A PI System's Journey at PPL: From Operations to Planning to Engineering to Asset Health

Presented by John Doncsecz

PPL – Pennsylvania USA

PPL

A Fortune 500 company with over 13,000 employees
$11.5 billion in annual revenue
8,000 megawatts of regulated generation capacity in the U.S.

- PPL Electric Utilities (Allentown, Pennsylvania USA)
  - Serving over 1.5 million customers in 29 countries
  - 48,000 miles of power lines (enough to reach around the world twice!)
  - 37 JD Power and Associates awards for top quality customer service
- Louisville Gas and Electric (Kentucky USA)
  - Serving 1.2 million customers in Kentucky and Virginia
- PPL Solutions
  - Providing a full range of customer-care and back-office services
- Western Power Distribution (United Kingdom)
  - Electricity distribution network operator for the Midlands, South West and Wales

PPL and the PI System

8 Separate PI Servers across PPL

- Transmission, Generation, Nuclear and Gen Regional Plants
- 700,000 PI Points combine with more each year
- + 500 PI Users and growing
- Heavy PI ProcessBook and PI DataLink users
- Moderate Asset Framework (AF), Notifications, and PI Coresight use

PPL is currently evaluating the OSISoft Enterprise Licensing Agreement program so that we may take advantage of :

- Enterprise Software Licensing
  - Software Installation and Configuration
  - Software Upgrades
  - Unlimited licenses for servers and clients
- Enterprise Services
  - Enterprise Project Management
  - Architecture Assistance
  - Access to the Center of Excellence
- Enterprise Support
  - Asset Monitoring
  - Vouchers for Training and Events

What my PI Server customers have to say about PI…

- "Catching problems with the PI System before it reaches catastrophic failure can save a $200K TCUL or a $2M transformer."
- "The PI System is the first tool I open in the morning and the last tool I turn off at the end of the day"
- "The PI System is an excellent tool which I use numerous times during the day, without it the productivity of the System Operator's job would be diminished."
- "If the PI Server was unavailable, it would delay in providing a solution to the customer's problem; reducing that customer's satisfaction with their service and with us."
- "The PI System allows us to make correct decisions and apply the proper solution the first time rather than solving a problem through trial and error."
- "It is our source for the data we need to do our job."
- "We use the PI Server data to prepare the 5 year budget. This budget is about $100 million per year. With PI Server data, we can confidently time the projects so that we spend the money when necessary."

Planning with the PI System

Case Study – Should we replace a Substation?

Motivations are:

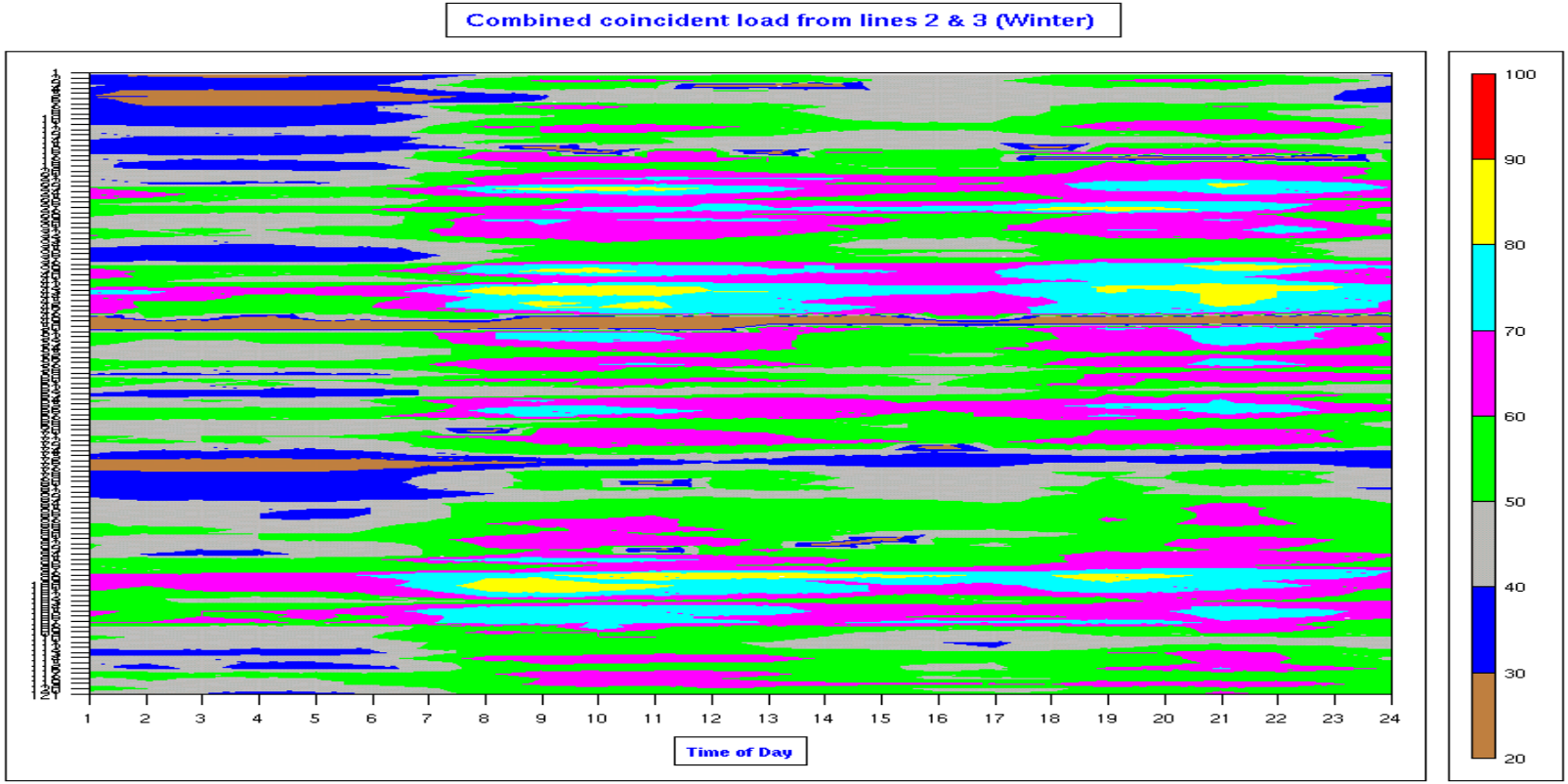
- Old Substation
- Isolated location
  - Difficult to service during winter months
- High Maintenance Cost $
  - Old equipment

Is best alternative to build a new sub?
(Four 12kv lines x $1.5 Million/mile)

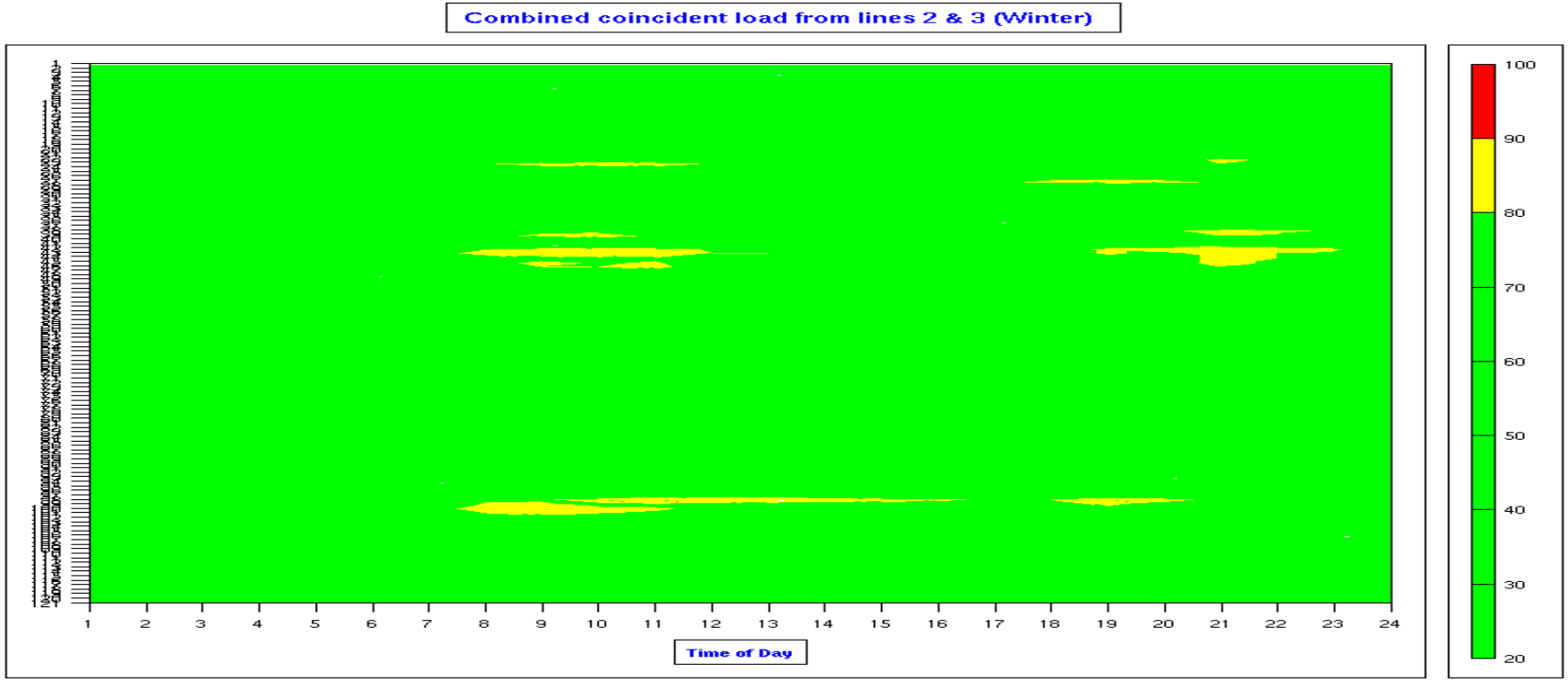
Line	Normal Capacity	Peak Load
1	10000	3300
2	8000	4400
3	8000	5500
4	8000	2900
Total		16100

9900>8000

Planning with the PI System



Planning with the PI System: Case Study – Replace Substation?



Planning with the PI System: Case Study – Replace Substation?

- YES, but build it smarter with the PI System!
  - New Substation – but now with only two 12 kV lines
    - We combined loads from #2 and #3 lines
    - We combined loads from #1 and #4 lines
    - 2 MW was transferred to an adjacent line

  ✓ Saved $1,500,000 at the sub by not building four - 12 kV lines & terminals (because we combined the four lines into 2 lines)

Electrical Engineering made easy(er) with the PI System

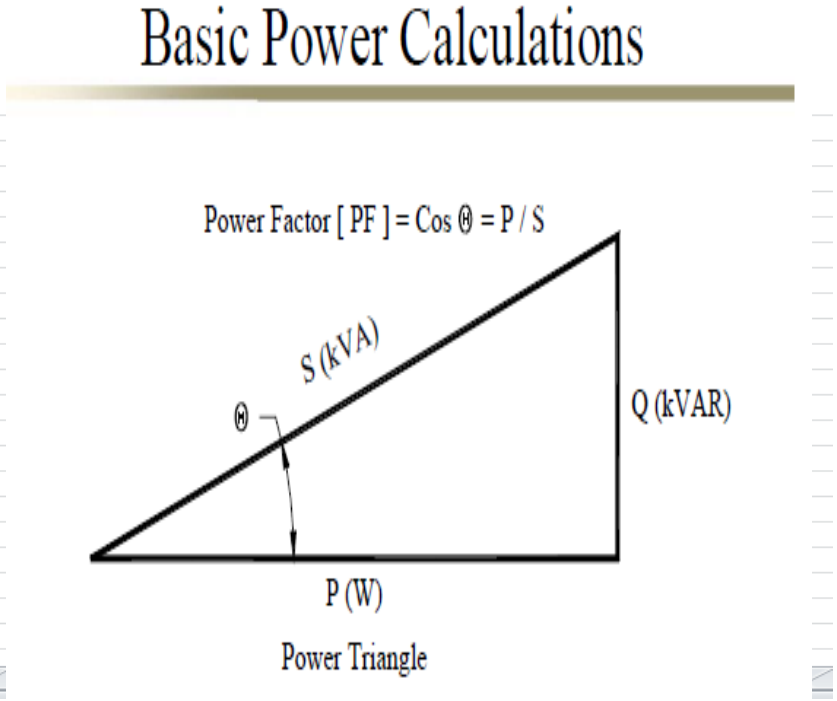
- Example: Local Amusement Park
  - Large Motors and Pumps = Large Power Factor

Electrical Engineering made easy(er) with the PI System

- Using PI DataLink to quickly determine Capacitor Bank size
- Makes for happier (large industrial) customers and cost savings for us!

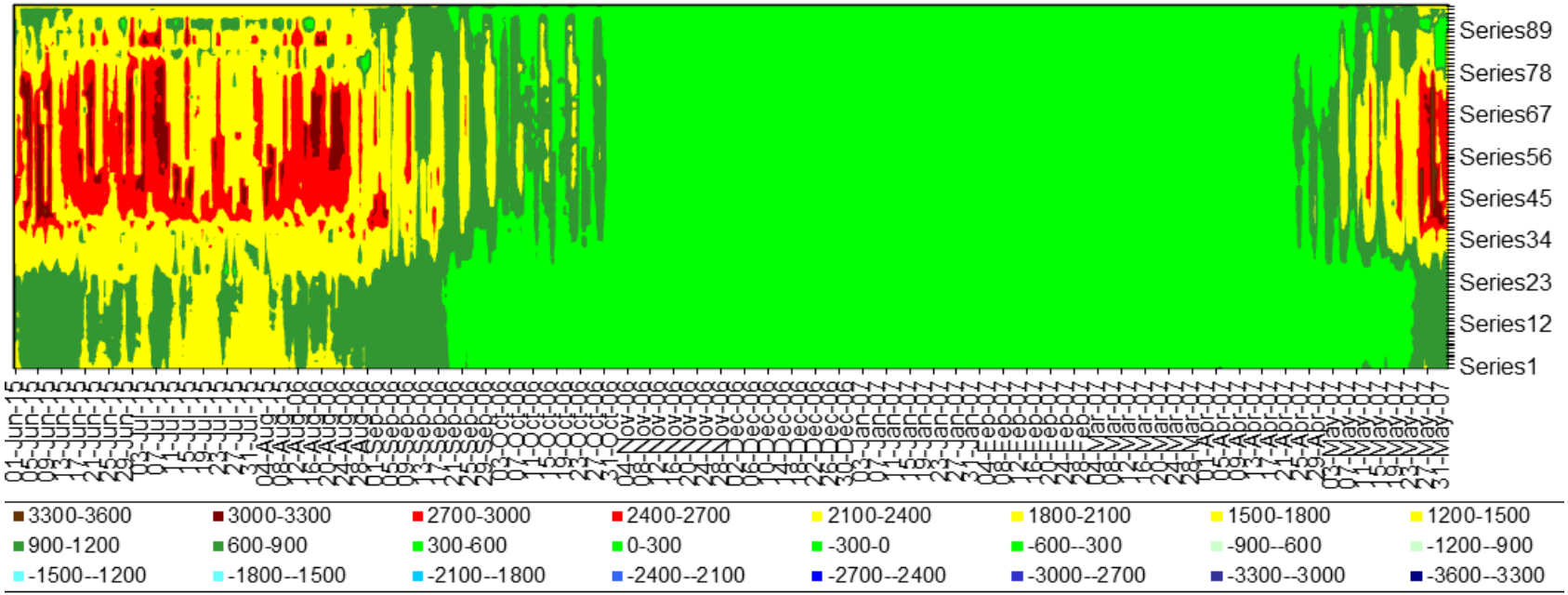
FIX CAPS		
SWT CAPS1	-1900	
START TIME1	7:00	01-Jun-15
END TIME1	23:59	02-Jun-15
SWT CAPS2	0	03-Jun-15
START TIME2	7:00	04-Jun-15
END TIME2	21:00	05-Jun-15
SWT CAPS3	0	06-Jun-15
START TIME3	5:30	07-Jun-15
END TIME3	20:00	08-Jun-15
SWT CAPS4	0	09-Jun-15
START DATE1	5/29/2015	10-Jun-15
END DATE1	9/6/2015	11-Jun-15
START DATE2		12-Jun-15
END DATE2		13-Jun-15
START TIME		14-Jun-15
END TIME		15-Jun-15
SWT CAPS4	0	16-Jun-15
Load	600	17-Jun-15
		18-Jun-15
		19-Jun-15
		20-Jun-15

Chart1 | MVAR SHEET | DAILY MVAR AFTER CAPS



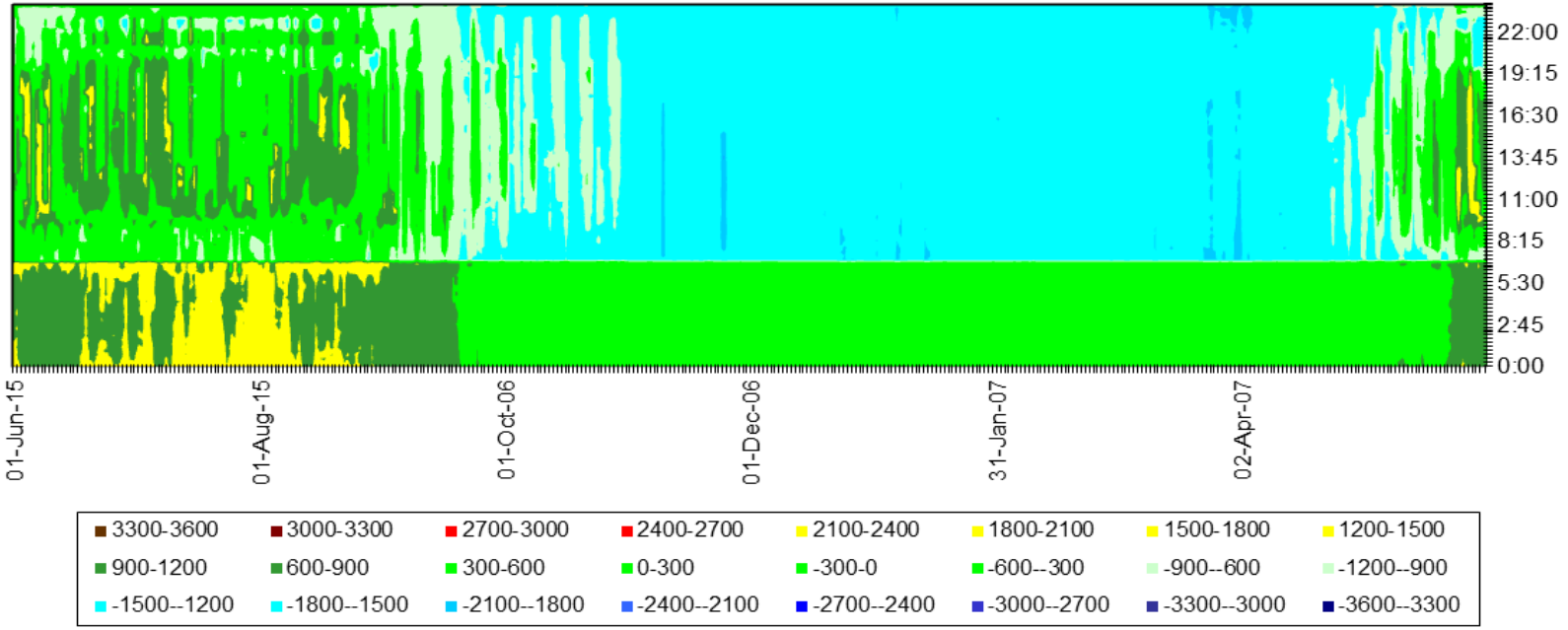
Electrical Engineering made easy(er) with the PI System

- Example: Local Amusement Park
- Large Motors and Water Pumps = Large Power Factor



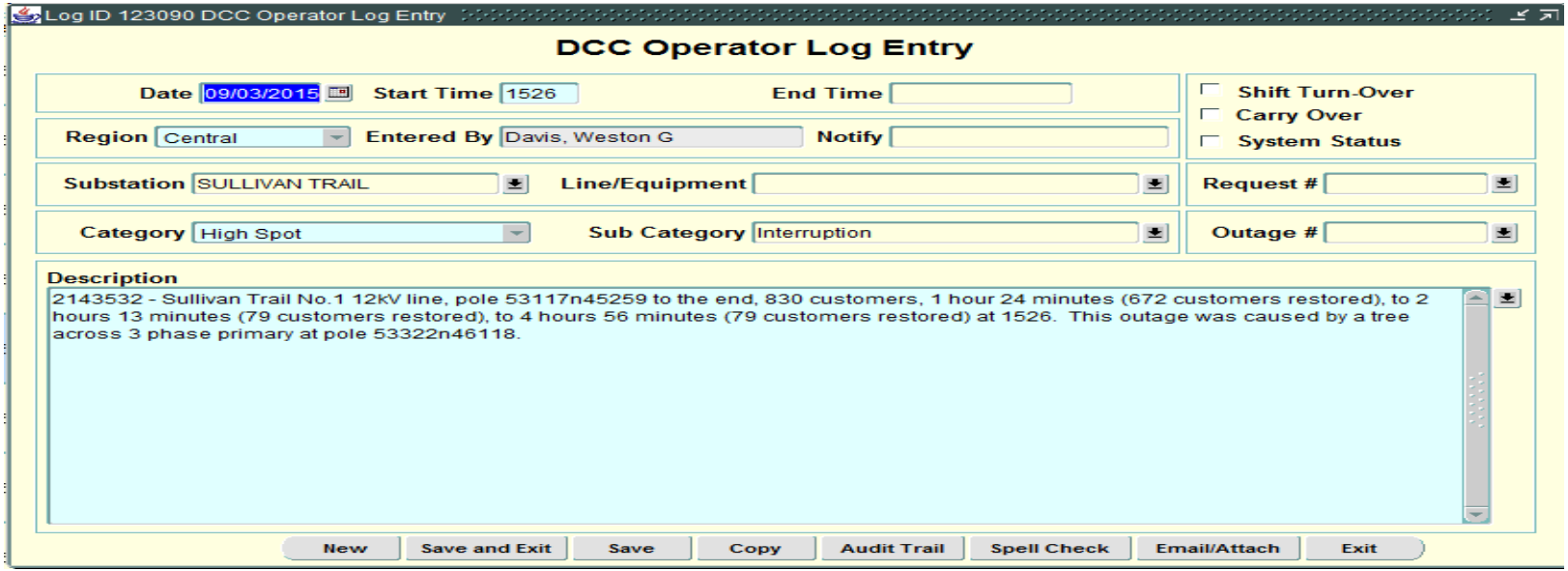
Electrical Engineering made easy(er) with the PI System

- Example: Switching in 1900 mVar Capacitor Bank



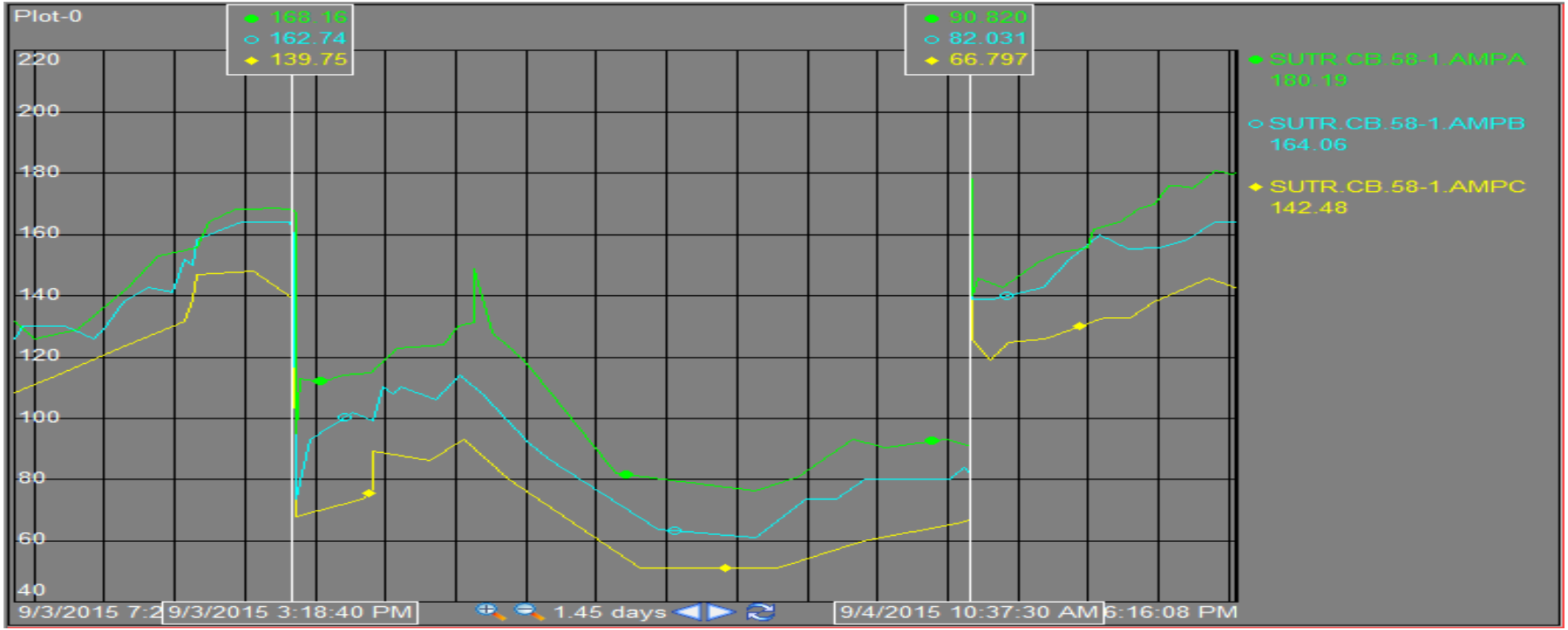
System Operations and the PI System

- The PI System assisting System Operations with restoring power after tree falls across 3 Phase Primary at pole



System Operations and the PI System

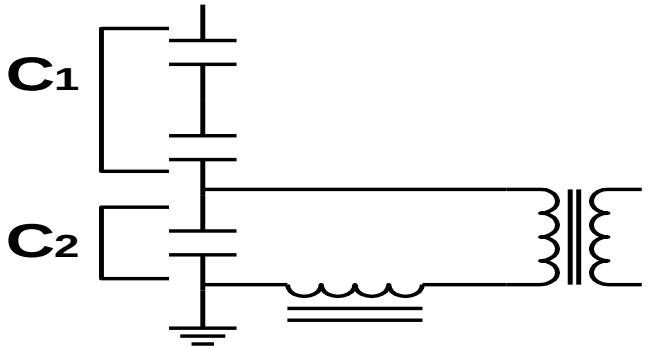
- PI ProcessBook depicting outage and power restoration



Operation & Failure Monitoring of CCVTs using the PI System

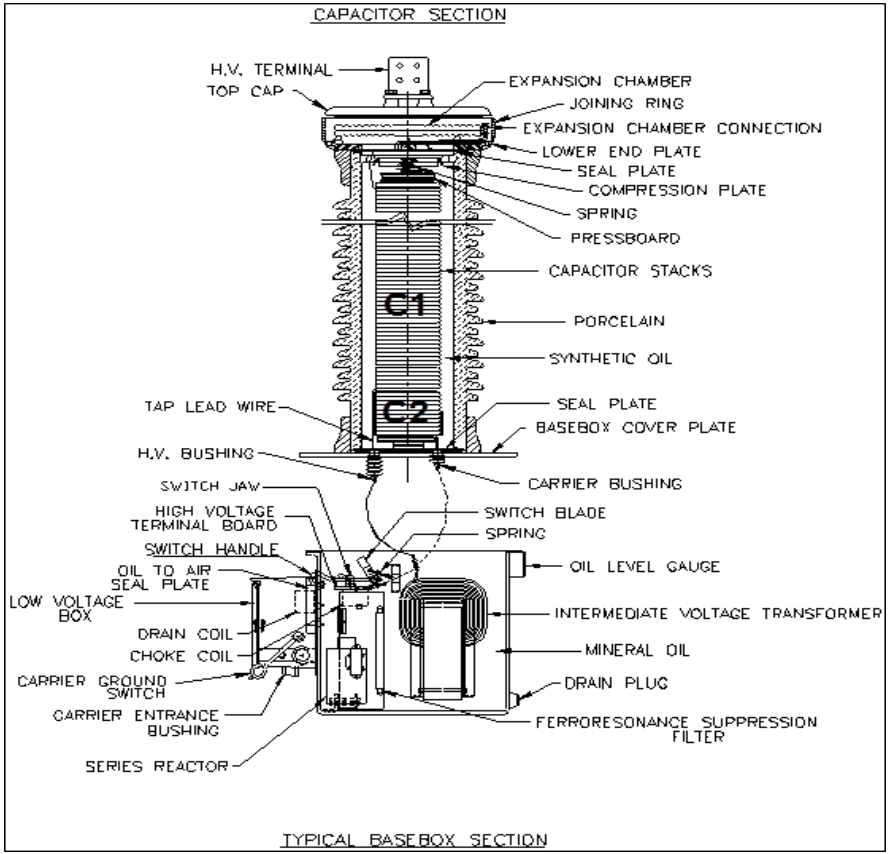
Typical CCVT Construction

Simplified Schematic Diagram



$$V_{secondary} = V_{primary} / Ratio$$

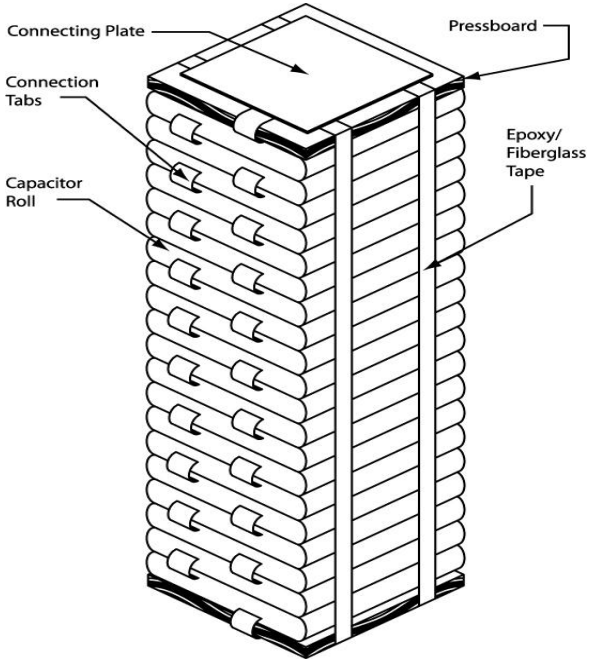
$$Ratio = \frac{(C1+C2)* N_{HV}}{C1*N_{LV}}$$



Operation & Failure Monitoring of CCVTs using the PI System

Typical CCVT Failure Mechanism

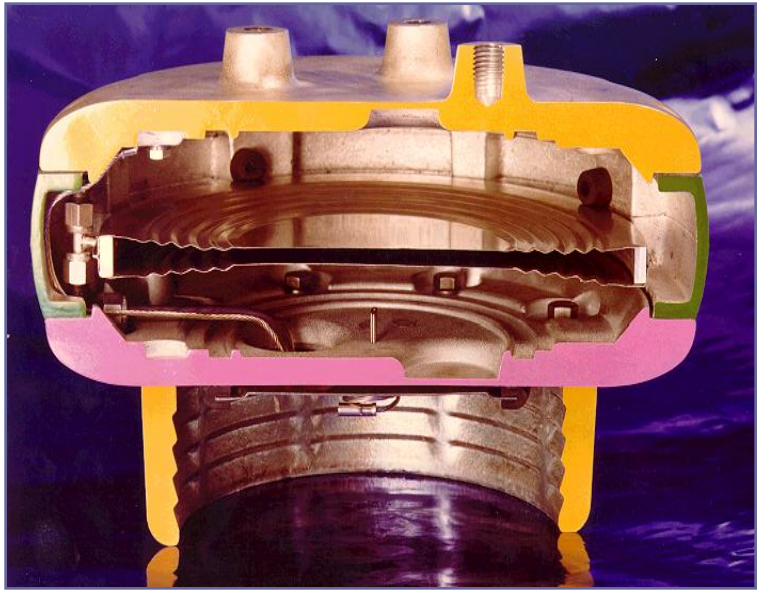
- The most common failure mechanism of a CCVT is dielectric failure (short circuiting) of individual capacitor elements.
- Capacitor element failure results in a change in output voltage.
- Manufacturers recommend replacement of a CCVT when the output voltage changes by more than 2 - 4%.



Operation & Failure Monitoring of CCVTs using the PI System

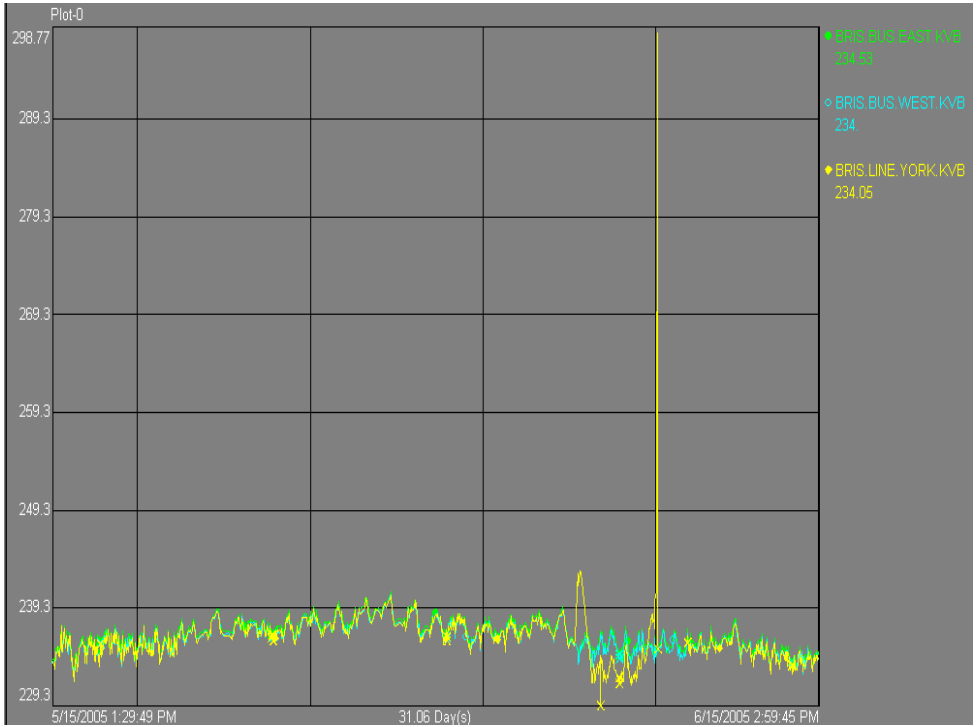
- Micro arcing will generate combustible gas from breakdown of the oil.
- Carbon in the oil will contaminate neighboring capacitor elements. Micro arcing also generates electrical transients in the capacitor stack stressing all capacitor elements
- As more capacitor elements fail, more stress is placed on the remaining elements until a rapid cascading failure develops.
- Finally, a power arc ensues in the oil and a supersonic pressure wave violently fractures the porcelain.

Bellows and Puncture Pin



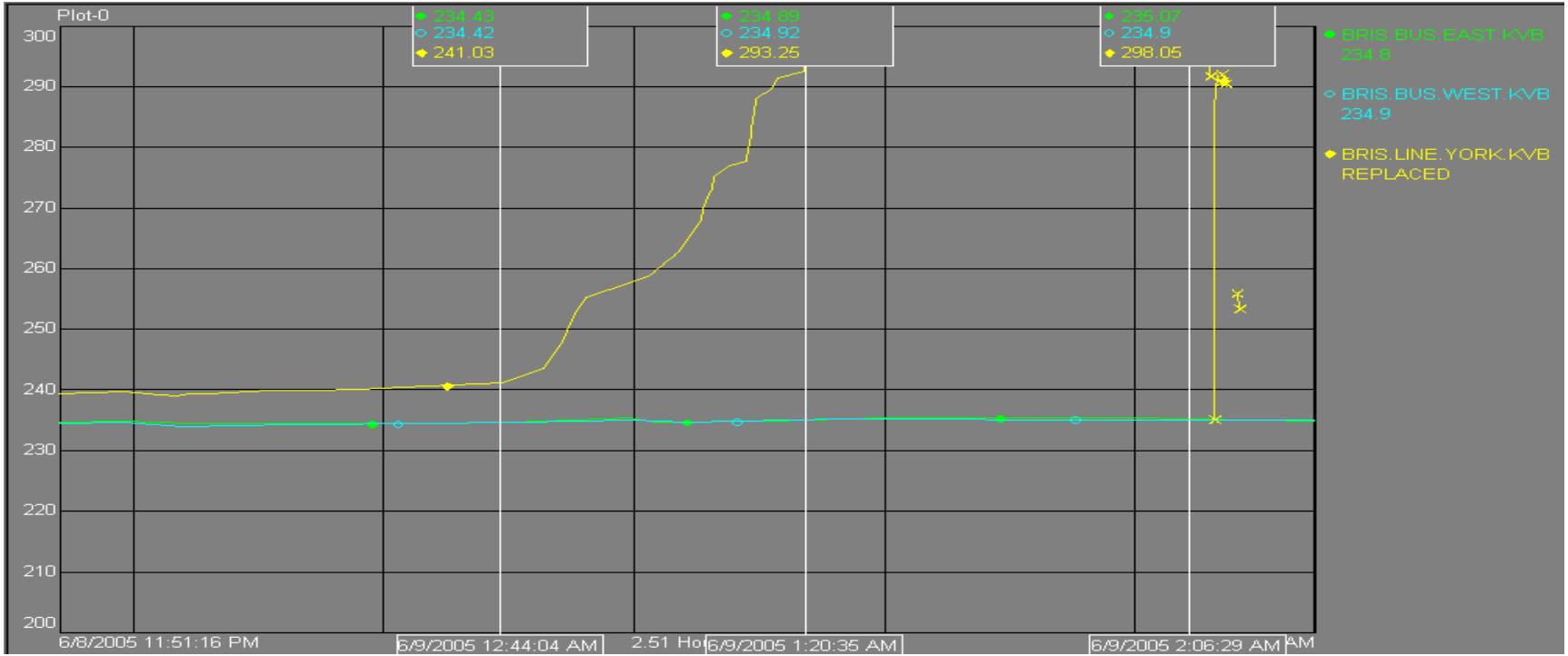
Operation & Failure Monitoring of CCVTs using the PI System

Identifying Critical System Changes with PI ProcessBook trending imminent failure of CCVT



If a tree falls in the woods does it make a sound…??

The PI System was telling us the CCVT was about to fail but no one was listening



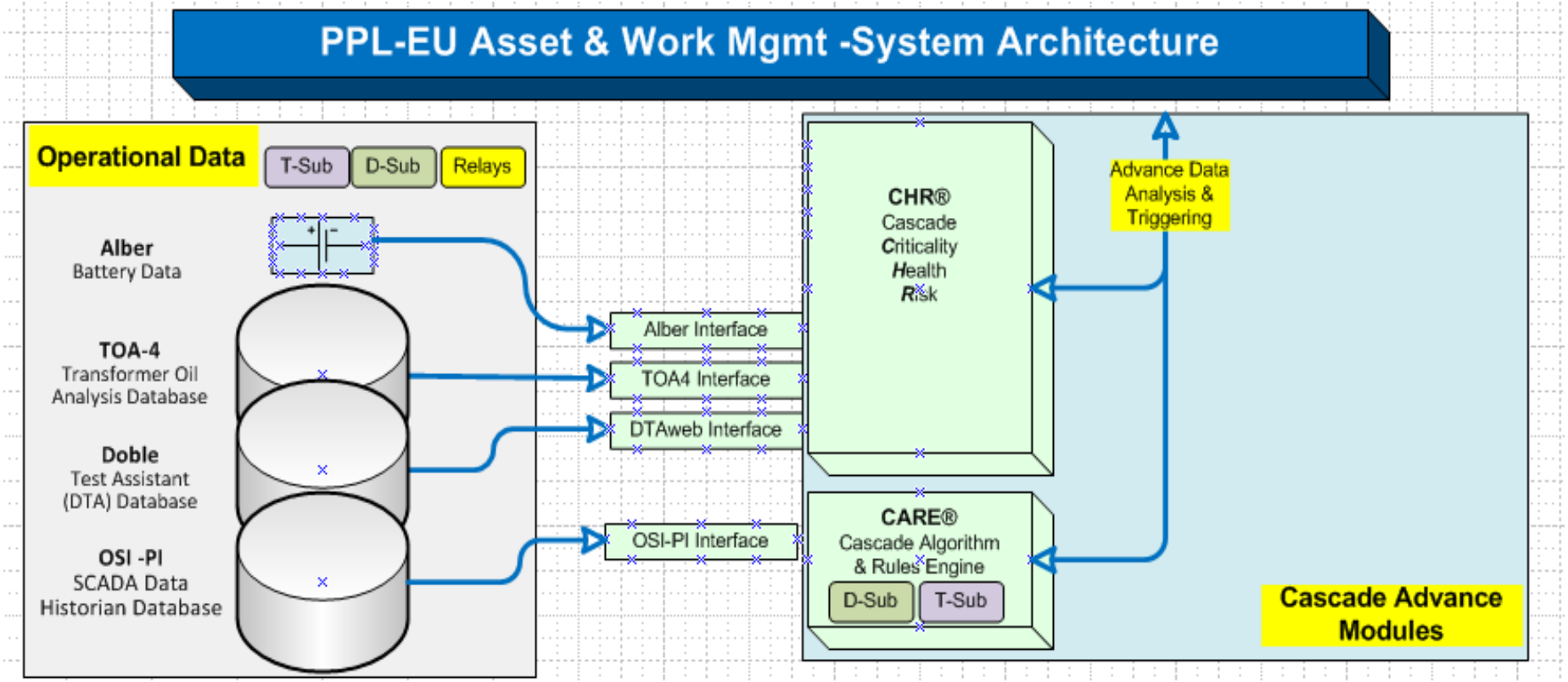
Resulting damage to substation equipment due to CCVT failure

New Alarm Guidelines

Early detection of SCADA Alarm Levels are now available to System Operators

- A change in voltage level (high or low from Average) is an indicator of a change
- Multiple alarms within one-half hour is a basis to remove the CCVT from service
- Future Implementation: Use AF / Notifications to detect then notify the Substation Engineering Team to investigate

New Predictive Maintenance DB Utilized (CASCADE)



- CASCADE is a registered trademark of Digital Inspections

Benefits of the PI System

Other examples where the PI System helped PPL save money:

- Deferred a $1,500,000 Transformer upgrade by 8 years
  - $1,200,000 savings in Carrying Charges
- Deferred a $15.5 million Transmission project by 8 years
  - $12 million savings in Carrying Charges
- Deferred a $7 million Substation by 8 years
  - $5.5 million savings in Carrying Charges

Summary

Where do we go from here?

- Upgrade to PI System 2015 across PPL
- Leverage AF and Notifications
- Deploy PI Coresight to more customers
- Explore Enterprise Agreement

PPL is successfully leveraging PI System technology resulting in:

- ✓ Increased Profitability for PPL !

Contact Information

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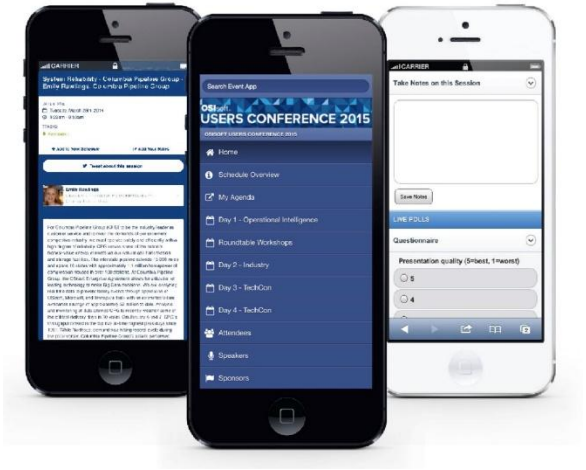
Questions

Please wait for the **microphone** before asking your questions

State your
name & company

Please don't forget to…

Complete the Online Survey for this session



http://eventmobi.com/emeauc15

감사합니다

谢谢

Danke

Gracias

Merci

Thank You

ありがとう

Спасибо

Obrigado

FIN