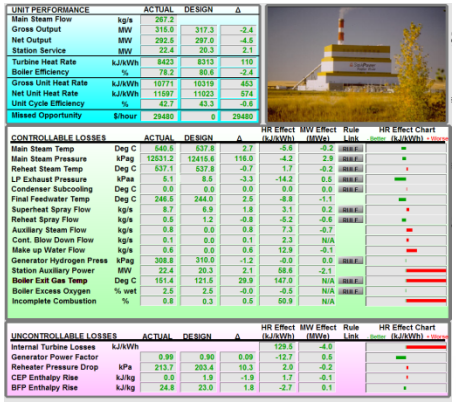
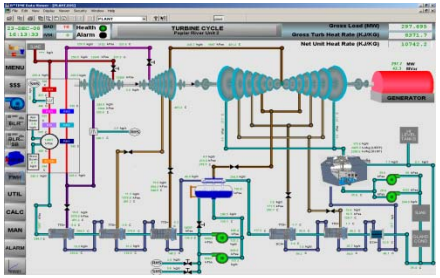
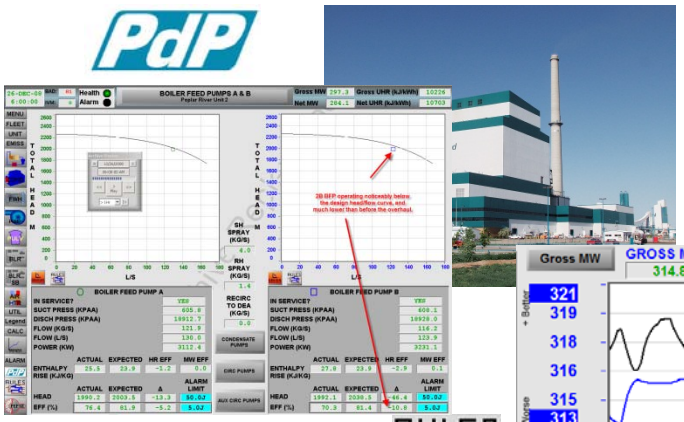
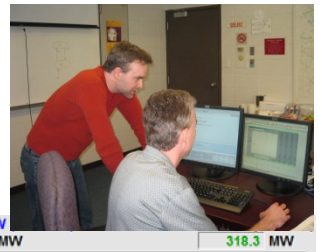
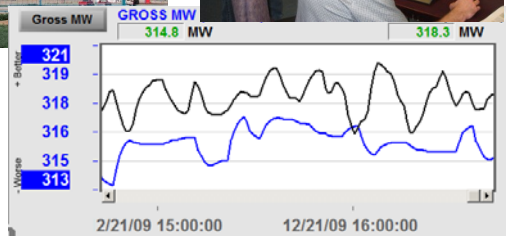




PdP

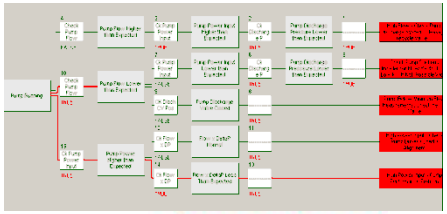






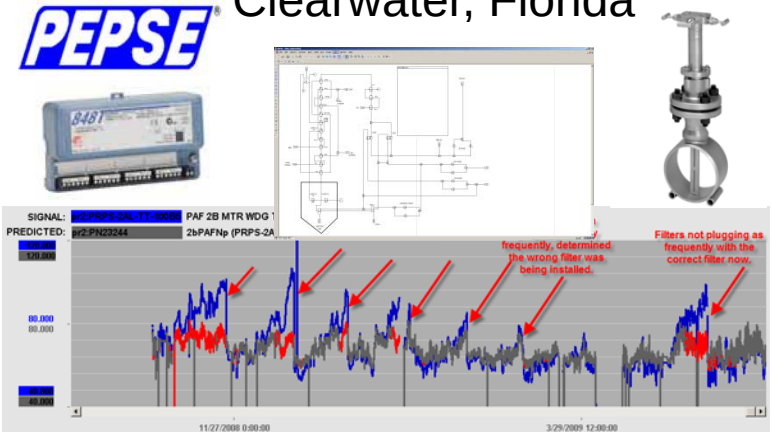
M&D Process Overview & Planned Enhancements

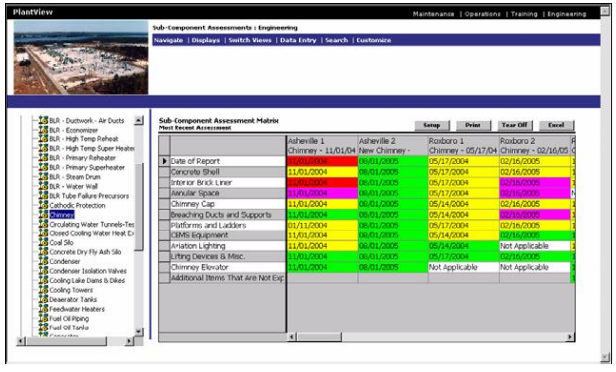
Presented by: Scott McLeod
August 6-9, 2013
Scientech Symposium
Clearwater, Florida



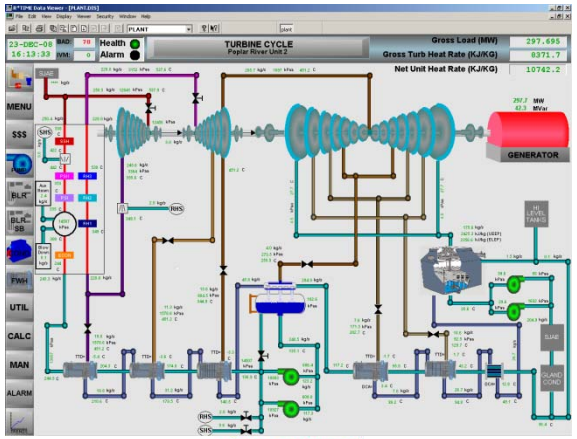
PEPSE

PMAX

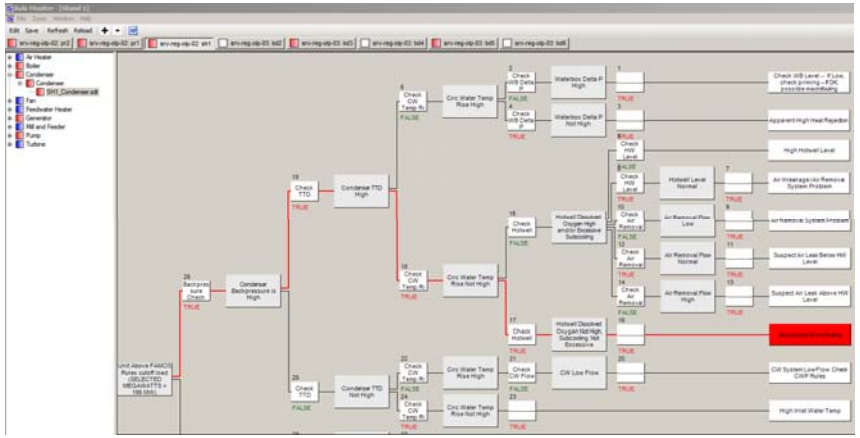




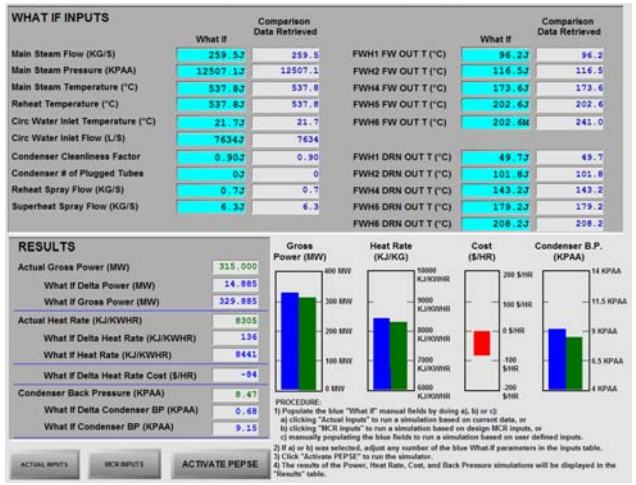
SaskPower's FAMOS system



PMAX



RULES



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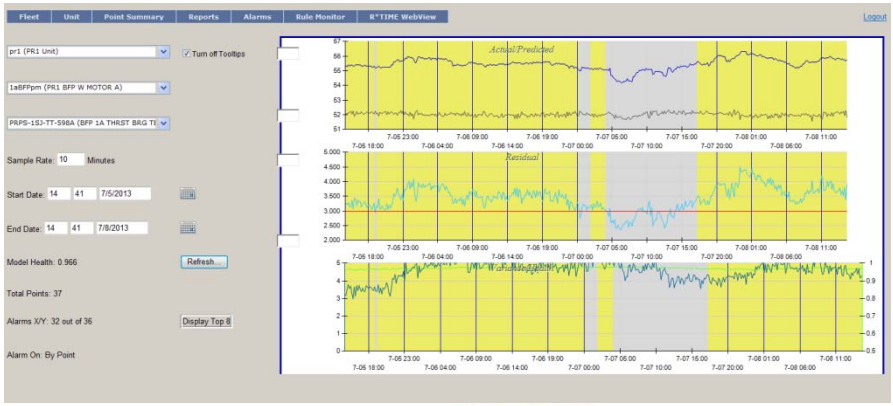
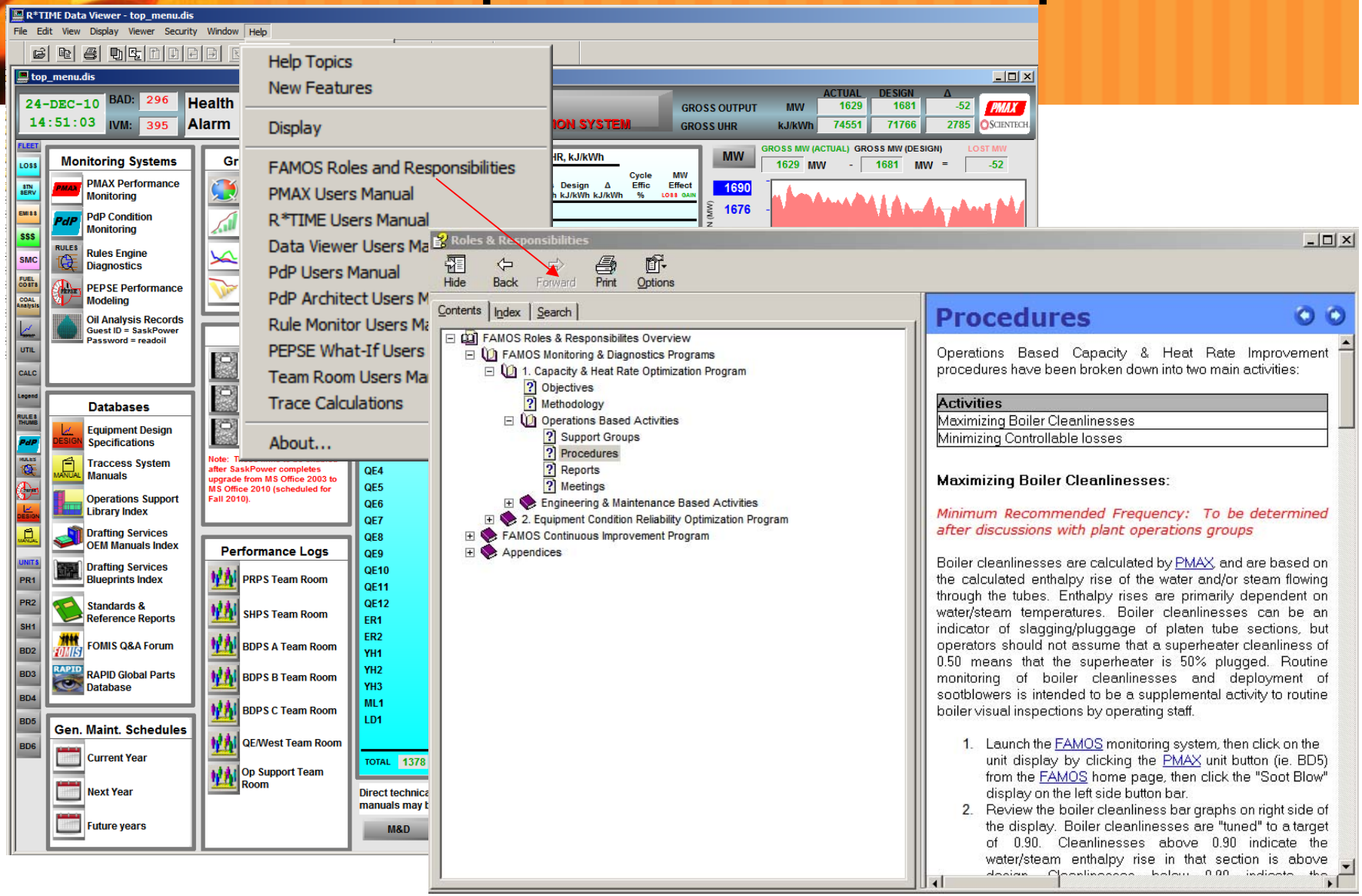


PdP

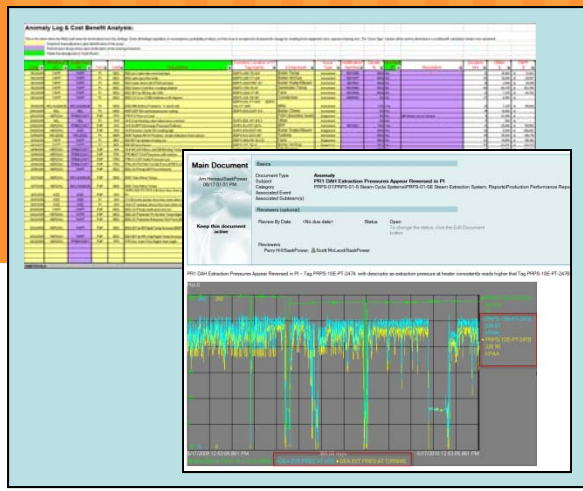
SaskPower

Roles & Responsibilities help file



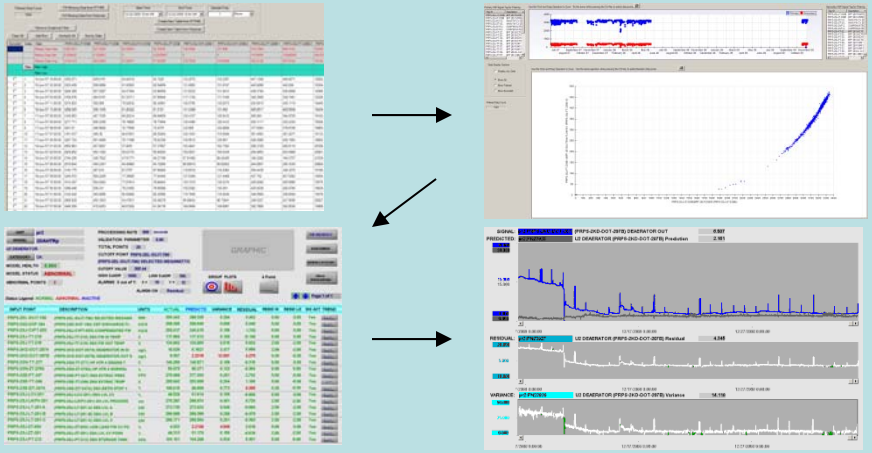
SaskPower

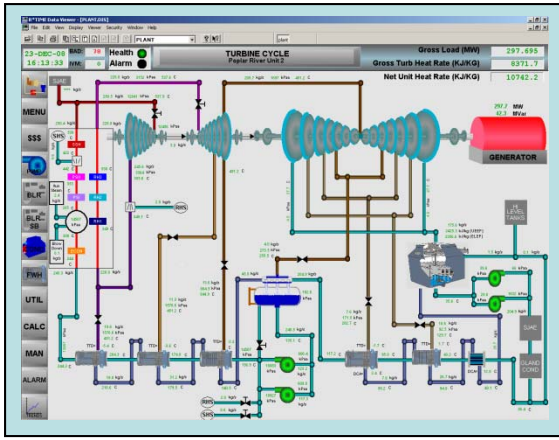
Roles & Responsibilities (Scientech)



Team Room document entry, cost benefit logging

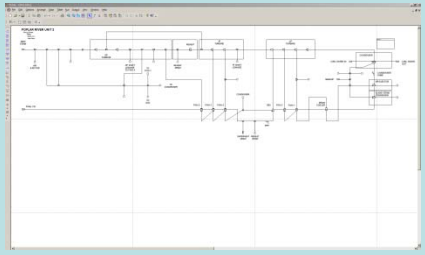
Monitor/Maintain/tune PdP models

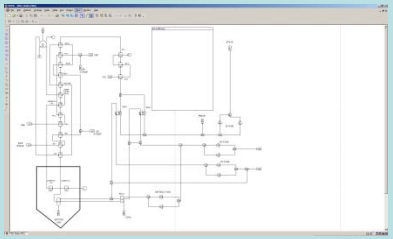


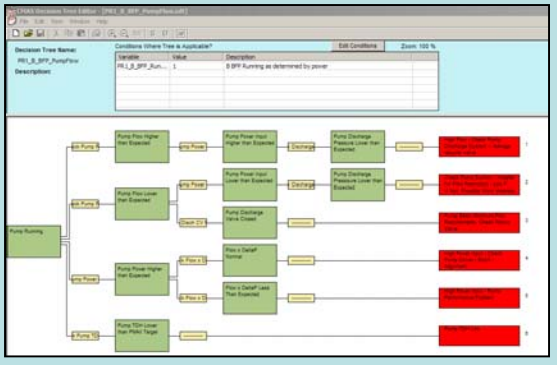


PMAX Monitoring, IVM's & Tuning

PEPSE Modeling, Upgrades & Tuning

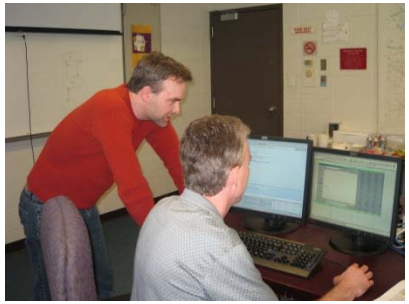




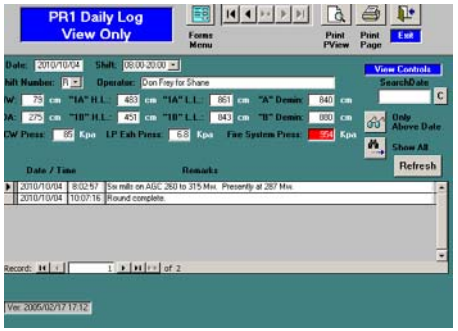


RULES Rules Monitoring & Continuous Improvement

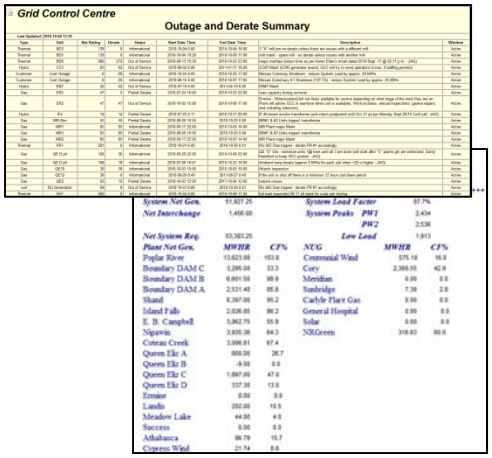
Roles & Responsibilities (Performance Group)



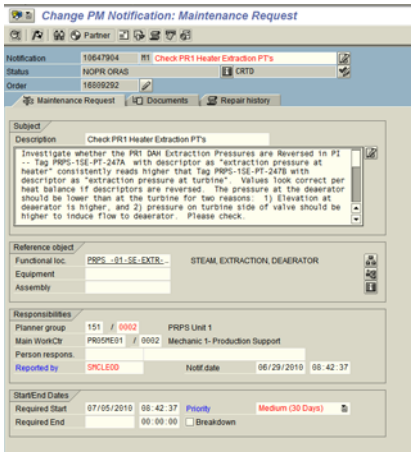
Review items logged by M&D Contractor



Review Unit Logs

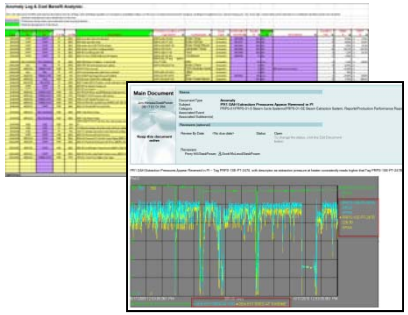


Review GCC reports



Search existing / enter SAP Work notifications

Notify operations of critical issues (liason w Shift lead)



Manage / prioritize issues

Site Inspections & Testing

Bi-Monthly Site meetings

SaskPower

Roles & Responsibilities (Plant Operations)

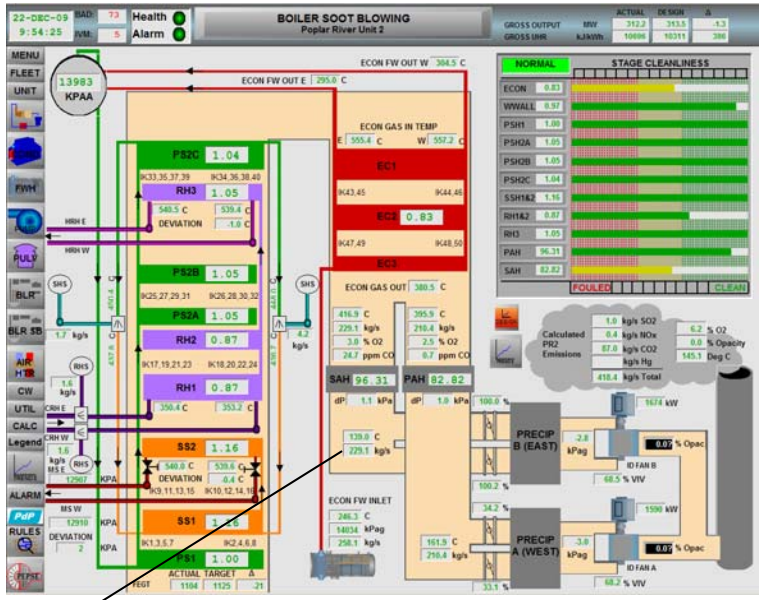
Plant Operations: Monitor & Optimize variables that change frequently.

UNIT PERFORMANCE		ACTUAL	DESIGN	Δ
Main Steam Flow	kg/s	267.2		
Gross Output	MW	315.0	317.3	-2.4
Net Output	MW	292.5	297.0	-4.5
Station Service	MW	22.4	20.3	2.1
Turbine Heat Rate	kJ/kWh	8423	8313	110
Boiler Efficiency	%	78.2	80.6	-2.4
Gross Unit Heat Rate	kJ/kWh	10771	10319	453
Net Unit Heat Rate	kJ/kWh	11597	11023	574
Unit Cycle Efficiency	%	42.7	43.3	-0.6
Missed Opportunity	$/hour	29480	0	29480

CONTROLLABLE LOSSES		ACTUAL	DESIGN	Δ	HR Effect (kJ/kWh)	MW Effect (MWe)	Rule Link	HR Effect Chart (kJ/kWh) - Better + Worse
Main Steam Temp	Deg C	540.5	537.8	2.7	-5.6	-0.2	RULE	
Main Steam Pressure	kPag	12531.2	12415.6	116.0	-4.2	2.9	RULE	
Reheat Steam Temp	Deg C	537.1	537.8	-0.7	1.7	-0.2	RULE	
LP Exhaust Pressure	kPaa	5.1	8.5	-3.3	-14.2	0.5	RULE	
Condenser Subcooling	Deg C	0.0	0.0	0.0	0.0	0.0	RULE	
Final Feedwater Temp	Deg C	246.5	244.0	2.5	-8.8	-1.1		
Superheat Spray Flow	kg/s	8.7	6.9	1.8	3.1	0.2	RULE	
Reheat Spray Flow	kg/s	0.5	1.2	-0.8	-5.2	-0.6	RULE	
Auxiliary Steam Flow	kg/s	0.8	0.0	0.8	7.3	-0.7		
Cont. Blow Down Flow	kg/s	0.1	0.0	0.1	2.3	N/A		
Make up Water Flow	kg/s	0.6	0.0	0.6	12.9	-0.1		
Generator Hydrogen Press	kPag	308.8	310.0	-1.2	-0.0	0.0	RULE	
Station Auxiliary Power	MW	22.4	20.3	2.1	58.6	-2.1		
Boiler Exit Gas Temp	Deg C	151.4	121.5	29.9	147.0	N/A	RULE	
Boiler Excess Oxygen	% wet	2.5	2.5	-0.0	-0.5	N/A	RULE	
Incomplete Combustion	%	0.8	0.3	0.5	50.9	N/A		

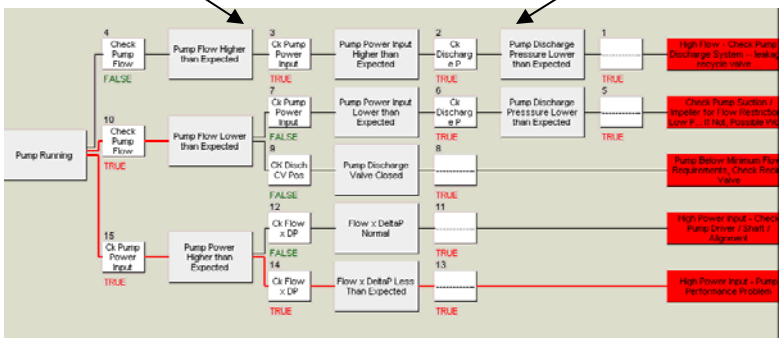
UNCONTROLLABLE LOSSES		ACTUAL	DESIGN	Δ	HR Effect (kJ/kWh)	MW Effect (MWe)	Rule Link	HR Effect Chart (kJ/kWh) - Better + Worse
Internal Turbine Losses	kJ/kWh				129.5	-4.0		
Generator Power Factor		0.99	0.90	0.09	-12.7	0.5		
Reheater Pressure Drop	kPa	213.7	203.4	10.3	2.0	-0.2		
CEP Enthalpy Rise	kJ/kg	0.0	1.9	-1.9	1.7	-0.1		
BFP Enthalpy Rise	kJ/kg	24.8	23.0	1.8	-2.7	0.1		

Controllable losses



Boiler Cleanliness

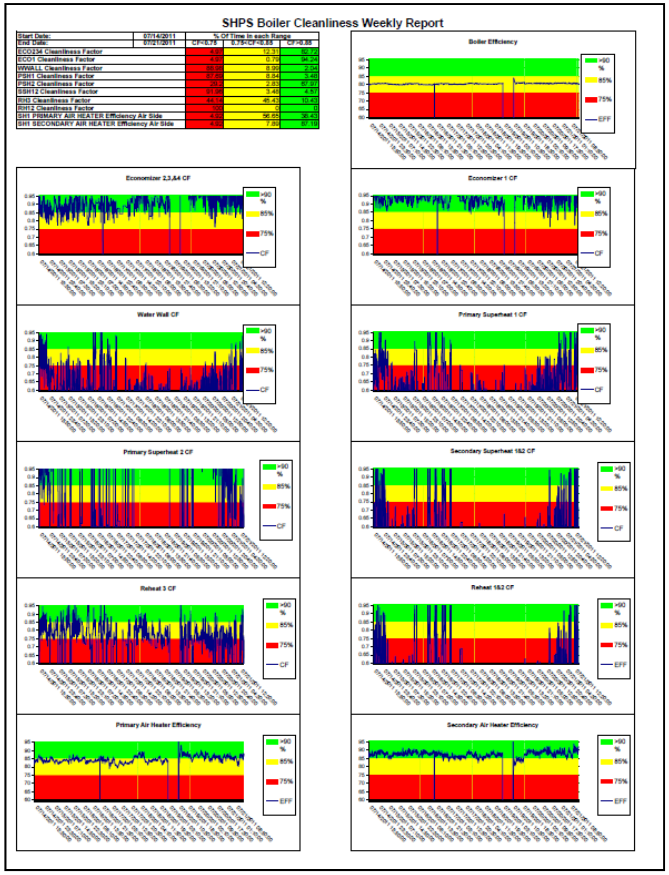
Diagnostic Rules



SaskPower

Roles & Responsibilities (Plant Operations)

Plant Operations: What reports do you need to support your responsibilities?



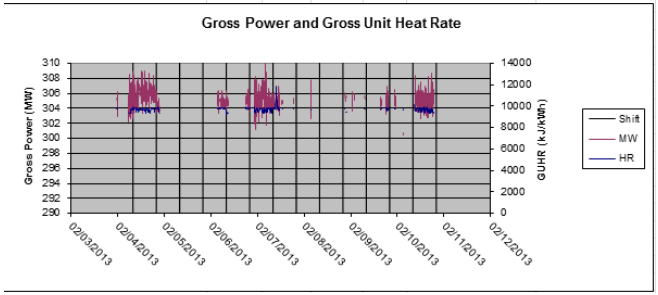
Boiler Cleanliness Report

BDPS Unit #6 Controllable Losses Weekly Average (Above 300 MW) Report

Percent Time above 300 MW: 35%

Unit Performance		Actual	Design	Δ	Operator Comments
Main Steam Flow	KPPH	1973			
Gross Output	MW	305.2	298.0	7	
Net Output	MW	294.0	280.0	14	
Station Service	MW	11.2	18.1	-7	
Turbine Heat Rate	kJ/kWh	7998	8372	-374	
Boiler Efficiency	%	82.4	82.5	0	
Gross Unit Heat Rate	kJ/kWh	9707	10157	-449	
Net Unit Heat Rate	kJ/kWh	10077	10810	-449	
Unit Cycle Efficiency	%	45.5	43.0	3	
Gross Revenue	$/hour	9835	9367	467	

Controllable Losses		Actual	Design	Δ	HR Effect (kJ/kWh)	MW Effect (MWe)
Main Steam Temp	Deg F	1000.0	1000.0	0.1	0.0	0.0
Main Steam Pressure	psia	1830.8	1814.0	16.8	-2.1	2.8
Reheat Steam Temp	Deg F	992.6	1000.0	-7.4	9.7	-1.1
LP Exhaust Pressure	in. Hg	2.3	1.6	0.8	43.6	-1.6
Condenser Subcooling	Deg F	4.1	0.0	4.1	5.5	-0.2
Final Feedwater Temp	Deg F	466.1	460.8	5.3	-8.1	-1.3
Superheat Spray Flow	KPPH	55.3	34.0	21.3	3.9	0.4
Reheat Spray Flow	KPPH	0.6	0.0	0.6	0.4	0.1
Auxiliary Steam Flow	KPPH	9.7	0.0	9.7	14.7	-1.3
Cont. Blow Down Flow	KPPH	0.4	0.0	0.4	2.5	N/A
Make up Water Flow	KPPH	89.1	0.0	89.0	178.4	-1.4
Sootblower Steam Flow	KPPH	9.4	0.0	9.4	27.8	N/A
Generator Hydrogen Press	psig	42.0	45.0	-3.9	-1.1	0.0
Station Auxiliary Power	MW	11.2	18.1	-6.9	-176.5	6.9
Boiler Exit Gas NL Temp	Deg F	309.8	343.0	-33.2	-53.8	N/A
Boiler Excess Oxygen	% Wet	2.6	2.6	0.0	3.0	N/A
Incomplete Combustion	%	0.1	0.2	-0.1	-9.2	N/A



Controllable Loss Report

SaskPower

Roles & Responsibilities (ongoing plant meetings)

Performance meeting concept

- Weekly (at Shand)
- Bi-monthly (other plants)

Technical Support

Operations

Maintenance

Performance Group

Historic discussion New Discussion Completed

Goal	Action Items	Date Due	Person Resp.	Percent Complete
Implement and maintain effective PF Fuel Sampling	• 2012-11-15: Verify if PRPS is using isokinetic fuel sampling equipment. • 2012-12-17: Joe is going to double check they are using the new equipment. Joe will double check if there are probe plugging problems (if it does plug, Larry had suggested other purging probe). Ports changed out during Fall 2012 overhaul to permit using Isokinetic sampling equipment.	2012-12-01	Joe Beliveau	50%
	• 2012-11-15: Verify frequency of PF sampling • 2012-12-17: Sampling done quarterly on a PM, or on ad-hoc basis. Discussed merits sampling before/after mill overhaul (Trent to build into existing PM job plan). Trent says nothing is done with the data right now. Agreed Trent would start sending PF data to Performance after each sample taken for review and recommendations.	2013-01-31	Trent Nystrom	50%
	• 2012-11-15: Obtain historic PF sampling data • 2012-12-17: Trent will send the spreadsheet.	2012-12-31	Trent Nystrom	0%
Maintain rated Coal Sizing leaving crushers	• 2012-11-15: Inspect coal size leaving crusher (on conveyor or at feeder inlet). Verify that coal handling is run fairly continuously, and using both crushers as much as available. • 2012-12-17: No progress.	2013-01-31	Joe Beliveau	0%
	• 2012-11-15: Verify what coal top size setting for crushers (<1-1/4"?) What is being observed for coal top size? • 2012-12-17: Joe says crushers are set to <1-1/2".	2012-12-15	Joe Beliveau	100%
	• 2012-11-15: Investigate opportunity to sample coal after crusher, then use the data to trigger crusher maintenance. Investigate how to take a coal sample (stop belt and take sample?) • 2012-12-17: Larry suggests sampling crusher & feeders by stopping the belt, and taking the contents. Sampling port above feeder is useless in Larry's experience. Trent to write job plan for sampling from crusher, and set up PM. PRPS to begin changing crusher rolls yearly.	2013-01-31	Trent Nystrom	10%
Monitor Coal quality	• 2012-11-15: Ongoing coal sampler maintenance, keep in service - suspicious of coal quality. • 2012-12-17 Joes says sampler works well. Coal quality is acceptable (variance and quality is ok). Contract doesn't stipulate quality. Sometimes ash content rises.	2012-12-15	Joe Beliveau	100%
	• 2012-12-17: Howard would like Tim Schuster to allocate a person to investigate how to drop ash content (recently risen to 15%, historically has been as low as 9%). Mine doing some night shift mining, which may be potential source of quality issues.	2013-12-31	Howard Matthews	0%

SaskPower

Process Enhancements (Quarterly ECM Committee meetings)

SaskPower

TERMS OF REFERENCE

SASKPOWER "EQUIPMENT CONDITION MONITORING OPTIMIZATION COMMITTEE"

1.0. Statement of Purpose

1.1. Cross-pollenate best practices related to components of an Equipment Condition Monitoring (ECM) program (standards, tools, resources, software systems, personnel training) among participating SaskPower areas/facilities staff.

1.2. Extend run times on equipment by deferring major maintenance through predictive maintenance where practicable.

1.3. Reduce frequency and severity of major equipment failures

2.0. Scope of Committee

2.1. The following ECM related programs will be subject for review by the committee:

- Vibration monitoring
- Lubrication management and used oil analysis
- Thermography
- Cycle Isolation Monitoring
- Preventative Maintenance Optimization (improve job plans, extend overhaul frequencies if possible, implement condition based triggers)

2.2. For each ECM related program, the committee will:

- Assess and optimize data collection methods and frequencies,
- Assess and optimize scope of equipment monitored,
- Establish standards/thresholds for resulting inspection/maintenance activities, and publish these for wide-area access on the EIN.

3.0. Committee Membership:

3.1. Membership to include two Steering Committee Leaders, two Working Committee Leaders, and Working Committee Members comprised of 2-3 representatives from each participating area/facility.

3.2. Membership may include, but not limited to Maintenance Supervisors, Plant Maintenance/Mechanical Engineers, Plant Mechanics.

3.3. Specific names appointed to the Committee members are maintained in Appendix A.

4.0. Duties of Committee Members:

A. Steering Committee Leaders

i. Shall assign projects to the Working Committee Leaders as required.
ii. Shall review and approve the meeting agendas and meeting minutes.
iii. Shall ensure that committee meetings are scheduled.

iv. Shall ensure that initiatives recommended by the committee are adequately supported and funded.
v. Shall ensure benchmark the performance of the Committee versus historical performance.

B. Working Committee Leaders

i. Shall assign projects to the Working Committee Members as required.
ii. Shall prepare and distribute the meeting agendas and meeting minutes.
iii. Shall schedule committee meetings.
iv. Shall investigate opportunities for ongoing improvement of the ECM program through comparing existing ECM programs among SaskPower areas/facilities, and through benchmarking SaskPower ECM programs against industry standards. ECM Program gaps among SaskPower areas/facilities will be identified and managed accordingly.
v. Shall ensure that relationships with third party experts are maintained and enhanced where it makes sense to sustain/improve the ECM program.
vi. Shall investigate opportunities for ongoing improvement and availability of ECM program components (standards, tools, resources, software systems, personnel training).
vii. Shall assess the training needs of committee members and staff at the areas/facilities they represent, and coordinate any resulting training courses required. Target is a minimum of one course per year to be hosted at a SaskPower facility, and made available to all interested SaskPower staff.
viii. Shall investigate industry best practices, and pursue opportunities to continuously improve the ECM program.
ix. Shall develop consistency of program implementation among participating areas/facilities where appropriate.
x. Shall maintain and continuously improve availability of ECM program components on the EIN.

C. Working Committee Members

i. Shall participate in committee meetings as scheduled by the Working Committee Leaders.
ii. Shall participate in projects and action items assigned by the Working Committee Leaders as required.
iii. Shall identify best practices being implemented at their area/facility which may be investigated by the Committee for implementation at other areas/facilities.

5.0. Committee Meetings

5.1. The Committee shall meet four times annually, twice in person, and twice via video-conference.

5.2. Minutes of each Committee meeting shall be kept, and distributed by the Working Committee Leaders.

Process Enhancements (Annual "M&D Summit" meeting)

Multi-plant meeting:

- Case studies
- Process improvements / new features
- Efficiency upgrades
- Two-way dialogue

Schedule	Description	Presenters	Presentation
08:00 - 08:15	**Opening remarks** • EIN posting	Scott McLeod	1) 2013-02 M&D Opening Remarks.ppt
08:15 - 09:00	**FAMOS Case Studies:** • Top 10 Major catches during the last period:	Alyssa Beisel, Scott Prokopetz, Jashandeep Chahal, Thomas Ingold	2) 2013-02 Case Studies.ppt
09:00 - 09:15	BREAK		

09:15 - 9:45	**M&D process overview and planned enhancements**
	• EIN - Performance Systems (PI, FAMOS, SPOAD, TP-PLUS)
	• FAMOS V17 upgrades (web client)
	• M&D service contract (expires year end 2013)
	• Cost Benefits / Team Room integration
	• Combustion Decision Tree
	• FAMOS Roles & Responsibilities
	  • Operations based activities
	  • Engineering and Maintenance based activities
	• reporting
		Scott McLeod	3) 2013-11 Process & Enhancements.ppt

9:45 - 10:15	**Shand CW System Evaluation** - testing, study, recommendations	Scott Prokopetz	4) 2013-02-13 SH1 KE System Presentation.ppt
10:15 - 10:30	BREAK		
10:30 - 11:00	**Efficiency Survey Results** • Marbek report on efficiency upgrade potential at BDPS, SHPS, PRPS	James Holtom	5) Efficiency Survey Results.pptx
11:00 - 11:30	**SPOAD** - demonstration, planned upgrades	David Mah	
11:20 - 12:00	**Fuel & Purchased Power Budget** - process overview, process enhancements, KIR Reporting	Dan Hemingway	7) F&PP Budget Process - for M&D Summit 2013-02-13.ppt
12:00 - 1:00	LUNCH		
1:00 - 1:30	**TP-PLUS cycle isolation project status:** - program overview, finds, future expansion	Alyssa Beisel	8) Cycle Isolation Monitoring Project Status.ppt
1:30 - 2:00	**2012 Boiler Tuning and controls modifications** - objectives, methodology, results, before/after trends, lessons learned	Jashandeep Chahal	9) 2013-02 Combustion Tuning.ppt
2:00 - 2:15	BREAK		
2:15 - 2:45	**2013 Planned Work:** • Summary of plant specific work • Summary of fleet-wide work (Performance Test Agreement, Combustion Tuning Agreement, Controls tuning agreement)	Alyssa Beisel, Scott Prokopetz, Jashandeep Chahal Thomas Ingold	10) Performance group 2013 work.ppt
2:45 - 3:15	**Bear-pit session:**	Scott McLeod	
3:15 - 3:30	**Closing remarks:**	Scott McLeod	
3:45	**Meeting Adjournement**		

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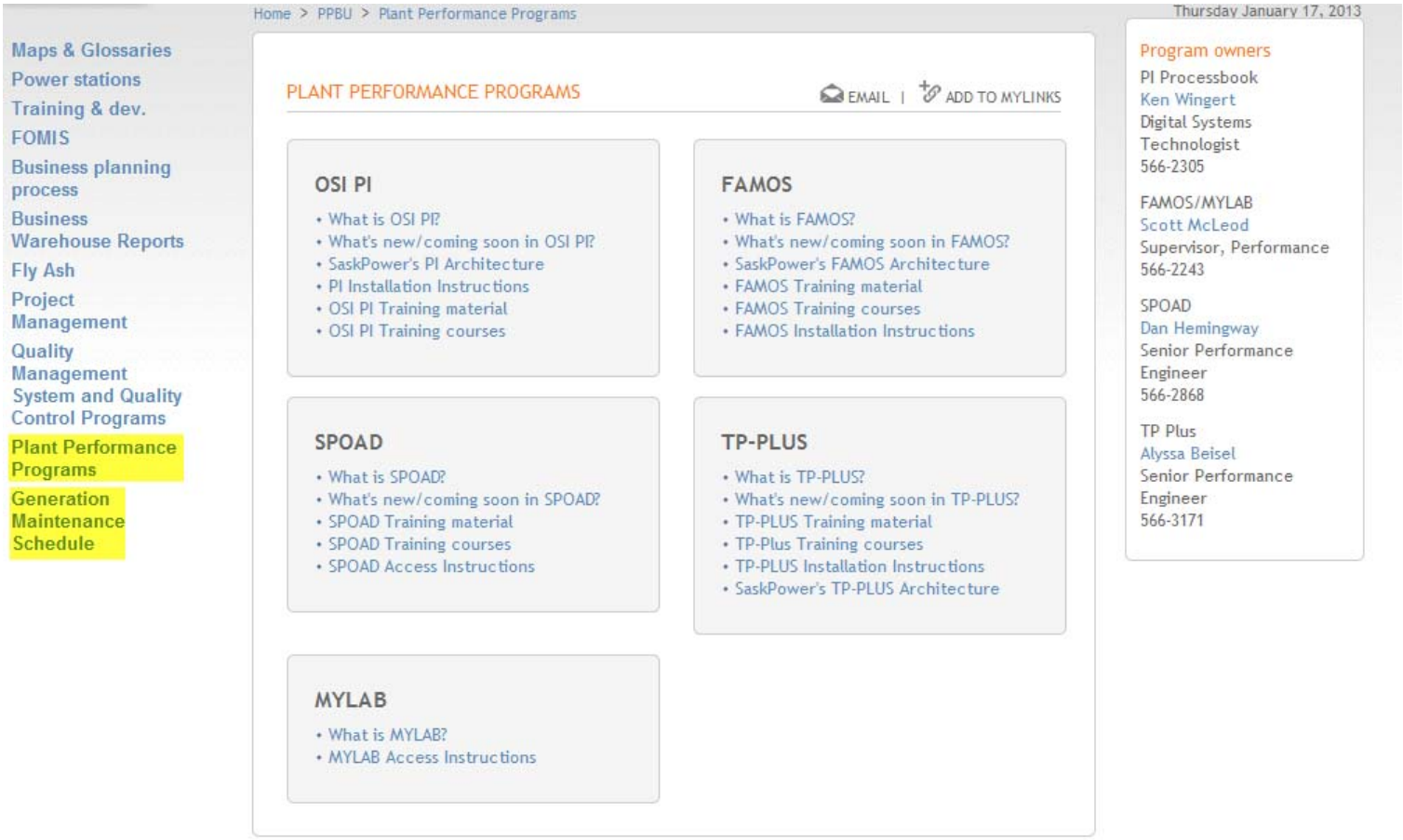
Process Enhancements (EIN Webpage – Performance Programs)



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Powering the future

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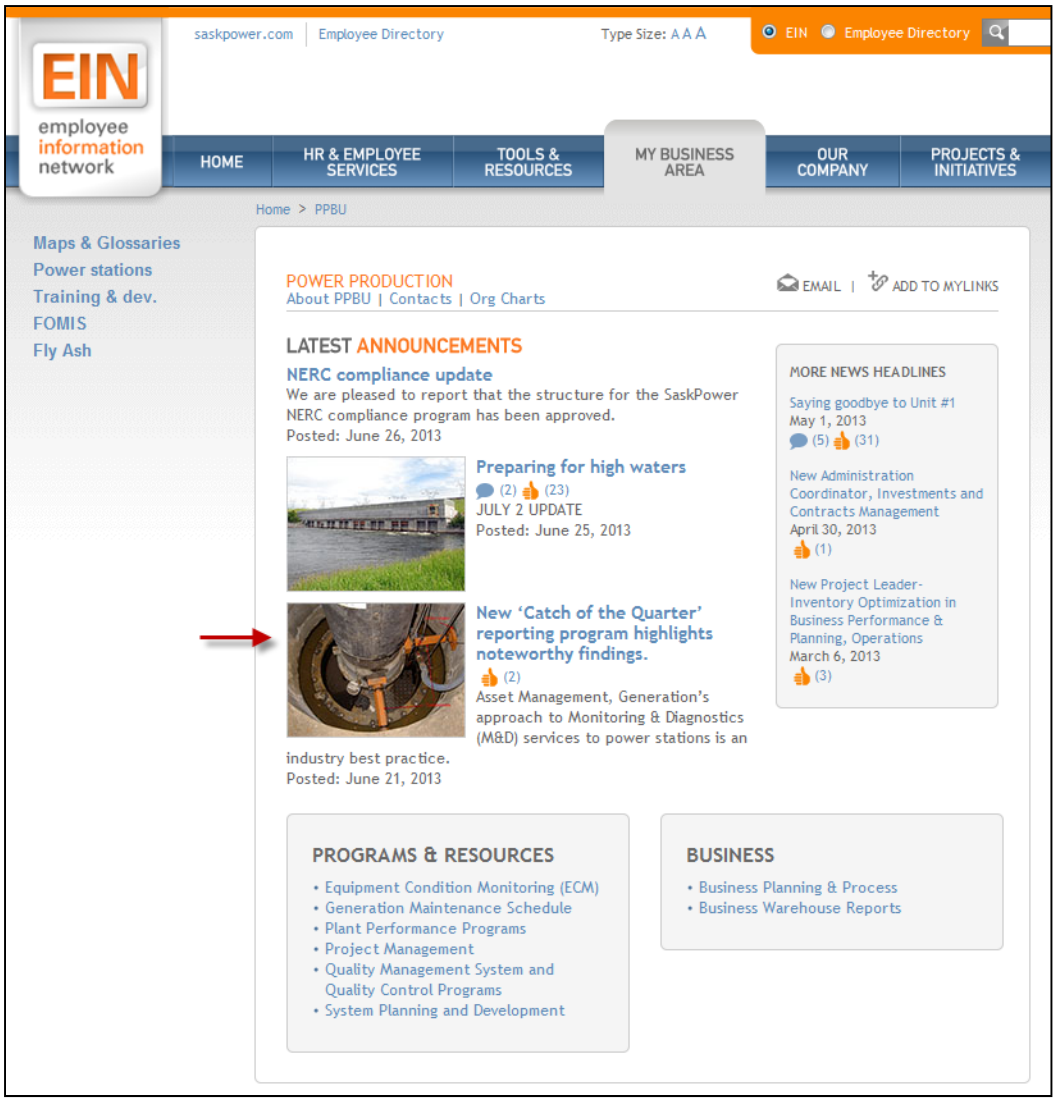
Process Enhancements ("Catch of the Quarter")



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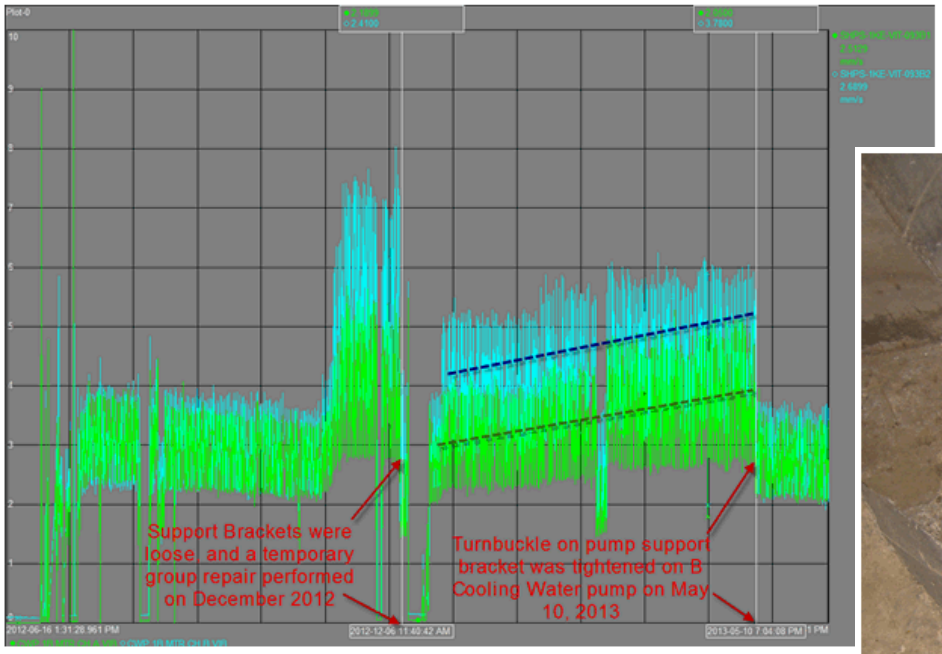
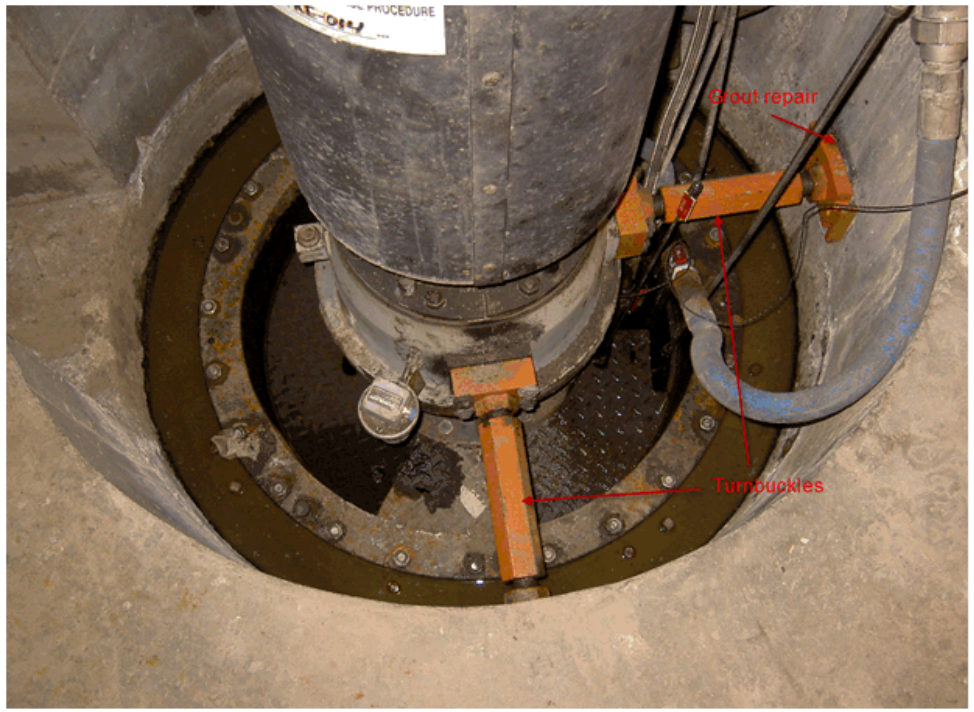
Process Enhancements ("Catch of the Quarter")

Anomaly Identified:

The vibrations on both motor bearings on B Cooling Water pump had been gradually increasing since a grouting repair on the pump support bracket was performed in December 2012. The PdP system produced an alarm on these bearings, and the Performance group notified Shand plant staff of the anomaly. Shand deployed a mechanic to inspect the pump.





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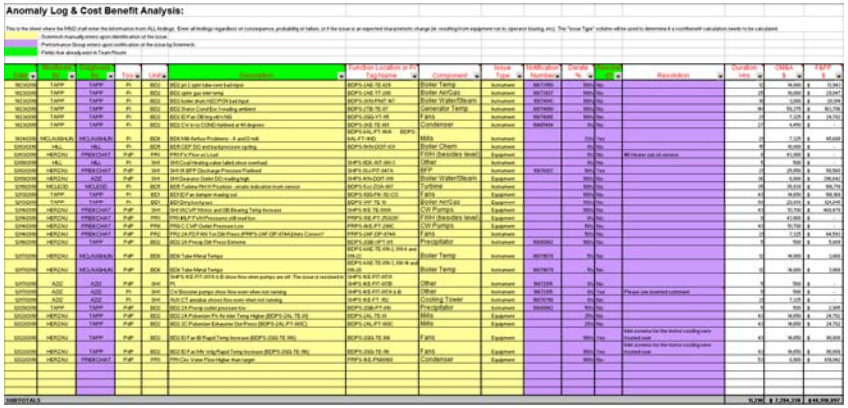
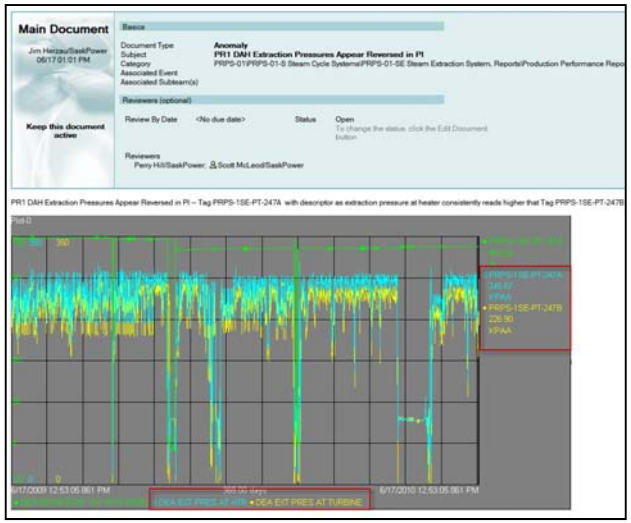
Process Enhancements
(Issues Management database upgrades)

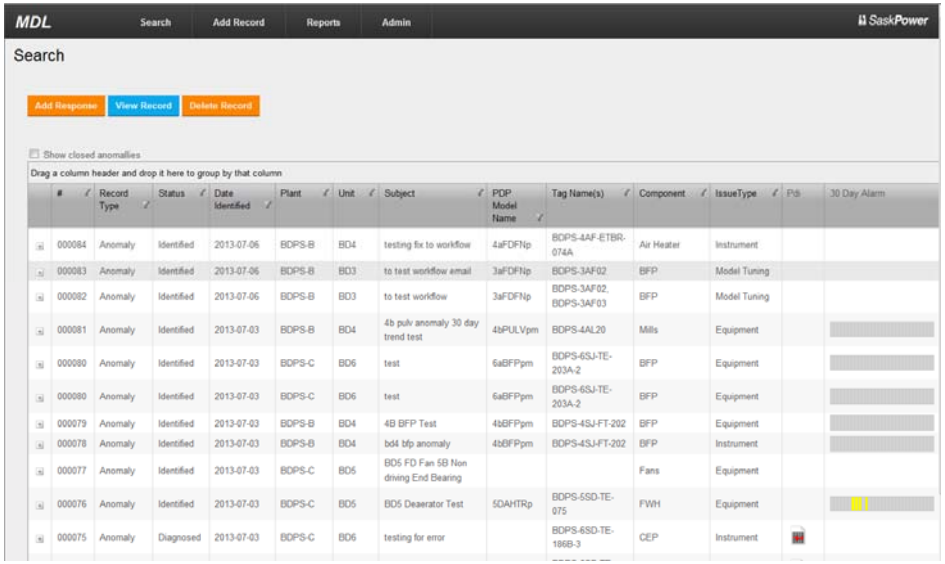


Integration of:

Issues Management + Cost benefits

Into single .NET application
(configured by SaskPower)





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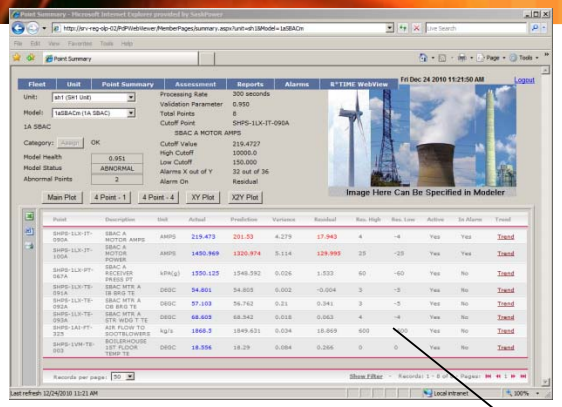
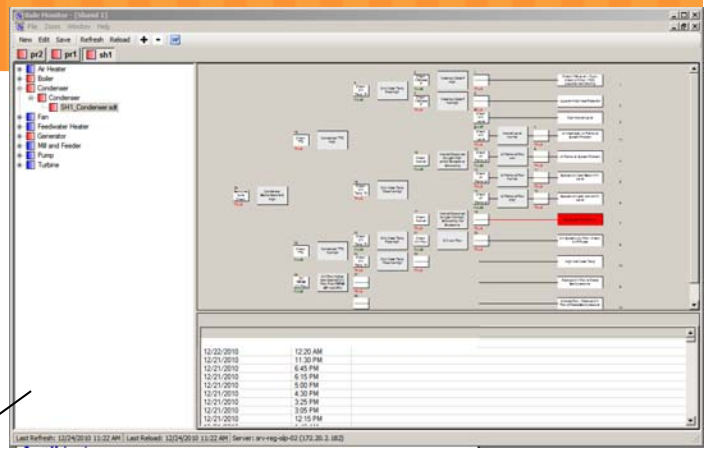
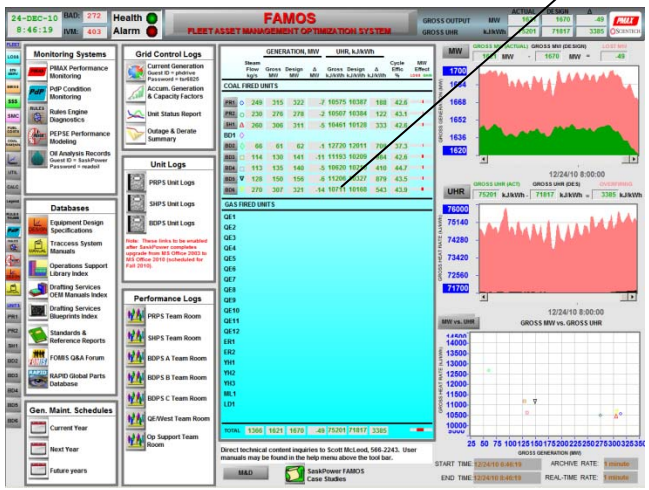
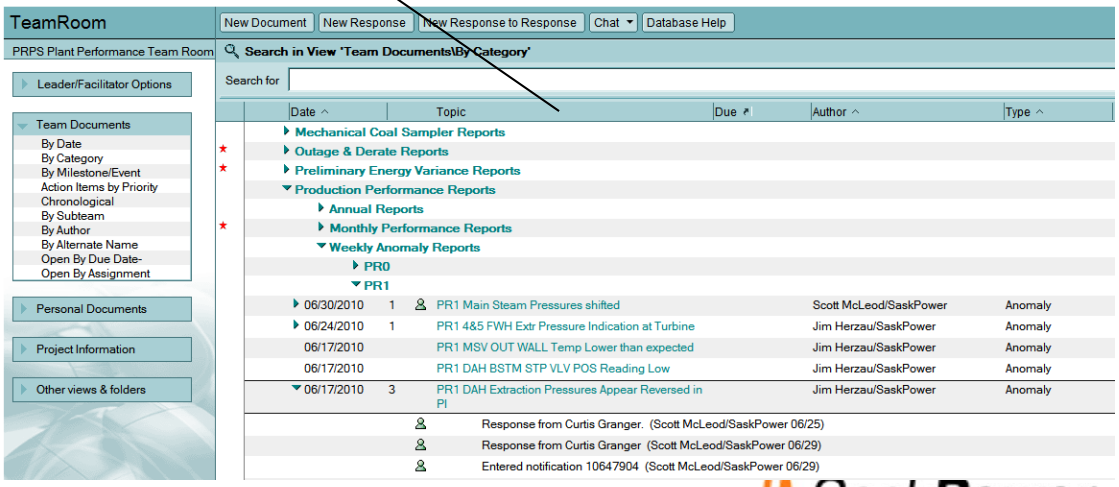
Planned Enhancements (Scientech)





"Project Facelift" – *Project "Facelift" - replace all MMI's with a single .NET application.*





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Planned Enhancements (M&D Services architecture)

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Current communications

Proposed communications

SaskPower ⇄ Manual VPN — SCIENTECH

Continuous VPN, automatic authentication

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Questions?

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