

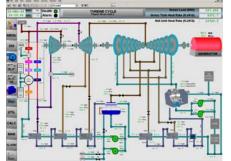
### **On-Line Performance at SaskPower**

### **Lessons Learned**

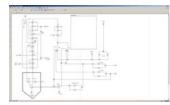














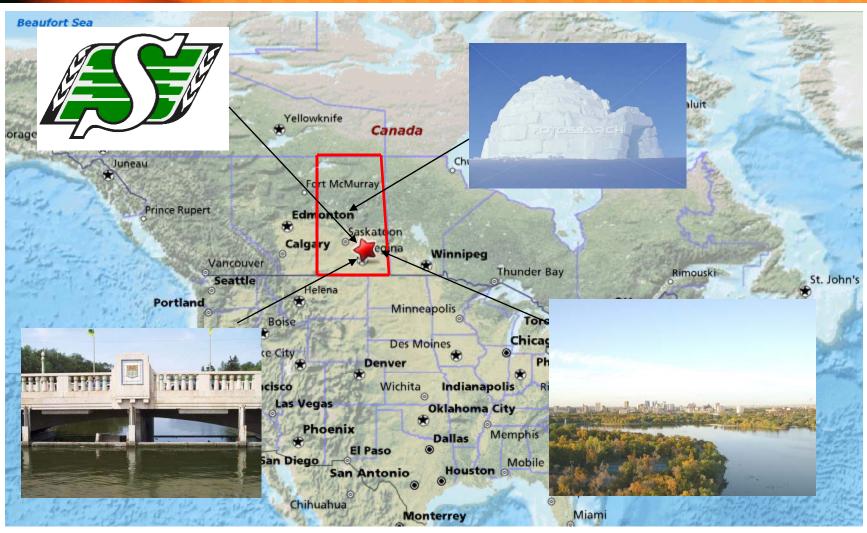








# Where is Saskatchewan?





# SaskPower's Assets

#### Generation (net capacity)

#### Hydroelectric

- Athabasca Hydroelectric System 23 MW
  - Wellington (5 MW)
  - Waterloo (8 MW)
  - . Charlot River (10 MW)
- Island Falls Hydroelectric Station 102 MW
- E. B. Campbell Hydroelectric Station 288 MW
- Nipawin Hydroelectric Station 255 MW
- Coteau Creek Hydroelectric Station 186 MW

#### Natural Gas

- Meadow Lake Power Station 44 MW
- Landis Power Station 79 MW
- Queen Elizabeth Power Station 385 MW
- Success Power Station 30 MW

#### Wind

- Centennial Wind Power Facility 150 MW
- Cyprose Wind Power Facility 11 MW

#### Coal

- Poplar River Power Station 572 MW
- Boundary Dam Power Station 813 MW
- Shand Power Station 276 MW

#### Independent Power Producer

- Meridian Cogeneration Station 210 MW
- Cory Cogeneration Station 228 MW
- SunBridge Wind Power Project 11 MW
- NRGreen Kerrobert Heat Recovery Project 5 MW

#### Transmission





### SaskPower capacity:

Hydro	854 MW	27%
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Gas 538 MW 17%

Wind 161 MW 5%

Coal 1661 MW 51%

SP Total 3214 MW 100%

#### **IPP Capacity:**

Gas 438 MW 96%

Wind 11 MW 3%

Heat Rec 5 MW 1%

IPP Total: 454 MW 100%

TOTAL 3668 MW

Population 1,040,000 (2008)





# Performance Group



### **Primary Functions**

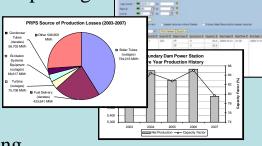
#### 1) Remote Monitoring





#### 2) Statistical Reporting





#### 3) Field testing







### Staff Members



W. Perry Hill
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Plant Contact: BDPS A Plant



Scott McLeod Senior Performance Engineer 566-2243 smcleod@saskpower.com Plant Contact: PRPS, Western Plants (& assigned to on-line performance project)



Alyssa McLaughlin Performance Engineer 566-3171 amclaughlin@saskpower.com Plant Contact: Boundary Dam B & C Plant



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Plant Contact: Shand



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(reassigned to the SPOAD
project)



David Mah
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Plant Contact: None (Full-time results support)



Akbar Aziz
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Plant Contact: None







# Project Scope

### 1) Instrumentation











Coincides with DCS upgrade

### **Scheduled Completion:**

•PR2 2006 •PR1 2008

•SH1 Jan 2010

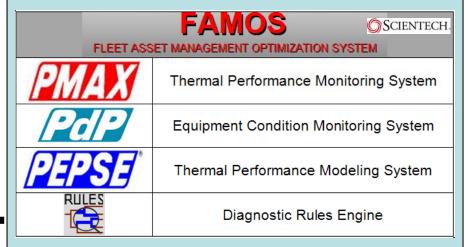
•BD5 Mar 2010

•BD4 & BD6 Dec 2010

•QEPS Dec 2010

•BD3 Oct 2011

### 2) Monitoring Software



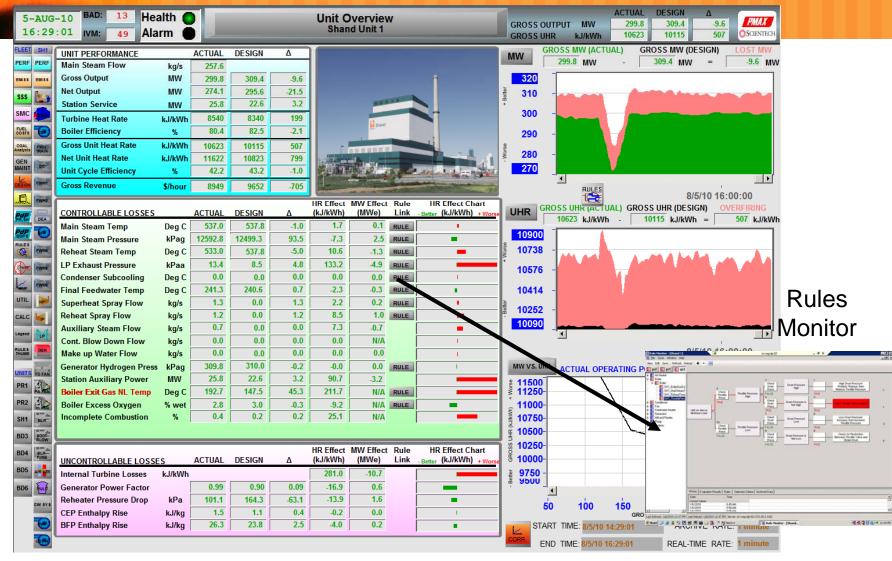


### **Scheduled Completion:**

Ochicadica Completion.	
•PR2 (pilot)	Dec 2009
•PR1, SH1	Dec 2009
•BD3,4,5,6	Jun 2010
•BD1,2	Dec 2010
•QE1-12, ERPS, YHPS	Dec 2011
<ul><li>Landis, Meadow Lake</li></ul>	Dec 2011
<ul><li>Cypress, Centennial</li></ul>	Jun 2011

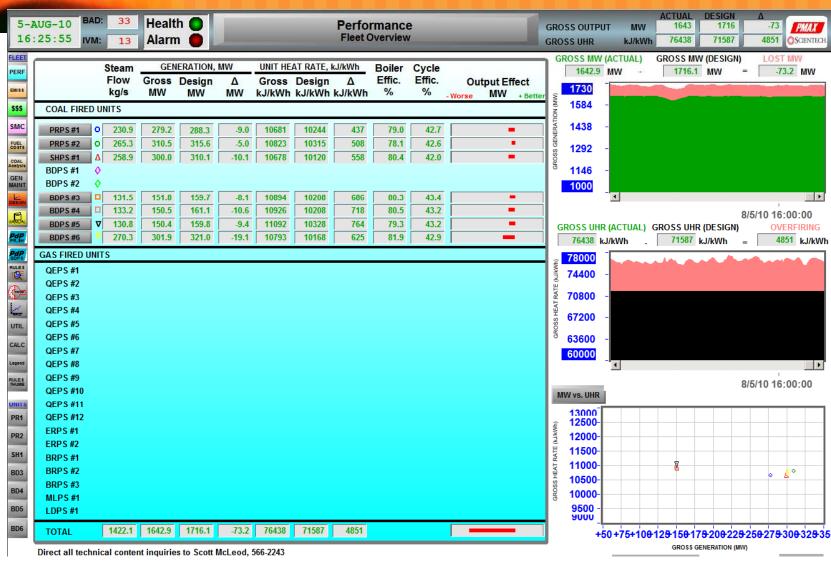


## Plan to get involved





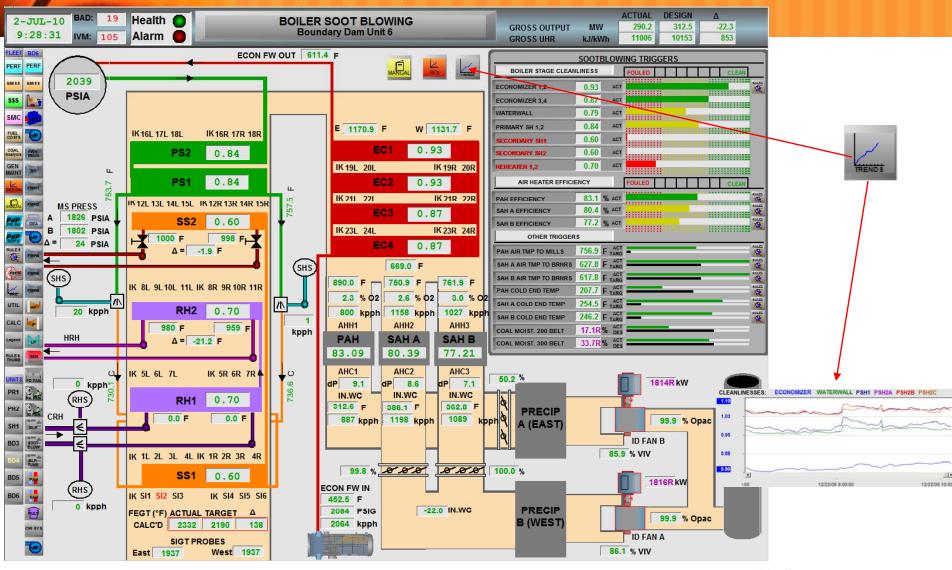
### 1. Plan to get involved





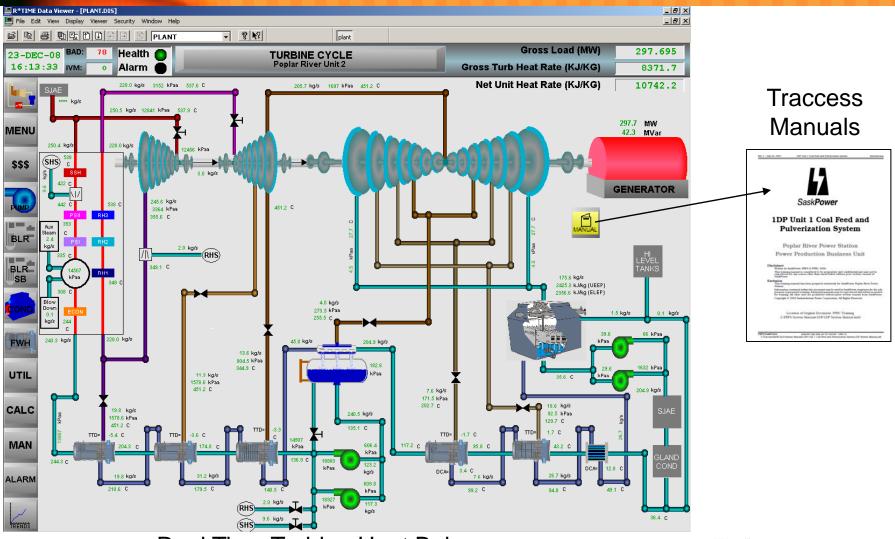


## Plan to get involved





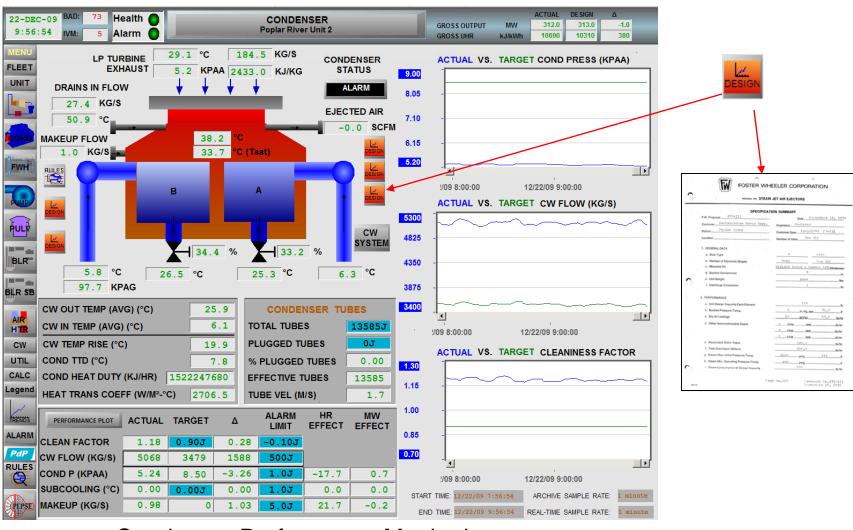
### 1. Plan to get involved



Real Time Turbine Heat Balance



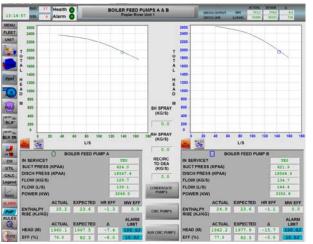
### 1. Plan to get involved



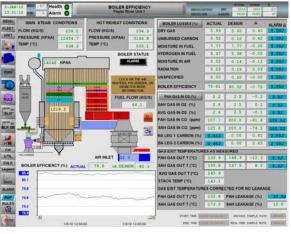




### 1. Plan to get involved



| PULLEREER | PULL

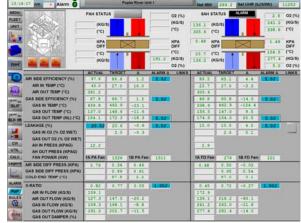


**Pump Curves** 

Mill Performance

**Boiler Efficiency** 







Turbine Stage Efficiencies

Air Heater Performance

### **Lessons Learned:** Manage your findings

 Managing issues in SaskPower's Lotus **Notes Team Room** 

Mechanical Coal Sampler Reports

▶ Preliminary Energy Variance Reports

**▼** Weekly Anomaly Reports

Monthly Performance Reports

8

8

PR1 Main Steam Pressures shifted

PR1 4&5 FWH Extr Pressure Indication at Turbine

PR1 MSV OUT WALL Temp Lower than expected

PR1 DAH BSTM STP VLV POS Reading Low

**▼** Production Performance Reports

▶ Outage & Derate Reports

Annual Reports

▶ PR0

▼ PR1

▶ 06/30/2010

▶ 06/24/2010

06/17/2010

06/17/2010

**▼** 06/17/2010

PRPS Plant Performance Team Room | Q Search in View 'Team Documents\By Category' Search for

TeamRoom

Leader/Facilitator Options

Team Documents

By Milestone/Event Action Items by Priority

Open By Due Date-

Personal Documents

Project Information

Other views & folders

Open By Assignment

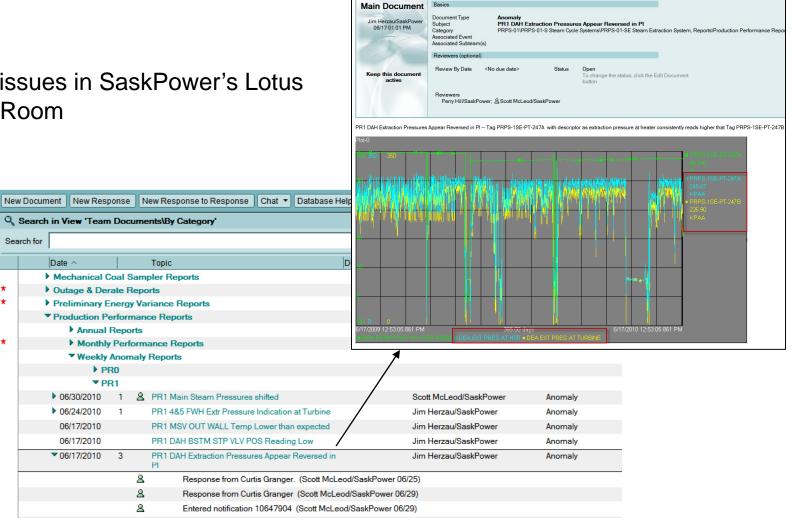
By Date

By Category

Chronological

By Subteam

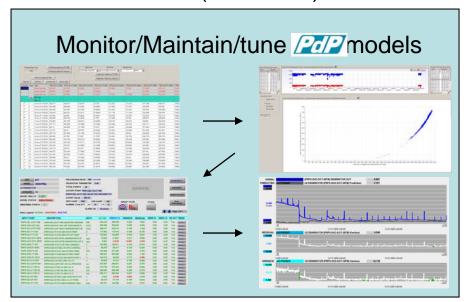
By Author By Alternate Name

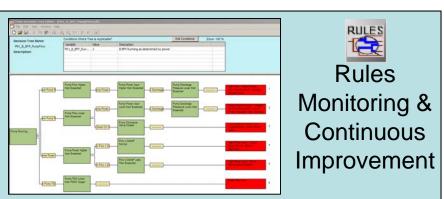


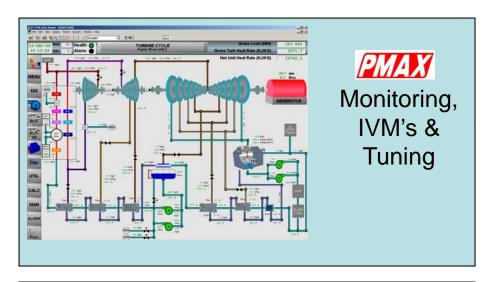


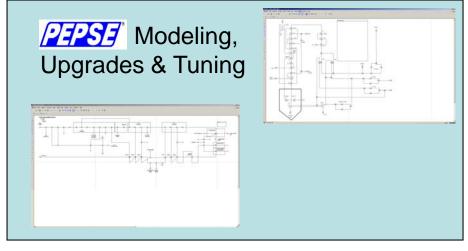
### 3. Define Roles & Responsibilities

### M&D Contractor (Scientech):









### 3. Define Roles & Responsibilities

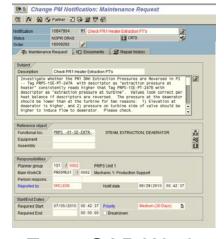
### Performance Group:



Review items logged by M&D Contractor



Notify operations of critical issues (liason w Shift lead)



Enter SAP Work notifications



Site Inspections & Testing

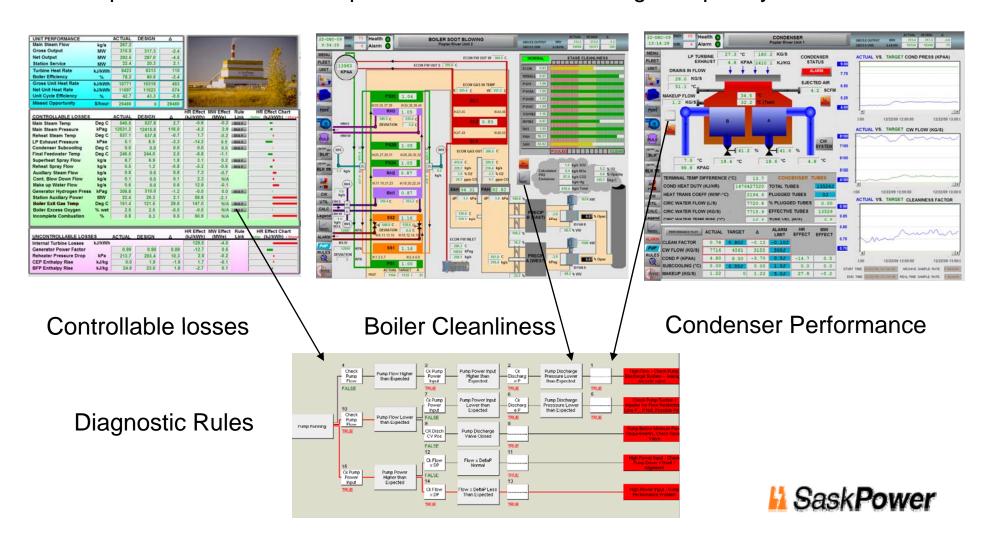


Monthly Site meetings



### 3. Define Roles & Responsibilities

Plant Operations: Monitor & Optimize variables that change frequently.



### 3. Define Roles & Responsibilities

Plant Maintenance: Participate in diagnoses, execute corrective action.



Vibration analysis



SAP – Corrective & Preventative Maintenance Continuous Improvement



Oil analysis



Calibrate/Maintain Instrumentation



### 3. Define Roles & Responsibilities

#### Plant Managers: Ask questions

"What's your heat rate?"

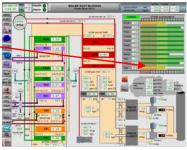


"Is your heat rate getting better?"



"What have you done to improve heat rate today?"



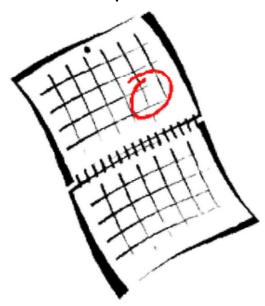




### 4. Schedule considerations missed

#### Consider in schedule:

- time to review calcs, apply IVM's
- time to review and customize displays
- time to ensure configuration server is stable before wide scale roll-out
- time to test local client install script

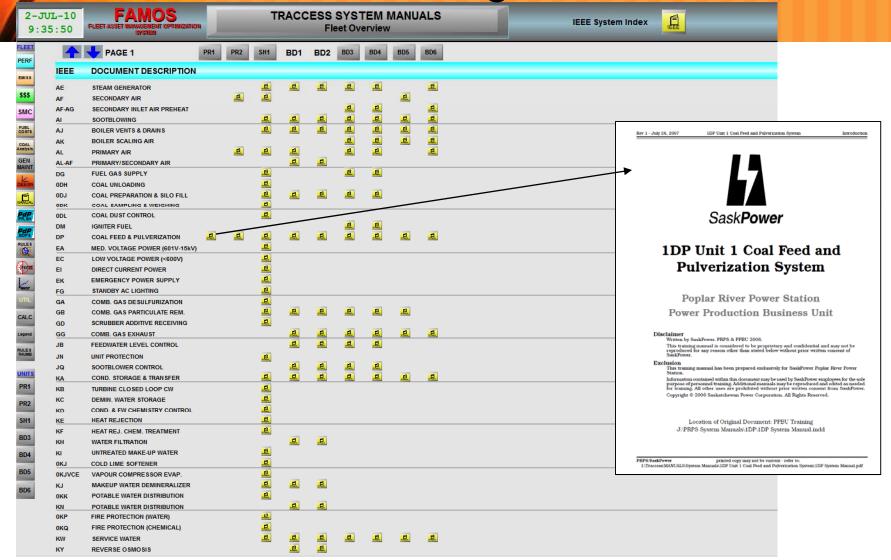




### 5. Increase Integration

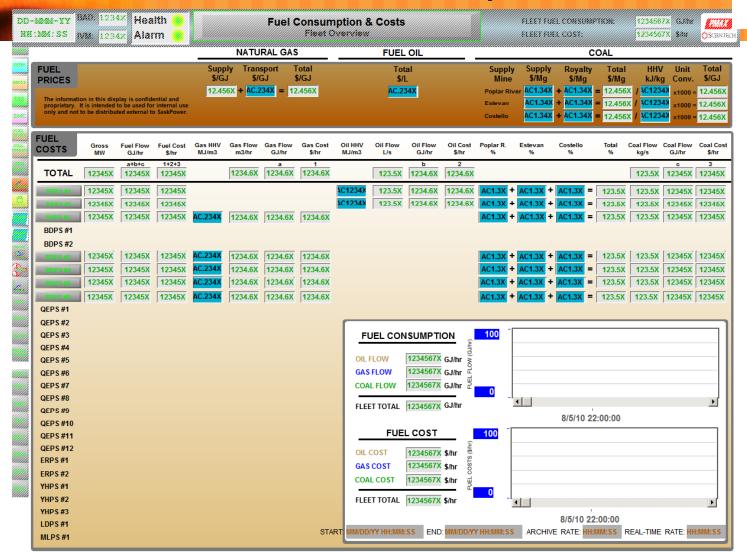
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GEN AINT LESION PAP R, SH	AF-FAN AF-FAN AF-FAN	FD FAN SPEC	<u></u>	<u></u>	<u></u>			<u></u>	<u></u>	<u></u>	<u></u>	N/A	N/A	<u></u>	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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ESION  IdP  R.SH  IdP  OPS		FD FAN CAPACITY CURVE	<u></u>	<u> </u>	-	_		<u> </u>		<u> </u>	<u></u>	N/A	N/A	<u> </u>	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IdP R, SH	AF-FAN	FD FAN SPEED-TORQUE CURVE		<u> </u>			_	<u></u>	<u></u>	<u></u>	_	N/A	N/A	<u> </u>	N/A	N/A	N/A	N/A	N/A	N/A	N/A
dP R, SH DPS		FD FAN MOTOR SPEC	100		<u></u>		_	_	<u>.K.</u>		-	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A
dP R, SH DP3	AF-HX	SECONDARY AIR HEATER SPEC	-	<u></u>	-				-	<u> </u>	E.	N/A	N/A	100		W			ELER CO		
dP OP3	AF-HX	SECONDARY AIR HEATER DWG						_	-		N/A	N/A	N/A			TAA	10012	VVI IL	LLLIN CO	JAFOA	ATION
DP8	AF-HX AI	SECONDARY AIR STEAM PREHEAT IK SOOTBLOWER	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1974	N/A	N/A	N/A	(3)		- 1	PROPOSAL F	on STEAM J	ET AIR EJEC	CTORS	
ULE8	AI	IR SOOTBLOWER	<u></u>	E.	E.				<u></u>	<u></u>		N/A N/A	N/A N/A								
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<b>}</b> ≡	AL-FAN	PA FAN SPEC	L.		<u> </u>		N/A					N/A	N/A	<b>T</b>	Station	Poplar R	iver				097 PF-631
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WALL .	AL-FAN	PA FAN CAPACITY CURVE	<u></u>	<u> </u>	<u></u>		N/A	<u></u>		<u> </u>	<u></u>	N/A	N/A	1	1. GENER	AL DATA					
JTIL	AL-FAN	PA FAN SPEED-TORQUE CURVE			<u></u>		N/A			<u> </u>		N/A	N/A	T Å	a. Size				9	-	1 DCI
ALC	AL-FAN	PA FAN MOTOR	<u></u>	<u>16.</u>	<u></u>		N/A	<b></b>	<u></u>		<u></u>	N/A	N/A		b. Num	ber of Elements	s/Stages		Twin		Two (2)
7	AL-HX	PRIMARY AIR HEATER SPEC	<u></u>	<b></b>	<u> </u>							N/A	N/A		c. Mou				Divided i	nter & Con	mon Aftendenser
egend	AL-HX	PRIMARY AIR HEATER DWG	<u></u>	<u></u>	<u></u>			<u></u>	<u></u>		<u></u>	N/A	N/A		e. Unit	ion Connection	s			6000	in.
ULE 8 HUMB																harge Connecti	on			3	lbs.
NITS															2. PERFOR	RMANCE					
PR1																Design Capacity		t		100	%
														2		ion Pressure/Te iir Leakage	emp.		1 15	in. Hg. abs	
PR2																ir Leakage r Noncondensa	ble Gases		CFM	SCFM	67.5 lb/hr
SH1														ž	ac 9 8 4 4				CFM		lb/hr
														1					СFМ		lb/hr
BD3																Cas Varan Min			-	148.5	lb/hr
3D4														o 0		Gas-Vapor Mix n Max. Initial Pr			2000	216.0	lb/hr
-														8.0		n Min. Operatin		mp.	400	psig	F
3D5														C .	i. Stean	n Consumption	@ Design Can	acity		200	
3D6																	C Boolgii Gupi	aony			lb/hr

### 5. Increase Integration





### 6. Plan for Continuous Improvement





Plan

Maintain

Install

Design

Supply

DD-MM-YY 1234X Health

## 6. Plan for Continuous Improvement

**Unit & System Marginal Costs** 



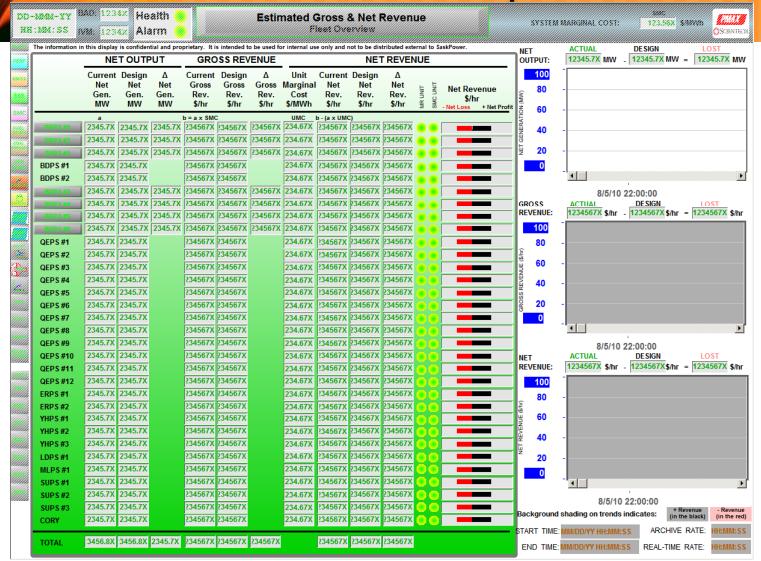
123.56X 5/800m

SYSTEM MARGINAL COST:

	GENERATION							T UHR	VA	RIABLE UN	III COST	S Unit	MUST	RUN?	Unit	Syst
	Gross	MPLE CYC Station	Net	Gross	Station	Net	Cycle	Combined Cycle	Variable Fuel Cost	Variable OM&A	Trans. Penalty	Marginal Cost	MR Net	Units in MR	Marginal Cost (w/o MR)	Mai C
	MW	MW	MW	MW	MW	MW	kJ/kWh	kJ/kWh	\$/MWh	\$/MWh	Factor	\$/MWh	MW	Status	\$/MWh	\$/1
COAL FIRED	UNITS										_		_			
PRPS#1	2345.7X	2345.7X	2345.7X				234567X		( 234.67X <sup>-1</sup>	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X		123.56X	1
PRPS #2	2345.7X	2345.7X	2345.7X				234567X		( 234.67X +	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
SHPS #1	2345.7X	2345.7X	2345.7X				234567X		( 234.67X +	AC1.34X) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
BDPS #1	2345.7X	2345.7X	2345.7X				234567X		( 234.67X <sub>+</sub>	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
BDPS #2	2345.7X	2345.7X	2345.7X				234567X		( 234.67X <sub>4</sub>	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X	•	123.56X	
BDPS#3	2345.7X	2345.7X	2345.7X				234567X		( 234.67X +	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
RDPS #4	2345.7X	2345.7X	2345.7X				234567X		( 234.67X -	AC1.34X ) x	AC1.34X	= 234.67X	AC12.4X	•	123.56X	
BDPS#5	2345.7X	2345.7X	2345.7X				234567X		(234.67X -	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X	•	123.56X	
BDPS#6	2345.7X	2345.7X	2345.7X				234567X		(234.67X +	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X	•	123.56X	
GAS FIRED U	NITS															
QEPS #1	2345.7X	2345.7X	2345.7X	2345.7X	2345.7X	2345.7X	234567X	234567X	(234.67X +	AC1.34X) x	AC1.34X	= 234.67X	AC12.4X	•	123.56X	- 1
QEPS #2	2345.7X	2345.7X	2345.7X	2345.7X	2345.7X	2345.7X	234567X	234567X	(234.67X +	AC1.34X) X	AC1.34X	= 234.67X	AC12.4X	ē	123.56X	
QEPS #3	2345.7X	2345.7X	2345.7X				234567X		(234.67X +	AC1.34X) X	AC1.34X	= 234.67X	AC12.4X	ě	123.56X	
QEPS #4	2345.7X	2345.7X	2345.7X				234567X		(234.67X +	AC1.34X) X	AC1.34X	= 234.67X	AC12.4X	ě	123.56X	
QEPS #5	2345.7X	2345.7X	2345.7X				234567X		(234.67X -	AC1.34X) x	AC1.34X	= 234.67X	AC12.4X	ē	123.56X	
QEPS#6	2345.7X	2345.7X	2345.7X				234567X		(234.67X -	AC1.34X) x	AC1.34X	= 234.67X	AC12.4X	•	123.56X	
QEPS #7	2345.7X	2345.7X	2345.7X				234567X		(234.67X +	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X	•	123.56X	
QEPS #8	2345.7X	2345.7X	2345.7X				234567X		(234.67X -	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
QEPS#9	2345.7X	2345.7X	2345.7X				234567X		(234.67X +	AC1.34X) x	AC1.34X	= 234.67X	AC12.4X	•	123.56X	
QEPS #10	2345.7X	2345.7X	2345.7X	The information			234567X		(234.67X -	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X	•	123.56X	
QEPS #11	2345.7X	2345.7X	2345.7X	confidential a intended to b	e used for inte	ernal use	234567X		(234.67X -	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
QEPS #12	2345.7X	2345.7X	2345.7X	only and not to SaskPower		teu external	234567X		(234.67X +	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
ERPS #1	2345.7X	2345.7X	2345.7X				234567X		(234.67X 4	AC1.34X) x	AC1.34X	= 234.67X	AC12.4X		123.56X	
ERPS #2	2345.7X	2345.7X	2345.7X				234567X		(234.67X +	AC1.34X) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
YHPS #1	2345.7X	2345.7X	2345.7X				234567X		( 234.67X +	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
YHPS #2	2345.7X	2345.7X	2345.7X				234567X		(234.67X +	AC1.34X) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
YHPS#3	2345.7X	2345.7X	2345.7X				234567X		(234.67X +	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
LDPS #1	2345.7X	2345.7X	2345.7X				234567X		( 234.67X +	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
MLPS #1	2345.7X	2345.7X	2345.7X				234567X		( 234.67X H	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
SUPS #1	2345.7X	2345.7X	2345.7X				234567X		( 234.67X H	AC1.34X ) X	AC1.34X	= 234.67X	AC12.4X		123.56X	
SUPS #2	2345.7X	2345.7X	2345.7X				234567X		( 234.67X +	AC1.34X) x	AC1.34X	= 234.67X	AC12.4X		123.56X	
SUPS#3	2345.7X	2345.7X	2345.7X				234567X		(234.67X +	AC1.34X) x	AC1.34X	= 234.67X	AC12.4X		123.56X	
CORY				2345.7X	2345.7X	2345.7X	234567X		(234.67X +	AC1.34X) X	AC1.34X	= 234.67X	AC12.4X		123.56X	



### 6. Plan for Continuous Improvement







Lessons Learned: Scientech is a nice company to

work with





# Lessons Learned - Summary

- 1) Need dedicated staff to support tools deployment, or risk losing investment
- PMAX / PdP / Rules is not necessarily a turn-key.
- Get a better system by co-designing the system with Scientech.
- 2) Need a system for managing findings
- Emails get lost
- Must accommodate multi-users.
- Avoid re-examining things already identified.
- 3) Need to have clear plan on Roles & Responsibilities:
- Automating monitoring does not result in reduced man-hour input (identify MORE problems, more problems to follow up on, Model maintenance overhead)
- adding FTE's not SaskPower option
- sub-contract the M&D
- 4) Schedule considerations missed
- 5) Increased Integration results in better chance of system succeeding
- 6) Plan & Budget for continuous improvement / enhancements
- system marginal price calculation
- gross/net revenue calculation
- 7) Scientech is a nice company to work with.

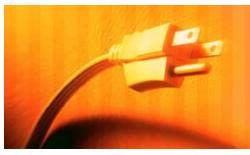




# Questions?







# Break!

