Regional Seminar Series
Atlanta

Using PI data/events for Asset Maintenance

Gopal GopalKrishnan
OSIsoft, LLC.

October 22, 2009

Empowering Business in Real Time.

What I want to convey

Key Message

- Get more value from PI by using operations data/events in Asset Maintenance

Use cases showing benefits (Detroit Edison and Basin Electric - power generation)

- Usage and condition based maintenance
- Common asset naming convention between PI and Maintenance

Eliminate risk

- Back-test, validate and predict savings even before deployment

Been there and done that ($$$$ Savings)

- PSE&G use cases - live since 2002
- Cytec use cases – live since 2004

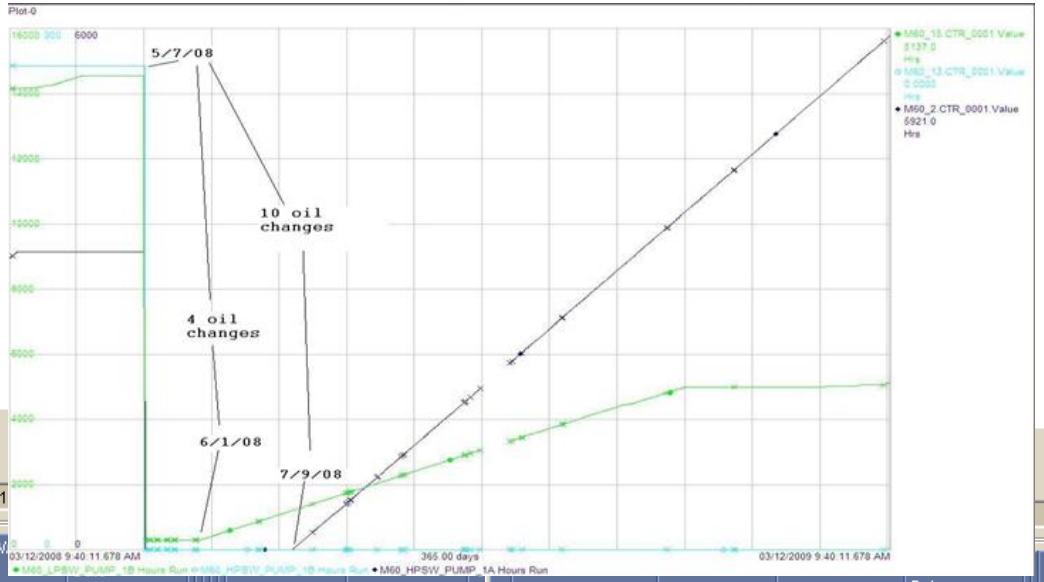
Maintenance can be Corrective or Preventive

- Corrective – this is after failure
- Preventive – this is before failure
  - Uses proactive and predictive strategies
  - Calendar based - ignores equipment utilization pattern
  - Condition based – aware of equipment conditions and utilization
    - Usage based (PI data & PI analysis)
    - Equipment condition based (PI data & PI analysis)
    - Overall Equipment health index (PI data + other data… age, criticality, lubricant oil analysis, dissolved gas analysis…)

Service water pump - calendar based PM ignores equipment usage pattern

Pumps were off for an extended period, however the PM WO still went out

Save 28 PM hours with usage based PM instead of calendar based



PMRQ: 00011158 01

Title: UNIT 1 HPSW PUMPS - PMID 11

Status: ACTIVE Execute

*	PM Gen WO No.	Complete Date	Credit W		
	40570635	07/23/2008		07/23/2008	07/25/2008
	40569808	07/16/2008		07/16/2008	07/18/2008
✓	40568850	07/09/2008		07/09/2008	07/11/2008
✓	40567774	07/02/2008		07/02/2008	07/04/2008
✓	40566242	06/24/2008		06/24/2008	06/27/2008
✓	40565071	06/18/2008		06/18/2008	06/20/2008
✓	40563940	06/10/2008		06/10/2008	06/13/2008
✓	40562894	06/03/2008		06/03/2008	06/06/2008
✓	40561747	05/29/2008		05/29/2008	05/30/2008
✓	40560634	05/20/2008		05/20/2008	05/23/2008
✓	40559666	05/14/2008		05/14/2008	05/16/2008
✓	40558644	05/09/2008		05/09/2008	05/09/2008
	40557601	05/01/2008		05/01/2008	05/02/2008
	40556368	04/23/2008		04/23/2008	04/25/2008
	40555216	04/23/2008		04/23/2008	04/18/2008

			Date	Due Date	Late Due Date	Cancel Code	Defer/Cancel Date
	40570636	07/23/2008	07/23/2008	07/25/2008			
	40569809	07/16/2008	07/16/2008	07/18/2008			
	40568851	07/09/2008	07/09/2008	07/11/2008			
	40567775	07/02/2008	07/02/2008	07/04/2008			
	40566243	06/24/2008	06/24/2008	06/27/2008			
	40565072	06/18/2008	06/18/2008	06/20/2008			
	40563941	06/10/2008	06/10/2008	06/13/2008			
	40562895	06/03/2008	06/03/2008	06/06/2008			
	40561748	05/29/2008	05/29/2008	05/30/2008			
	40560635	05/20/2008	05/20/2008	05/23/2008			
	40559667	05/14/2008	05/14/2008	05/16/2008			
	40558645	05/09/2008	05/09/2008	05/09/2008			
			05/01/2008	05/02/2008			
			04/23/2008	04/25/2008			
			08/19/2008	04/18/2008			

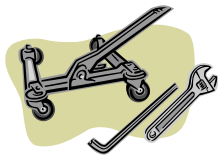
Calendar based PMs

Different types of usage based maintenance

- PI totalizer
- PI time-filtered conditional expressions (time-weighted and event-weighted)

- Run-hours
  - Coal feed conveyor
  - Pulverizer (Amperage > 0)
  - High pressure service water pumps

- Run-modes
  - number of starts (peaker combustion turbine (CT) blades)
  - number of trips
- Run-weight
  - tonnage processed (mining industry)
  - flow-rate (time-integral) converted to volume



Validate usage based strategy - Pulverizer

Maintenance: 160 PM hours per pulverizer per year; 16 pulverizers per site, 6 sites

Actual runhours: 80% based on PI data, implies a 20% savings

Projected savings: 480+ PM hours (about $25K at $50/hr) per site per year

PI TAG		DELIMITER FOR RUNNING OR NOT		Frequency	DATE	DATE	VARIABLE	PM GENERATED	variable by	
2M1009:AMP	02M1009	'2M1009:AMP'>10	>10				299.35	USE EXCEL AND MANUAL COUNT TO FIND OUT WHEN A PULVERIZER IS ABOUT TO HAVE RUN 4000 HOURS		82.0%
2M1010:AMP	02M1010	'2M1010:AMP'>10	>10				273.68	USE EXCEL AND MANUAL COUNT TO FIND OUT WHEN A PULVERIZER IS ABOUT TO HAVE RUN 4000 HOURS		75.0%
2M1011:AMP	02M1011	'2M1011:AMP'>10	>10				189.36	USE EXCEL AND MANUAL COUNT TO FIND OUT WHEN A PULVERIZER IS ABOUT TO HAVE RUN 4000 HOURS		51.9%

	PMNUM	pm desc	FR	FREQUNIT	CRAF	LABO	CREWID	JPNUM	jp descri	
	10001951	YELLOW MILL COAL PULVERIZER LUBE OIL PUMP(01P100	2	MONTHS	OPER	1	OPS1	20003380	MILL CO	
	10002250	YELLOW COAL MILL DAMPER OIL CHANGES. OUTAGE OF	1	YEARS	OPER	6	OPS5	20058889	COAL M	
2M1012	10002544	YELLOW COAL PULVERIZER, CLEAN AFTER 6000 HR. INS	6	MONTHS	OPER	2	OPS6	20003425	COAL P	86.0%
	10002680	CALIBRATE MOTOR CURRENT INDICATION (PERIODIC) 4	4	YEARS	ENG	2	PERT	20038712	CALIBRA	
	10002812	YELLOW COAL MILL DRIVE GEAR GREASING. SEMI-ANNU	6	MONTHS	OPER	0.5	OPS5	20058888	COAL M	
	10004420	YELLOW COAL MILL 6000 HR LUBRICATION, OUTAGE OPI	3	MONTHS	OPER	4	OPS5	20058891	COAL M	
2M1013	10005953	YELLOW COAL MILL DAMPER LUBE CHECKS, QUARTERL	3	MONTHS	OPER	2	OPS5	20058887	COAL M	84.0%
	20014282	OBTAIN OIL SAMPLES FROM ALL WEST SIDE COAL MILLS	0	MONTHS	OPER	1	OPS1	21042975	COAL M	
	20014293	ROD OUT WITH BRUSH AND BLOW BACK PITOT TUBES I	0	DAYS	TECHI	2	INST	20002673	ROD OU	
	20014295	COAL MILL DAMPER LUBE CHECKS	3	MONTHS	OPER	2	OPS1	20058887	COAL M	
	20014296	COAL MILL, 6000 HR LUBRICATION	2	YEARS	OPER	4	OPS5	20058896	GRAY C	
2M1014	20014297	OBTAIN 1 120CC OIL SAMPLE FROM SAMPLE TAPS AT OIL	0	MONTHS	OPER	1	OPS1	21000063	TAKE OI	84.9%
	20014298	OBTAIN 1 120CC OIL SAMPLE FROM THRUST BEARING O	0	MONTHS	OPER	1	OPS1	21000063	TAKE OI	
	20012436	Perform full spectrum vibration monitoring. Establish baseline	1	MONTHS	ENG	1	MPDM	21000061	VIBRATI	
	20012437	Perform thermographic inspection.	3	MONTHS	ENG	1	MPDM	21000066	THERMO	
1M1007	20012438	OPERATIONS - COAL MILL, 6000 HR LUBRICATION, OUTA	8	MONTHS	OPER	1	OPS1	21007394	OPERAT	0.1%
	20012441	OPERATIONS: GREASE LUBE OIL PUMP BEARINGS.	5	YEARS	OPER	1	OPS1	21007375	OPERAT	
	20010570	Perform full spectrum vibration monitoring. Establish baseline	1	MONTHS	ENG	1	MPDM	21000061	VIBRATI	
	20010571	Perform thermographic inspection.	1	MONTHS	ENG	1	MPDM	21000066	THERMO	
1M1008	20010572	OPERATIONS: COAL MILL DRIVE GEAR GREASING, GREA	6	MONTHS	OPER	1	OPS1	21007455	OPERAT	66.5%
	20010537	TES GROUP: PERFORM CRACKED ROTOR CHECK. MO	1	YEARS	ENG	4	PERT	21007412	TES GR	
	20010556	OPERATIONS: CHANGE OIL IN MILL MOTOR BEARINGS, C	2	YEARS	OPER	1	OPS1	21007082	CHANGE	
	20010557	FUTURE: MAINTAIN EXTRA MILL MOTOR ON SITE IN STOF	1	YEARS	CSUPV	0	WHSE	21007459	FUTURE	
	20010558	OBTAIN 1 120CC OIL SAMPLE FROM THRUST BEARING O	0	YEARS	OPER	1	OPS1	21000063	TAKE OI	
1M1009	20010573	Perform Motor circuit evaluation. Establish action levels. Trend	1	YEARS	ENG	4	PERT	21000050	MOTOR	61.9%
	20010574	PERT: CALIBRATE MOTOR CURRENT INDICATION (PERIC	4	YEARS	TECHI	4	PERT	21000055	CALIBRA	
	20010575	Perform full spectrum vibration monitoring. Establish baseline	1	MONTHS	ENG	1	MPDM	21000061	VIBRATI	
	20010576	Perform thermographic inspection.	3	MONTHS	ENG	1	MPDM	21000066	THERMO	
	20010577	OBTAIN OIL SAMPLES, YELLOW COAL MILL MOTOR	0	YEARS	OPER	1	OPS1	21000063	TAKE OI	

Validate usage based strategy - Coal conveyor

Maintenance: 60 PM hours per conveyor per year; 22 conveyors per site, 6 sites

Actual runhours: 25% based on PI data, implies a 75% savings

Projected savings: 900+ PM hours (approx. $45,000 at $50/hr) per year per site

	PI TAG		DELIMITER FOR RUNNING OR NOT		Frequency	START DATE	FINISH DATE	RUNNING VARIABLE	HOW IS THE CURRENT PM GENERATED
									USE EXCEL AND MANUAL COUNT
18	FS_1,DI,432	FE101	('FS_1,DI,432')="RUNNING"	"RUNNING"				3849.906389	
19	FS_2,DI,432	FE102	('FS_2,DI,432')="RUNNING"	"RUNNING"				2634.860278	
20	FS_1,DI,63	CV101	('FS_1,DI,63')="RUNNING"	"RUNNING"				2942.039167	
21	FS_2,DI,63	CV102	('FS_2,DI,63')="RUNNING"	"RUNNING"				2143.709444	
22	FS_1,DI,77	CV103	('FS_1,DI,77')="RUNNING"	"RUNNING"				1511.963611	
23	FS_2,DI,77	CV104	('FS_2,DI,77')="RUNNING"	"RUNNING"				1184.925556	
24	FS_1,DI,92	CV105	('FS_1,DI,92')="RUNNING"	"RUNNING"				1974.299722	
25	FS_2,DI,92	CV106	('FS_2,DI,92')="RUNNING"	"RUNNING"				1396.757778	
26	FS_1,DI,109	CV107	('FS_1,DI,109')="RUNNING"	"RUNNING"				1634.999722	
27	FS_1,DI,122	CV108	('FS_1,DI,122')="RUNNING"	"RUNNING"				1825.271111	
28	FS_1,DI,157	CV109	('FS_1,DI,157')="RUNNING"	"RUNNING"				861.23	
29	FS_1,DI,173	CV110	('FS_1,DI,173')="RUNNING"	"RUNNING"				951.8636111	
30	FS_1,DI,141	CV111	('FS_1,DI,141')="RUNNING"	"RUNNING"				2102.226111	
31	FS_2,DI,141	CV112	('FS_2,DI,141')="RUNNING"	"RUNNING"				1440.511944	
32	FS_1,DI,189	CV113	('FS_1,DI,189')="RUNNING"	"RUNNING"				1176.373611	
33	FS_2,DI,189	CV114	('FS_2,DI,189')="RUNNING"	"RUNNING"				886.025	

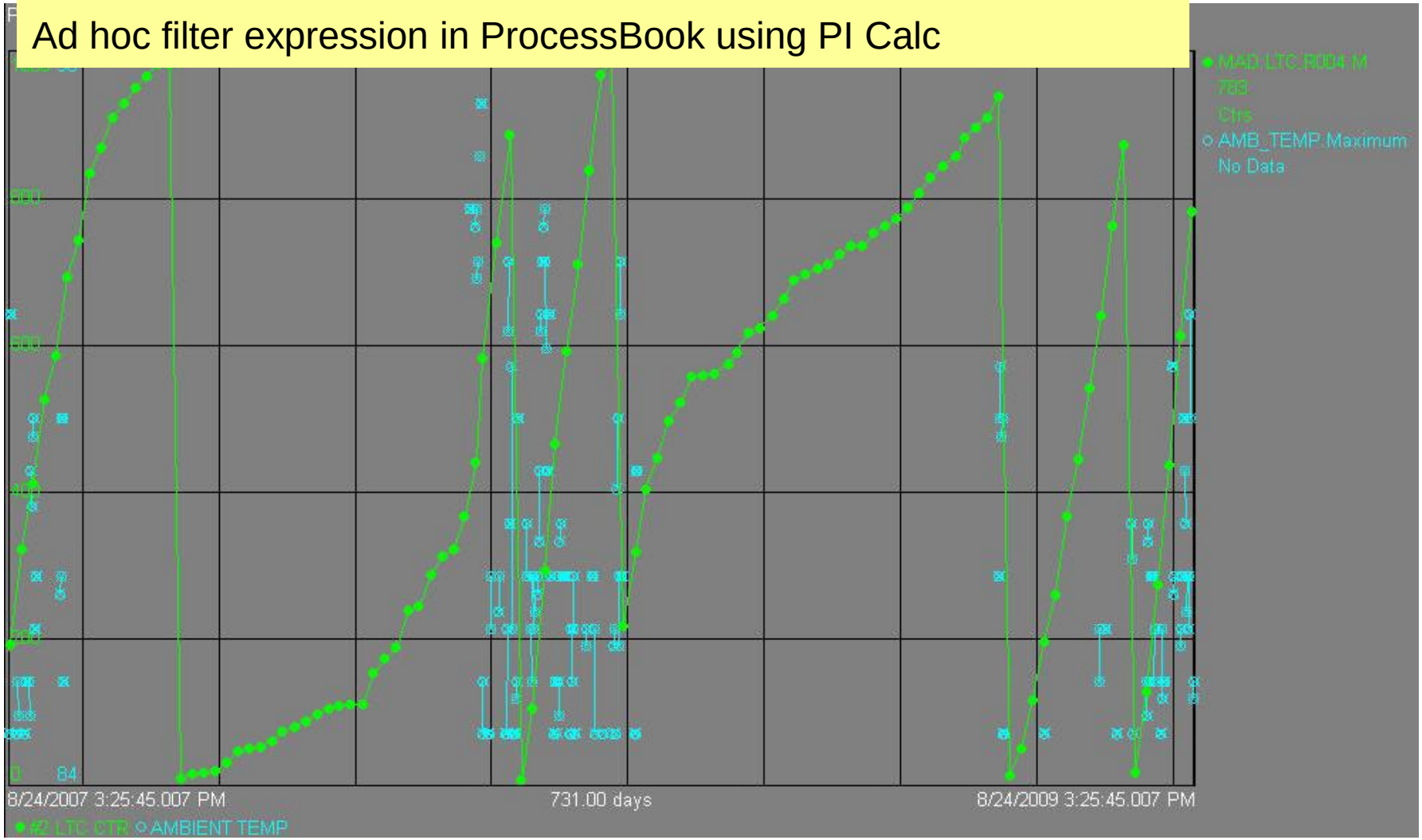
PM Labor hrs by Location

PMNUM	pm desc	FREQUEN	FREQUNIT	LABORHRS	CREWID
10002025	INSP.INSIDE CHUTE AND GATES FOR WEAR. 3CV107,3ZM761,3ZM	6	MONTHS	4	MMILLS
10003498	GREASE HEAD & TAIL END PILLOW BLOCK BEARINGS QUARTER	3	MONTHS	1	OPS6
10004363	INSPECT SCRAPERS,PLOW,SKIRTING,FOR WEAR ECT. 3CV107 S	6	MONTHS	4	MMILLS
10005221	CONV MOTOR COUPLING LUBRICATION ANNUAL, MAINT.	3	YEARS	4	MMILLS
10006415	COUPLING, CONVEYOR FLUID (03CV107111) QUARTERLY, C	3	MONTHS	0.5	OPS6
10007029	GREASE MOTOR BEARINGS (2) SEMI-ANNUAL, MAINTENANCE	1	YEARS	1	MELEC
20016362	Perform vibration monitoring on bearings and gears. Establish baseline	2	YEARS	1	MPDM
20015109	Perform full spectrum vibration monitoring. Establish baseline and actic	2	YEARS	1	MPDM
20015691	Perform IR scan.	1	YEARS	1	MPDM

Load Tap Change (LTC) counter use case

LTC Counter (green) and Daily Max Ambient temperature (blue) for last 2 years - note excessive LTC operations during hotter days

Ad hoc filter expression in ProcessBook using PI Calc



Equipment condition based strategies

- Failure or performance correlated to a slowly degrading metric

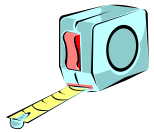
  - Temperature (bearings, motor windings, gas circuit breaker etc.)

  - Pressure or DeltaP (Heat-exchanger plugging, Filters, Nitrogen cylinder low pressure, GCB low pressure

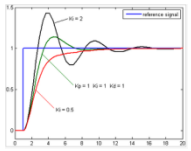
  - Vibration, amplitude (need to interpret along with operations data in PI)

  - Level (Transformer oil tank level too low)

- Instrument and transmitter drift



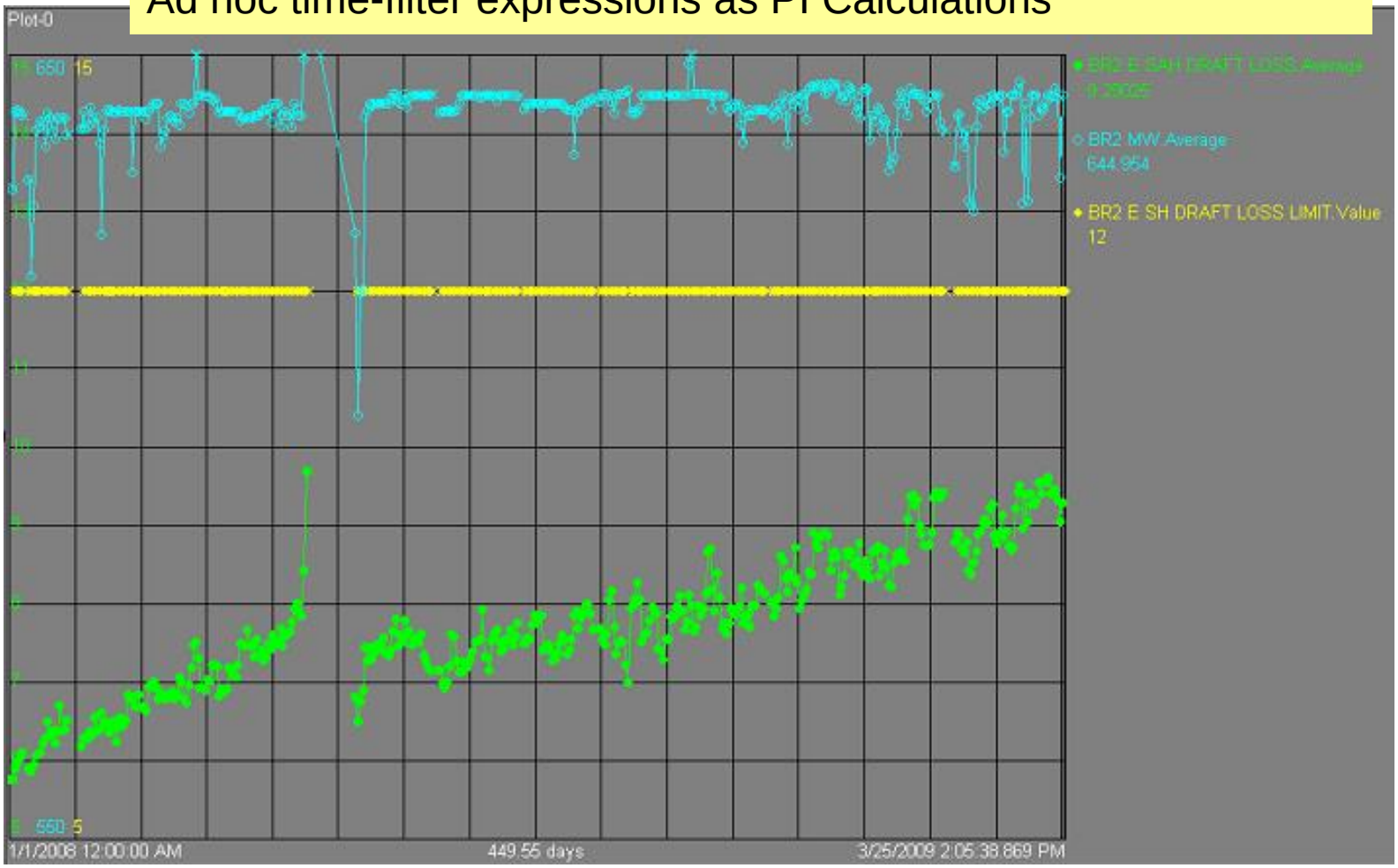
- Control loop health



Secondary air heater plugging

Air heater tube plugging causes DeltaP (green line) to increase over several months and is a trigger for maintenance

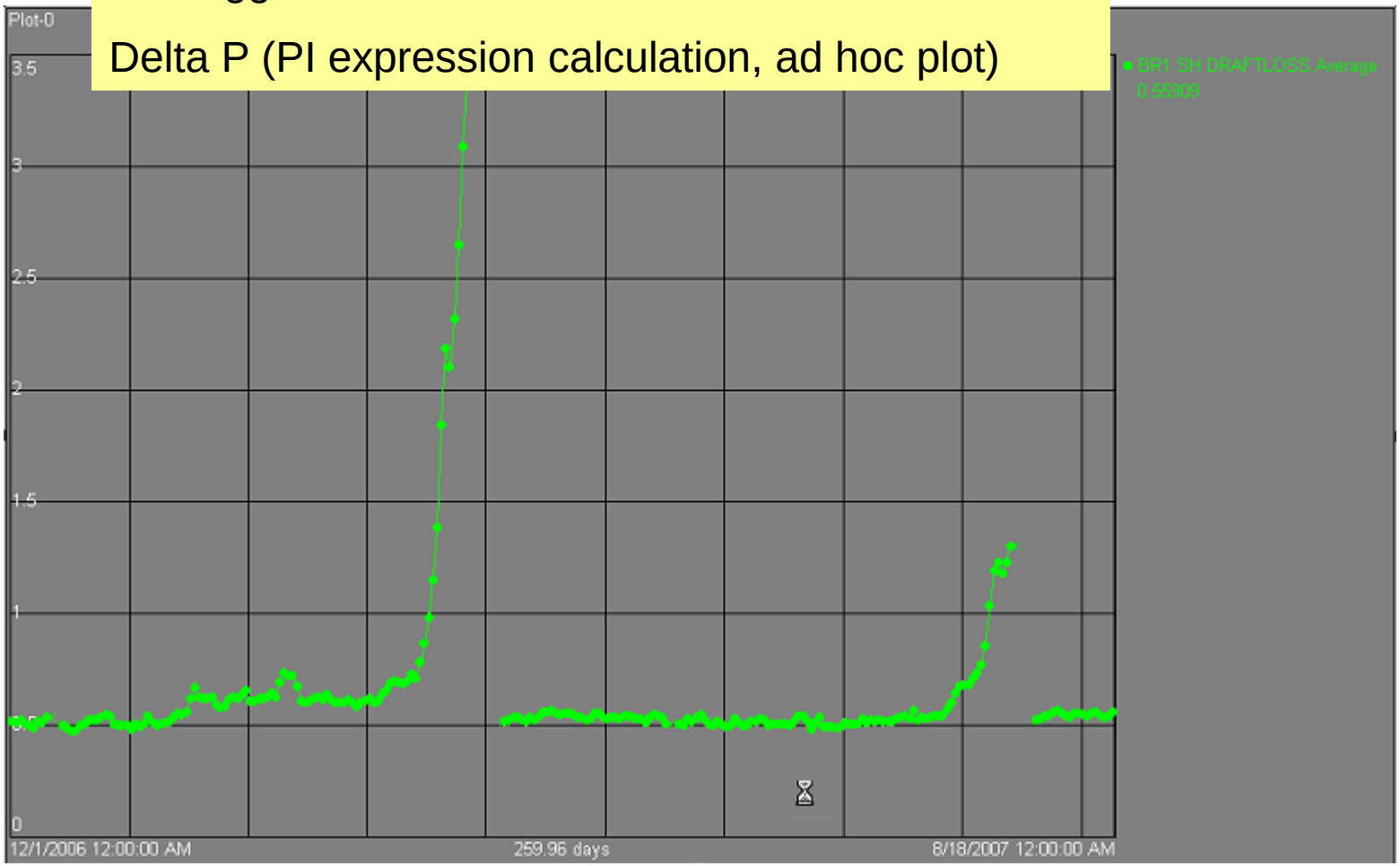
Ad hoc time-filter expressions as PI Calculations



Boiler (convection) tubes plugging

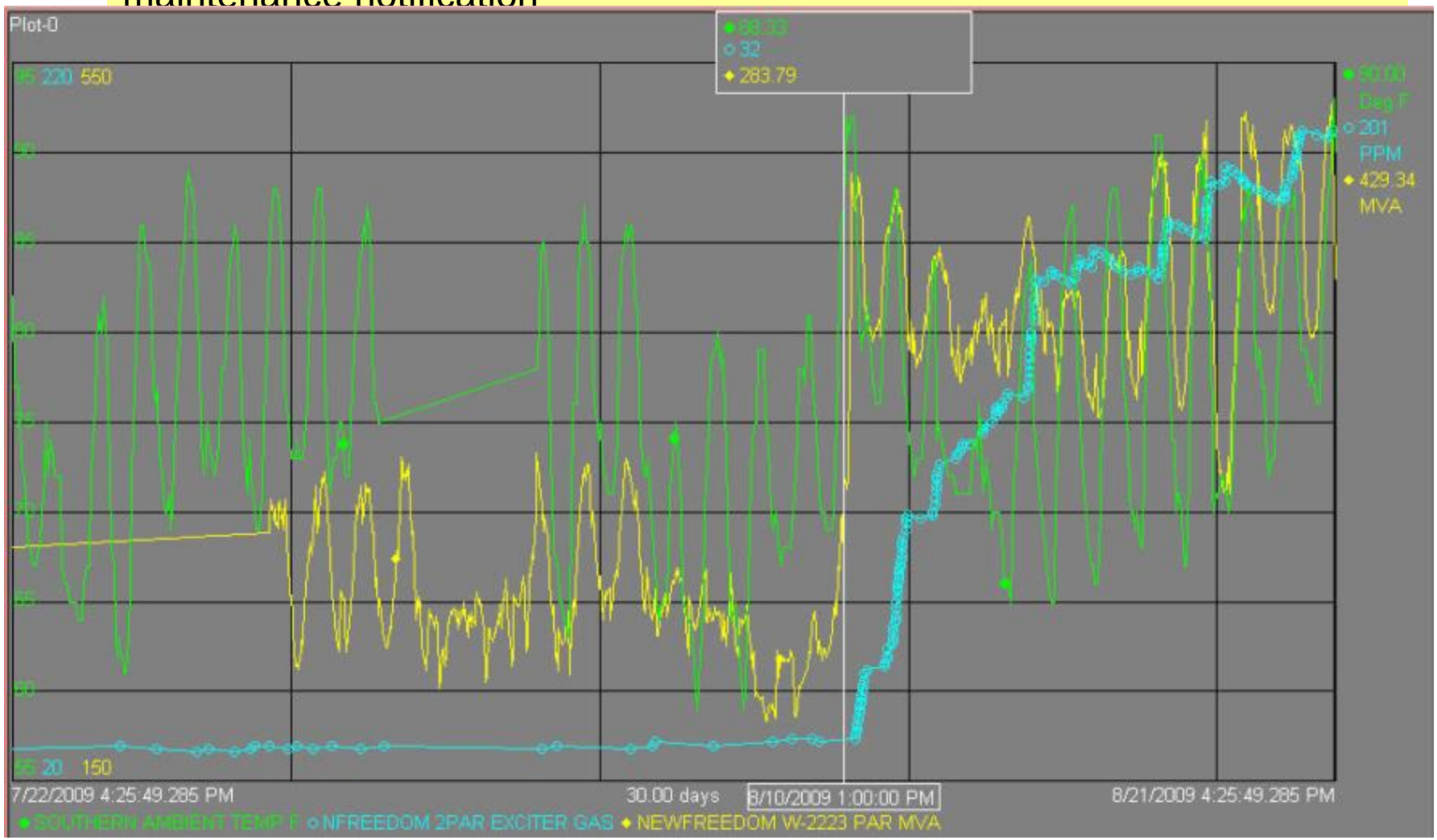
Rapid rate of change of Delta P over several days is a trigger for maintenance

Delta P (PI expression calculation, ad hoc plot)



Transformer Oil - Exciter gas - parts per million

Increasing PPM (over several days) detected which triggers a SAP maintenance notification

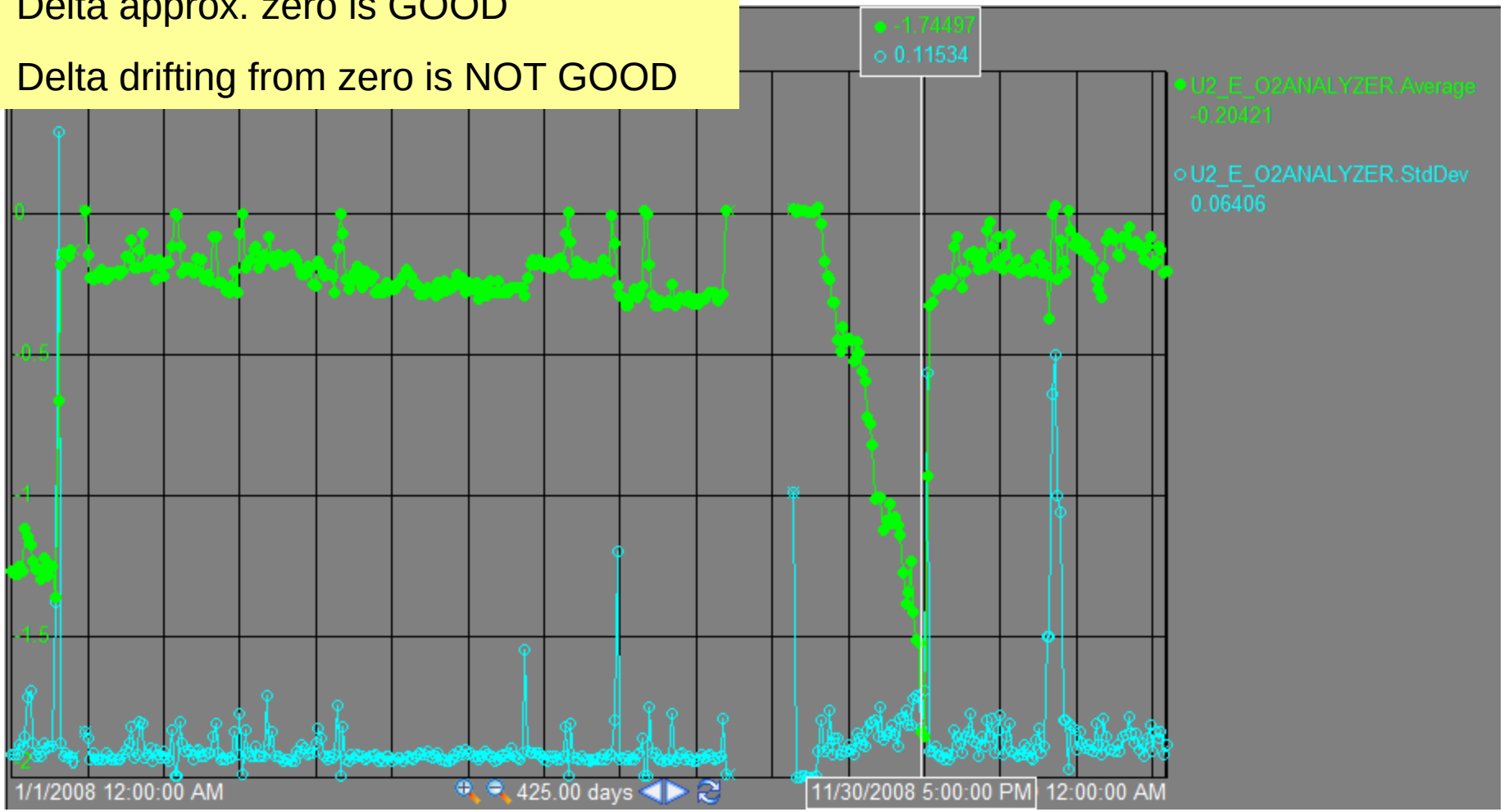


Instrument drift – O2 analyzer

Based on redundant dual sensors

Delta approx. zero is GOOD

Delta drifting from zero is NOT GOOD



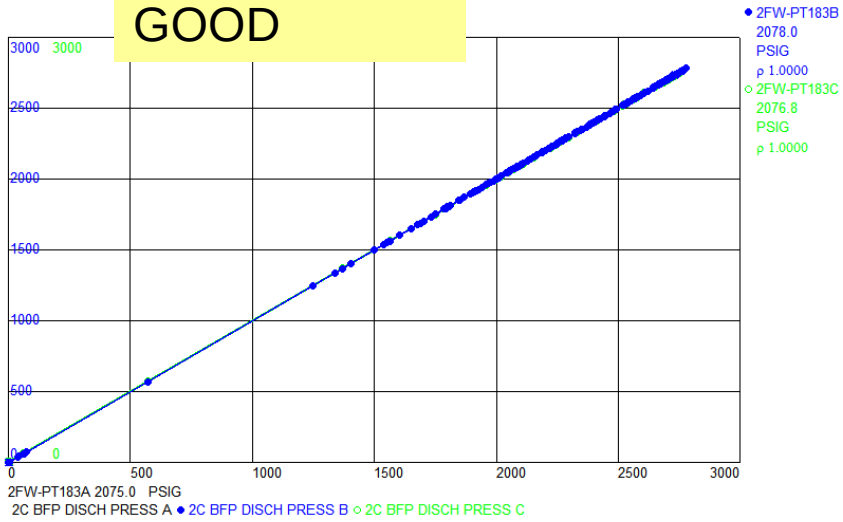
Transmitter drift

Boiler feedwater pump discharge pressure

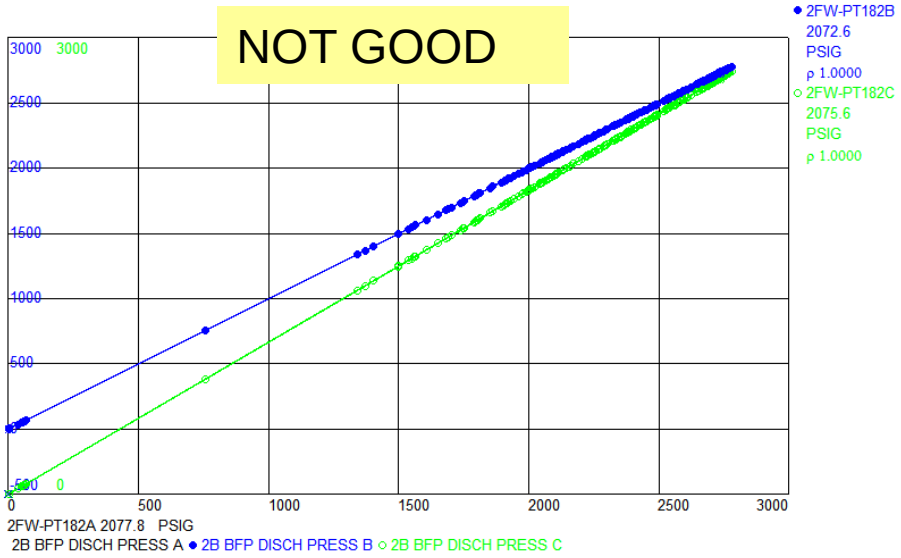
Based on redundant triple transmitters (PressA, PressB and PressC)

XY Plot, PressA (X) vs. PressB (Y1), PressC(Y2)

GOOD



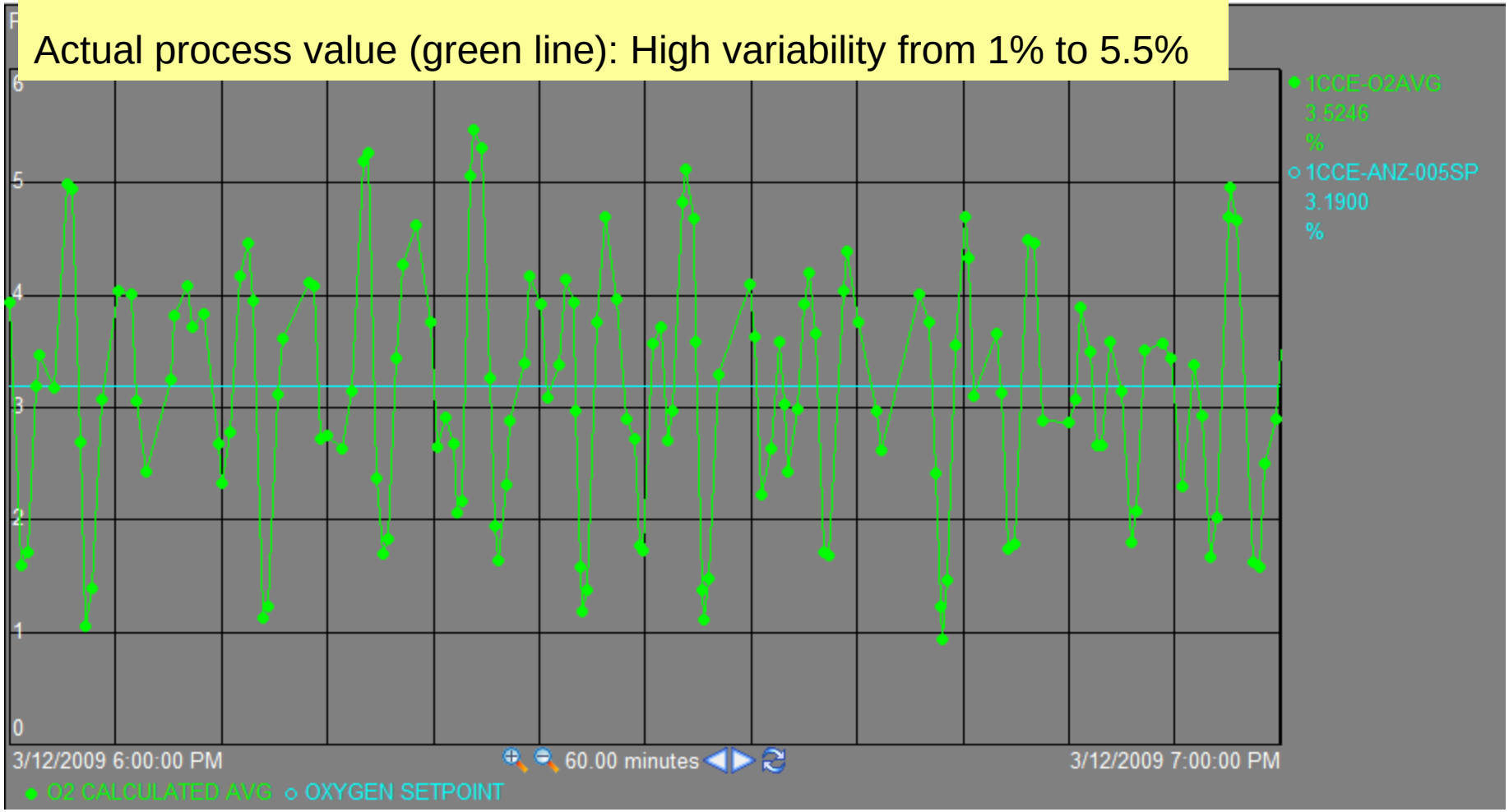
NOT GOOD



Firing rate control loop

Boiler exit O2 set point: Approx. 3.2%

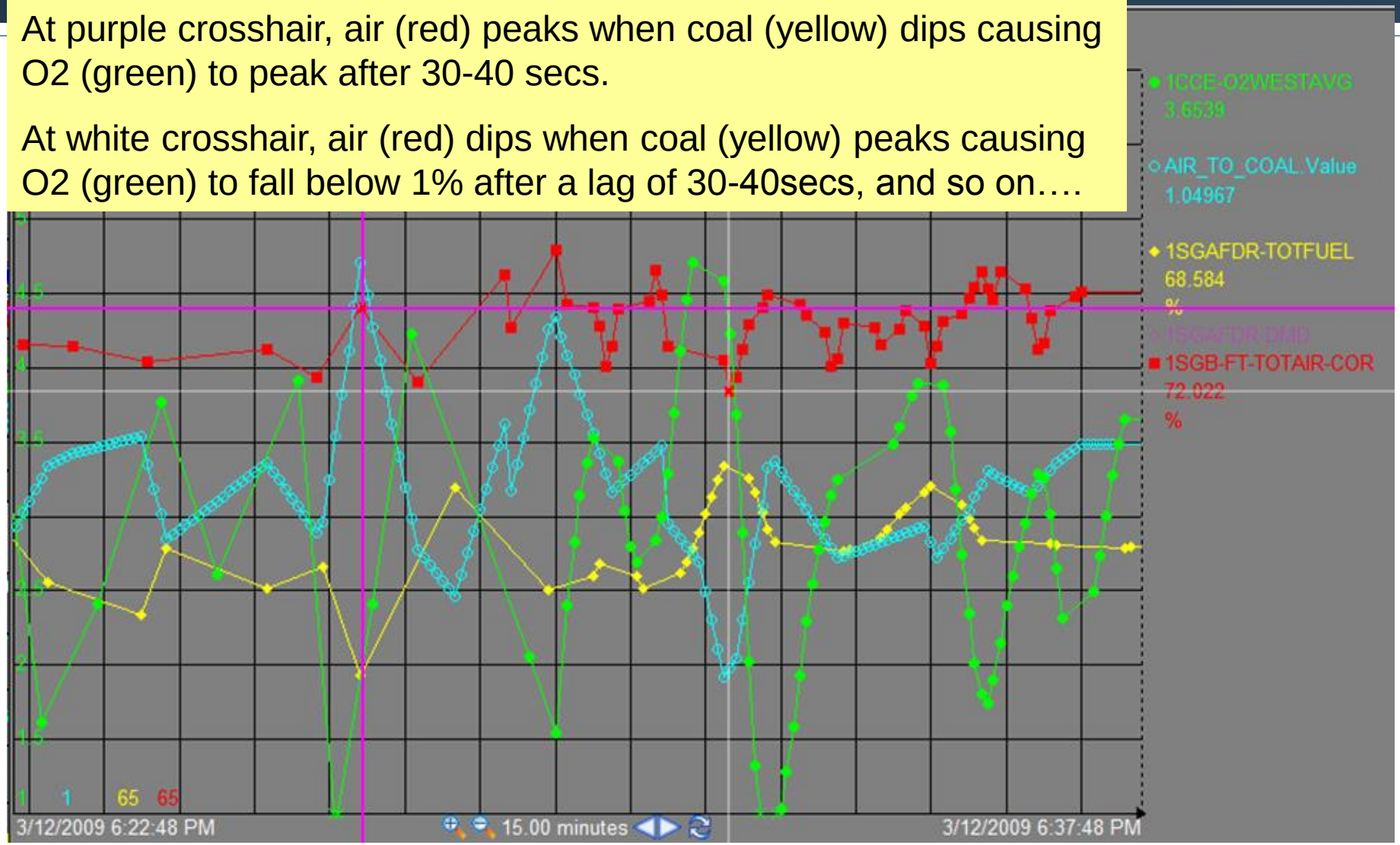
Actual process value (green line): High variability from 1% to 5.5%



Firing rate control loop

At purple crosshair, air (red) peaks when coal (yellow) dips causing O2 (green) to peak after 30-40 secs.

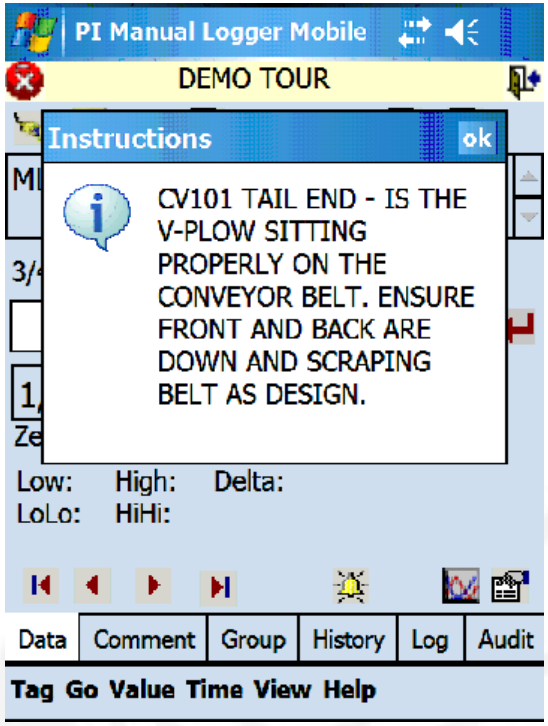
At white crosshair, air (red) dips when coal (yellow) peaks causing O2 (green) to fall below 1% after a lag of 30-40secs, and so on….

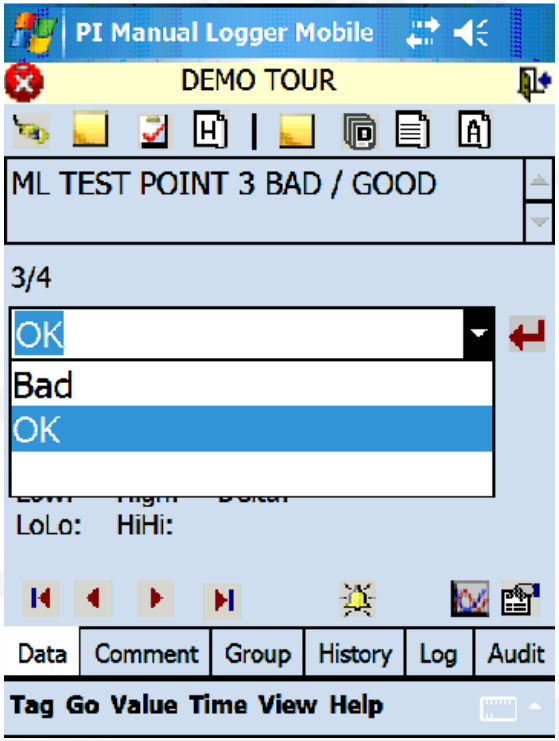


Operator & Maintenance Rounds

Equipment inspection data collection

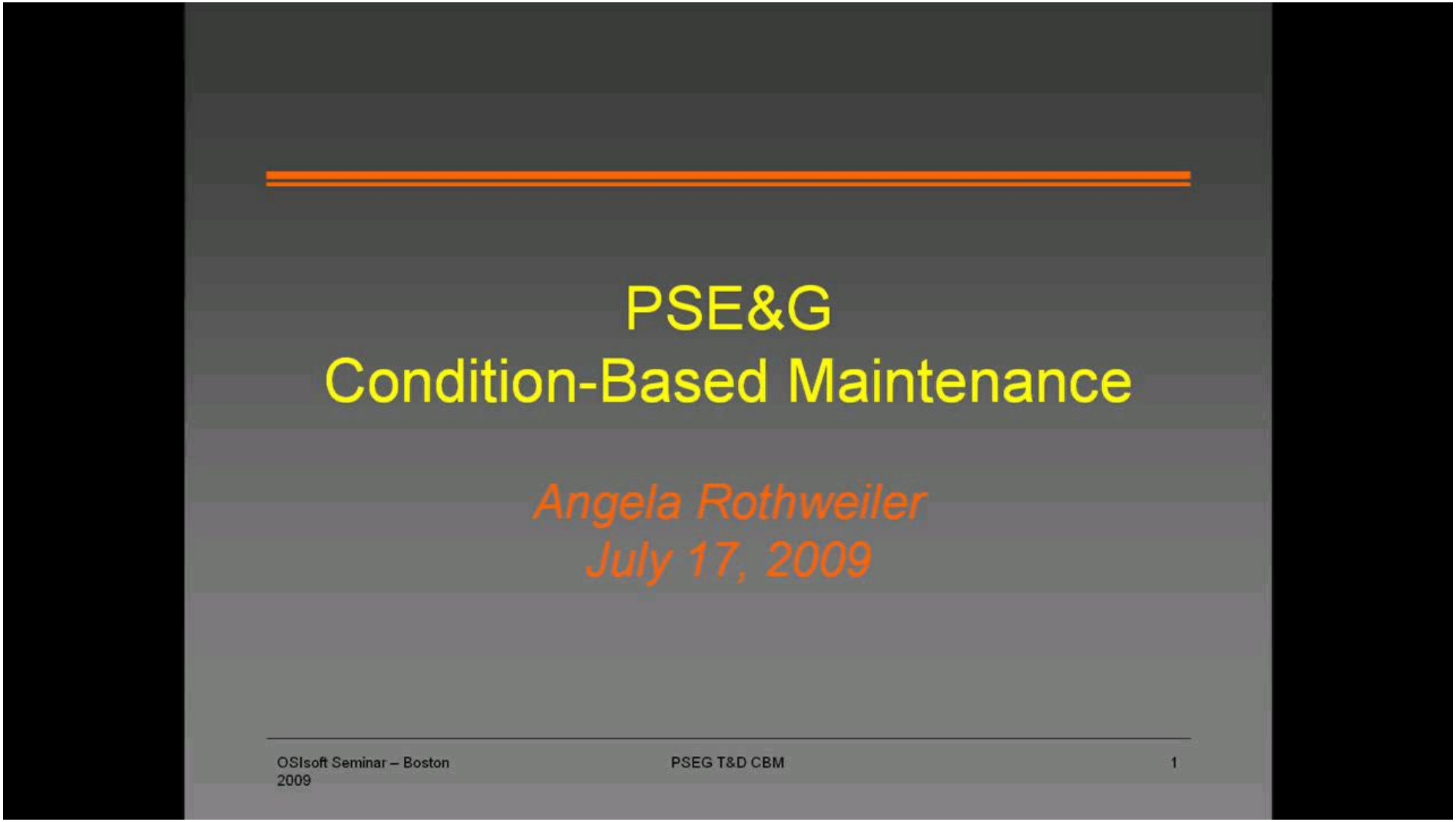
Source:
www.aeec.com/conveyor/Belt_Cleaners/Vplow.aspx (retrieved Jan 2009)





V-PLOW status on a coal conveyor belt

PSE&G use case VIDEO



Cytec Use Cases

- Reduce Time to Troubleshoot
- Avoidance of Catastrophic Failures
- Increase in “Process Visibility”
- Process Monitoring and Alerting
- Process Efficiency and Cost Avoidance
- Customer Compliance Reporting
- Cooling Tower Water Chemistry
- Event Monitoring
- Post-Maintenance Efficiency Validation
- Loop Tuning
- Environmental Compliance Monitoring
- Green Efforts
- Handhelds / Reliability Centered Maintenance
- Data Center & IT Monitoring

Cytec - Use case VIDEO

OSIsoft

Regional Seminar Series
New Orleans, LA

CYTEC

Delivering Technology Beyond
Our Customers' Imagination™

August 11, 2009

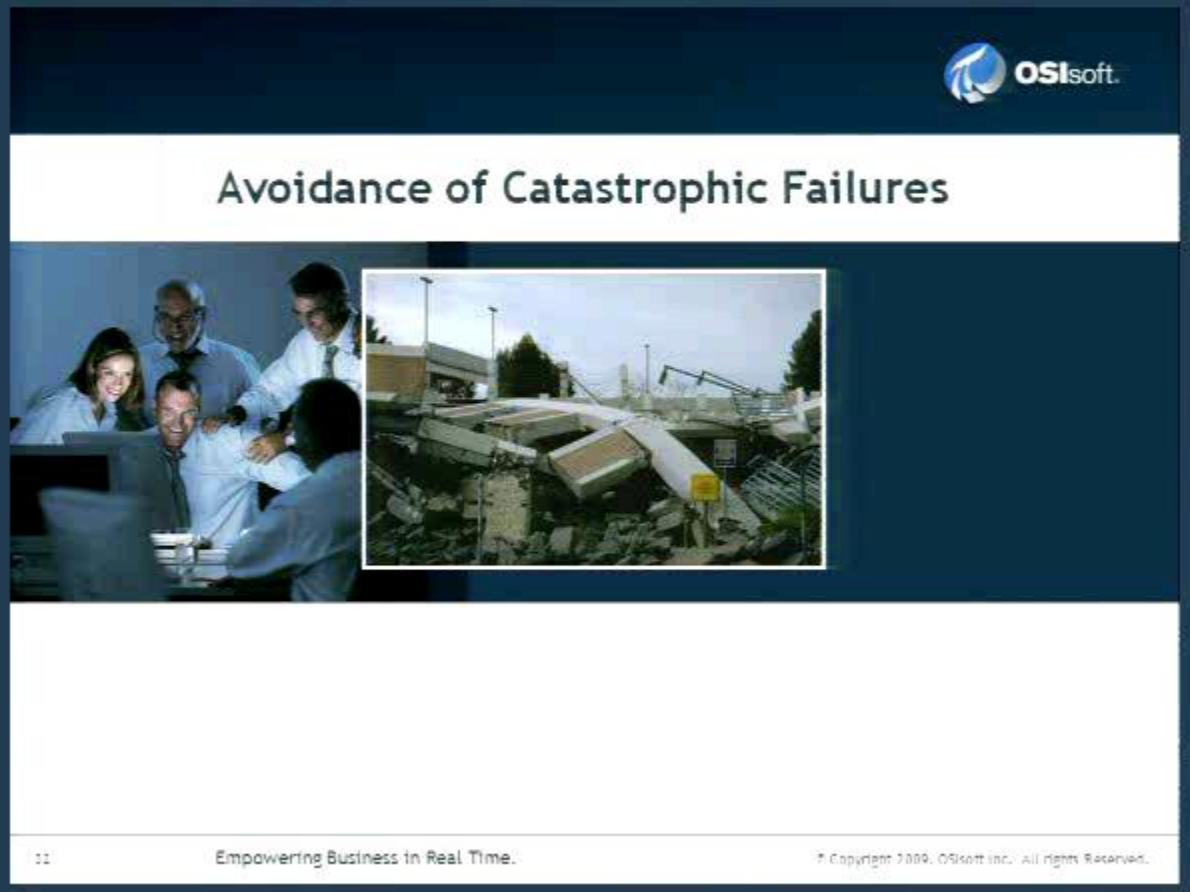
Cytec Fortier Plant
Where PI = Possibilities Infinite

Anthony Fregosi - Manufacturing Systems Engineer
Dave Stevenson - Process Automation and Control Engineer
Cytec Industries Inc.

Empowering Business in Real Time.

Cytec - Use case VIDEO

REGIONAL SEMINAR SERIES



Empowering Business in Real Time.

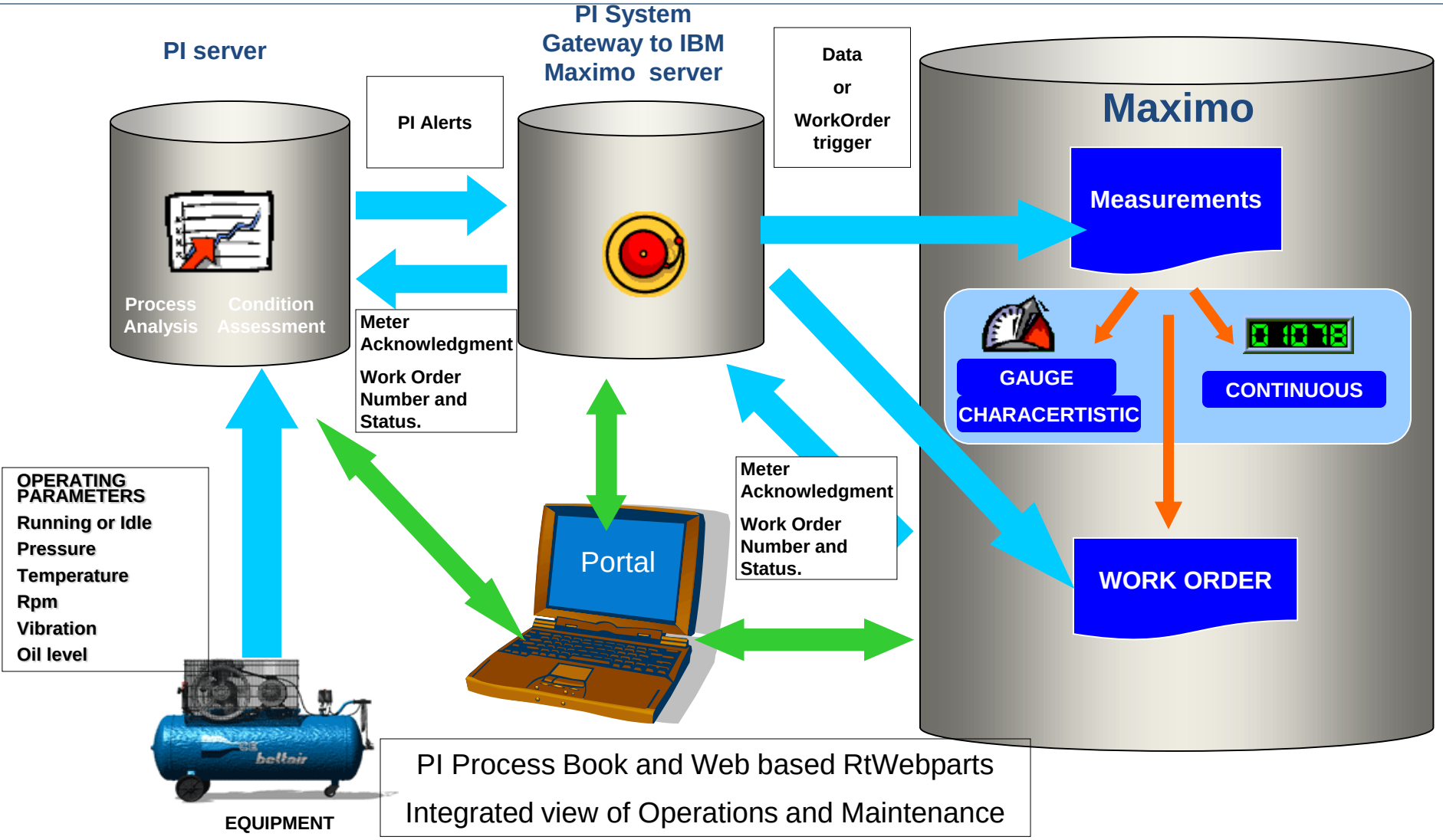
Summary and Call to action + Q&A

- ✓ Get more value from PI by using operations data and events in Maintenance
- ✓ Get started today – you already have the tools
- ✓ Validate/test your strategies and predict savings even before implementation/deployment
- ✓ Talk to other PI users who are already doing this

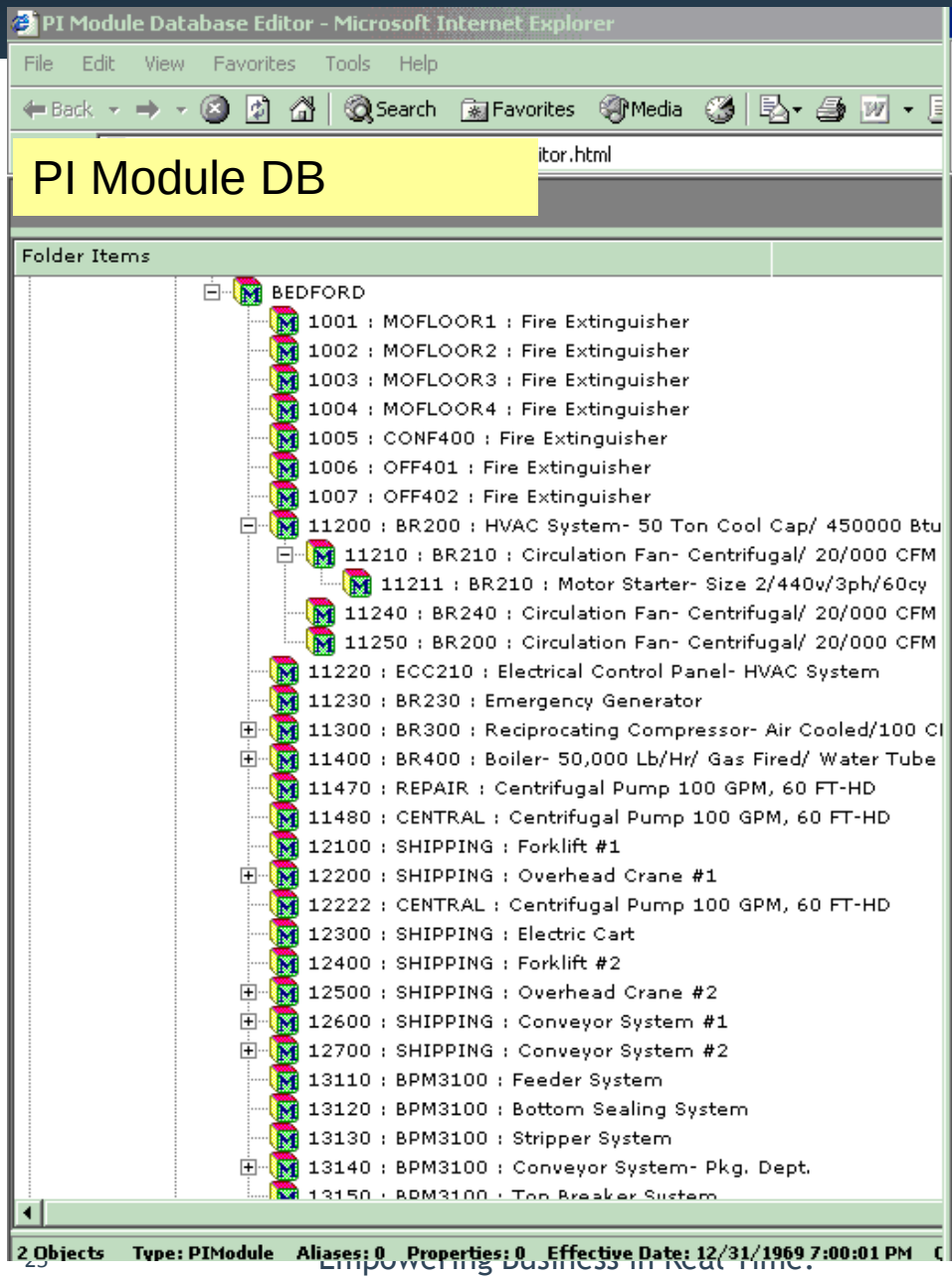
Back up slides

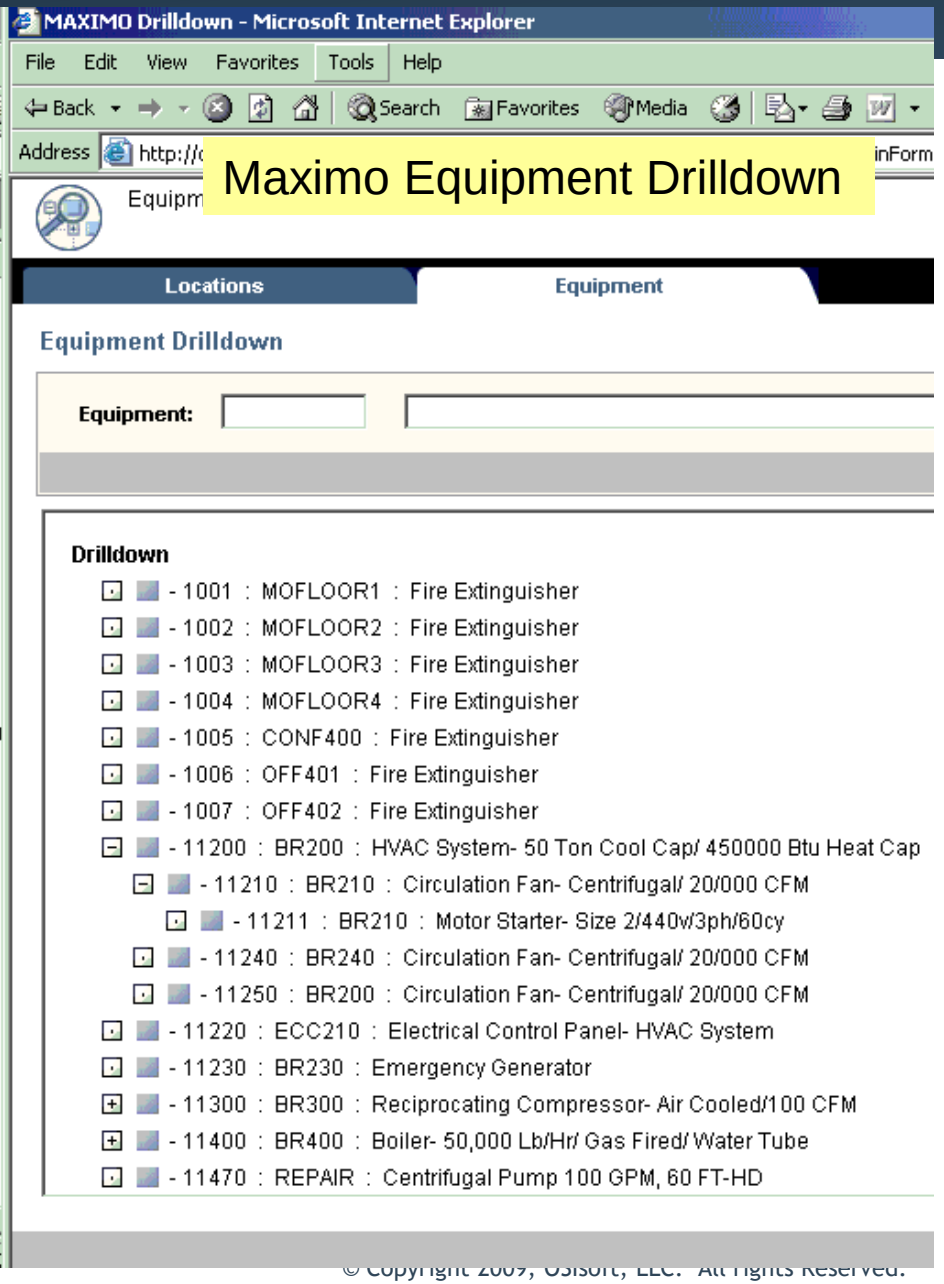
BACKUP SLIDES – IF TIME PERMITS

PI to Maximo data flow

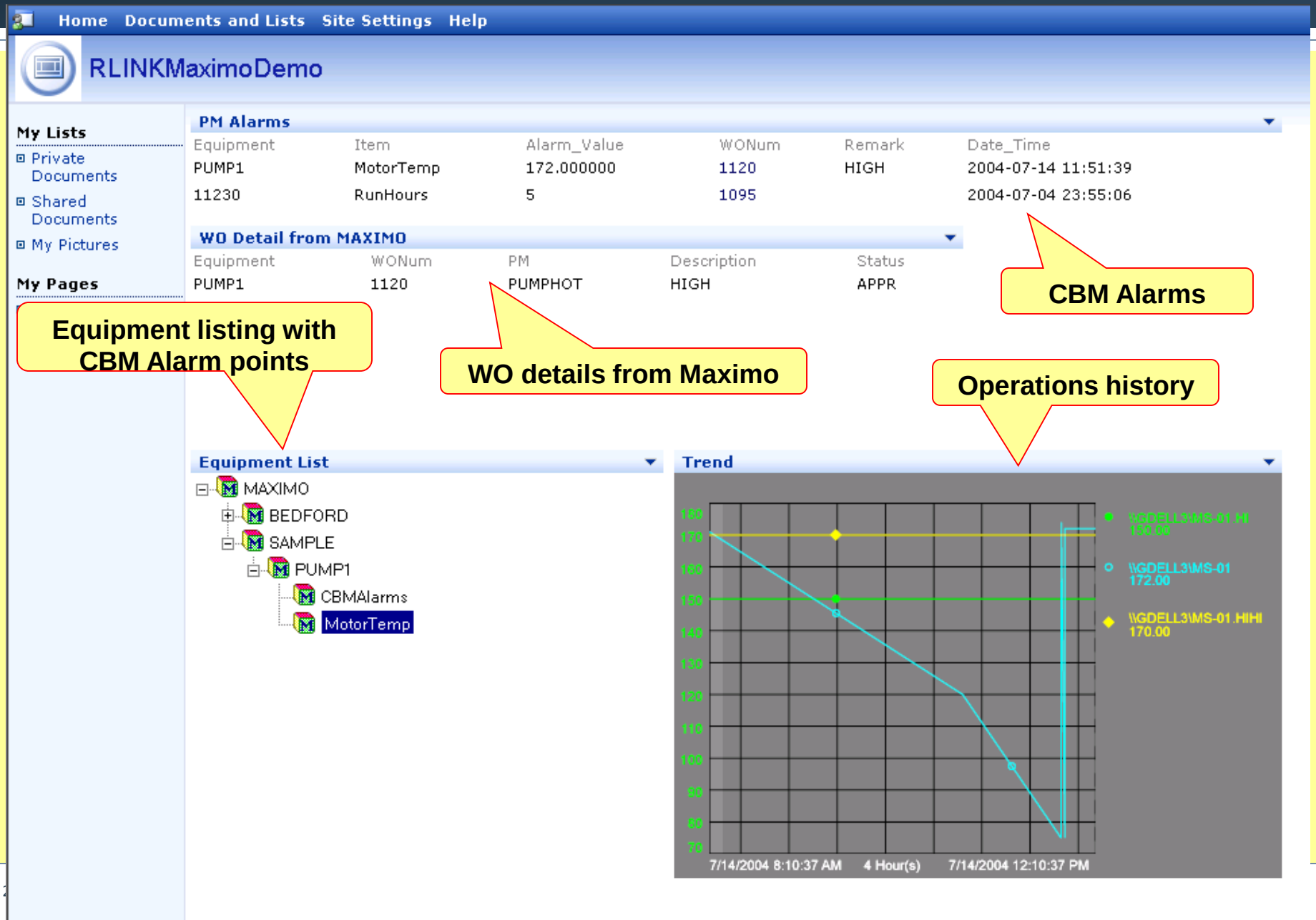


Common equipment names in PI and Maximo





Combined Maintenance and Operations



PI enabled maintenance for the enterprise

Maximo_Asset_Registry and WorkOrder_Demo

Hyperlink launches the demo only during a live session

Other resources

PRODUCTS and FEATURES

- ✓ PI Manual Logger for Operator and Maintenance rounds (equipment inspection)
- ✓ Advanced Calculation Engine
- ✓ PI Notification
- ✓ PI Web parts
- ✓ PI ProcessBook
- ✓ PI DataLink
- ✓ PI TimeFilter, PI Expressions, PI Performance Equations (included in PI Server)
- ✓ PI web services (to be released later in 2009)

Other resources

Using PI to Back - Test Usage and Condition Based Maintenance Strategies to predict Quantifiable Benefits Prior to Deployment in Asset Management (Sebastien Cournoyer, DTE Energy, Laurence Hruby, Basin Electric Power Cooperative, Gopal GopalKrishnan, OSIsoft) – PPT

Using Basic PI Tools to Implement a Critical Variables Program that is Inexpensive and Easy to Maintain, Cytec Industries Inc.

http://www.osisoft.com/templates/item-abstract.aspx?id=2521&terms=cytec

http://videostar.osisoft.com/Regional_Seminars/2009/NOLA/Video/RS2009_NOLA_Cytec_Fregosi.wmv

Substation Inspection and Condition Based Maintenance using PI

http://videostar.osisoft.com/Regional_Seminars/2009/Boston/Video/RS2009_Boston_CBM_PSEG_Gopal_Rothweiler.wmv

http://www.osisoft.com/templates/item-abstract.aspx?id=2651&terms=PSE&G

SDG&E PI-based Substation Real-Time Condition Based Maintenance System (Neal Bartek, Subburaman Sankaran, SDG&E) – PPT

Thank you

777 Davis St., Suite 250 San Leandro, CA 94577