Oil and Gas

Gas Compressor Performance Analysis

Mike Teter, Sr. Engineer - Williams

October, 11 2016

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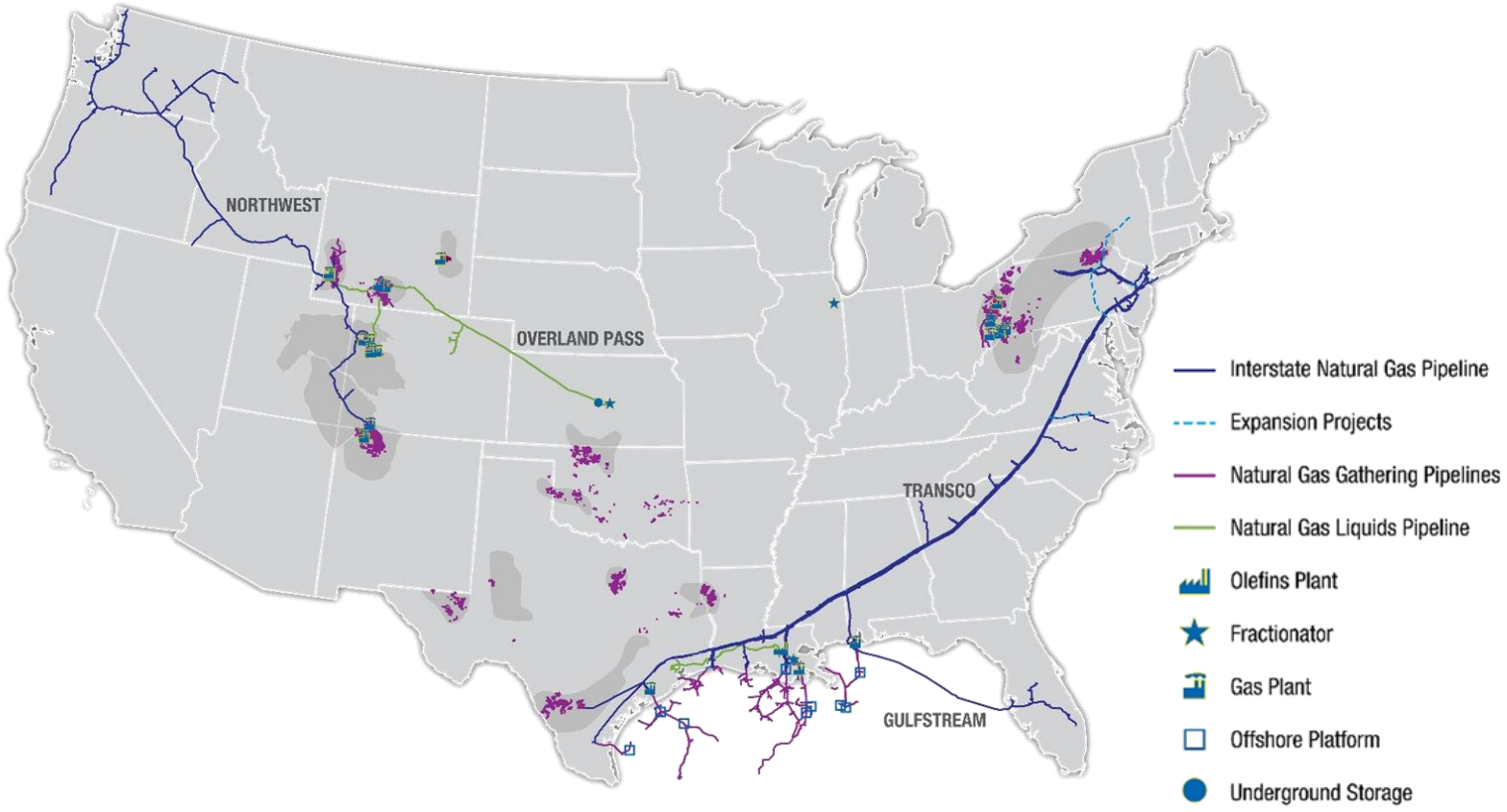
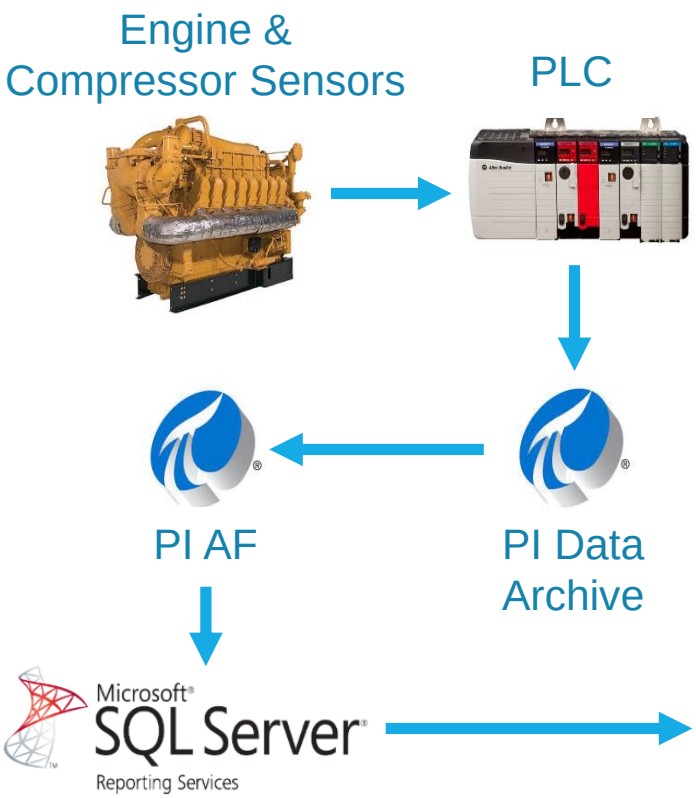


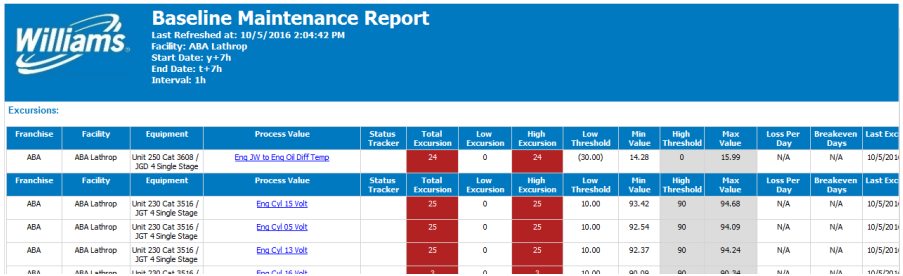
Williams Reciprocating Compressor Equipment Monitoring Program

- The PI System is used to monitor, evaluate and assess asset condition in order to reduce undesired down time and improve equipment efficiency.
- The tools built are designed to expose data exceptions and provide users quick access to supporting information to determine if a data exception is actionable.
- There are two AF Databases constructed to perform the different analytic functions described in this presentation
- PI AF, PI Asset-Based Analytics, PI Coresight, and Microsoft SSRS reporting tools provide the foundation that supports data examination

PI System Data Flow



- Sensor data from the engine and compressor are collected by the PLC
- PI Interfaces collect data from the PLC and send that data to the PI Data Archive
- PI AF reads data from the PI Archive, performs calculations, and contextualizes results in a format that SQL Server Reporting Services can surface in the form of an exception report



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Baseline Maintenance Report

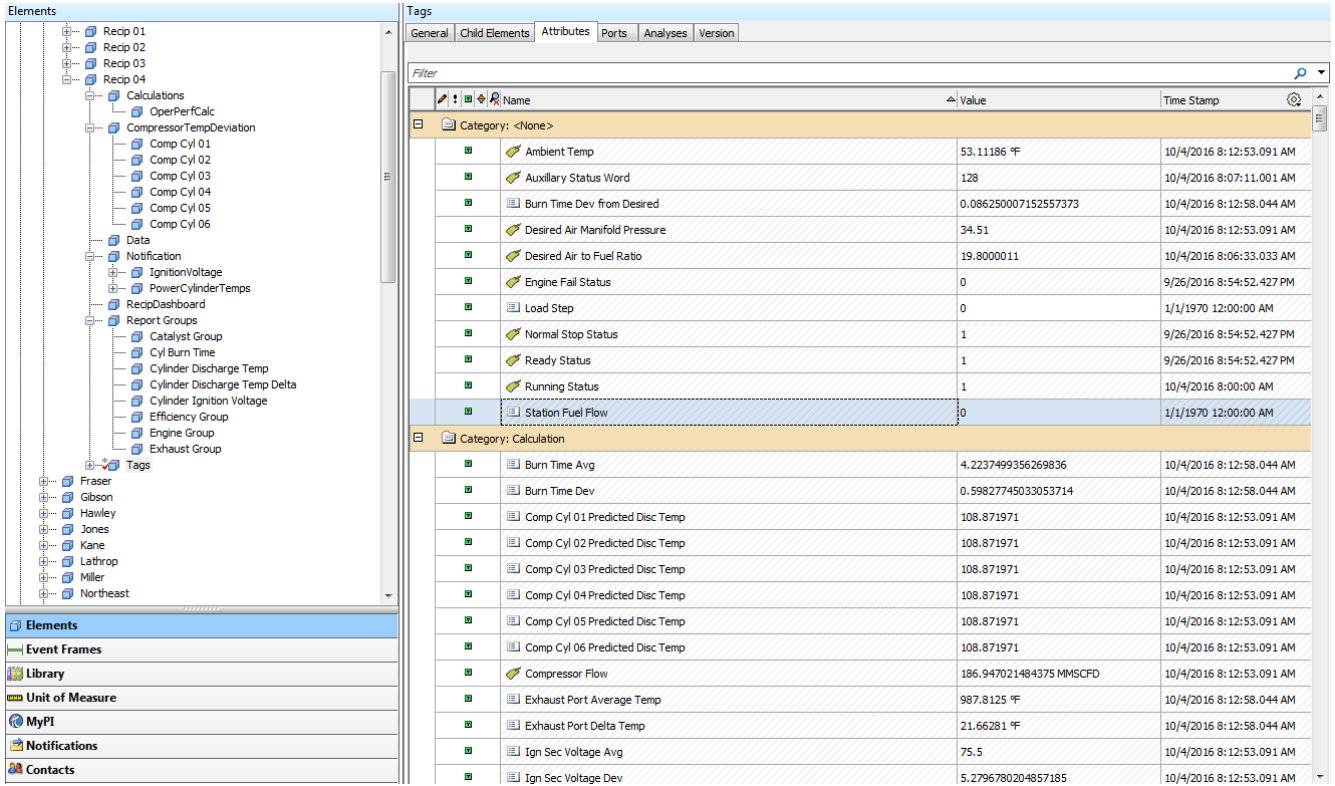
Last Refreshed at: 10/5/2016 2:04:42 PM
Facility: ABA Lathrop
Start Date: y+7h
End Date: t+7h
Interval: 1h

Excursions:

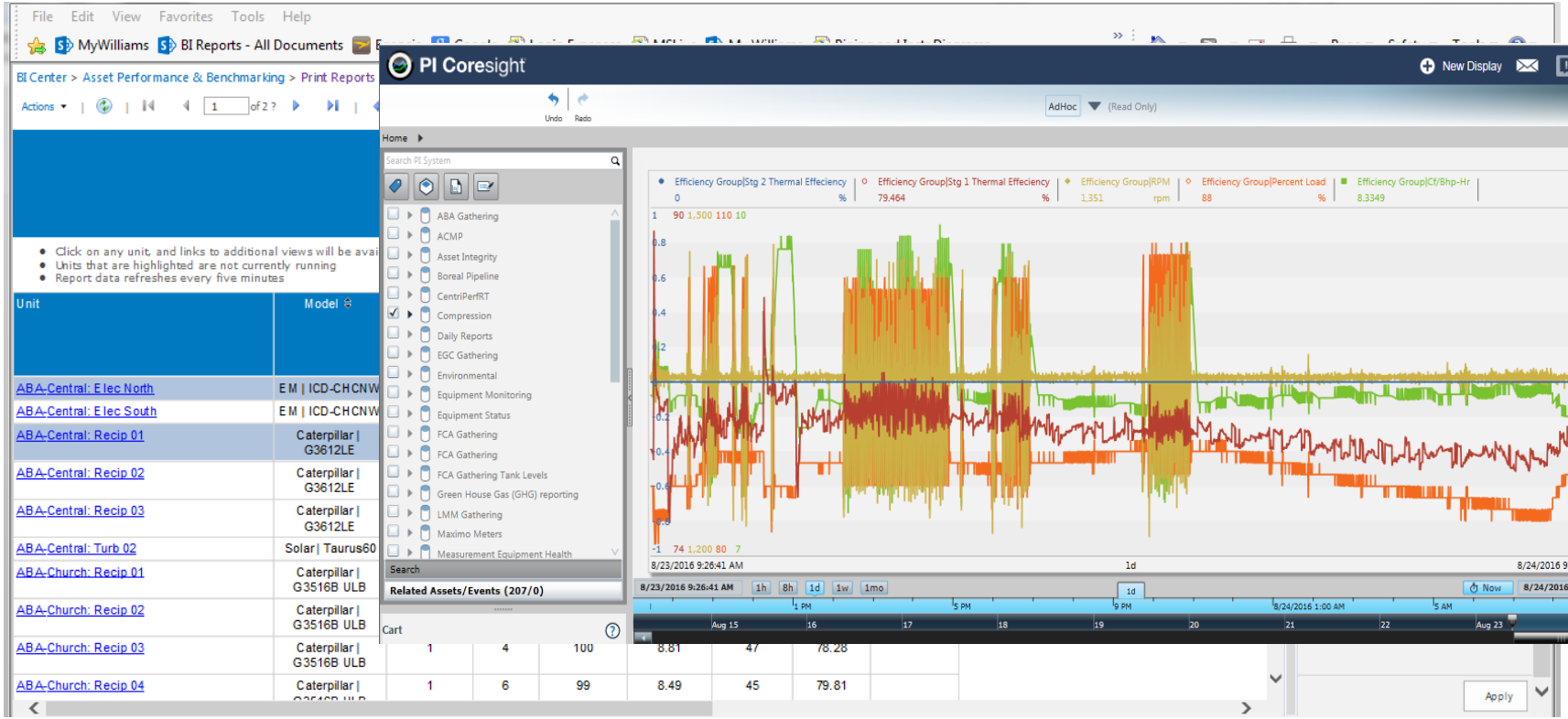
Franchise	Facility	Equipment	Process Value	Status Tracker	Total Excursion	Low Excursion	High Excursion	Low Threshold	Min Value	High Threshold	Max Value	Loss Per Day	Breakeven Days	Last Exc
ABA	ABA Lathrop	Unit 250 Cat 3608 / JGD 4 Single Stage	Eng JW to Eng Oil Diff Temp		24	0	24	(30.00)	14.28	0	15.99	N/A	N/A	10/5/201

Franchise	Facility	Equipment	Process Value	Status Tracker	Total Excursion	Low Excursion	High Excursion	Low Threshold	Min Value	High Threshold	Max Value	Loss Per Day	Breakeven Days	Last Exc
ABA	ABA Lathrop	Unit 230 Cat 3516 / JGT 4 Single Stage	Eng Cyl 15 Volt		25	0	25	10.00	93.42	90	94.68	N/A	N/A	10/5/201
ABA	ABA Lathrop	Unit 230 Cat 3516 / JGT 4 Single Stage	Eng Cyl 05 Volt		25	0	25	10.00	92.54	90	94.09	N/A	N/A	10/5/201
ABA	ABA Lathrop	Unit 230 Cat 3516 / JGT 4 Single Stage	Eng Cyl 13 Volt		25	0	25	10.00	92.37	90	94.24	N/A	N/A	10/5/201

Asset Framework Database

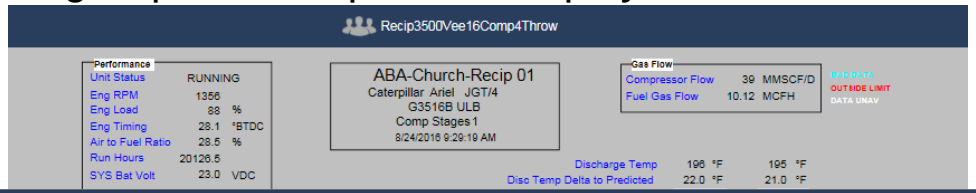


Reciprocating Compressor Dashboard

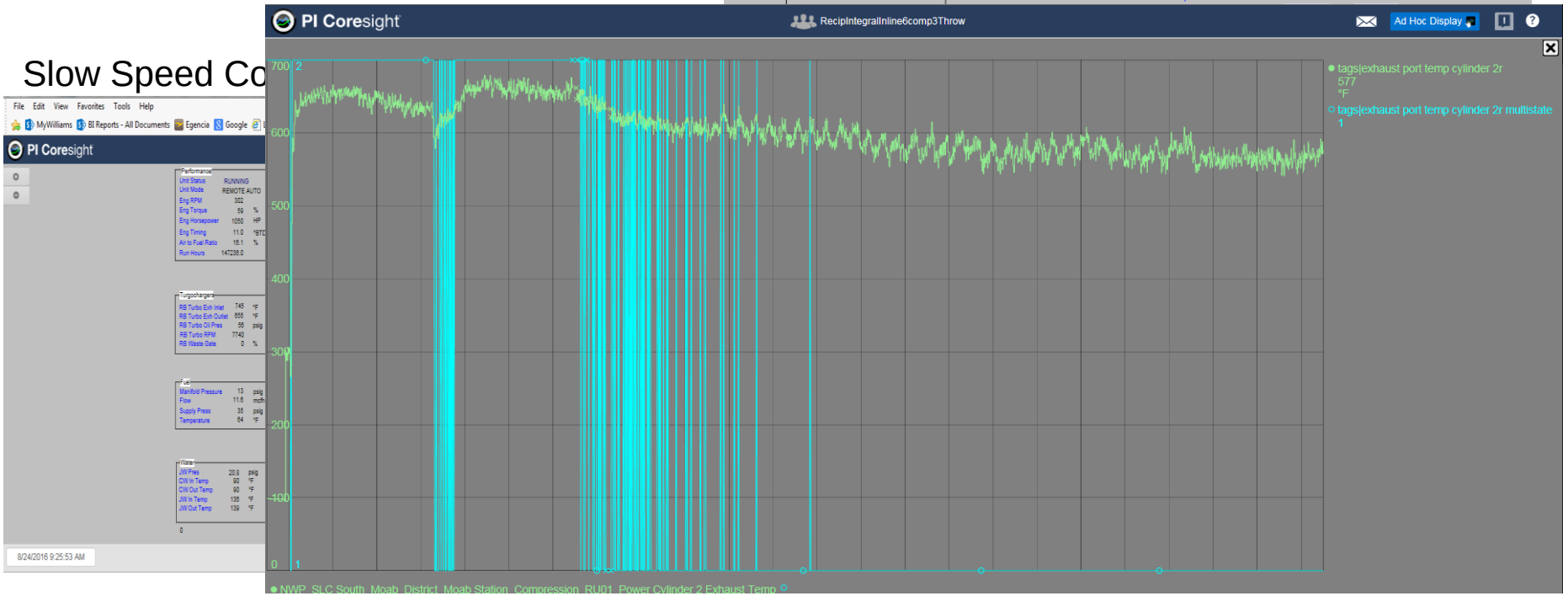


Overview Screens
Ad hoc trends
Multi-state colors for high or low alerts
Mobile compatibility

High Speed Compressor Display

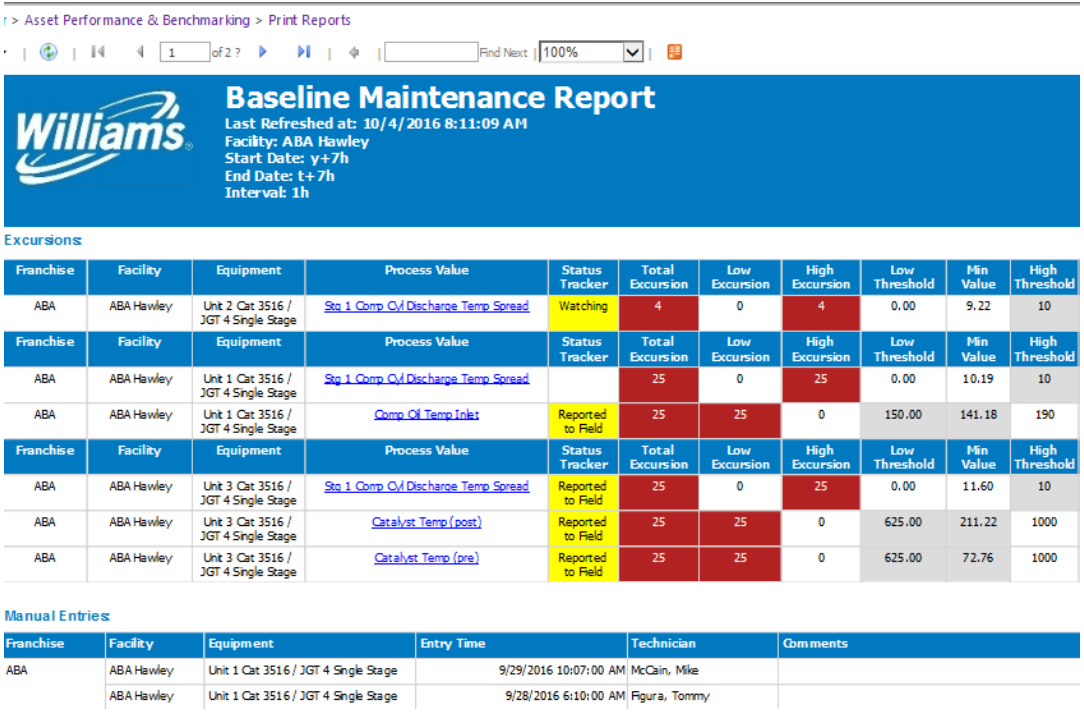


Slow Speed Co



Baseline Data Mining

- Evaluates one hour after startup until one hour prior to shutdown
- Shows data values outside normal operating thresholds
- Shows number of excursions over the report period
- Links to a Coresight trend with data, average, thresholds, and analysis window



r > Asset Performance & Benchmarking > Print Reports

1 of 2 ? Find Next 100%

Baseline Maintenance Report

Last Refreshed at: 10/4/2016 8:11:09 AM
Facility: ABA Hawley
Start Date: y+7h
End Date: t+7h
Interval: 1h

Excursions:

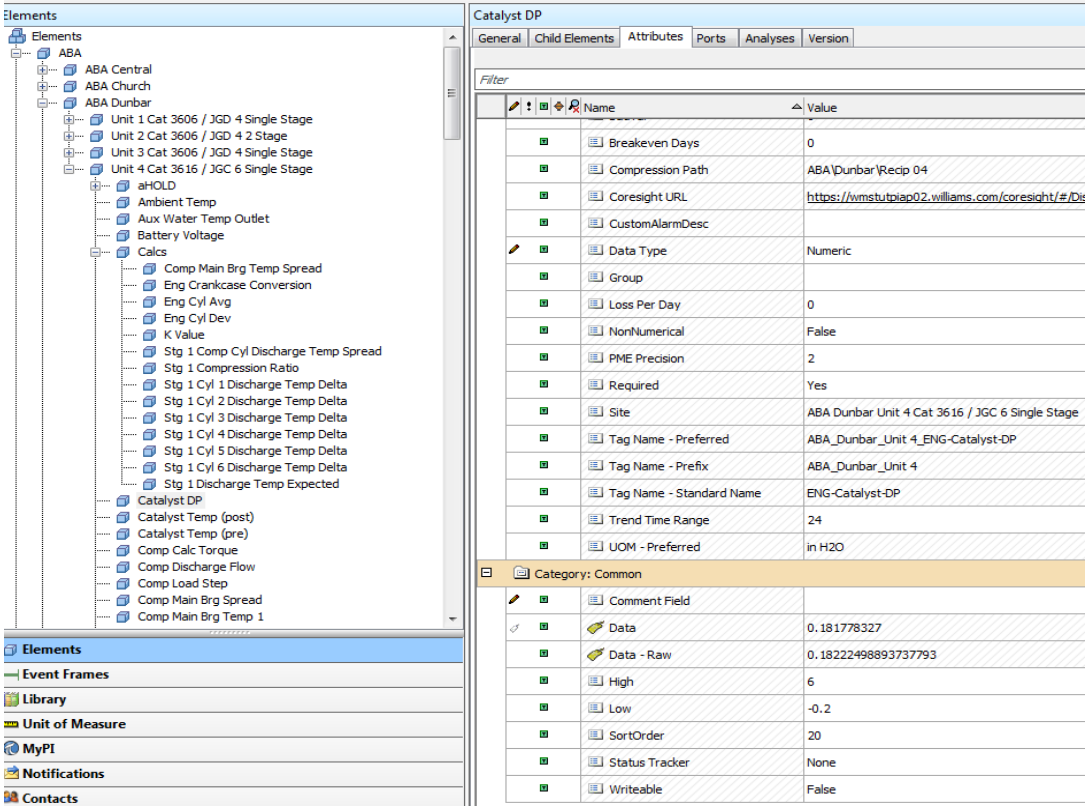
Franchise	Facility	Equipment	Process Value	Status Tracker	Total Excursion	Low Excursion	High Excursion	Low Threshold	Min Value	High Threshold
ABA	ABA Hawley	Unit 2 Cat 3516 / JGT 4 Single Stage	Stg 1 Comp Cyl Discharge Temp Spread	Watching	4	0	4	0.00	9.22	10
Franchise	**Facility**	**Equipment**	**Process Value**	**Status Tracker**	**Total Excursion**	**Low Excursion**	**High Excursion**	**Low Threshold**	**Min Value**	**High Threshold**
ABA	ABA Hawley	Unit 1 Cat 3516 / JGT 4 Single Stage	Stg 1 Comp Cyl Discharge Temp Spread		25	0	25	0.00	10.19	10
ABA	ABA Hawley	Unit 1 Cat 3516 / JGT 4 Single Stage	Comp Oil Temp Inlet	Reported to Field	25	25	0	150.00	141.18	190
Franchise	**Facility**	**Equipment**	**Process Value**	**Status Tracker**	**Total Excursion**	**Low Excursion**	**High Excursion**	**Low Threshold**	**Min Value**	**High Threshold**
ABA	ABA Hawley	Unit 3 Cat 3516 / JGT 4 Single Stage	Stg 1 Comp Cyl Discharge Temp Spread	Reported to Field	25	0	25	0.00	11.60	10
ABA	ABA Hawley	Unit 3 Cat 3516 / JGT 4 Single Stage	Catalyst Temp (post)	Reported to Field	25	25	0	625.00	211.22	1000
ABA	ABA Hawley	Unit 3 Cat 3516 / JGT 4 Single Stage	Catalyst Temp (pre)	Reported to Field	25	25	0	625.00	72.76	1000

Manual Entries:

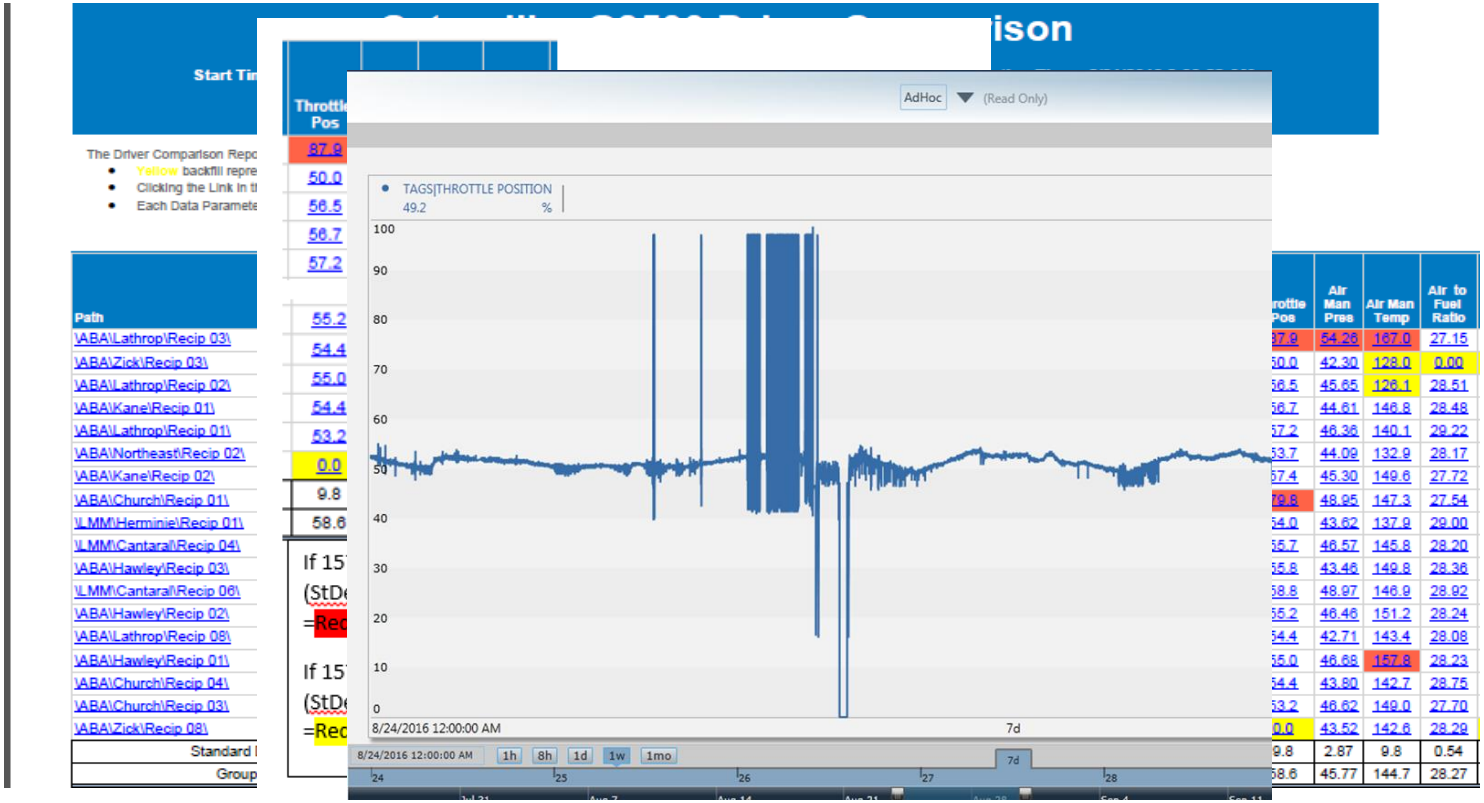
Franchise	Facility	Equipment	Entry Time	Technician	Comments
ABA	ABA Hawley	Unit 1 Cat 3516 / JGT 4 Single Stage	9/29/2016 10:07:00 AM	McCain, Mike	
	ABA Hawley	Unit 1 Cat 3516 / JGT 4 Single Stage	9/28/2016 6:10:00 AM	Figura, Tommy	

Baseline Data Mining

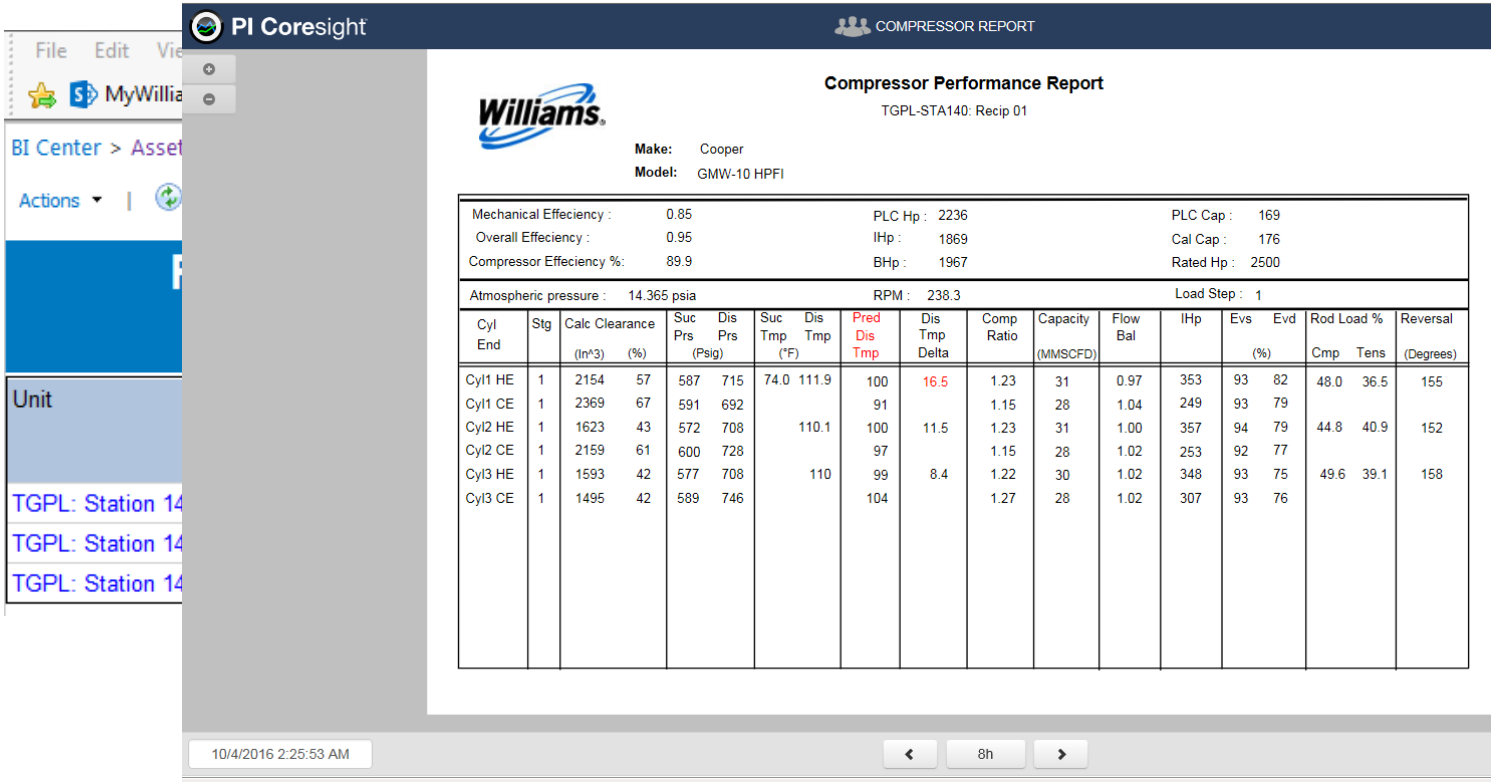
- Powered by PI AF and Microsoft Reporting Tools
- Assigns each data value is to a specific template designed to supply the report
- Accepts manual data entry
- Evaluates parameters under normal operation against normal operating thresholds



Compressor Comparison Report



Reciprocating Compressor On-Line Monitor Report



Cyl End	Stg	Calc Clearance (In^3)	Calc Clearance (%)	Suc Prs (Psig)	Dis Prs (Psig)	Suc Tmp (°F)	Dis Tmp (°F)	Pred Dis Tmp	Dis Tmp Delta	Comp Ratio	Capacity (MMSCFD)	Flow Bal	IHp	Evs (%)	Evd (%)	Rod Load % Cmp	Rod Load % Tens	Reversal (Degrees)
Cyl1 HE	1	2154	57	587	715	74.0	111.9	100	16.5	1.23	31	0.97	353	93	82	48.0	36.5	155
Cyl1 CE	1	2369	67	591	692			91		1.15	28	1.04	249	93	79			
Cyl2 HE	1	1623	43	572	708		110.1	100	11.5	1.23	31	1.00	357	94	79	44.8	40.9	152
Cyl2 CE	1	2159	61	600	728			97		1.15	28	1.02	253	92	77			
Cyl3 HE	1	1593	42	577	708		110	99	8.4	1.22	30	1.02	348	93	75	49.6	39.1	158
Cyl3 CE	1	1495	42	589	746			104		1.27	28	1.02	307	93	76			

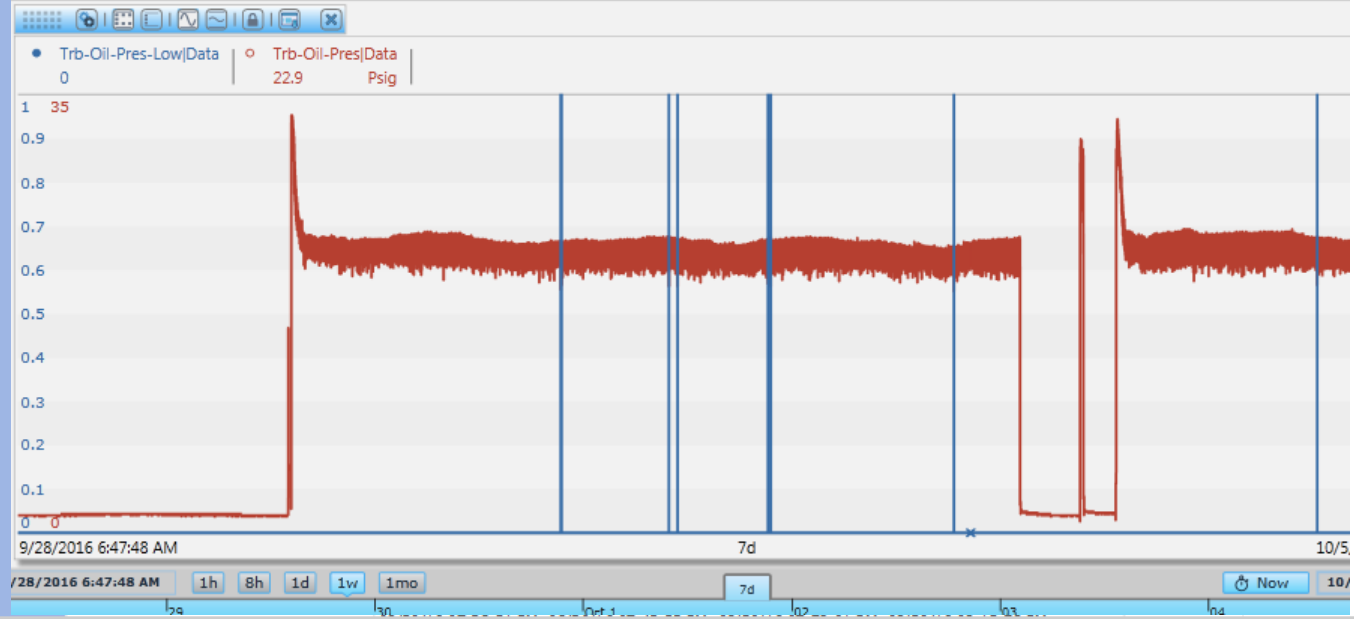
Alarm/Shutdown Report

BI Center > Asset Perform

Actions

\NWP\Mountain Home\Recip 02\% - Archived Between Start Time= *-1w and End Time= *	Alarm/Shutdown Description	Date/Time	Event Count
NWP-Mountain Home: Recip 02	Alarm.Compressor Cylinder 1 Temperature Rise Alarm	09/29/16 02:19:51 PM	1
	Alarm.Compressor Cylinder 2 Temperature Rise Alarm	09/29/16 02:19:51 PM	1

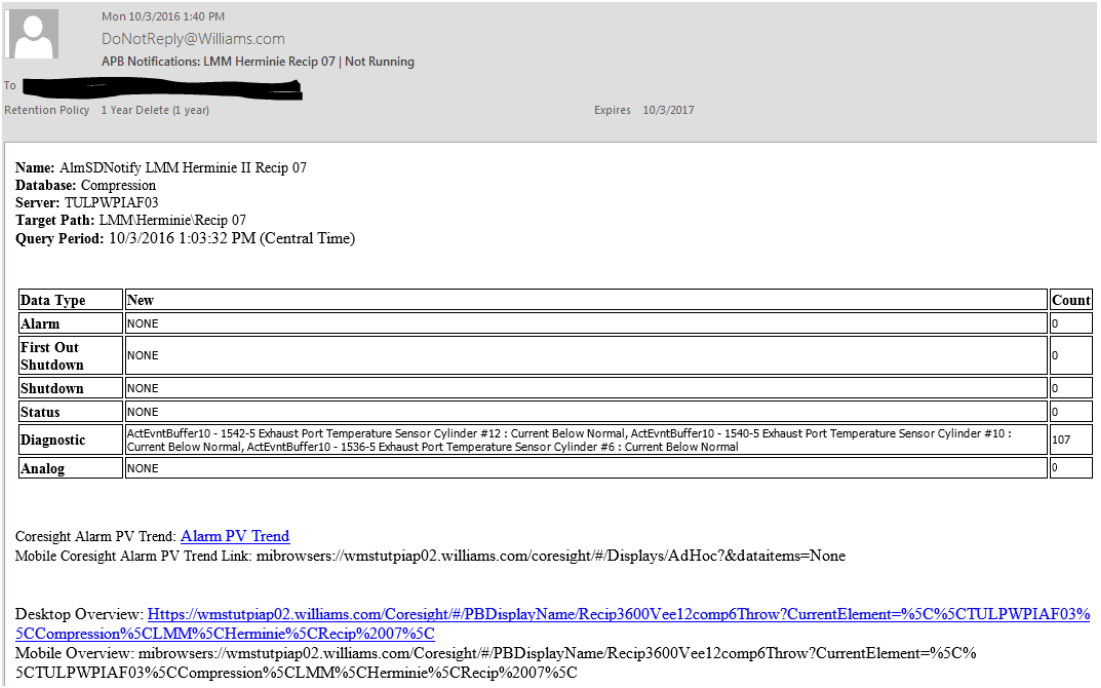
Recip 02 ▸ Tags ▸ Analog ▸ Trb-Oil-Pres



Event Notifications

- SQL query of AF allows determining if a new event has occurred
- AF both decodes the event codes from the control system into associated text and supplies links
- Alarm, shutdown, status, diagnostic, and analog threshold deviations are distributed in one notification
- Email includes links for the associated process variable – if applicable – and for unit overview displays

  (Mobile and desktop PI Coresight)



Mon 10/3/2016 1:40 PM
DoNotReply@Williams.com
APB Notifications: LMM Herminie Recip 07 | Not Running
To [redacted]
Retention Policy 1 Year Delete (1 year) Expires 10/3/2017

Name: AlmSDNotify LMM Herminie II Recip 07
Database: Compression
Server: TULPWPIAF03
Target Path: LMM\Herminie\Recip 07
Query Period: 10/3/2016 1:03:32 PM (Central Time)

Data Type	New	Count
Alarm	NONE	0
First Out Shutdown	NONE	0
Shutdown	NONE	0
Status	NONE	0
Diagnostic	ActEvntBuffer10 - 1542-5 Exhaust Port Temperature Sensor Cylinder #12 : Current Below Normal, ActEvntBuffer10 - 1540-5 Exhaust Port Temperature Sensor Cylinder #10 : Current Below Normal, ActEvntBuffer10 - 1536-5 Exhaust Port Temperature Sensor Cylinder #6 : Current Below Normal	107
Analog	NONE	0

Coresight Alarm PV Trend: Alarm PV Trend
Mobile Coresight Alarm PV Trend Link: mibrowsers://wmstutpiap02.williams.com/coresight/#/Displays/AdHoc?&dataitems=None

Desktop Overview: Https://wmstutpiap02.williams.com/Coresight/#/PBDisplayName/Recip3600Vee12comp6Throw?CurrentElement=%5C%5CTULPWPIAF03%5CCompression%5CLMM%5CHerminie%5CRecip%2007%5C
Mobile Overview: mibrowsers://wmstutpiap02.williams.com/Coresight/#/PBDisplayName/Recip3600Vee12comp6Throw?CurrentElement=%5C%5CTULPWPIAF03%5CCompression%5CLMM%5CHerminie%5CRecip%2007%5C

Summary

COMPANY and GOAL

Williams - Equipment monitoring

1) Improve reliability
2) Increase operating efficiency

CHALLENGE

Improve the efficiency and reliability of the operating assets

- Focus on the low hanging fruit by identifying the fruit
- Use the operational data to provide warning of pending issues to help eliminate and reduce costly unexpected down time

SOLUTION

Expose opportunities through analysis of operating data

- Provide early warning of possible issues through exposing operational data exceptions
- Using operational data to Identify opportunities for improvement

RESULTS

Creation a suite of tools that help identify opportunities for improvement and reduce steps between identification and action

- Eliminate as many of the steps as possible between identifying an issue and examining the supporting information
- Provide the right data to the right individuals at the right time

Contact Information

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Sr. Engineer – Asset Performance and Benchmarking
Williams

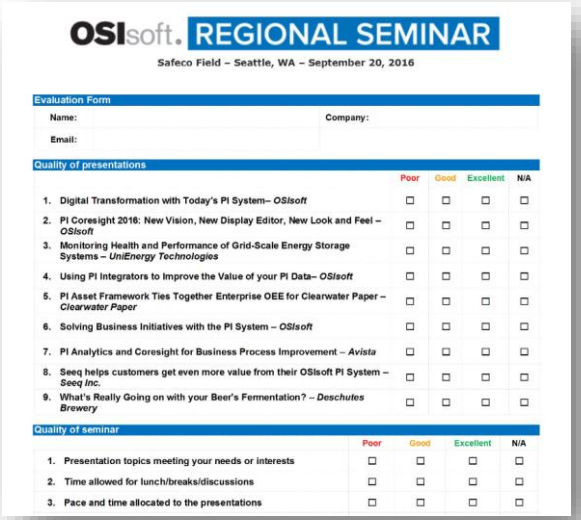
Questions

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

State your **name & company**

Please remember to…

Complete the Survey for this session



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Safeco Field – Seattle, WA – September 20, 2016

Evaluation Form

Name: Company:

Email:

Quality of presentations

	Poor	Good	Excellent	N/A
1. Digital Transformation with Today's PI System– *OSIsoft*	☐	☐	☐	☐
2. PI Coresight 2016: New Vision, New Display Editor, New Look and Feel – *OSIsoft*	☐	☐	☐	☐
3. Monitoring Health and Performance of Grid-Scale Energy Storage Systems – *UniEnergy Technologies*	☐	☐	☐	☐
4. Using PI Integrators to Improve the Value of your PI Data– *OSIsoft*	☐	☐	☐	☐
5. PI Asset Framework Ties Together Enterprise OEE for Clearwater Paper – *Clearwater Paper*	☐	☐	☐	☐
6. Solving Business Initiatives with the PI System – *OSIsoft*	☐	☐	☐	☐
7. PI Analytics and Coresight for Business Process Improvement – *Avista*	☐	☐	☐	☐
8. Seeq helps customers get even more value from their OSIsoft PI System – *Seeq Inc.*	☐	☐	☐	☐
9. What's Really Going on with your Beer's Fermentation? – *Deschutes Brewery*	☐	☐	☐	☐

Quality of seminar

	Poor	Good	Excellent	N/A
1. Presentation topics meeting your needs or interests	☐	☐	☐	☐
2. Time allowed for lunch/breaks/discussions	☐	☐	☐	☐
3. Pace and time allocated to the presentations	☐	☐	☐	☐

Thank You