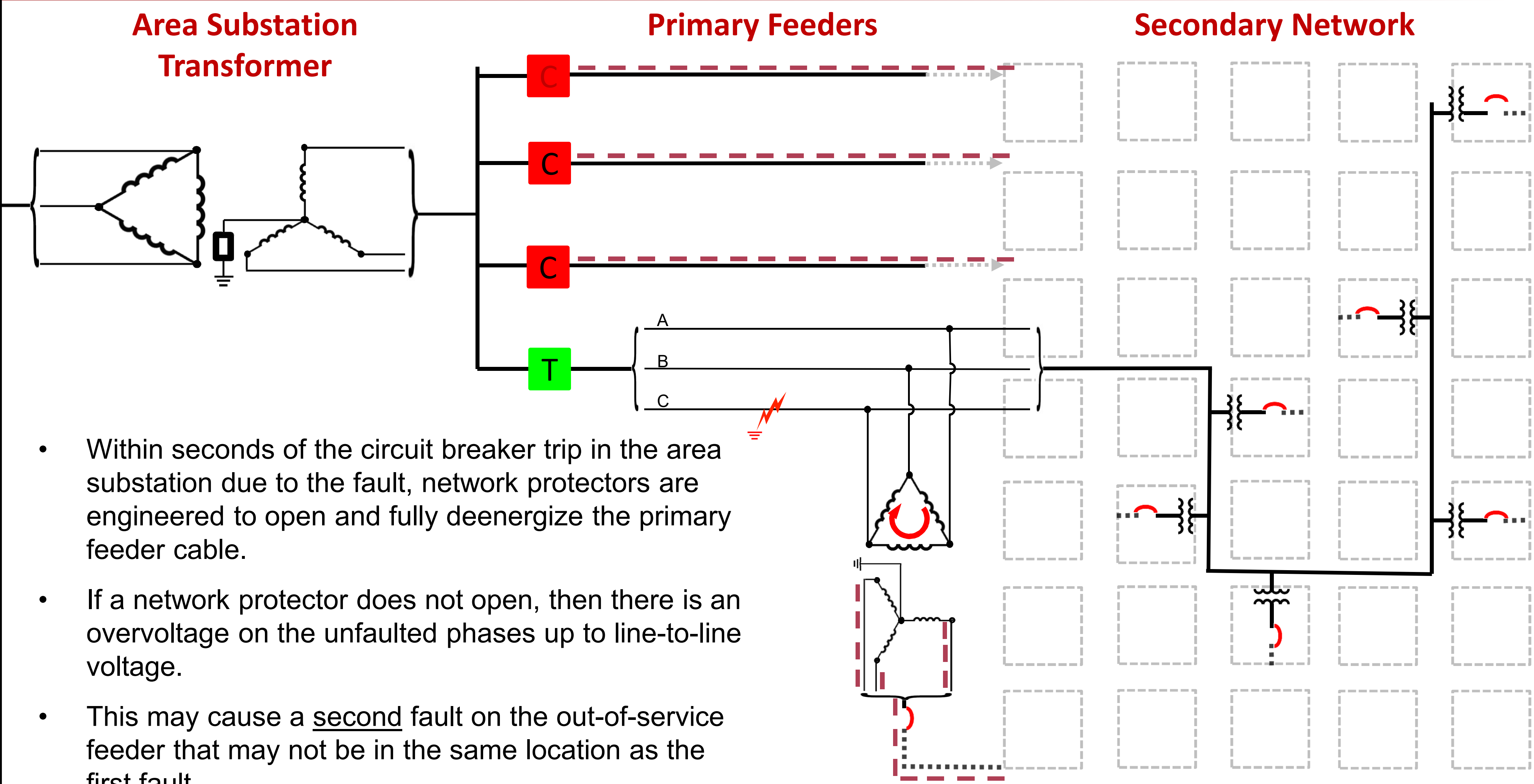
Single Line to Ground Fault



- Within seconds of the circuit breaker trip in the area substation due to the fault, network protectors are engineered to open and fully deenergize the primary feeder cable.
- If a network protector does not open, then there is an overvoltage on the unfaulted phases up to line-to-line voltage.
- This may cause a second fault on the out-of-service feeder that may not be in the same location as the first fault.

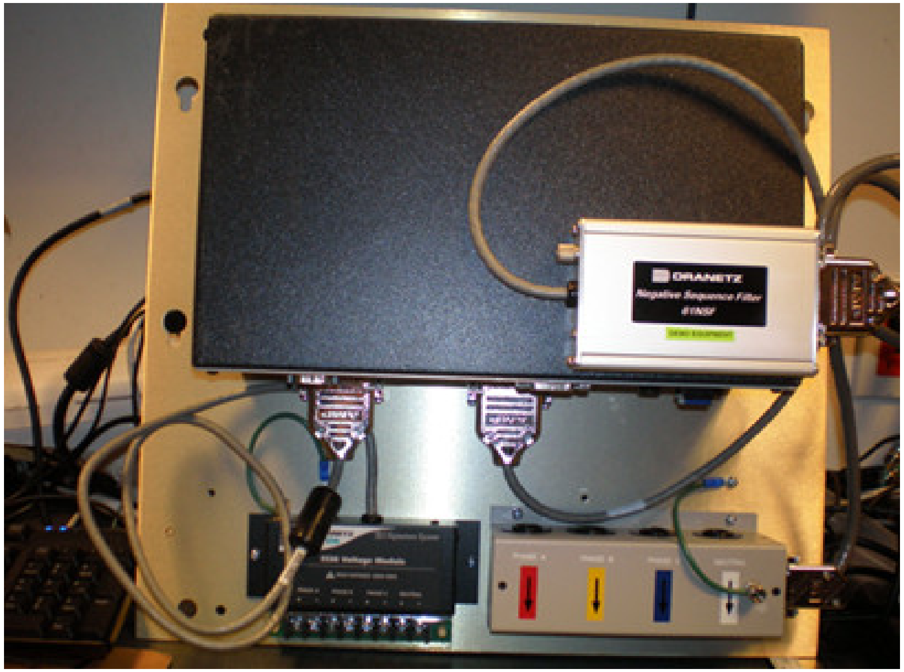
Capturing Waveforms during Second Faults and Sending Notifications

Secondary Network

- Two Voltage Sags Recorded by PQ Monitors at "Master Point"
- Only One SCADA Operation

Area Substations

- SLG Fault with Zero-Sequence
- Subsequent Negative-Sequence Overcurrent
- One SCADA Operation



PQ Monitor Retrofitted
with Negative-Sequence Filter

ELECTROTEK CONCEPTS

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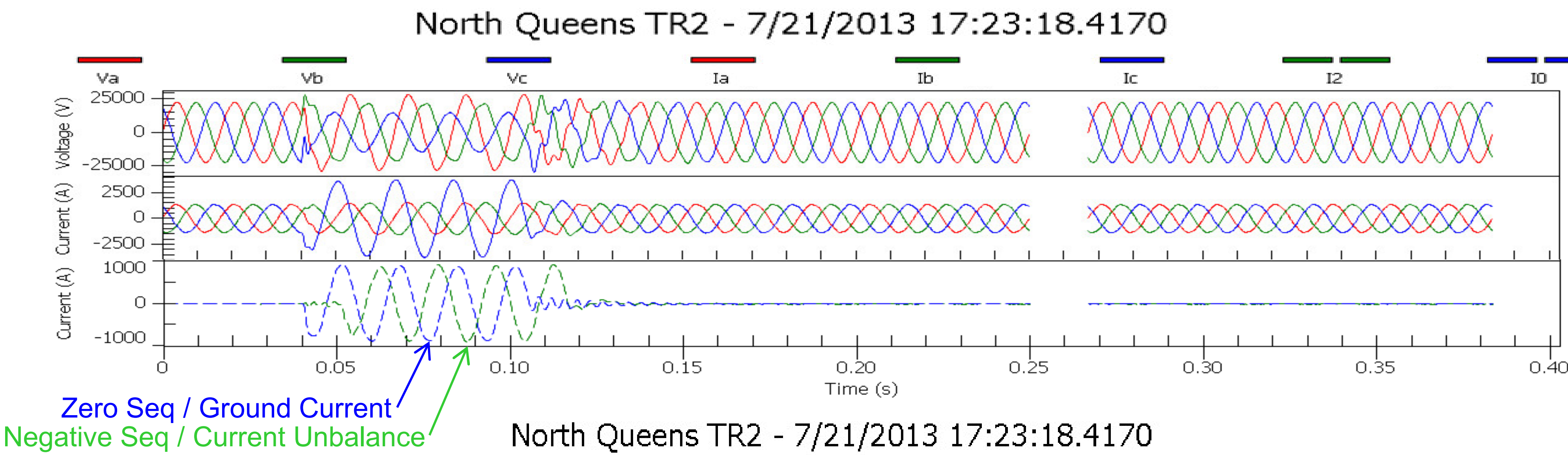
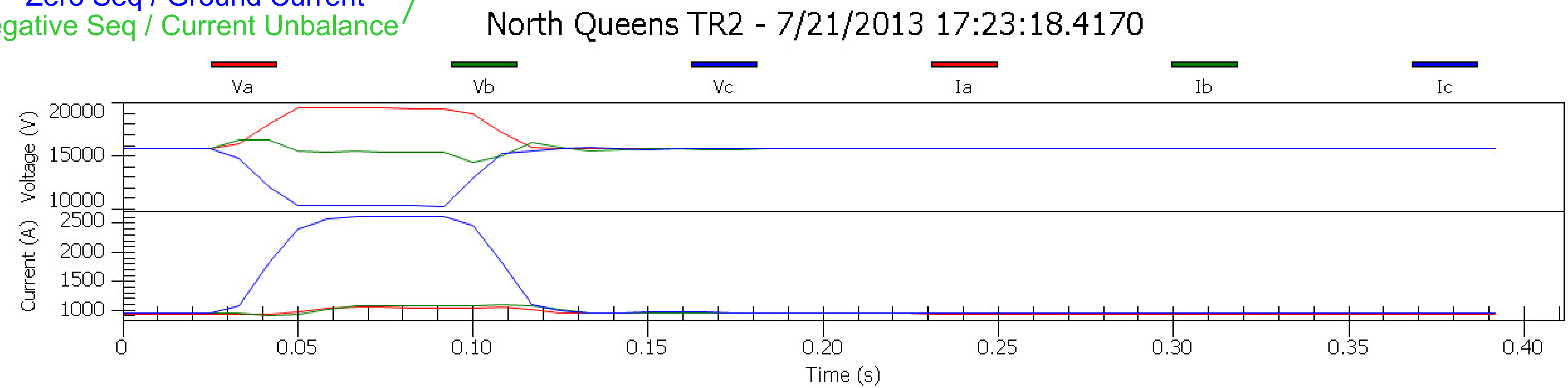
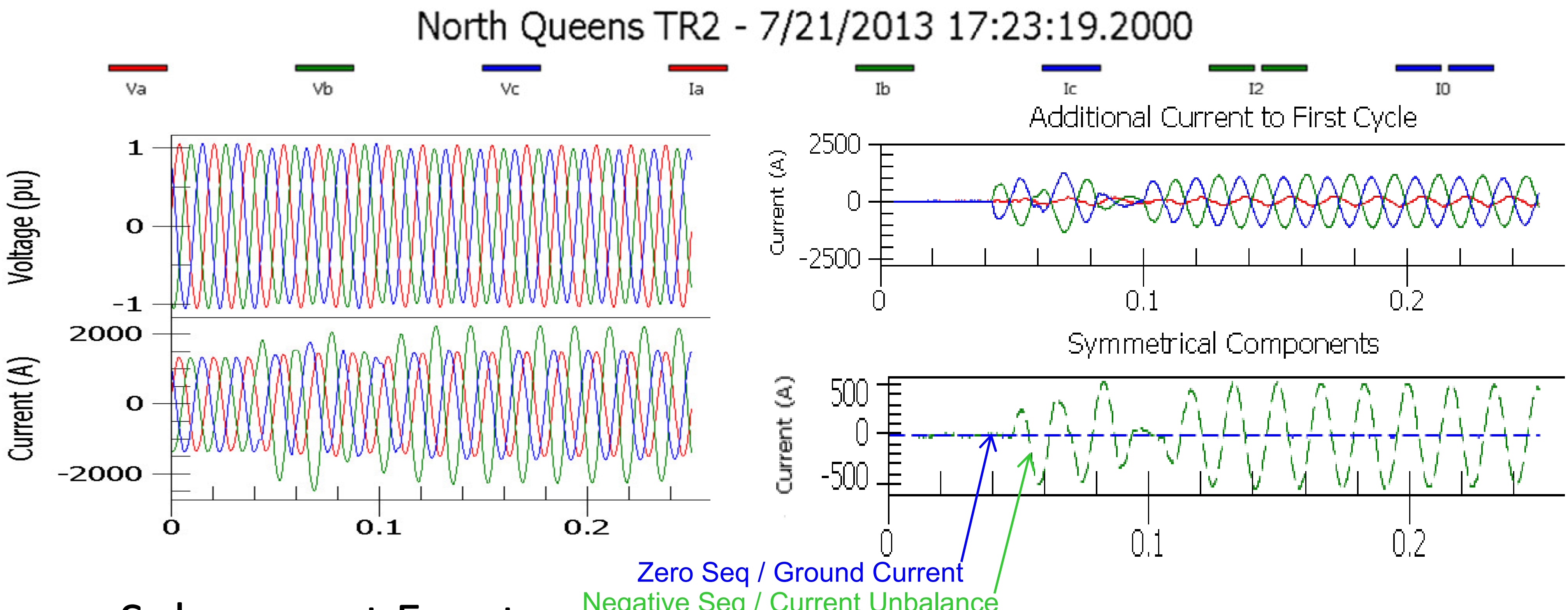
Second Fault: Initial Fault Measured at the Substation





Second Fault: Subsequent Overcurrent Measured at Substation



- Subsequent Event
  - A Negative-Sequence Current Filter installed on the monitor triggers when a current unbalance is detected to capture the event.
  - The presence of negative-sequence current with no zero-sequence current indicates current is passing through a network transformer to a second fault.

Second Fault E-mail Notification

PQView sends an email notification after detecting a second fault and no operations.

- Fault

From: PQView Infonode RTF4 <pqview@coned.com> Sent: Wed 10/16/2013 12:57
To: dl RTFNotificationX_W; mousaa; fogliolj; gilstrom
Subject: Fault Notification: Plymouth ST TR4

This email has been sent to you by rule from PQVIEW Substation_Nodes

Site Name	Local Time	Hyperlinks	Fault Type	RMS Dur	Time Offset(s)	XTF (Ω)	Va (V)	Vb (V)	Vc (V)	Ia (A)	Ib (A)	Ic (A)	I0 (A)	k1	Relay Channels	Operations			
Plymouth ST TR4	10/16/2013 12:52:02.4040	Waveforms One-Line	1A	5.498 c	0.09963	1.092	7085	20302	17114	2527	1106	705	841	3		2013-10-16 12:52:03	PYBX44S.DX	PLYMOUTH BKR 44S (1B56)	CLOSE-TRIP

- Second Fault

From: PQView Infonode RTF4 <pqview@coned.com>
To: pq
Subject: Possible Second Fault Detected: Plymouth ST TR4

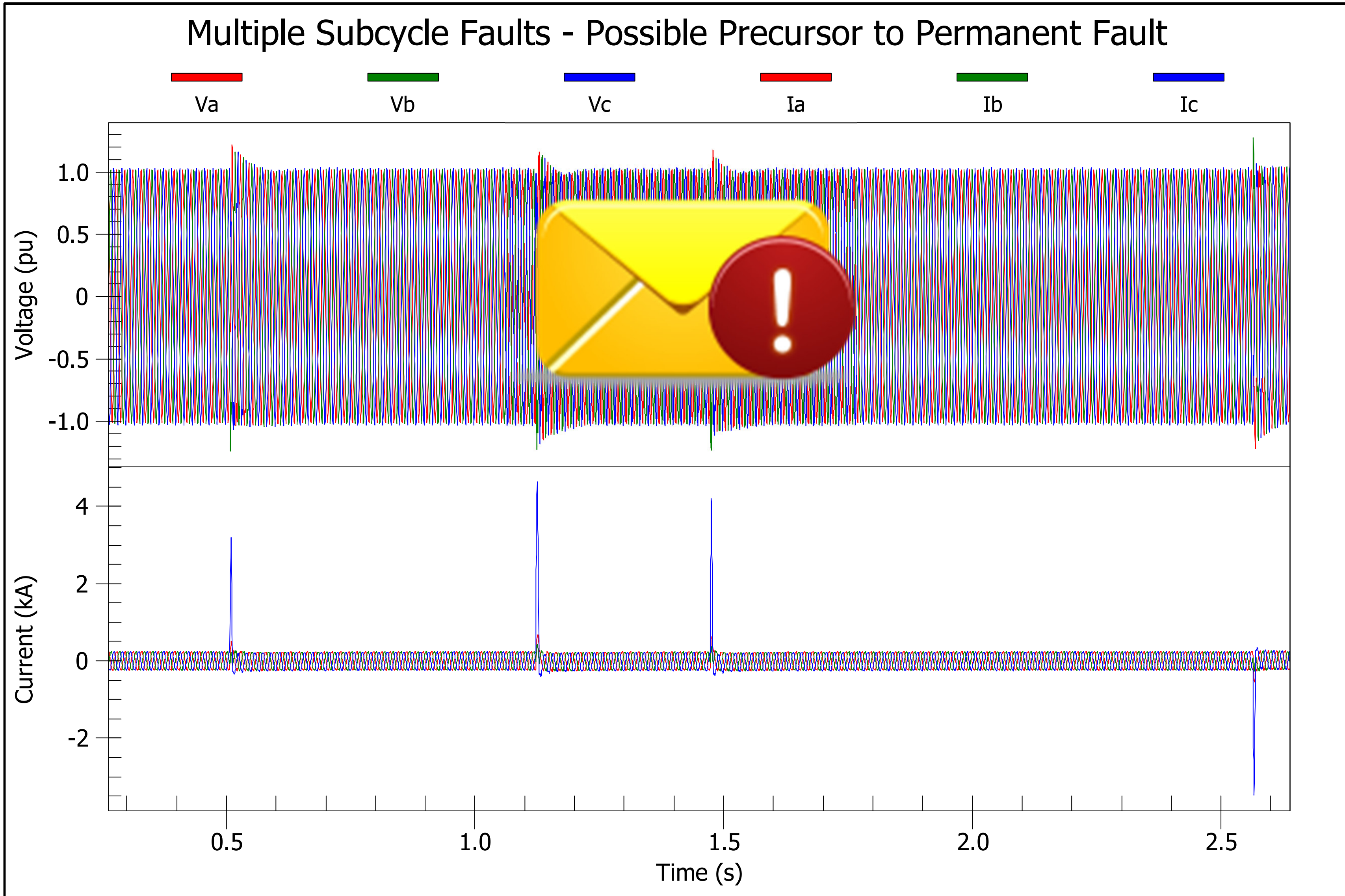
This email has been sent to you by rule from PQVIEW Substation_Nodes

Site Name	Local Time	Hyperlinks	Fault Type	RMS Dur	Time Offset(s)	XTF (Ω)	Va (V)	Vb (V)	Vc (V)	Ia (A)	Ib (A)	Ic (A)	I0 (A)	k1	Relay Channels	Operations
Plymouth ST TR4	10/16/2013 12:54:32.9310	Waveforms One-Line	I2	15 c	0.1820	0	14590	15267	14536	828	952	1229	2	3		

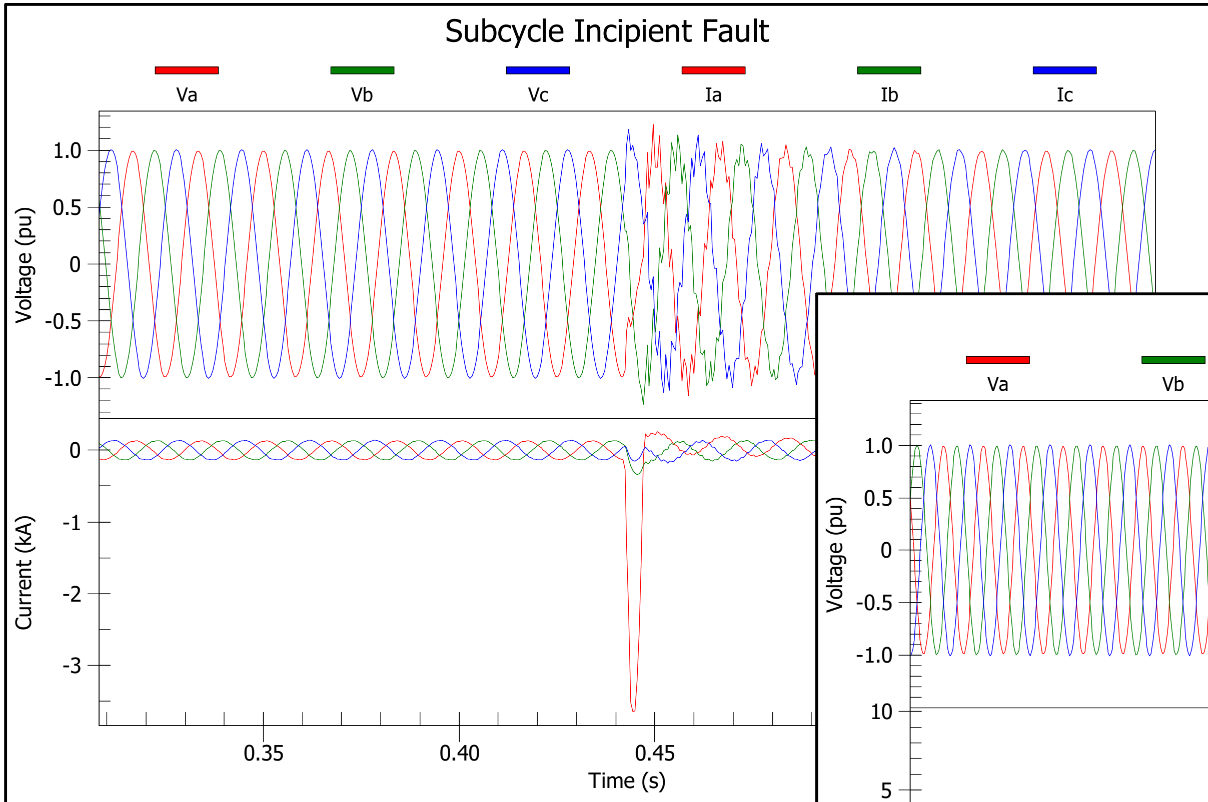
Power Quality Monitoring System (PQMS) at the Consolidated Edison Company of New York

- Data Integration and Basic Analysis
- Permanent Faults
- Inrush Events
- Second Faults
- **Incipient Faults**
- SCADA/PQ System Federation

Incipient Fault Identification and Notification

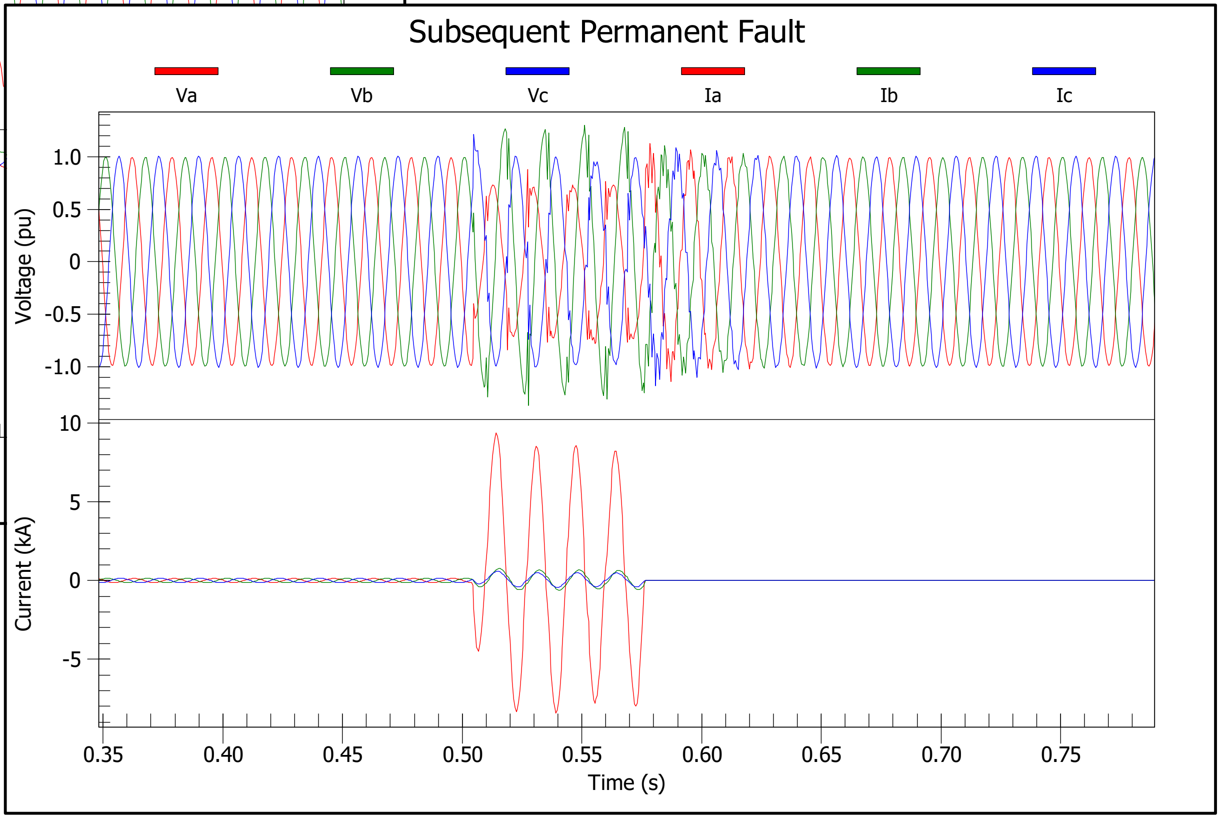


Incipient Subcycle Fault Location Using Time-Domain Estimation

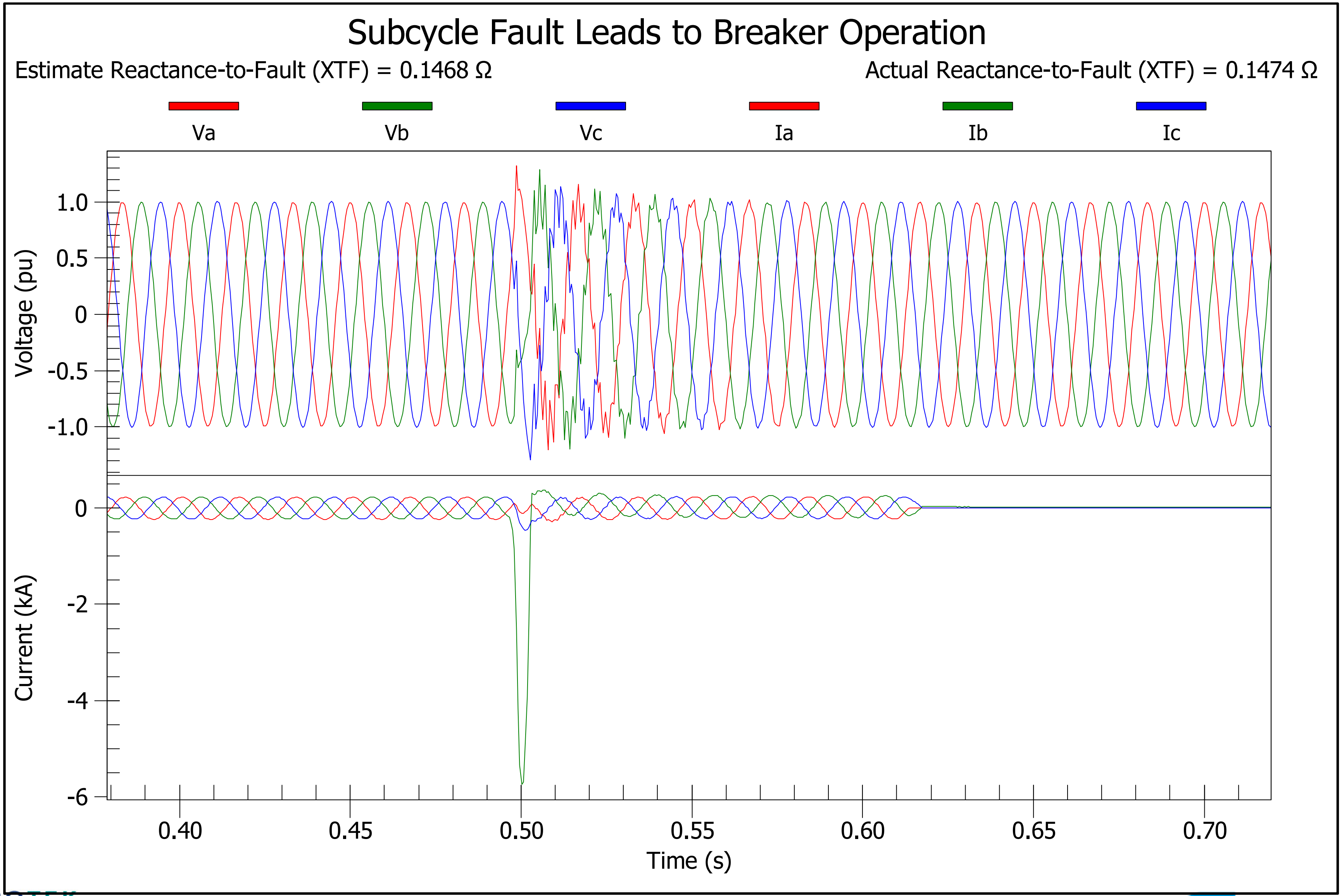


Estimated XTF: 0.3235 Ω

Actual XTF: 0.3221 Ω



Subcycle Fault with Breaker Operation



Power Quality Monitoring System (PQMS) at the Consolidated Edison Company of New York

- Data Integration and Basic Analysis
- Permanent Faults
- Inrush Events
- Second Faults
- Incipient Faults
- **SCADA/PQ System Federation**

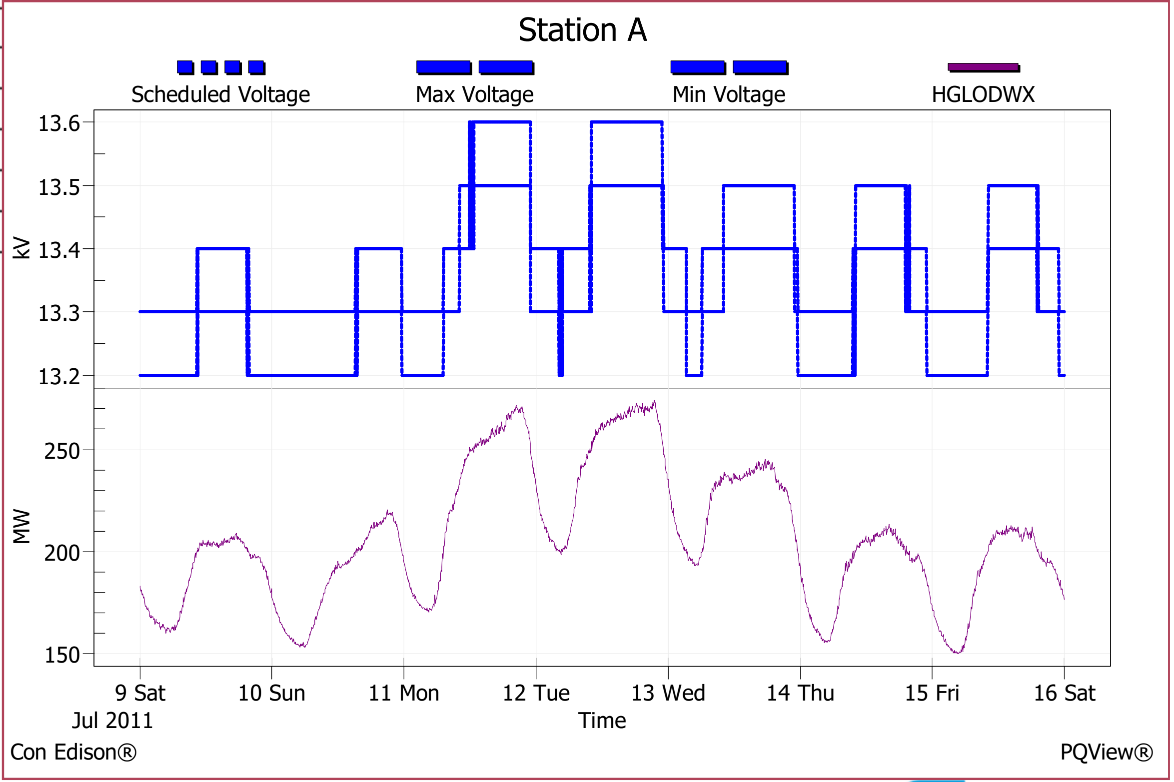
Area Substation Voltage Control

- The amount of MW load determines what the voltage should be at the area substation following a set of rules called the “voltage schedule”.
  - Whether the voltage can be above or below the scheduled voltage depends upong the time of day and the day of week
- Methods of Controlling Area Substation Voltage
  - Voltage Var Control (VVC Mode)
  - Local Tap Changer Control System (CMVM Mode)
  - Manual Adjustment of Transformer Taps

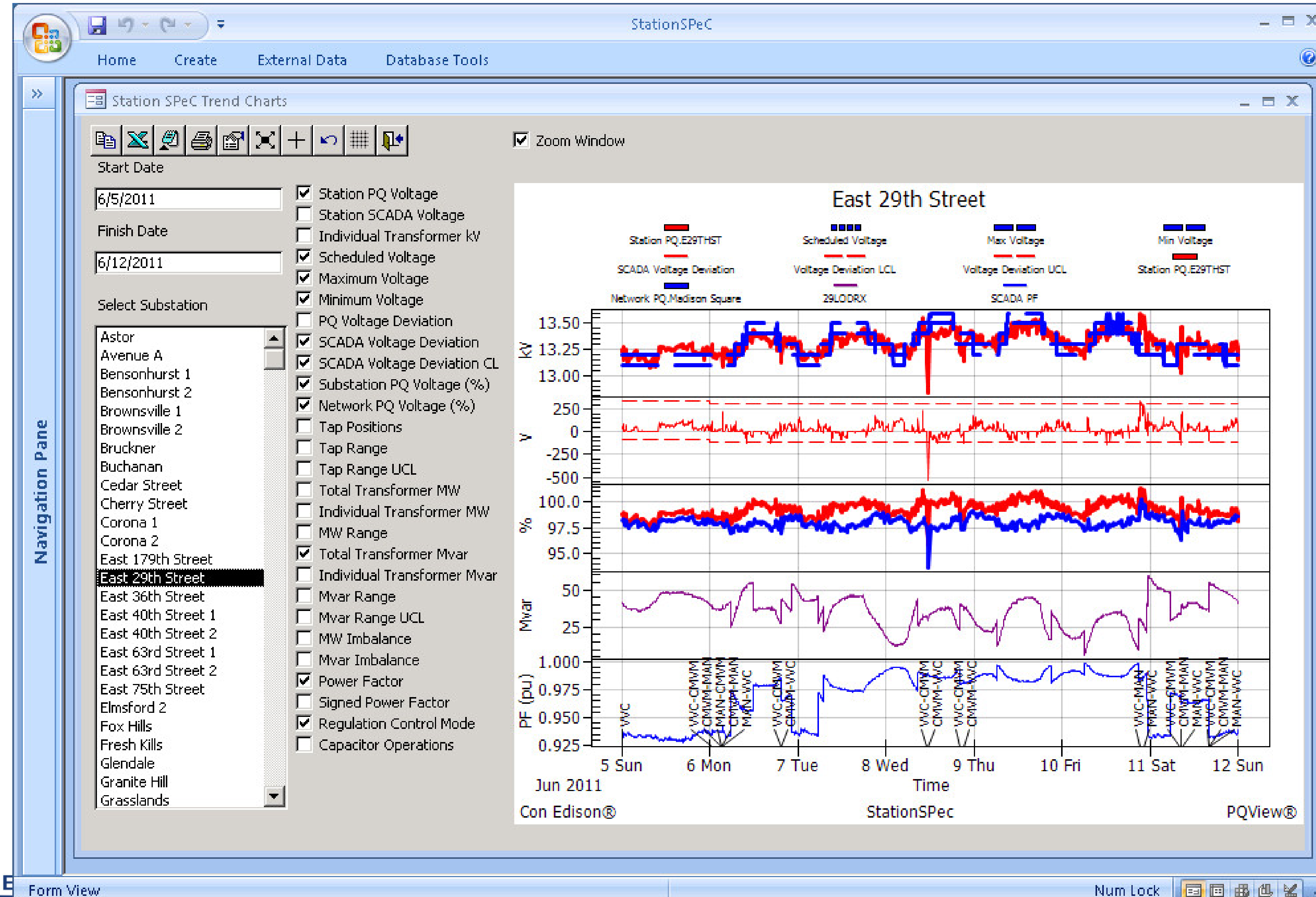
Area Substation Voltage Control

Area Substation Load versus Voltage Schedule

TOTAL 13KV BUS LOAD (Megawatts)	13KV Feeder Bus Volts
0 - 50	13,000
51 - 100	13,100
101 - 150	13,200
151 - 200	13,300
201 - 250	13,400
251 - 300	13,500
Above 300	13,600



Con Edison PQMS Module:
Voltage and Reactive Power Control Analysis



Area Substation Voltage Control

Voltage Control and Optimization

- Process Control Tool Development
  - Control Variables
    - Voltage Deviation from Schedule
    - Range of Tap positions on Parallel Transformers
    - Range of Mvar Load on Parallel Transformers
  - Apply control chart methods to develop upper and lower control limits

Simple Application of Statistical Process Control Methods

- Early each Monday morning, derive weekly average and standard deviation values for the control variables
- At the same time, create weekly summary reports for distribution via e-mail and on the company intranet
- When analyzing a week for statistical process control, derive upper control limit (UCL) and lower control limits (LCL) value that compare the average and standard deviation for the past week to the average and standard deviations of the eight weeks prior to the past week.

$$UCL_n = \frac{Avg_{n-1} + Avg_{n-2} + \ldots Avg_{n-8}}{8} + 3\frac{StDev_{n-1} + StDev_{n-2} + \ldots StDev_{n-8}}{8}$$

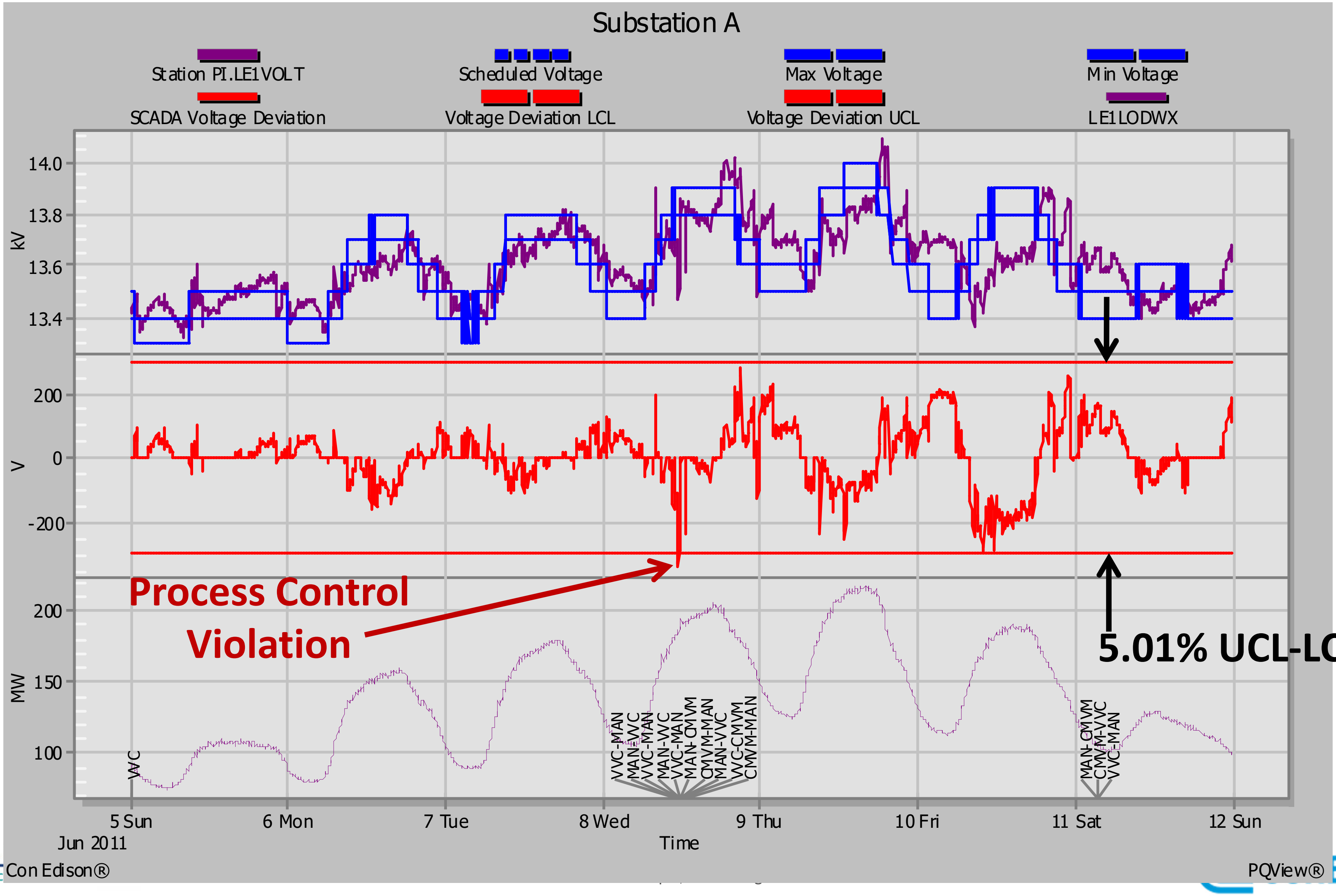
$$LCL_n = \frac{Avg_{n-1} + Avg_{n-2} + \ldots Avg_{n-8}}{8} - 3\frac{StDev_{n-1} + StDev_{n-2} + \ldots StDev_{n-8}}{8}$$

$Avg = \text{Weekly Average of Controlled Variable}$

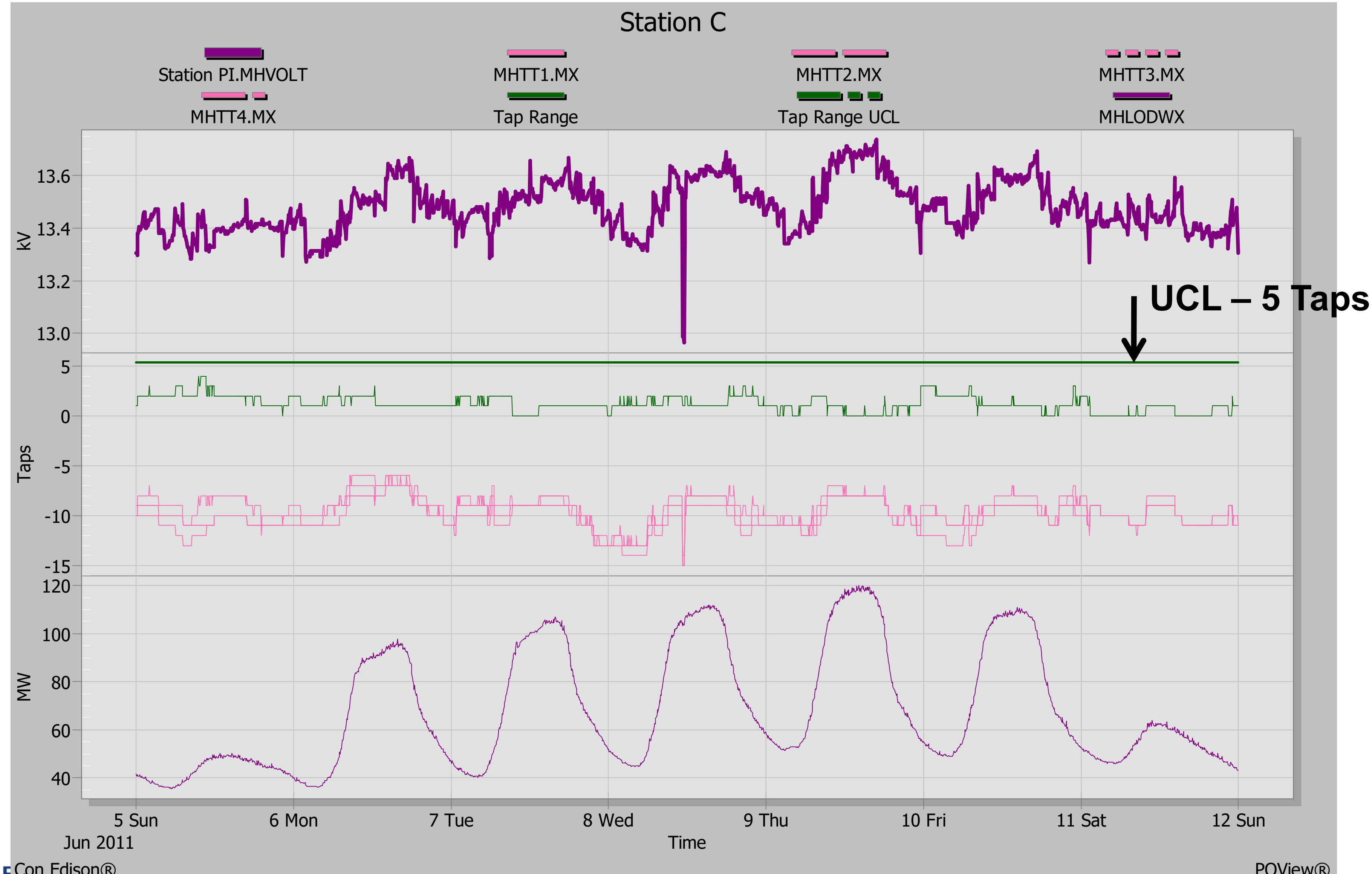
$StDev = \text{Weekly Average of Controlled Variable}$

$n = \text{The week being analyzed}$

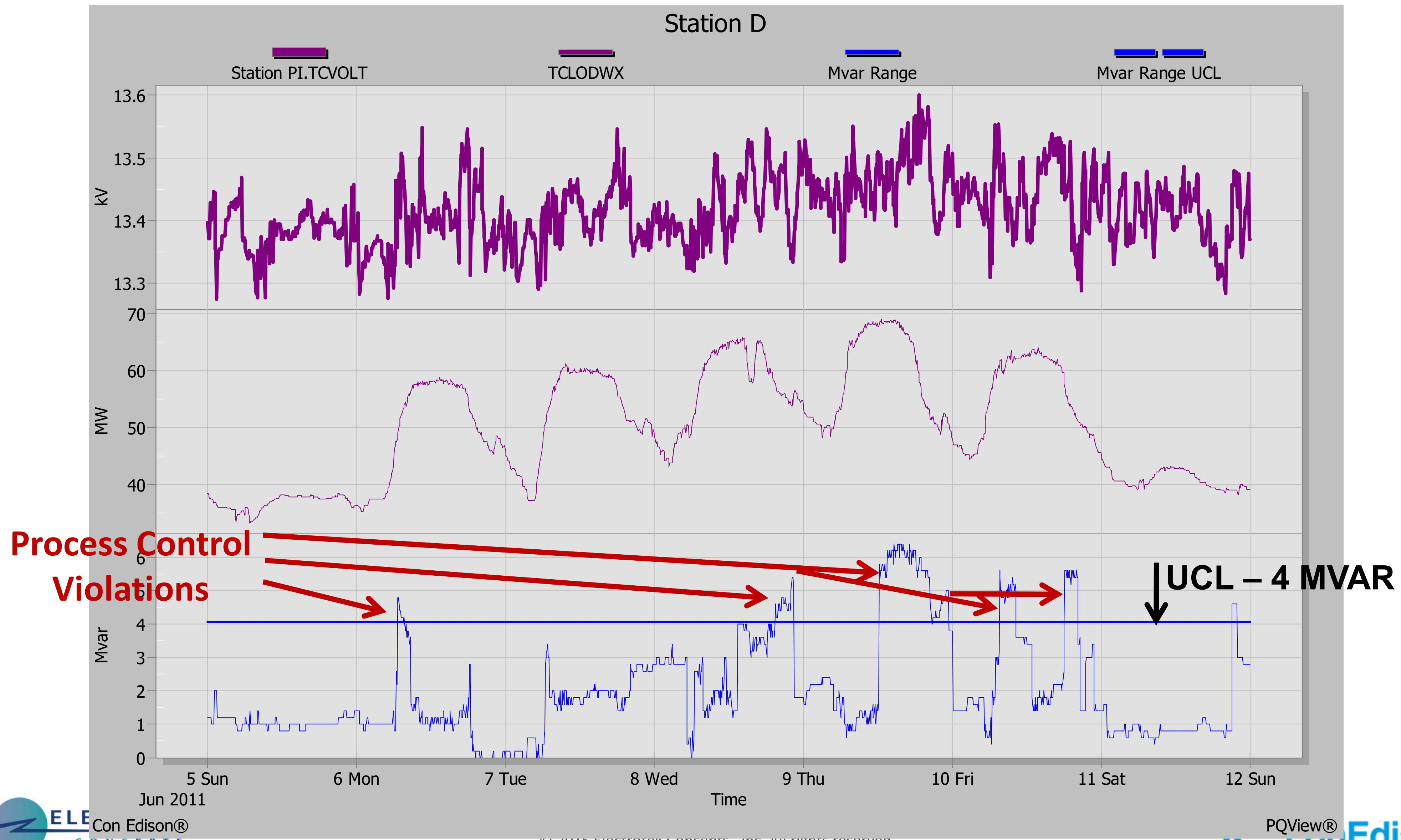
Voltage Deviation Control Chart



Tap Range Control Chart



Reactive Power Balance Control Chart



Power Factor Summary Weekly Report

StationSPeC

Home Create External Data Database Tools

Navigation Pane

	Station	Week	PF Min	PF Avg	PF Max	Weekday PF Min	Weekday PF Avg	Weekday PF Max	Weekend PF Min	Weekend PF Avg	Weekend PF Max	Leading PF Hours	Leading PF Avg	Service Hours Cap 1	Service Hours Cap 2	Service Hours Cap 3
	East 29th Street	07/11/2011	83.63%	97.49%	99.94%	93.20%	97.89%	99.94%	83.63%	96.48%	99.17%	0.00%		74.26%	71.38%	37.55%
	East 36th Street	07/11/2011	87.26%	96.65%	100.00%	87.26%	97.50%	100.00%	88.41%	94.59%	99.85%	1.39%	-99.82%	80.06%	57.24%	31.75%
	East 40th Street 1	07/11/2011	89.74%	97.73%	100.00%	89.74%	97.62%	100.00%	0.00%	97.85%	100.00%	5.26%	-99.86%	31.85%	62.40%	94.59%
	East 40th Street 2	07/11/2011	89.57%	96.90%	100.00%	89.87%	97.24%	100.00%	0.00%	95.99%	99.68%	40.28%	-99.58%	76.98%	62.75%	37.40%
	East 63rd Street 1	07/11/2011	89.92%	96.44%	99.99%	89.92%	95.55%	99.80%	96.44%	98.66%	99.99%	0.00%		85.32%	75.15%	0.00%
	East 63rd Street 2	07/11/2011	95.06%	98.09%	100.00%	95.06%	97.70%	100.00%	97.15%	99.16%	100.00%	5.85%	-99.98%	71.78%	0.00%	0.00%
	Hell Gate	07/11/2011	98.00%	99.55%	100.00%	98.00%	99.51%	100.00%	98.25%	99.63%	100.00%	12.60%	-99.85%	88.84%	90.87%	82.94%
	Murray Hill	07/11/2011	91.64%	94.84%	99.78%	91.73%	95.80%	99.78%	91.64%	92.44%	93.15%	0.00%		0.00%	0.00%	100.00%
	Parkview	07/11/2011	93.48%	96.54%	99.46%	93.57%	96.97%	99.46%	93.48%	95.46%	99.06%	0.00%		100.00%	0.00%	0.00%
	Plymouth Street	07/11/2011	93.15%	97.13%	100.00%	93.15%	97.20%	100.00%	93.49%	96.96%	99.75%	4.71%	-99.93%	55.36%	54.27%	38.64%
	Seaport 1	07/11/2011	91.60%	97.21%	100.00%	91.60%	97.18%	100.00%	92.55%	97.28%	99.41%	1.84%	-99.97%	89.29%	100.00%	100.00%
	Seaport 2	07/11/2011	89.19%	96.20%	100.00%	89.19%	95.51%	100.00%	90.20%	97.34%	99.98%	24.11%	-99.71%	45.44%	20.29%	64.73%
	Sherman Creek	07/11/2011	95.49%	99.21%	100.00%	97.82%	99.58%	100.00%	95.49%	98.20%	100.00%	7.59%	-99.98%	86.71%	89.19%	85.86%
	Trade Center 1	07/11/2011	91.90%	95.09%	100.00%	91.90%	95.31%	100.00%	92.27%	94.78%	99.01%	32.24%	-96.77%	100.00%	100.00%	79.37%

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Tap Changer Summary Weekly Report

StationSPeC

Home | Create | External Data | Database Tools

Navigation Pane

StationSPeC Weekly Reports

Select Report: Tap Changer Summary

Select Week

8/1/2011
7/25/2011
7/18/2011
7/11/2011
7/4/2011
6/27/2011
6/20/2011
6/13/2011
6/6/2011
5/30/2011
5/23/2011
5/16/2011
5/9/2011
5/2/2011
4/25/2011
4/18/2011
4/11/2011
4/4/2011
3/28/2011

Select Station

Granite Hill
Grasslands
Greenwood
Harrison
Hell Gate
Jamaica
Leonard Street 1
Leonard Street 2
Millwood West
Mott Haven
Murray Hill
Newtown
North Queens
Ossinning
Parkchester 1
Parkchester 2
Parkview
Pleasantville
Plymouth Street
Rockview
Seaport 1
Seaport 2
Sherman Creek
Trade Center 1

Station	Week	Tap Range Min	Tap Range Avg	Tap Range Max	Tap Min	Tap Max	Tap 1 Ops	Tap 2 Ops	Tap 3 Ops	Tap 4 Ops	Tap 5 Ops
East 29th Street	07/11/2011	0	0.07	4	-16	-5	130	128	124	135	0
East 36th Street	07/11/2011	0	0.46	2	-16	-7	93	89	87	87	0
East 40th Street 1	07/11/2011	0	0.59	3	-14	-3	112	112	115	119	0
East 40th Street 2	07/11/2011	0	1.06	7	-10	2	0				
East 63rd Street 1	07/11/2011	0	9.45	21	-14	16	0	213	159	0	165
East 63rd Street 2	07/11/2011	1	8.02	17	-12	9	0				
Hell Gate	07/11/2011	0	2.50	13	-13	2	92	77	188	63	0
Murray Hill	07/11/2011	0	1.16	3	-13	-6	81	88	88	288	
Parkview	07/11/2011	0	0.00	0	-15	-8	64	64	64	64	
Plymouth Street	07/11/2011	0	0.48	7	-15	2	137	129	136	131	0
Seaport 1	07/11/2011	1	4.59	6	-15	-1	114	100	107	114	0
Seaport 2	07/11/2011	0	3.97	6	-16	-5	0				
Sherman Creek	07/11/2011	0	3.83	15	-14	1			75	41	44
Trade Center 1	07/11/2011	0	2.68	9	-16	-6	65	61	78	135	

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ELECTROTEK CONCEPTS

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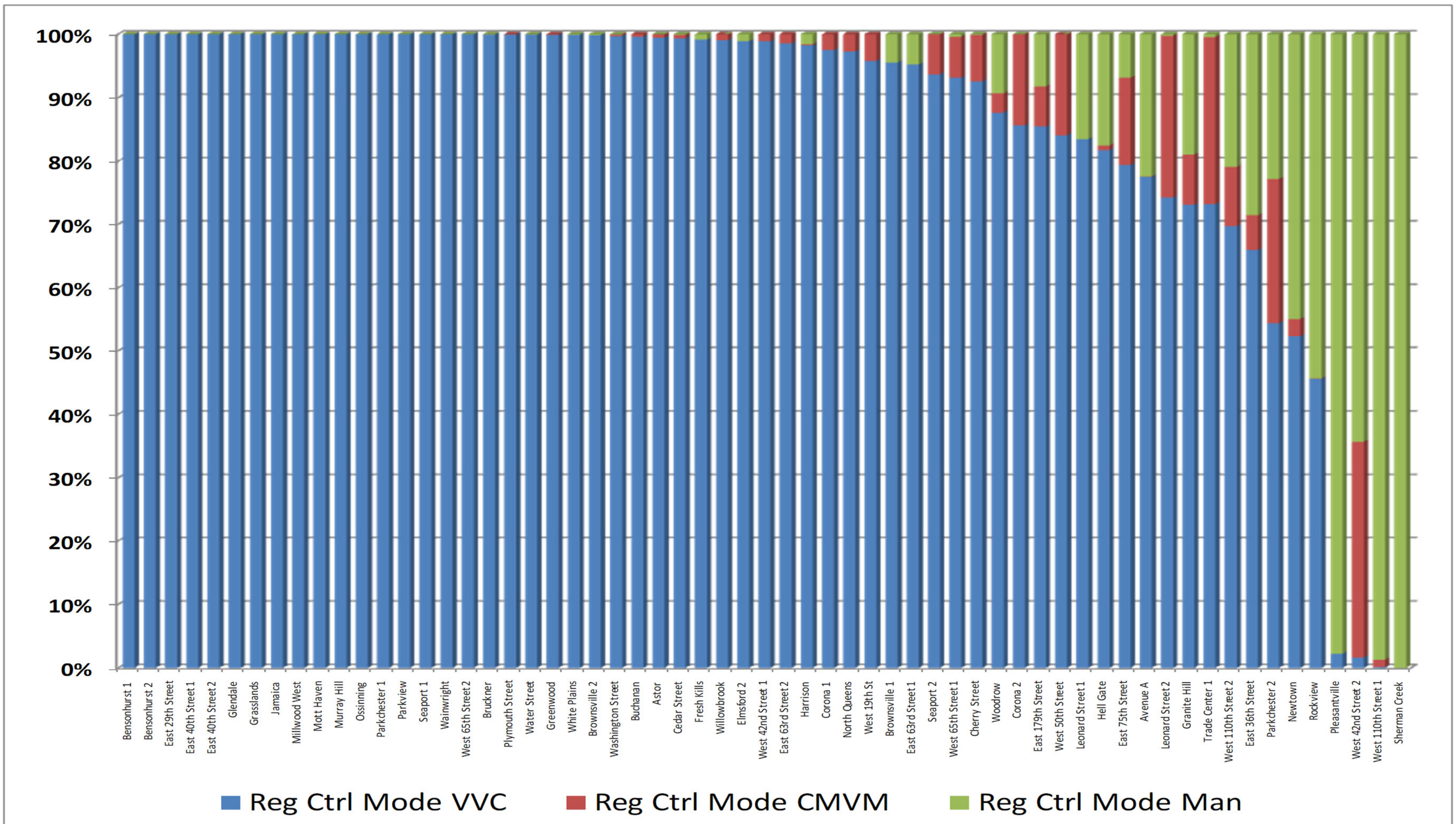
Area Substation Voltage Control Summary

conEdison, inc.

- Regulation Control Mode Performance Across the Area Substation Population for One Week

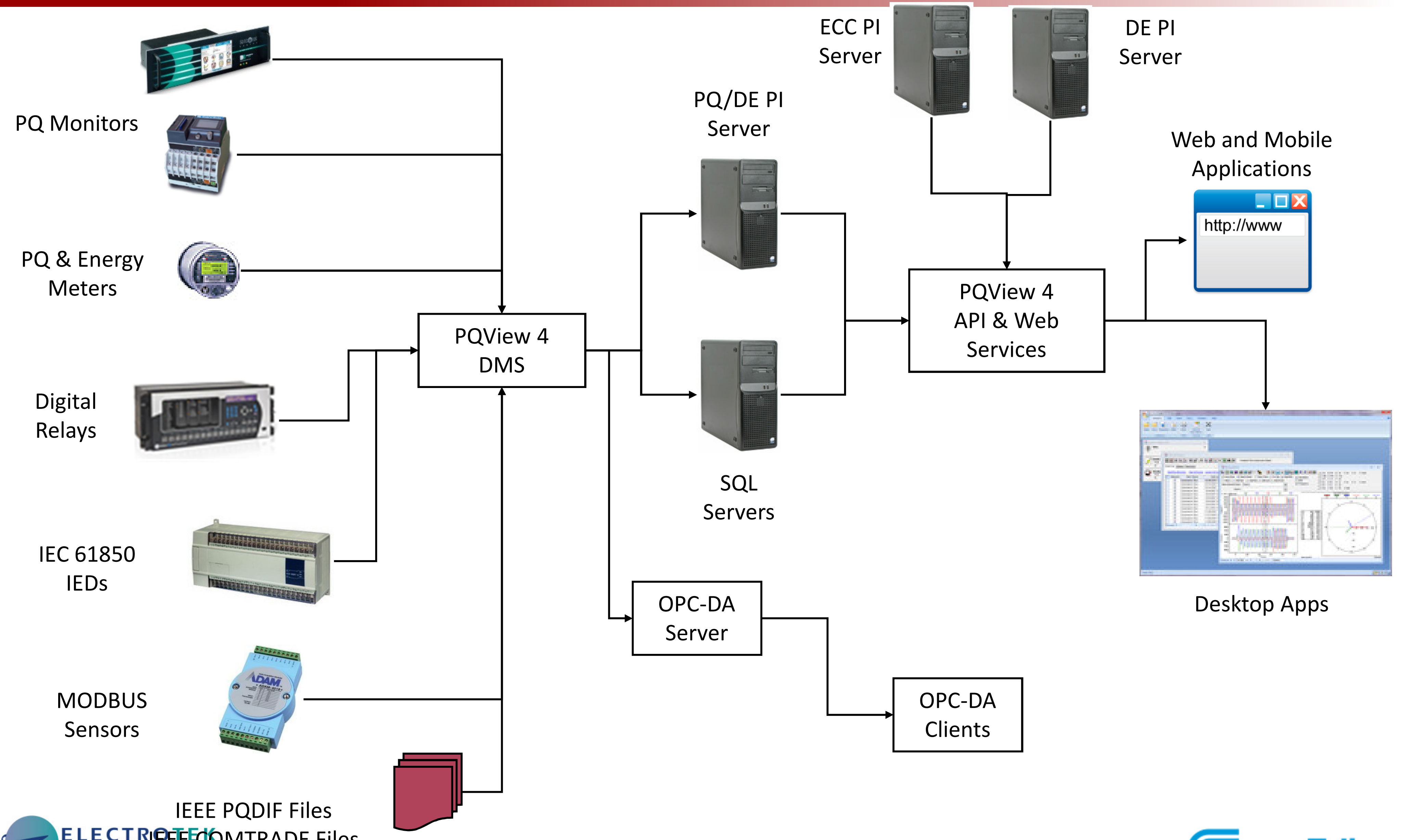


ELECTROTEK CONCEPTS

conEdison

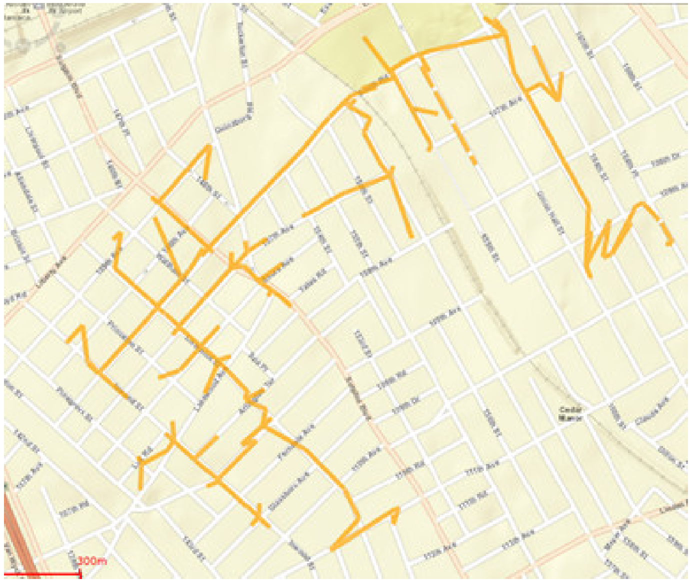
What's Next at Con Edison?

Increased Data Integration Functions in PQView 4



What's Next: Fault Location in Overhead Distribution System

- New power quality monitors installed in Queens as part of the American Recovery and Reinvestment Act
  - New monitors installed to complete a pilot project on overhead fault location with a primary goal to locate problem line sections or equipment after measuring momentary faults
- Radial feeder models from integrated from on company modeling software in 2013
- SCADA correlation added in January 2014
- Both resistance-to-fault and reactance-to-fault will be explored
- The project includes display of the feeders using aerial imagery with one-line feeder overlays



What’s Next for Area Substation for Fault Location

- New Firmware for Monitor to Compute/Trigger on Negative-Sequence Current internally
- Automation of Subcycle/Incipient Fault Location Estimation

For more information:

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