

SMART GRID DISTRIBUTION AUTOMATION WHAT IS IT DOING FOR YOU?

Tom Musick, P. E.
Director of Engineering and Operations
Pioneer Electric Cooperative - Ohio

Pioneer Summary

**2nd largest electric distribution
Cooperative in Ohio =>kWh sales**

**Honda of America and KTH Parts => 50
MW peak demand**

**16,515 other distribution members => 57
MW peak demand**

60 employees in two office locations

Piqua Office



Urbana Office



Pioneer's Smart Grid Purpose

Is to exceed the energy needs and expectations of our member-consumers by providing safe, high quality and responsive service at competitive prices, consistent with sound business practices and in adherence to the 7 Cooperative Principles.

Pioneer Residential Members

- Pioneer serves 14,000 members & 16,517 services
- 2,644 miles of distribution line
- On average there are 6.25 members per mile
- Plant investment is \$91 million



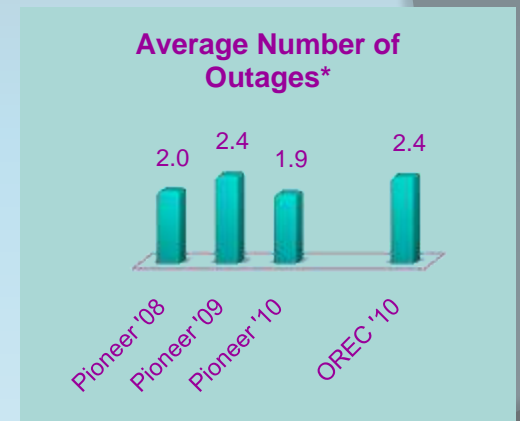
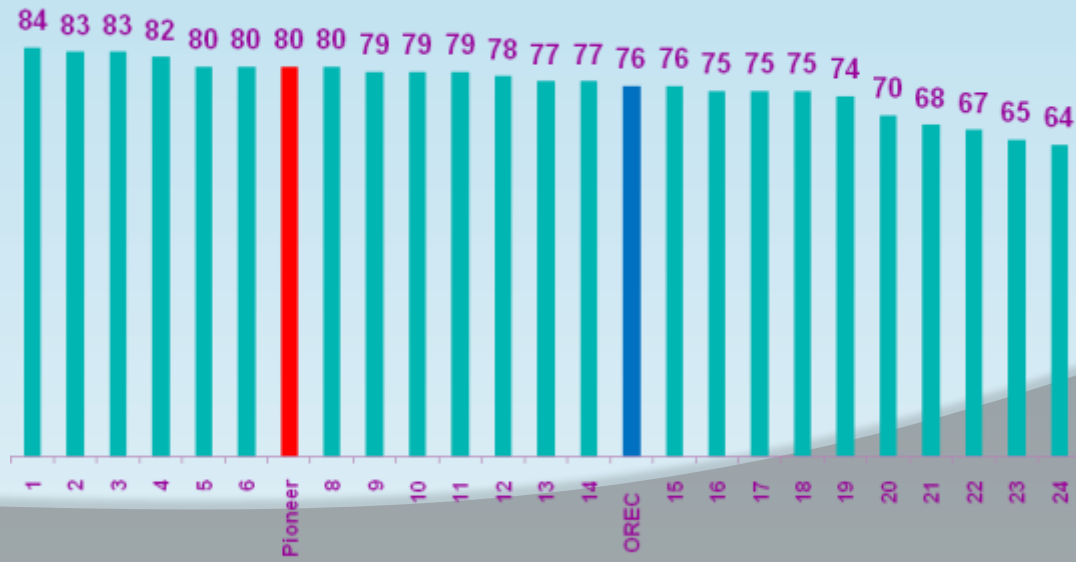
Only 9% of Pioneer's members make their full-time living in agriculture

Pioneer Member Satisfaction

Member Satisfaction

- 53% of members overall “very satisfied” + 38% “satisfied” = **91% positive**
- 84% of members want proactive communication with planned outages, etc.
- With rising prices, “value for the money” attributes need attention
- Very Satisfied dropped 51% to 46% on contacts

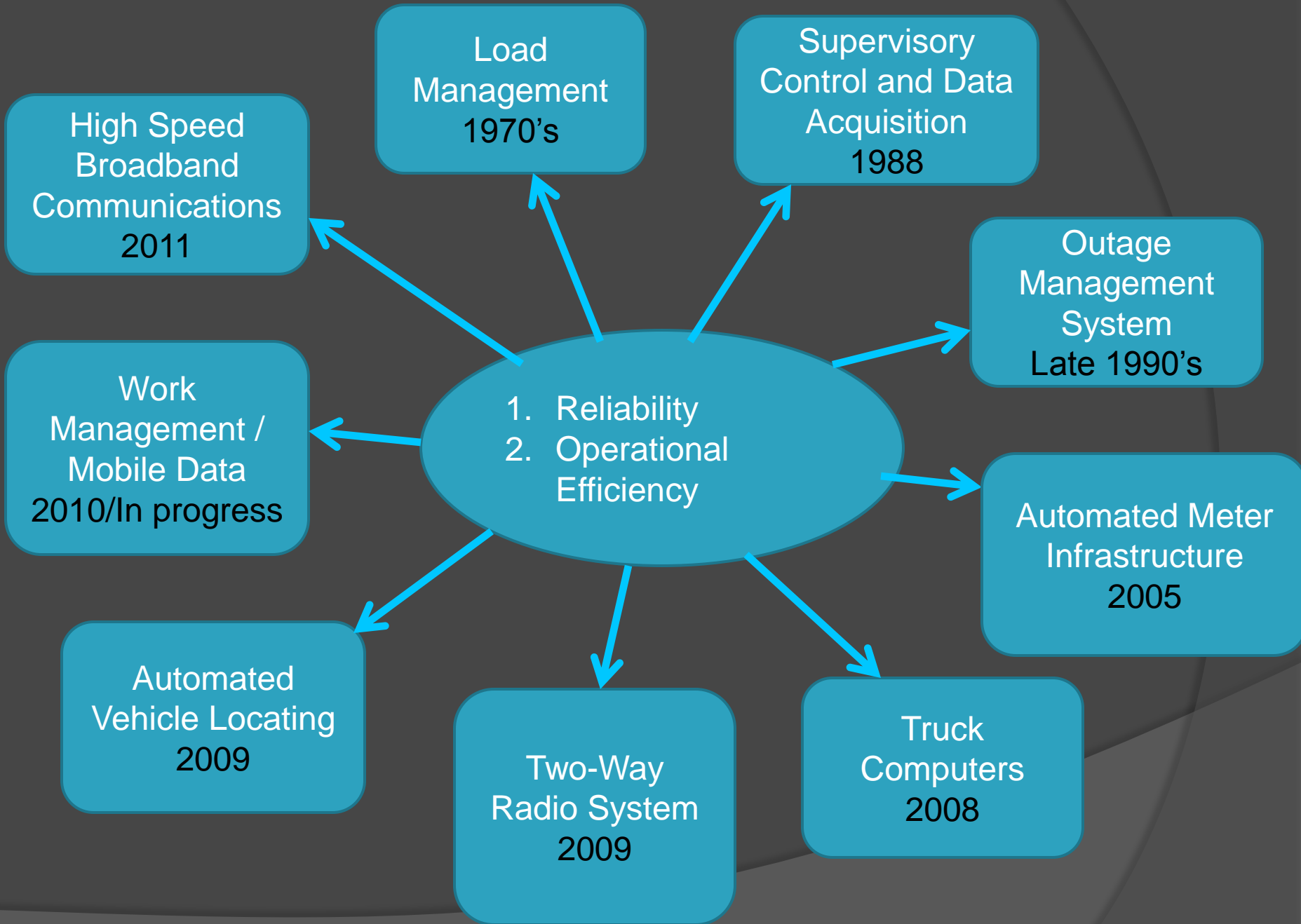
2010 ACSI Member Satisfaction Score



	2009	2010
Pioneer	79	80
Touchstone	82	82
OREC	77	76
Energy Utilities	74	75
First Energy	74	75
Duke	77	76
AEP	74	73

Pioneer's Smart Grid (Distribution Automation)

1. Reliability
2. Operational Efficiency
3. Energy Efficiency



Distribution Automation

- Scada System (1988 – Present)

36 substation breakers; 9 (12-kV) delivery points; 27 Motor Operated Air Break Switches; 16 Downstream Devices; Data monitoring over 85 points



Switching Orders:

\\svrfile\Shared\Sub_SwitchOrd\halter_fm.htm

138 KV GOAB - 21138

138 KV CIRCUIT SWITCHER - 21CS

12 KV MOTOR OPERATED SWITCH - 21B

FDR # 3

AMPS
22.40
16.40
22.10

Voltage Trend

123.7 VOLTS
123.3 VOLTS
123.5 VOLTS

Current Trend

129.8 AMPS
121.7 AMPS
128.6 AMPS

FDR # 1

AMPS
37.40
50.40
49.80

FDR # 2

AMPS
72.40
56.60
56.00

EAST

NORTH

21F3T

21F1T

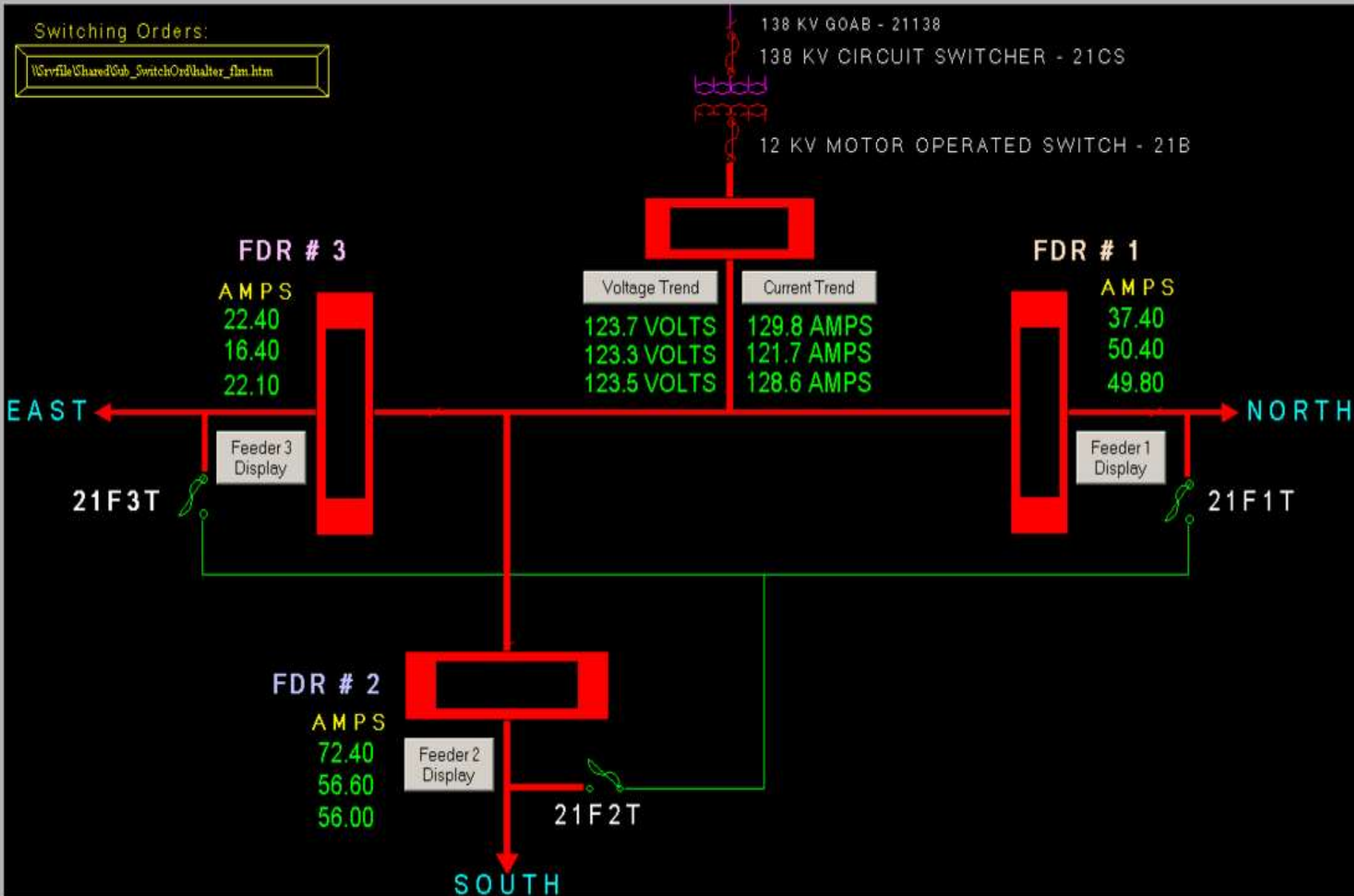
21F2T

SOUTH

Feeder 3 Display

Feeder 1 Display

Feeder 2 Display



■ Anna

Feeder 1 RECLOSE GROUND TRIP
 Feeder 2 RECLOSE GROUND TRIP
 Feeder 3 RECLOSE GROUND TRIP
 Feeder 4 RECLOSE GROUND TRIP

Volts: A B C
 123.00 122.78 123.08

■ East Sidney

Feeder 1 RECLOSE GROUND TRIP
 Feeder 2 RECLOSE GROUND TRIP
 Feeder 3 RECLOSE GROUND TRIP
 Feeder 4 RECLOSE GROUND TRIP

Volts: A B C
 125.9 126.6 125.8

■ NW Urbana

Feeder 1 RECLOSE GROUND TRIP
 Feeder 2 RECLOSE GROUND TRIP
 Feeder 3 RECLOSE GROUND TRIP
 Feeder 4 RECLOSE GROUND TRIP

Volts: A B C
 125.3 124.7 124.2

■ Newport

Feeder 1 RECLOSE GROUND TRIP
 Feeder 2 RECLOSE GROUND TRIP
 Feeder 3 RECLOSE GROUND TRIP

Volts: A B C
 124.05 123.97 123.83

■ Route 66

Feeder 1 RECLOSE GROUND TRIP
 Feeder 2 RECLOSE GROUND TRIP
 Feeder 3 RECLOSE GROUND TRIP

Volts: A B C
 124.1 124.1 124.5

■ Givens

Feeder 2 RECLOSE GROUND TRIP
 Feeder 3 RECLOSE GROUND TRIP
 Feeder 4 RECLOSE GROUND TRIP

Volts: A B C
 123.9 123.8 124.5

■ McCartyville

Feeder 1 RECLOSE GROUND TRIP
 Feeder 2 RECLOSE GROUND TRIP
 Feeder 3 RECLOSE GROUND TRIP

Volts: A B C
 122.3 123.0 122.7

■ Mingo

Feeder 1 RECLOSE GROUND TRIP
 Feeder 2 RECLOSE GROUND TRIP
 Feeder 4 RECLOSE GROUND TRIP

Volts: A B C
 125.6 124.3 125.9

■ Halterman

Feeder 1 RECLOSE GROUND TRIP
 Feeder 2 RECLOSE GROUND TRIP
 Feeder 3 RECLOSE GROUND TRIP

Volts: A B C
 123.7 123.3 123.5

■ East Casstown

Feeder 1 RECLOSE GROUND TRIP
 Feeder 2 RECLOSE GROUND TRIP
 Feeder 4 RECLOSE GROUND TRIP

Volts: A B C
 124.3 123.7 124.0

■ Eagle

Feeder 2 RECLOSE GROUND TRIP
 Feeder 3 RECLOSE GROUND TRIP
 Feeder 4 RECLOSE GROUND TRIP

Volts: A B C
 124.3 124.3 124.7

D_455_LM2 (Low Miami)

	Volts	Amps
A Ø	122.93	80.80
B Ø	123.83	52.60
C Ø	123.75	66.00

RECLOSE GROUND TRIP

M_451_LM

Amps	Volts
99.45	122.40
72.00	123.83
79.20	124.65

Device 511 to be built

D_2289_ED (Edinger)

Breaker Status RECLOSE GROUND TRIP

Volts	Amps
124.88	26.55
123.53	26.10
121.43	20.70

D_8013_EL1 (Eldean 1)

Breaker Status RECLOSE GROUND TRIP

Volts	Amps
123.08	93.15
122.25	95.40
122.85	98.10

M_133_EC2HL2

Amps	Volts
0.00	94.28
0.45	94.28
0.90	118.65

M_798_AN4BO1

Amps	Volts
0.00	126.30
0.45	127.60
0.45	125.78

M_1906_MI4EG2

Amps	Volts
0.90	123.08
0.90	121.43
0.45	122.85

D_40_MO (Monroe MP)

Volts	Amps
123.60	6.76
124.72	22.52
125.55	10.64

RECLOSE GROUND TRIP

D_8015_EL2 (Eldean 2)

Breaker Status RECLOSE GROUND TRIP

Volts	Amps
123.00	59.85
122.25	55.35
122.78	67.95

M_188_ES4HL1

Amps	Volts
0.45	123.60
0.00	125.03
0.90	124.88

M_863_AN2MC1

Amps	Volts
0.45	123.60
0.45	122.78
0.45	121.80

M_2013_GV3NW2

Amps	Volts
0.45	123.75
0.45	125.18
0.90	123.00

D_2361_LP1 (Lipp 1)

Volts	Amps
124.13	7.65
123.15	9.45
123.97	24.30

RECLOSE GROUND TRIP

M_2420_LP

Amps	Volts
16.20	124.50
22.05	123.75
32.85	124.13

D_2351_LP2 (Lipp 2)

Volts	Amps
124.20	8.10
123.45	13.95
123.45	12.15

RECLOSE GROUND TRIP

D_1140_BO (Botkins)

Volts	Amps
125.40	18.42
123.60	3.68
124.72	9.83

RECLOSE GROUND TRIP

M_173_HL3ES3

Amps	Volts
0.90	124.35
0.00	122.65
0.00	125.70

M_953_MC2NE1

Amps	Volts
0.45	120.15
0.45	114.53
0.00	25.28

M_2214_EG4ED1

Amps	Volts
0.50	123.60
0.45	123.00
0.45	124.75

M_303_HL1661

Amps	Volts
0.90	124.43
0.45	123.75
0.90	123.75

M_957_MC2NE1

Amps	Volts
37.35	122.78
28.80	122.78
30.15	122.10

M_2219_EG4GV2

Amps	Volts
0.90	124.28
0.45	126.88
0.45	124.50

D_1100_HD (Hardin MP)

Breaker Status RECLOSE GROUND TRIP

Volts	Amps
123.97	38.40
123.38	32.20
124.20	24.80

M_47_MO1SW1

Amps	Volts
0.90	122.85
0.90	120.90
1.35	120.90

M_434_EC4LM2

Amps	Volts
0.45	122.85
0.45	123.80
0.45	123.45

M_964_MC2NE2

Amps	Volts
0.90	123.08
0.45	122.78
0.00	123.97

M_2359_LP2MI1

Amps	Volts
0.45	127.85
0.90	122.88
0.45	124.72

D_2_CO1 (Concord S)

Volts	Amps
122.40	51.79
121.65	46.67
121.28	59.36

RECLOSE GROUND TRIP

M_100_CO

Amps	Volts
0.45	107.47
0.45	118.43
0.90	118.35

D_26_CO2 (Concord N)

Volts	Amps
121.58	49.60
121.88	43.80
121.58	57.40

RECLOSE GROUND TRIP

D_80_SW (SW Troy MP)

Volts	Amps
125.47	34.65
122.63	31.50
122.18	35.10

RECLOSE GROUND TRIP

M_61-2_CO1MO1

Amps	Volts
0.90	121.13
0.00	122.47
0.45	120.97

M_582_ES3NW3

Amps	Volts
1.80	123.90
1.80	110.55
1.80	123.90

M_1092_MC3NE2

Amps	Volts
0.90	121.88
0.00	122.25
0.00	124.72

M_2370_LP1NW3

Amps	Volts
1.35	125.10
1.35	122.70
1.35	122.55

M_116_EL1HL2

Amps	Volts
0.00	123.60
0.90	122.25
0.50	121.43

M_683_ANTIES1

Amps	Volts
0.45	119.03
0.45	123.30
0.90	121.95

M_1116_HD2661

Amps	Volts
0.45	125.25
0.90	121.05
0.45	122.85

M_2397_LP1NW1

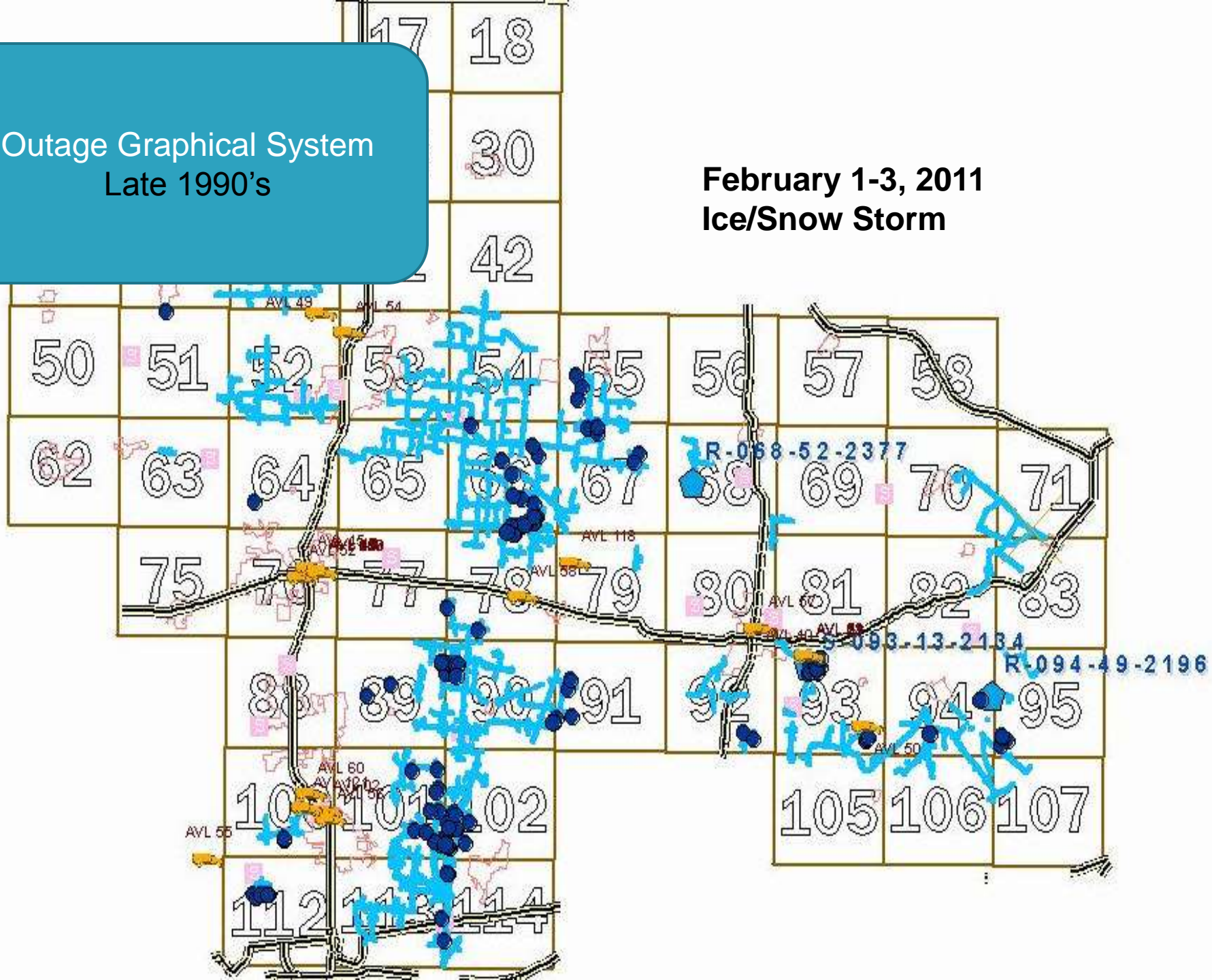
Amps	Volts
0.90	123.90
0.00	122.63
0.45	124.43

Outage Management

- Integrated with SCADA system
- Integrated with AMI system
- Vehicle location displayed on map
- Graphical outage display
- Internet outage map

Outage Graphical System
Late 1990's

February 1-3, 2011
Ice/Snow Storm





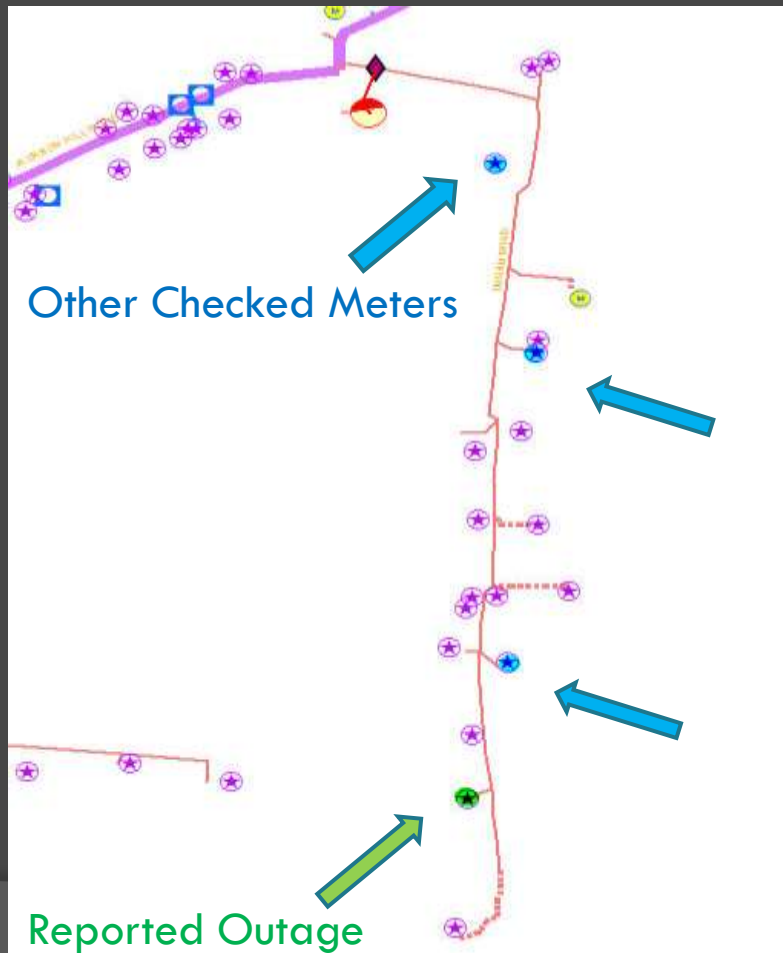
Automated Meters

- AMI (2005 – Present)
- ◆ **100% AMI for all residential and commercial members**

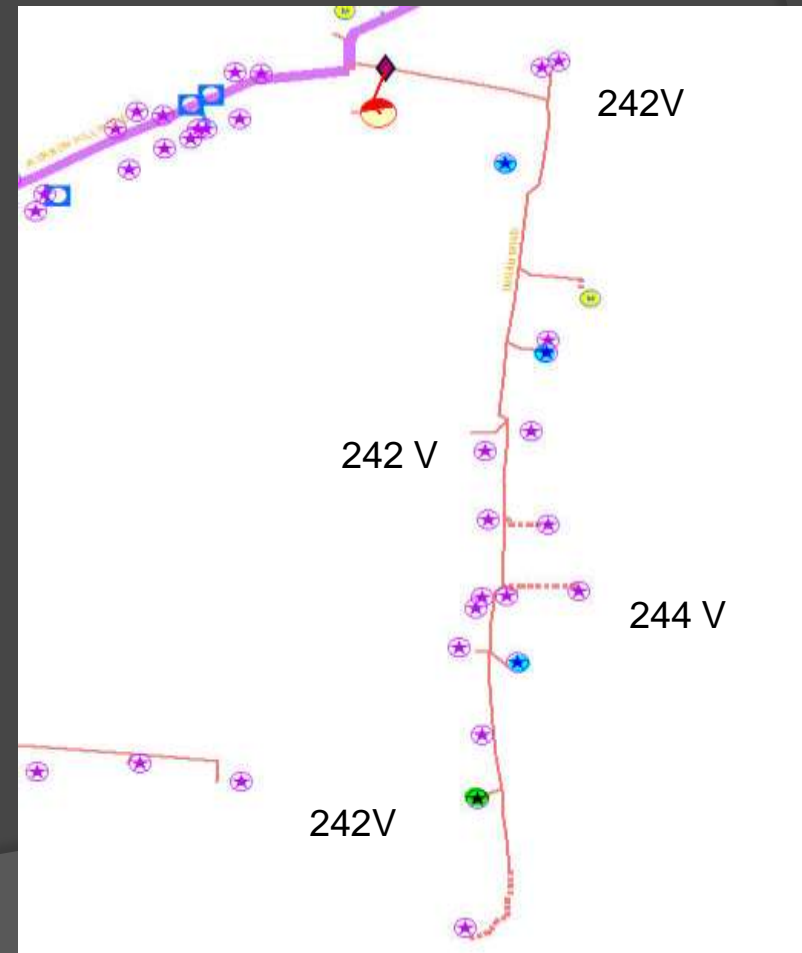


AMI Toolbox

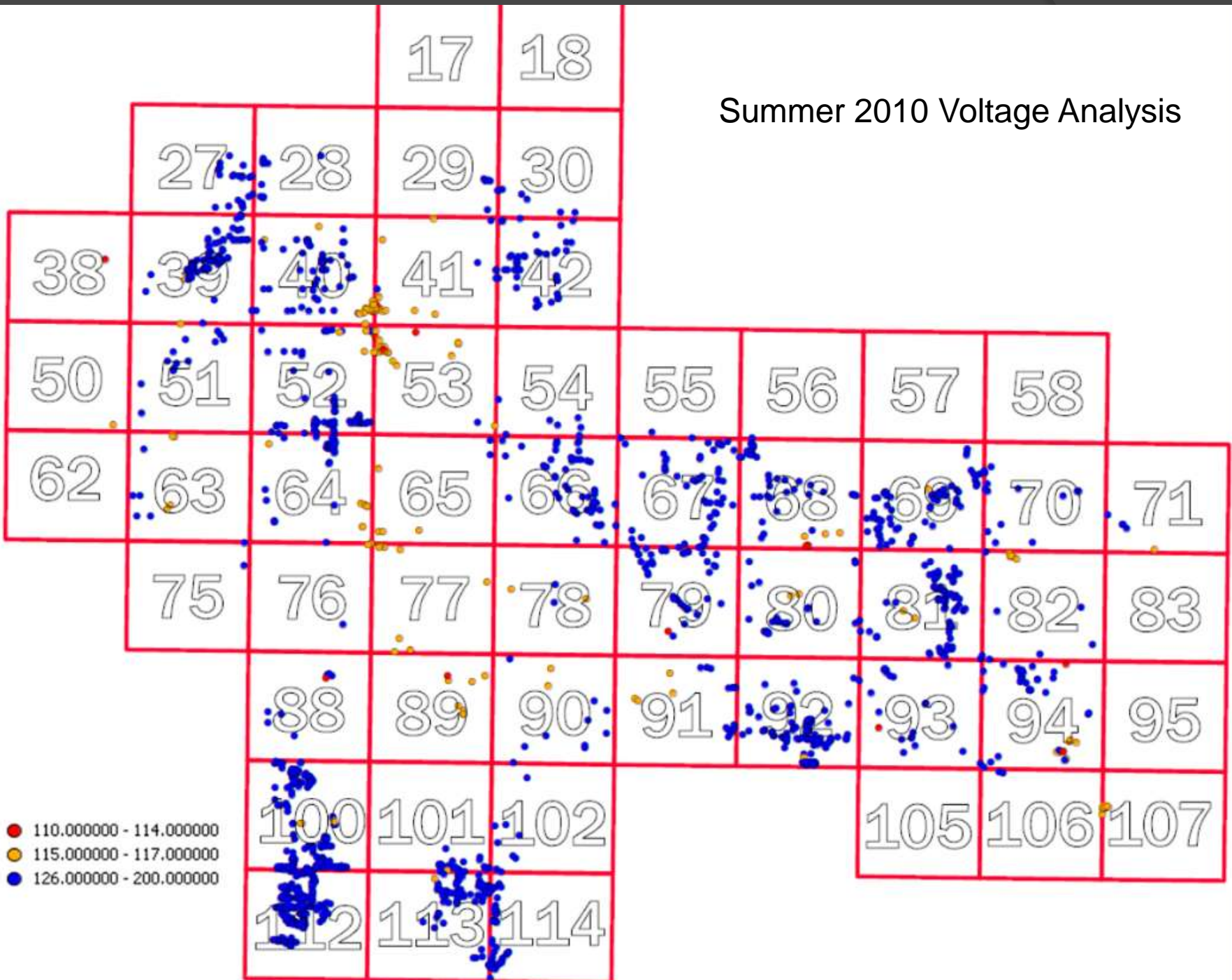
Outage Analysis



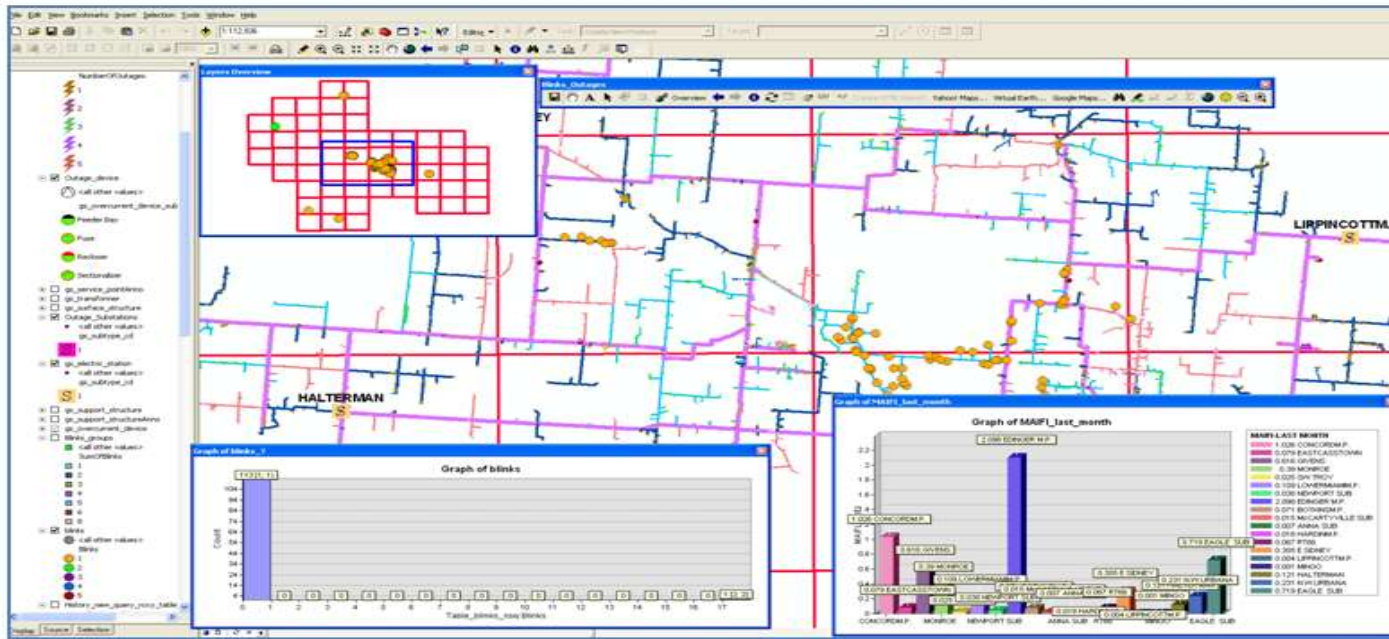
Voltage Analysis



Summer 2010 Voltage Analysis



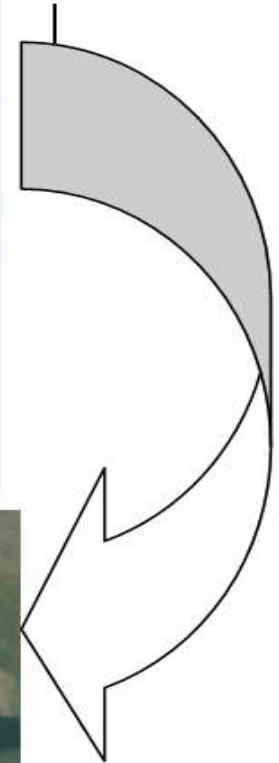
Blinking Lights/Power Quality



29-Aug-2010 4:01:25 PM	30-Aug-2010 4:00:30 PM	0	0 Days 23:59:05
28-Aug-2010 4:00:43 PM	29-Aug-2010 4:01:25 PM	0	1 Day 0:00:42
27-Aug-2010 4:00:44 PM	28-Aug-2010 4:00:43 PM	39	0 Days 23:59:59
26-Aug-2010 4:00:46 PM	27-Aug-2010 4:00:44 PM	13	0 Days 23:59:58
24-Aug-2010 4:00:24 PM	26-Aug-2010 4:00:46 PM	528	2 Days 0:00:22
23-Aug-2010 4:01:54 PM	24-Aug-2010 4:00:24 PM	205	0 Days 23:58:30
22-Aug-2010 4:00:21 PM	23-Aug-2010 4:01:54 PM	27	1 Day 0:01:33
21-Aug-2010 4:00:26 PM	22-Aug-2010 4:00:21 PM	0	0 Days 23:59:55



The software applications used to identify and analyse the blinks:
Pioneer Blinks App and Proasys



Solving Member Issues



Hot wire (triplex)

Solving Member Issues

March 2011

- 26 blinks - loose lug at transformer
- 16 blinks - repaired connection at service
- 14 blinks - loose lug at transformer
- 12 blinks – repaired connection at M.B.
- 11 blinks – broken wire on bottom of cutout
- 7 blinks – bad connection at weatherhead

What are the real benefits of
Smart Grid Automation?

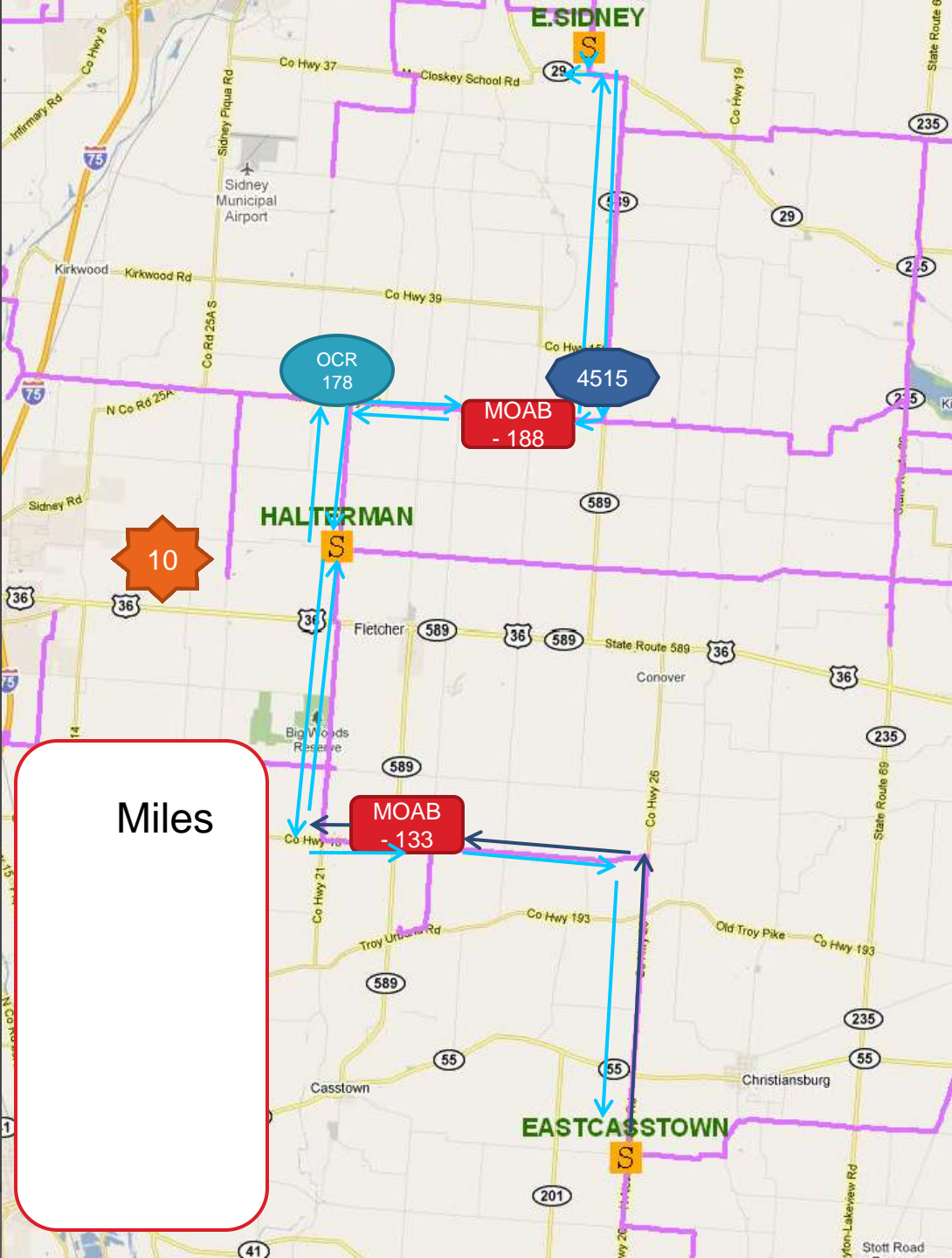
Before Smart Grid - Automation

⦿ Outage Example:

- Broken high voltage transmission pole causing power loss to our Halterman Substation – 1355 members
- Time to fix the transmission pole is estimated to be 10 + hours

⦿ Solution

- Pioneer to transfer Halterman Substation to alternative redundant power sources



Miles

10

OCR
178

MOAB
- 188

4515

MOAB
- 133

HALTERMAN

EASTCASSTOWN

SIDNEY

After Distribution Automation

Lower Miami MP Faults

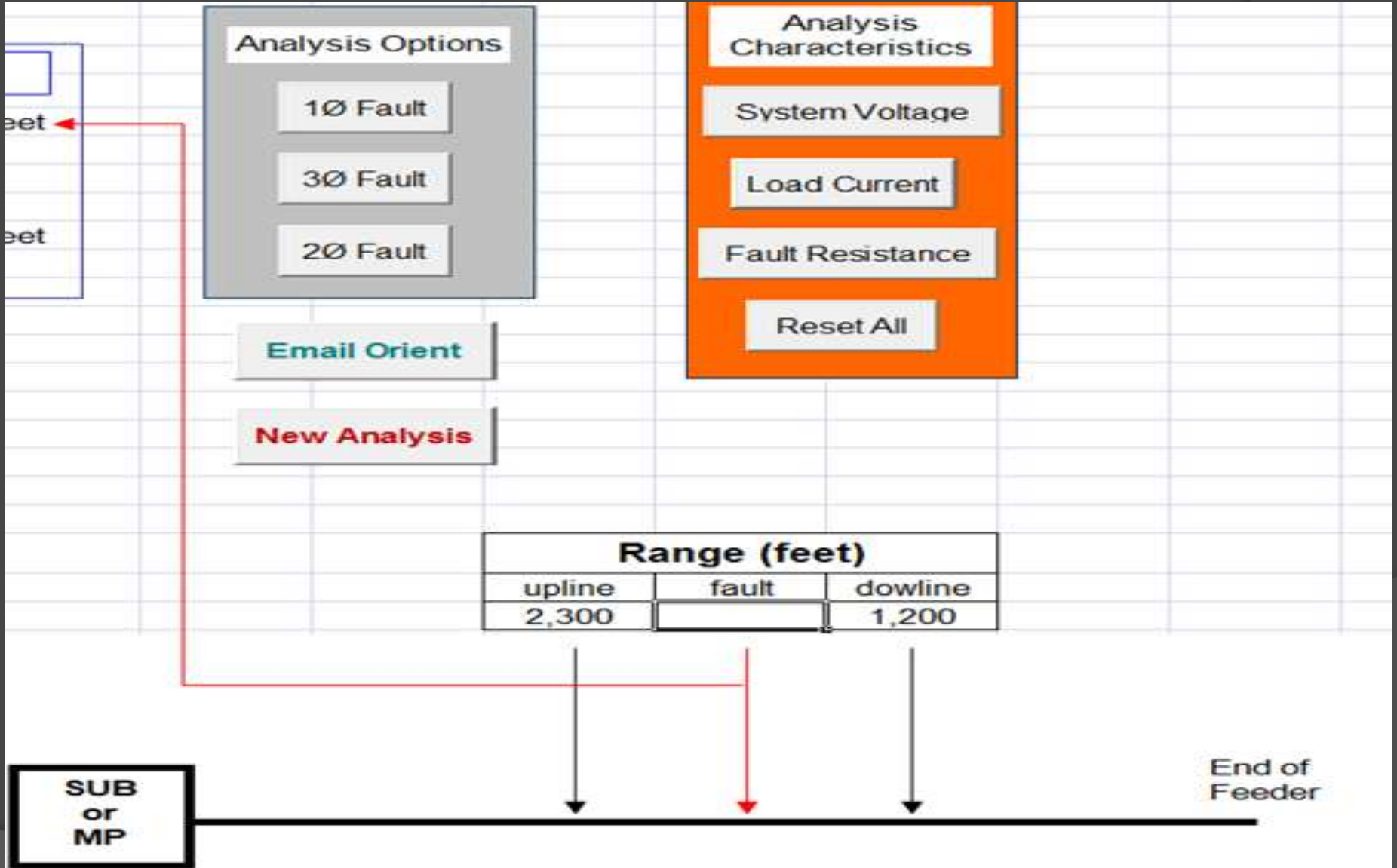
Lower Miami Meter Point

Last Recorded Fault Data

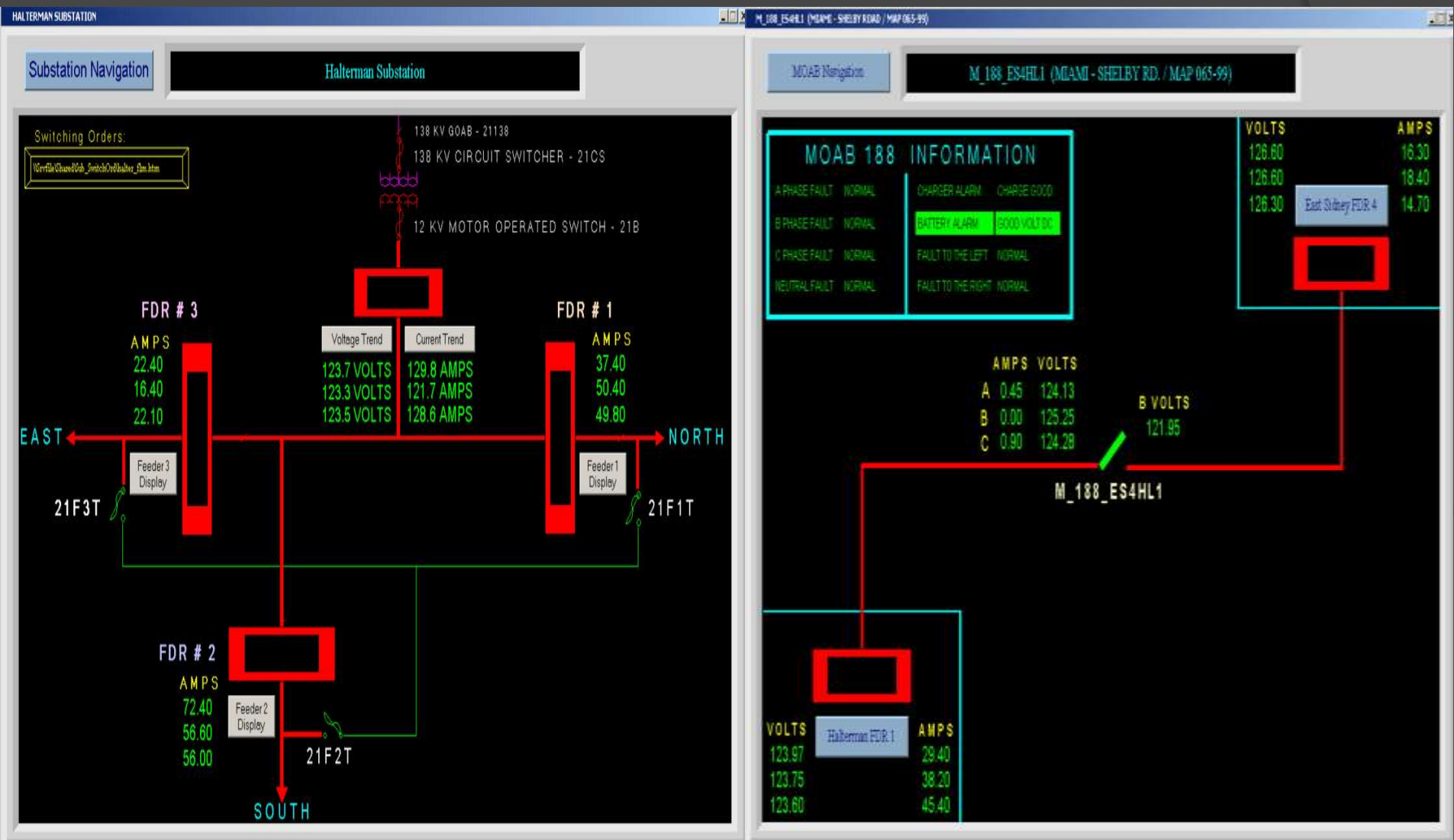
	AØ	BØ	CØ	GND	Time	Month	Day	Year
455	78	54	3340	3300	1 : 45 : 26	4	20	2011
D_473_LM2 (Aileron TSR)								
	AØ	BØ	CØ	GND	Time	Month	Day	Year
	34	757	40	720	19 : 28 : 26	4	2	2011

Note: Time is expressed in Military hours.

After Smart Grid



After Smart Grid



Outage Time Savings

- ⦿ Before Smart Grid
 - 3-4 Hour Outage

- ⦿ After Smart Grid
 - 15-30 Minute Outage

Additional Outage Restoral Benefits

- All meters are checked to confirm all members power has been restored before the crews leaves the area
- Eliminates unnecessary trips
- Reduces individual service restoration during large storms by days (know what's out of power and can direct crews more effectively)
- Huge Savings\$\$\$\$\$\$\$\$

Future Smart Grid Initiative

3. Energy Efficiency

Pioneer Electric Cooperative's Mission...

*... is to
expect
by p
respon*

**Goal: use less kWh via every
available technology and
system**

*consistent with sound business
practices and in adherence to the
7 Cooperative Principles*



Usage Explorer Analysis Billing Comparison Planning

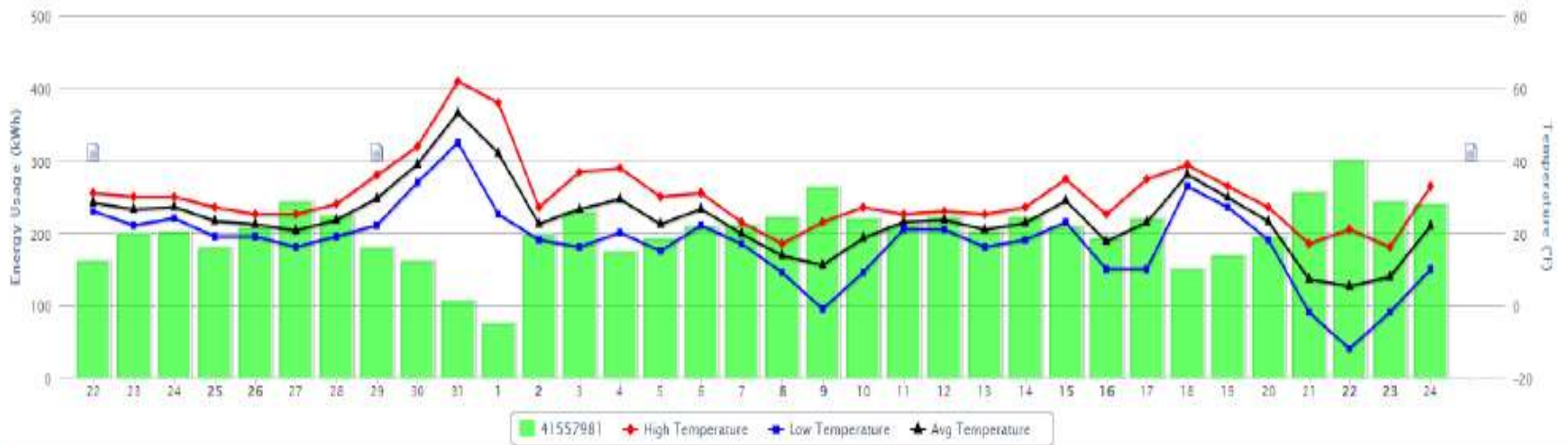
Help

View your actual billed usage as a result of your household consumption.

Acct: 2060700

Monthly > Daily

Energy Usage for Wed Dec 22, 2010 - Mon Jan 24, 2011



Billing	
Bill Date:	Jan 2011
Billing Days:	12/22/2010 to 1/25/2011
Days in Period:	34
Usage Charge:	\$634.77
Billed kWh Usage:	6,951.00

Usage	
Meter:	41557981
Peak Usage:	301.76
Low Usage:	77.06
Average kWh Usage:	204.42
Total kWh Usage:	6,950.18

Weather	
Average Temperature:	24° F
High Temperature:	62° F
Low Temperature:	-12° F

Pioneer's Future Focus Items

- ① Energy tracker
- ① Mobile Applications
- ① Pre-paid options
- ① Additional remote disconnect capabilities
- ① Smart switching schemes using SCADA
- ① And many more.....

Questions?



Tom Musick, P.E.

tmusick@pioneerec.com

937-381-0640