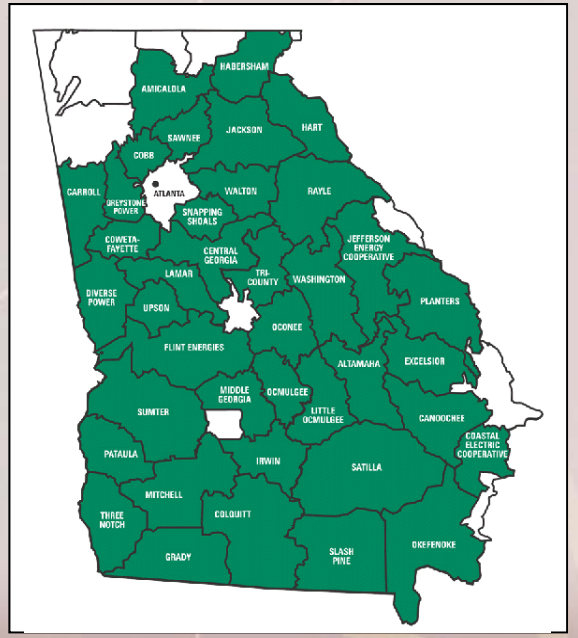
About Georgia Transmission Corporation (GTC)

- Transmission-only, not-for-profit cooperative
- Formed in March 1997 from the restructuring of Oglethorpe Power Corporation (OPC)
  - GTC provides network transmission services to 38 Member EMCs in Georgia
  - GTC provides point-to-point service to other customers



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GTC Overview – System Assets

Transmission Lines	
46 kV lines	275 miles
69 kV lines	14 miles
115 kV lines	1,132 miles
230 kV lines	1,274 miles
500 kV lines	477 miles
Total lines	*3,172 miles*

Substations	
Transmission substations	91
Distribution substations	569
Total substations	*660*

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Georgia ITS

- GTC owns more than 3,100 miles of transmission lines
- GTC has access to more than 17,000 miles of transmission lines in Georgia through the Georgia Integrated Transmission System (ITS)
  - Assets owned by GTC, Georgia Power, MEAG Power and Dalton Utilities

GTC Functional Areas

Planning

- Bulk System Planning
- Member Planning
- Area Planning
- System Protection & Control

Engineering & Construction

- Substation and T/L Design
- Relay/Control Design
- Transmission Projects
- Land Services
- Environmental
- Construction Inspection

Maintenance

- Substation Maintenance
- Transmission Line Maintenance
- Electronics Maintenance
- Relay Maintenance
- Cyber Operations

Support

- System Services
- Reliability
- Finance, Treasury, Administration, Legal
- Procurement
- External Affairs
- Audit/Compliance
- Human Resources
- Safety/Training
- Project Reporting

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GTC Goals for the PQ Dashboard Project (DFR)

1. Use the PQ Dashboard, with records from the Digital Fault Recorders (DFR), to look at non-trip events that were recorded (Voltage and Current Sags and Swells)
2. Using DFR data to perform automatic double ended fault location calculations and send out email
3. Using the DFR data to monitor breaker trip times and send out notifications for slow operating breakers

openXDA/PQ Dashboard
Server and Database Configuration

DFR Server

- Digital Fault Recorder data is pushed to the Web Server by PeerSync software

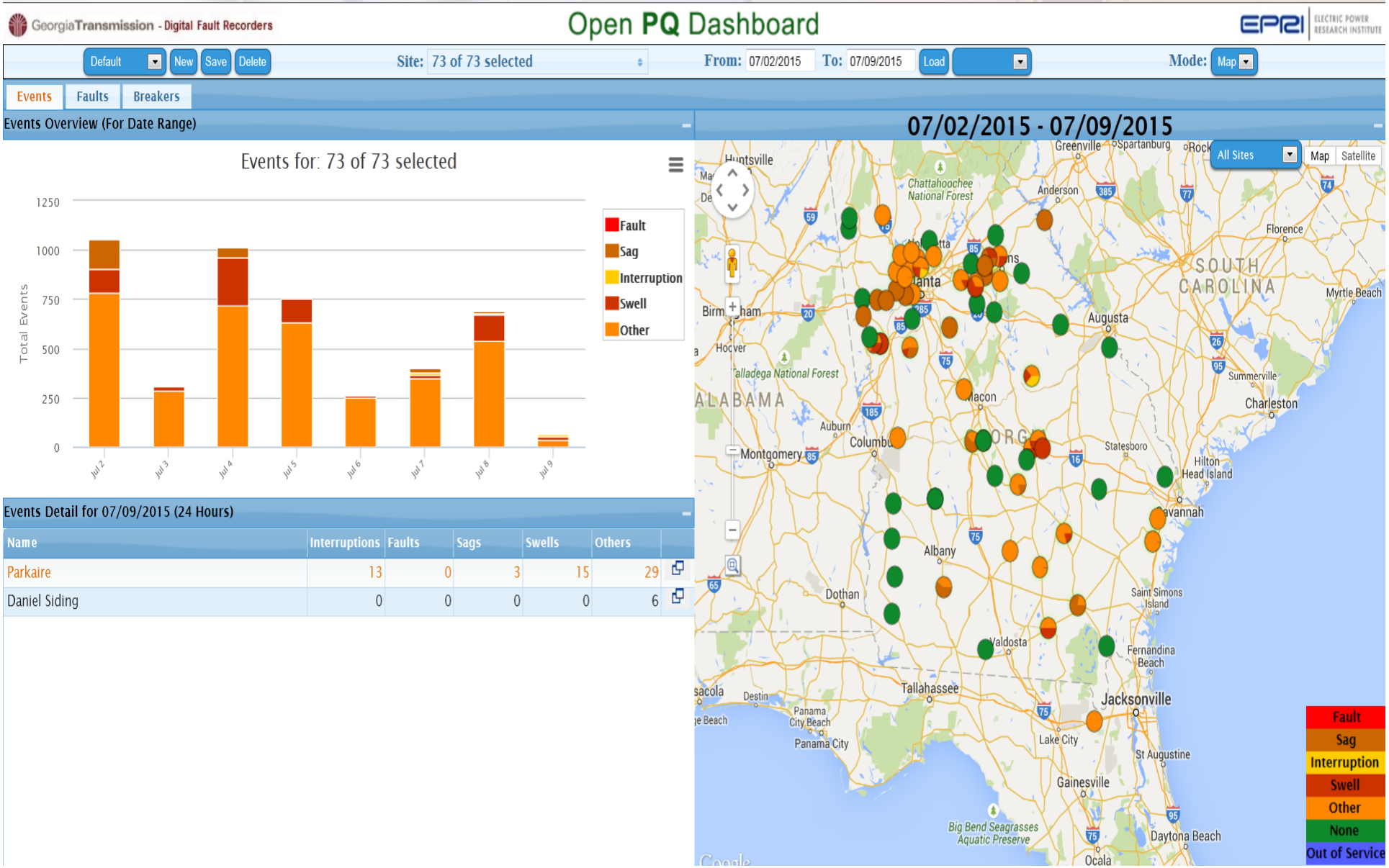
Web Server and Database Server

- Contains all the pushed DFR Event data; COMTRADE and Line Configuration files
- File Watcher program looks for new files to process
- openXDA program analyzes the file data and updates the database with calculations
- openXDA Database is Microsoft SQL Server

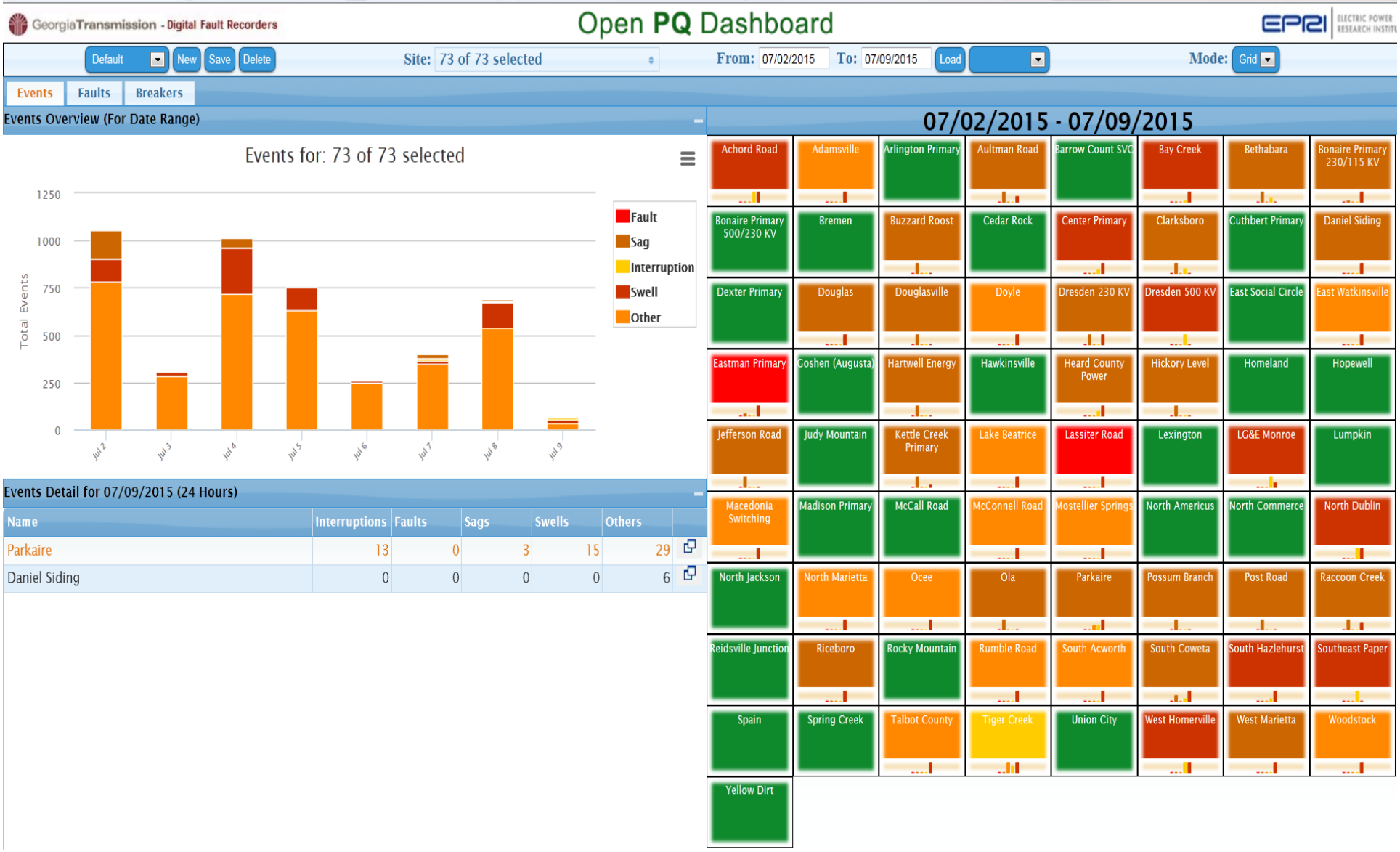
PQ Dashboard

- Event data and calculations are displayed in the PQ Dashboard which runs in a browser
- Select group of individuals receive Fault notification emails

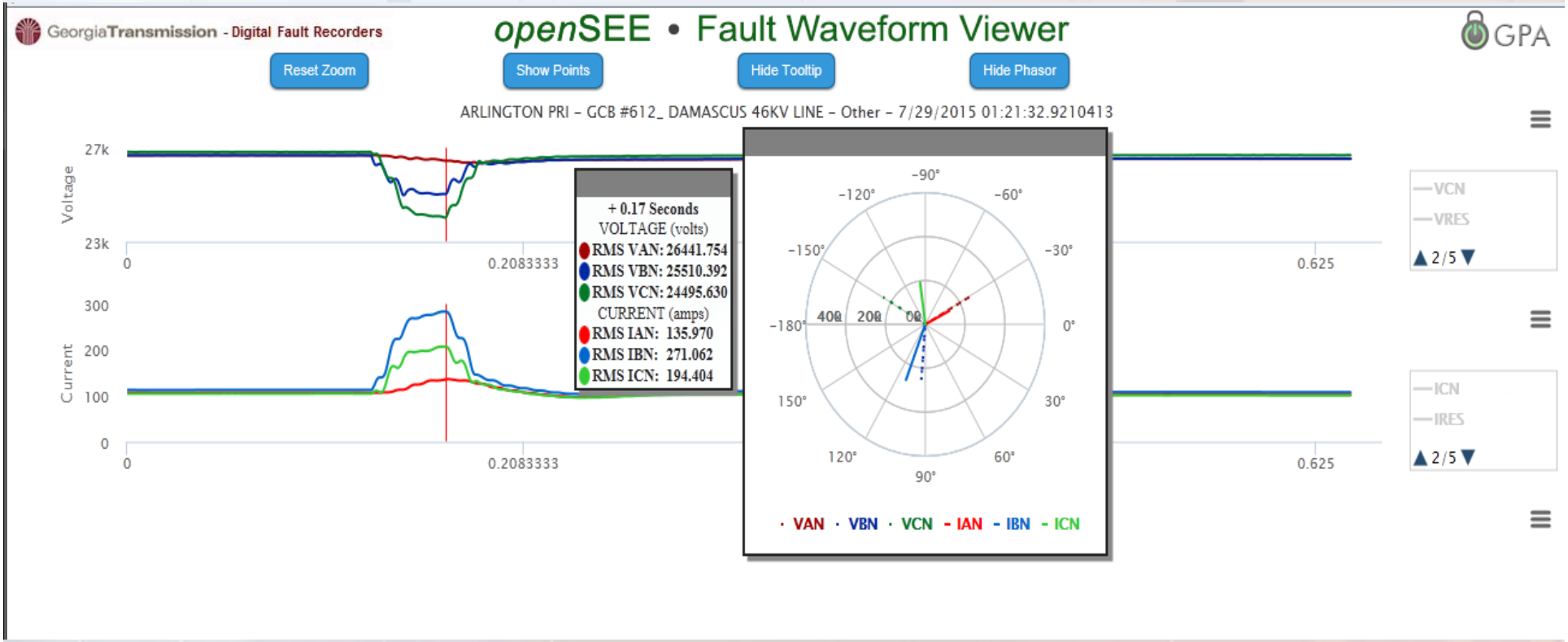
GTC - PQ Dashboard (DFR) Map View



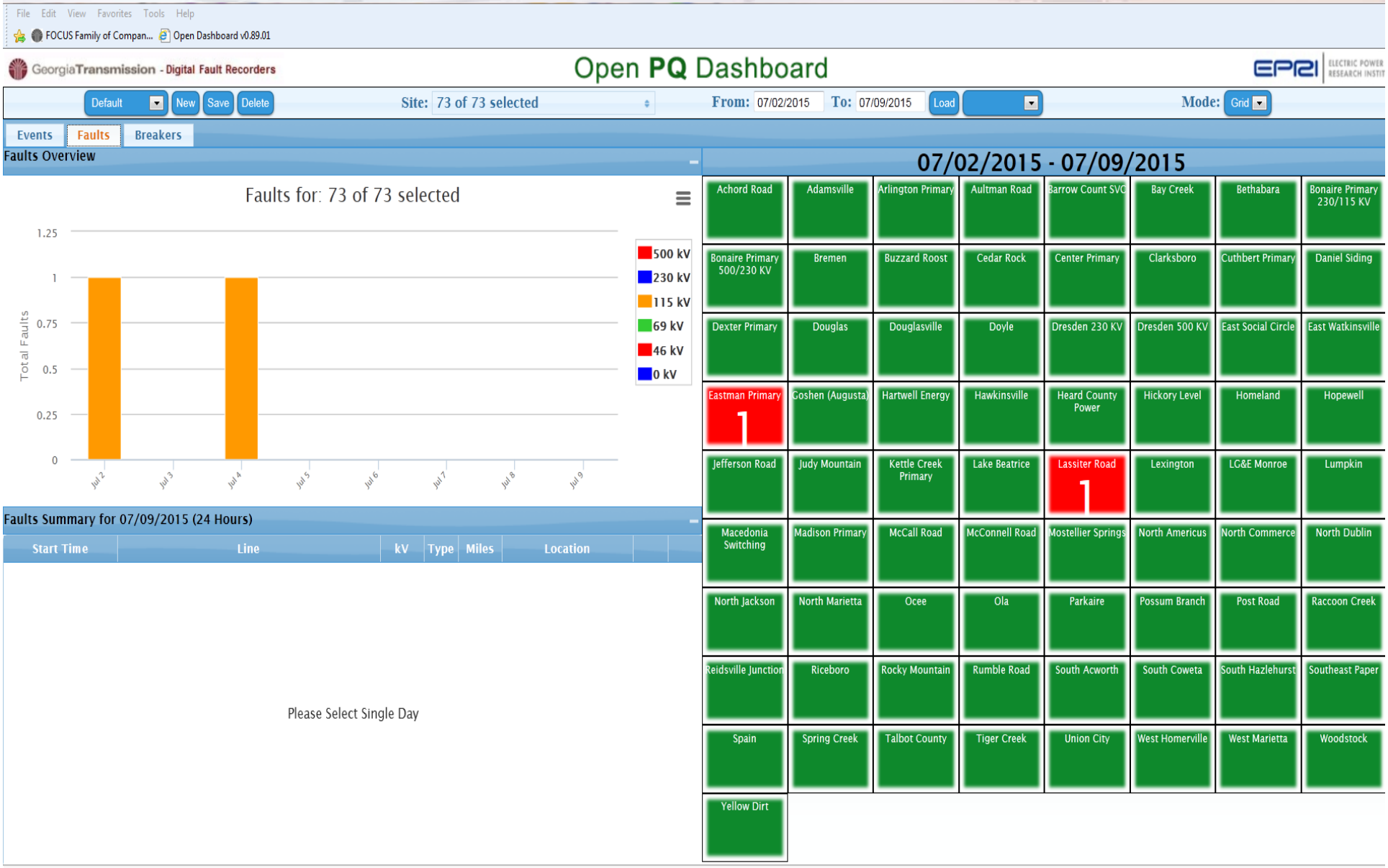
GTC - PQ Dashboard (DFR) Grid View



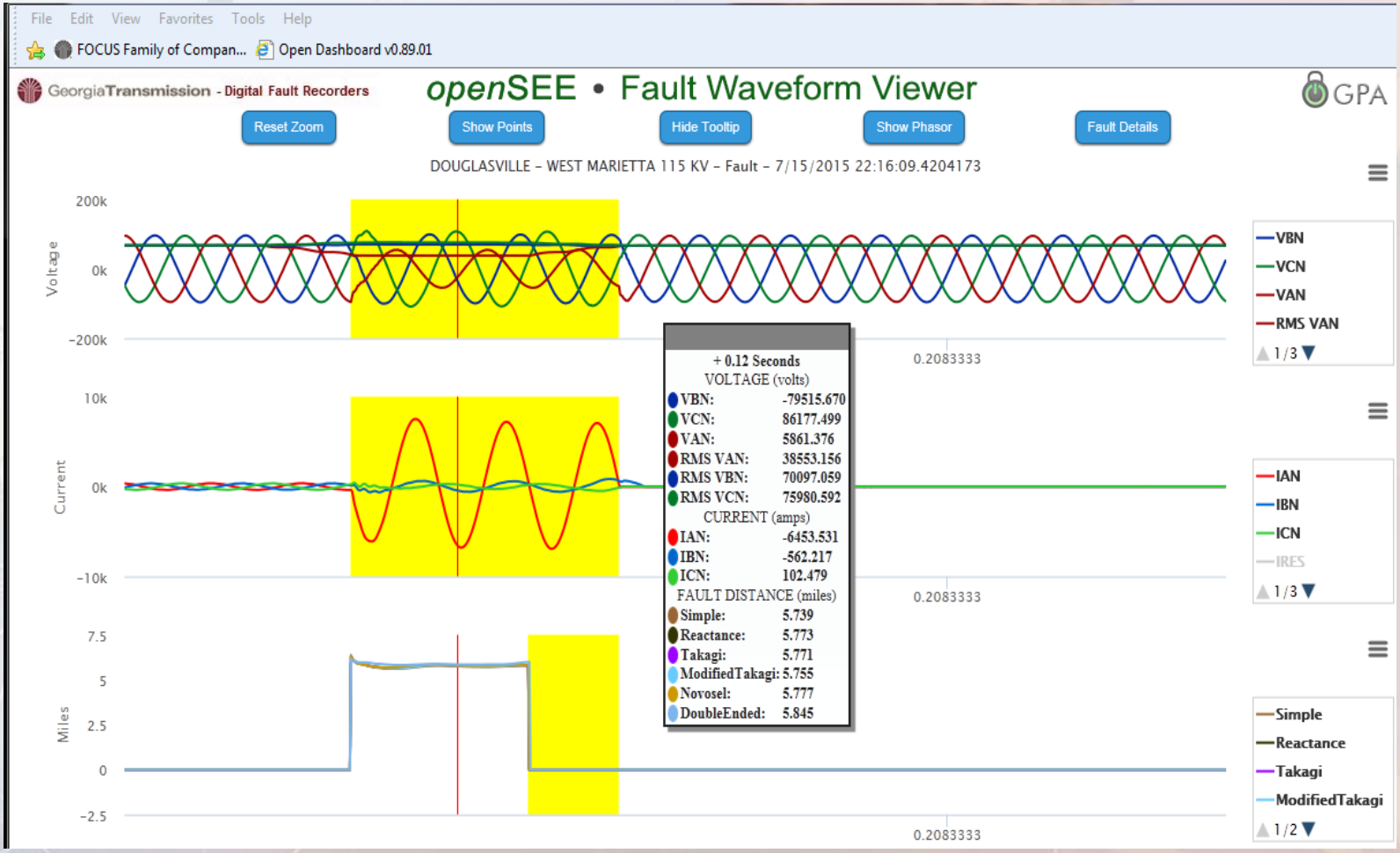
Non Fault Event – Voltage Sag



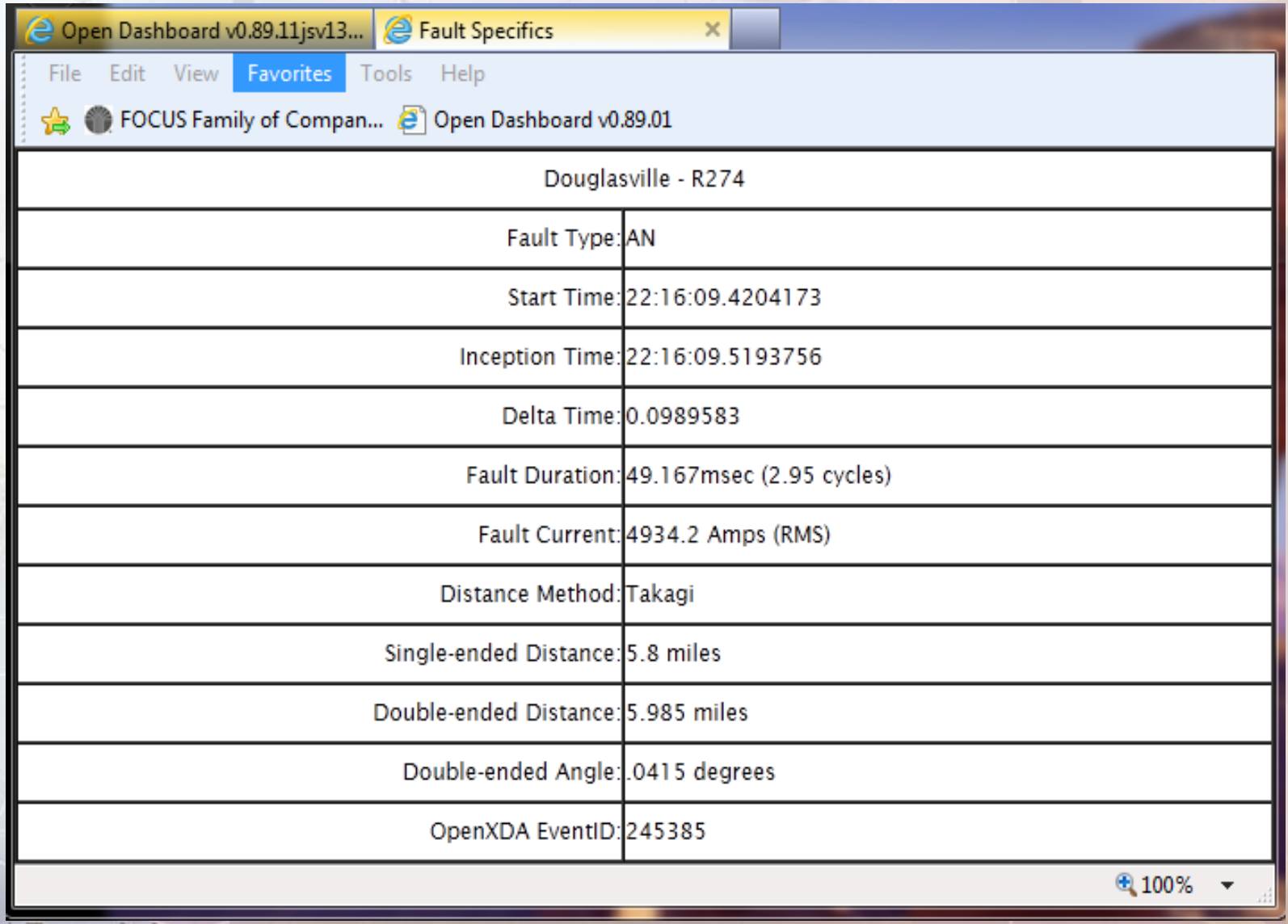
PQ Dashboard (DFR) Faults



Fault Event


File Edit View Favorites Tools Help
FOCUS Family of Compan... Open Dashboard v0.89.01
GeorgiaTransmission - Digital Fault Recorders
openSEE • Fault Waveform Viewer
GPA
Reset Zoom
Show Points
Hide Tooltip
Show Phasor
Fault Details
DOUGLASVILLE – WEST MARIETTA 115 KV – Fault – 7/15/2015 22:16:09.4204173
Voltage
200k
0k
-200k
0.2083333
VBN
VCN
VAN
RMS VAN
1 / 3
Current
10k
0k
-10k
0.2083333
IAN
IBN
ICN
IRES
1 / 3
Miles
7.5
5
2.5
0
-2.5
0.2083333
Simple
Reactance
Takagi
ModifiedTakagi
1 / 2
+ 0.12 Seconds
VOLTAGE (volts)
VBN: -79515.670
VCN: 86177.499
VAN: 5861.376
RMS VAN: 38553.156
RMS VBN: 70097.059
RMS VCN: 75980.592
CURRENT (amps)
IAN: -6453.531
IBN: -562.217
ICN: 102.479
FAULT DISTANCE (miles)
Simple: 5.739
Reactance: 5.773
Takagi: 5.771
ModifiedTakagi: 5.755
Novosel: 5.777
DoubleEnded: 5.845

Fault Details



Douglasville - R274	
Fault Type:	AN
Start Time:	22:16:09.4204173
Inception Time:	22:16:09.5193756
Delta Time:	0.0989583
Fault Duration:	49.167msec (2.95 cycles)
Fault Current:	4934.2 Amps (RMS)
Distance Method:	Takagi
Single-ended Distance:	5.8 miles
Double-ended Distance:	5.985 miles
Double-ended Angle:	.0415 degrees
OpenXDA EventID:	245385

Typical E-mail sent out by the PQ Dashboard

Subject: Fault detected on CUTHBERT PRIMARY - GCB 552 - BLUFFTON 46KV LINE (3139)

Fault 1 - 2015-07-28 14:14:39.6193753

DFRs: R01 at Cuthbert Primary triggered at 14:14:39.4568753 (click for waveform)

Files: 150728,141439616,-5t,R01-Cuthbert Primary 115_46Kv,APP601,GEORGIA TRANSMISSION CORPORATION,F0901.dat

Line: CUTHBERT PRIMARY - GCB 552 - BLUFFTON 46KV LINE (21.21 miles)

	Cuthbert Primary - R01
Fault Type:	AN
Inception Time:	14:14:39.6193753
Fault Duration:	42.500 msec (2.55 cycles)
Fault Current:	624.1 Amps (RMS)
Prefault Current:	50.5 Amps (RMS)
Postfault Current:	4.0 Amps (RMS)
Distance Method:	Novosel
Single-ended Distance:	21.119 miles
Short file name:	F0901.dat
openXDA Event ID:	254793

Line Parameters:	Value:	Per Mile:
Length (Mi)	21.21	1.0
Pos-Seq Imp Z1 (Ohm) (LLL,LLLG,LL,LLG)	17.5912∠61.847° 8.3+j15.51	0.8294∠61.847° 0.3913+j0.8294
Zero-Seq Imp Z0 (Ohm)	61.0666∠73.494° 17.35+j58.55	2.8791∠73.494° 0.818+j2.7605
Loop Imp ZS (Ohm) (LG)	31.9294∠69.2416° 11.3167+j29.8567	1.5054∠69.2416° 0.5336+j1.4077

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E-Mail Showing Double Ended Fault Distance

From: PQDashboard@gasoc.com
To: Browning, Marlin; Lowery, Joey; Connell, Deb; Grid Protection Alliance (Stephen Wills); Grid Protection Alliance (Jeffrey Walker); Grid Protection Alliance (Fred Elmendorf)
Cc:
Subject: Fault detected on DOUGLASVILLE - POST ROAD 115 KV (00003327)

Fault 1 – 2015-07-18 20:04:41.5795836

DFRs: R274 at Douglasville triggered at 20:04:41.4812503 (click for waveform)
R134 at Post Road triggered at 20:04:41.4225003 (click for waveform)

Files: 150718,200441581,-6td,Douglasville 230_115_46_25kV,USI_2002,Georgia Transmission Corporation,R274F0353.dat
150718,200441582,-3td,POST ROAD 115KV SWITCHYARD,USI_2002,GTC,R134F0916.dat

Line: DOUGLASVILLE – POST ROAD 115 KV (13.79 miles)

	Douglasville – R274	Post Road – R134
Fault Type:	CA	CA
Inception Time:	20:04:41.5795836	20:04:41.5793753
Fault Duration:	51.667 msec (3.10 cycles)	65.625 msec (3.94 cycles)
Fault Current:	19889.1 Amps (RMS)	8734.6 Amps (RMS)
Prefault Current:	124.2 Amps (RMS)	391.1 Amps (RMS)
Postfault Current:	5.5 Amps (RMS)	7.5 Amps (RMS)
Distance Method:	Takagi	Novosel
Single-ended Distance:	2.767 miles	11.572 miles
Double-ended Distance:	2.283 miles	11.609 miles
Double-ended Angle:	0.275°	-0.053°
Short file name:	R274F0353.dat	R134F0916.dat
openXDA Event ID:	246756	246747

Line Parameters:	Value:	Per Mile:
Length (Mi)	13.79	1.0
Pos-Seq Imp Z1 (Ohm) (LLL,LLLG,LL,LLG)	10.6248∠78.5124° 2.116+j10.412	0.7705∠78.5124° 0.1534+j0.7705
Zero-Seq Imp Z0 (Ohm)	30.4343∠72.464° 9.17+j29.02	2.207∠72.464° 0.665+j2.1044
Loop Imp ZS (Ohm) (LG)	17.2048∠74.9503° 4.4673+j16.6147	1.2476∠74.9503° 0.324+j1.2048

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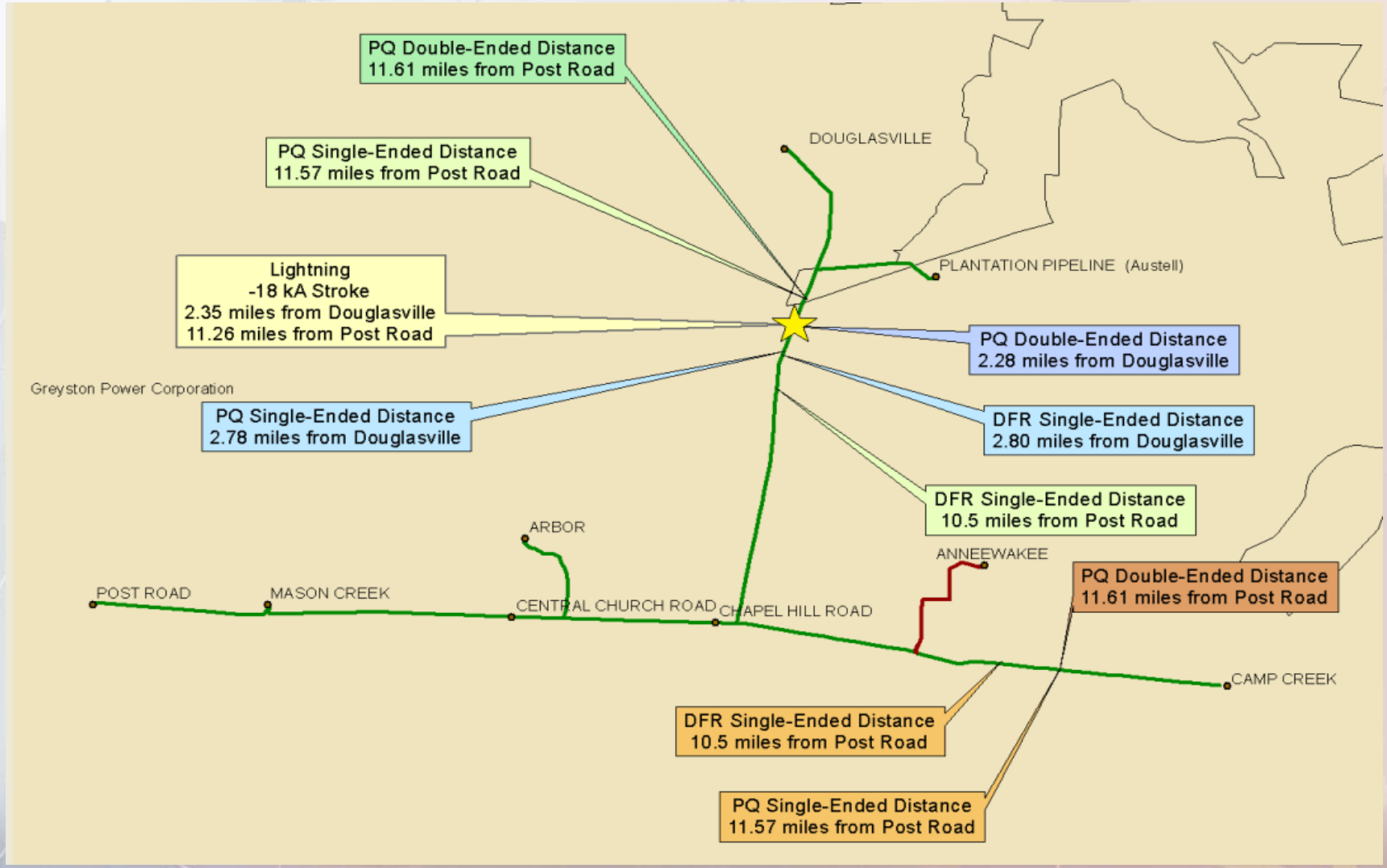
Fault Location from Lightning, DFR and PQ Dashboard



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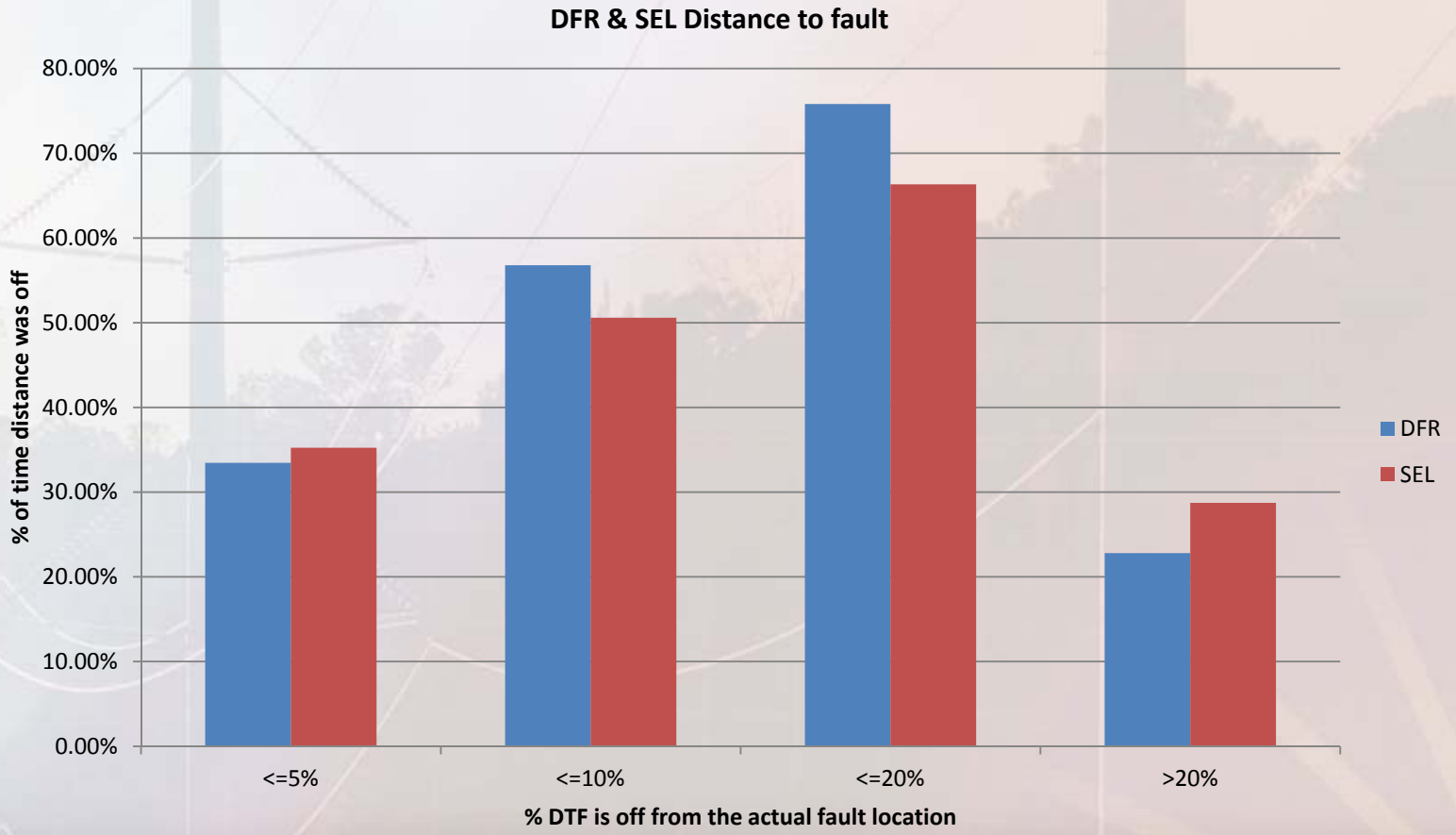
Accuracy of DFR and SEL Relays calculating Distance to Fault
January 1, 2011 – September 30, 2014

A total of 1637 records from DFRs and from SEL Relays were compiled. There were 817 DFR records and 820 SEL Relay records.



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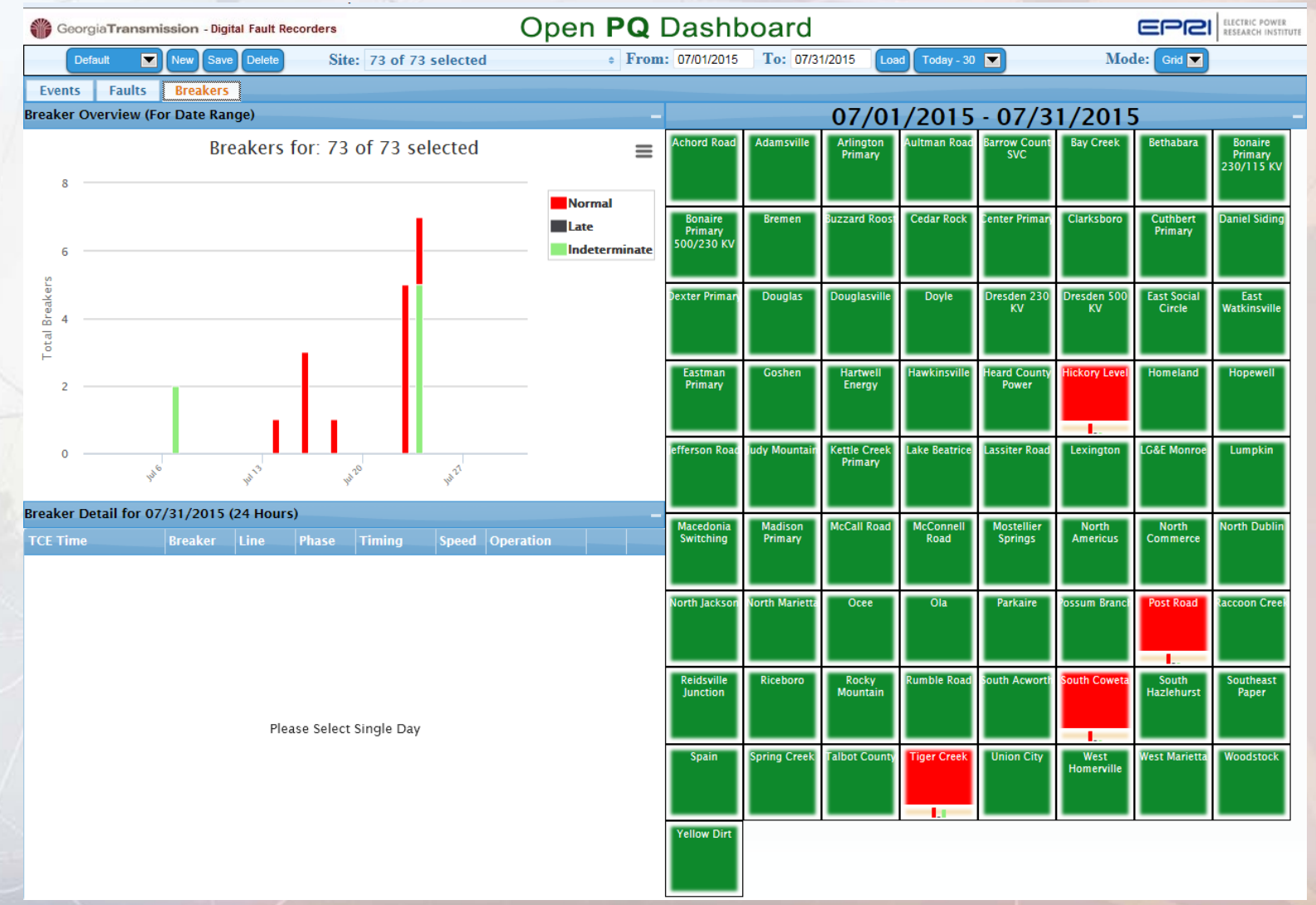
Breaker Timing



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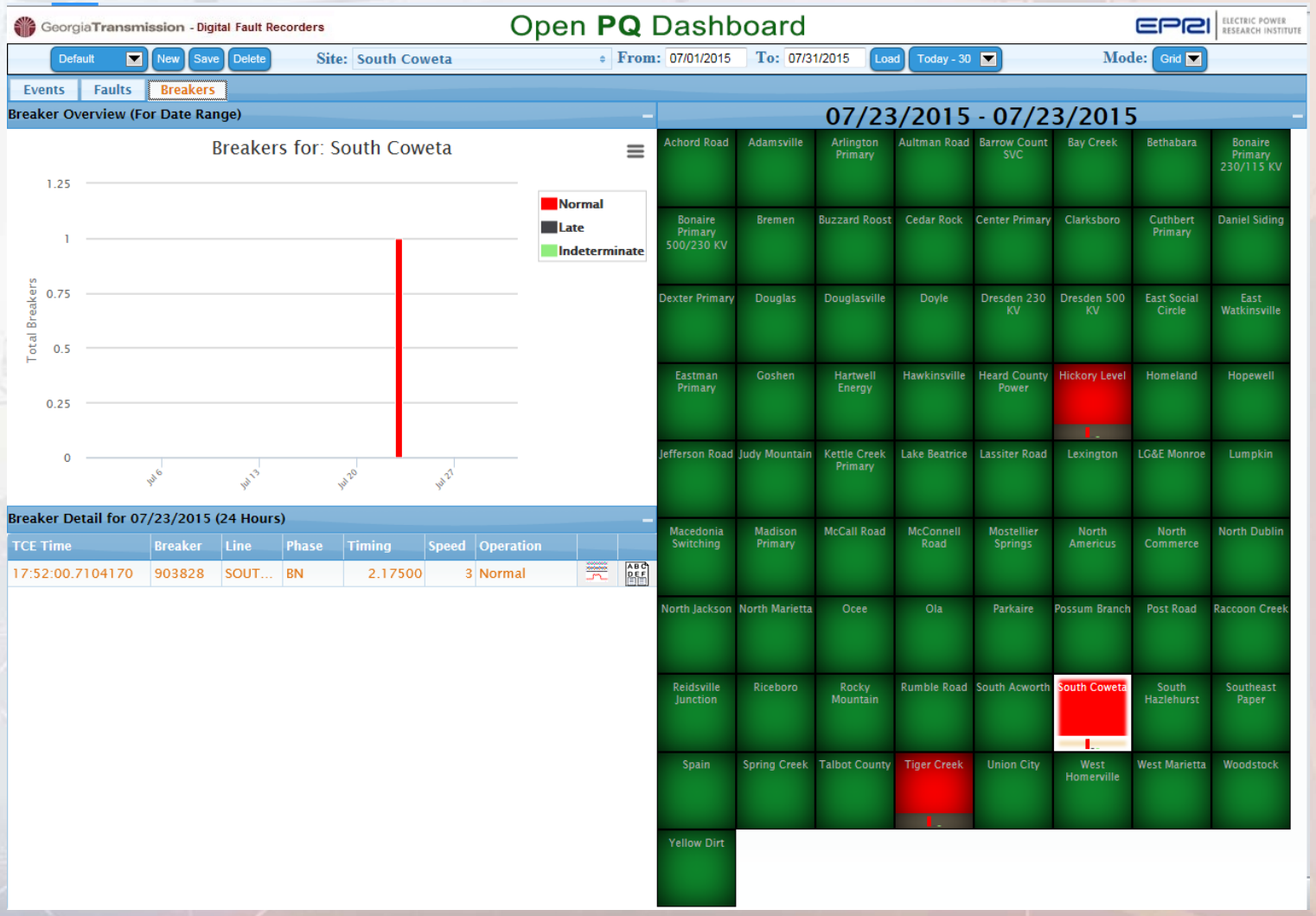
Breaker Timing



Breaker Timing

Breaker Timing

Things we had to do to apply the PQ Dashboard

1. Worked with USI and APP to modify the line files. Added the breaker number in order to link to MAXIMO.
2. Cleaned up line file numbers in the DFRs to match the STOMP data base. Lots of files were brought up to date.
3. Added non-line breakers to the DFR line files for breaker timing.
4. Large data clean up effort with the MAXIMO data. Added breaker operate time to data base.
5. Created a database with thermal line rating for each line.

2016 and Beyond

1. Geographic enhancements and reporting (GIS)
   - Show T/L with fault location, lightning location, and other information
2. Event correlation with lightning
3. Incorporate Fault Indicator data
4. Add GTC Power Quality meters to the dashboard
5. Additional breaker analytics and reporting
6. Add functions to the PQ Dashboard such as Event Reclassification and Tagging
7. Identification and reporting of out of service DFRs and Power Quality meters