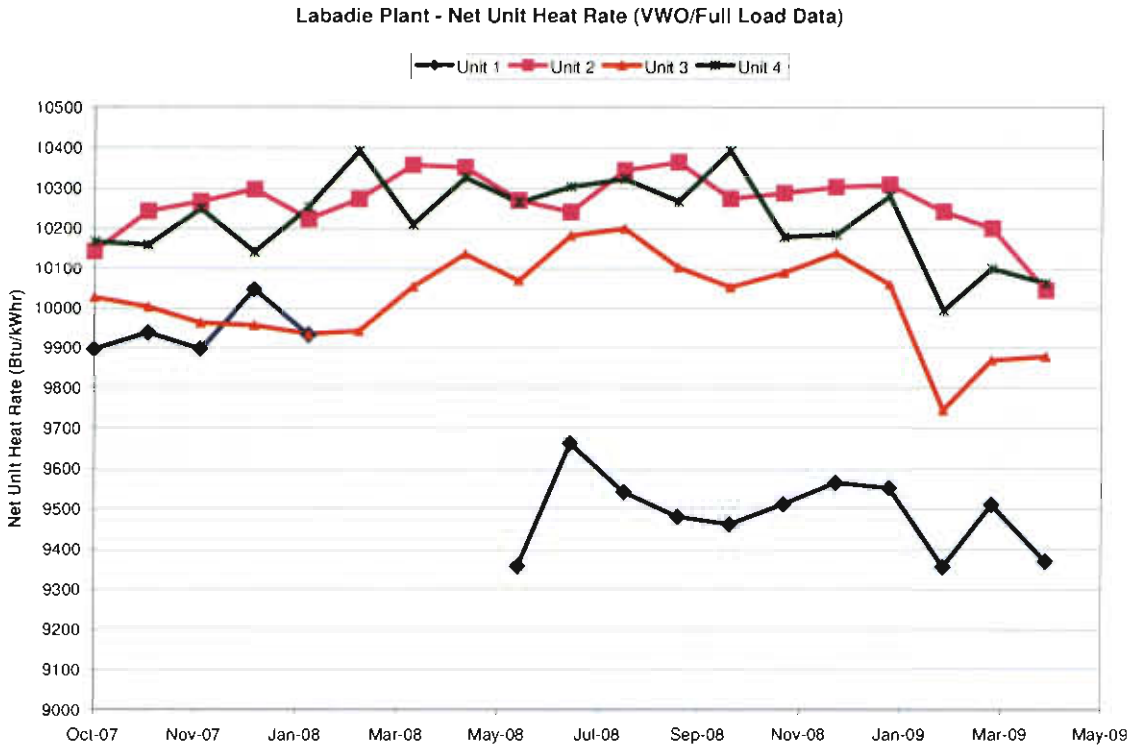


Heat Rate KPI

A trend only heat rate KPI has been created for 2009 with the intent of having a pay heat rate KPI in 2010. Below is a table showing the actual performance of the plant through April.

Plant	2009 Actual	Threshold	Target	Stretch
Labadie	9868	9888	9807	9764

A separate e-mail was sent to the plant describing how the trend only KPI targets were derived for 2009. Performance engineering intends to do more work in this area and present the proposed methodology for the heat rate KPI at our quarterly heat rate meeting in the summer (to be scheduled).

Action Items:

- Performance Engineering will review performance on each unit following the spring outages on Units 3 and 4 (Unit 2 is evaluated in this report).
- Performance Engineering will setup a meeting with the plant after the Unit 4 outage to discuss phasing out the OPM performance monitor and creating more PI tags related to EtaPro.

Unit 1 Observations

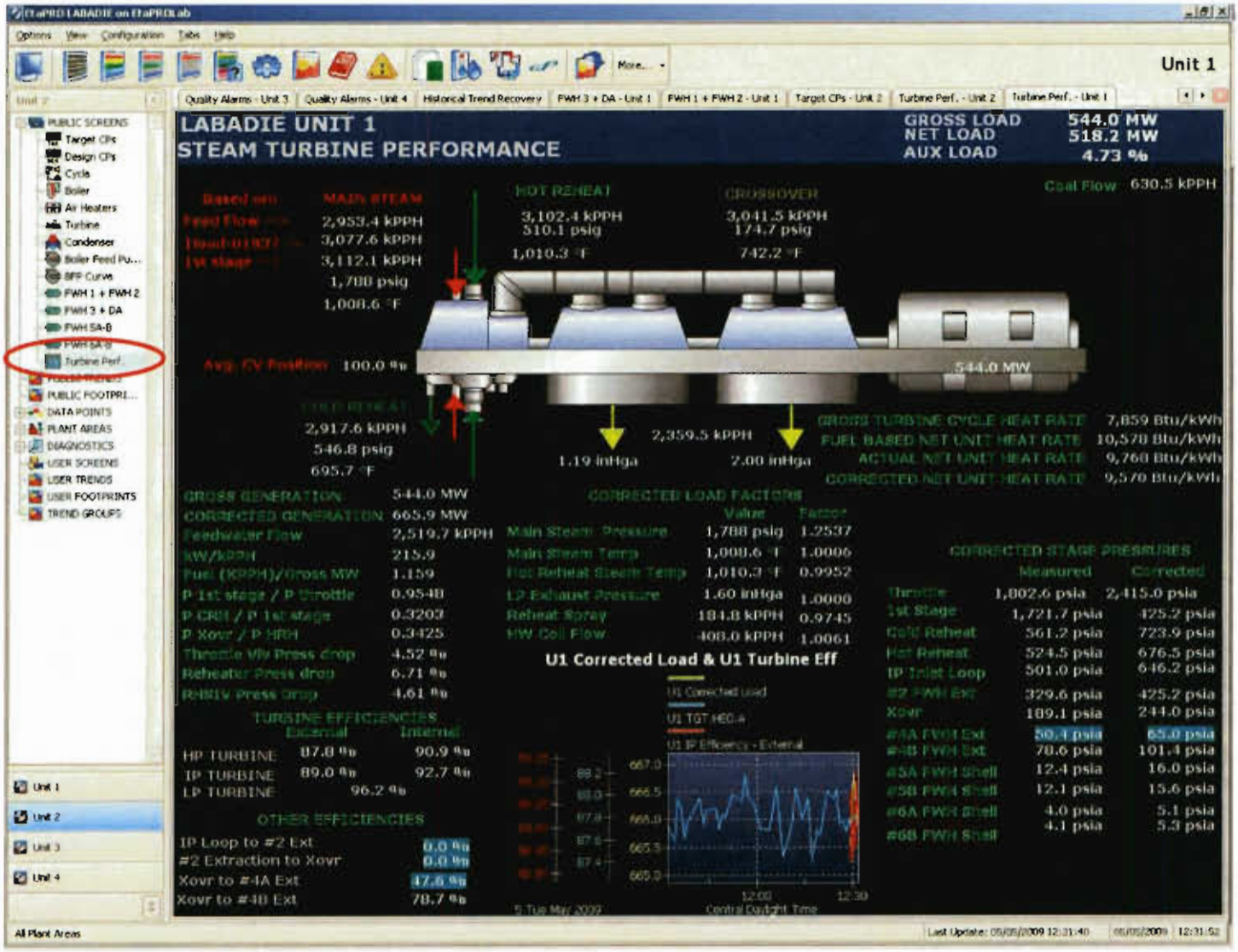
The following observations were made regarding Unit 1 operation and performance:

- The heat rate on the unit was lower in April than in March due to having the second circulating water pump in service the entire month (lower backpressure) and operating with the control valves more open (higher HP turbine efficiency).
- The 1B HPBFPT turbine failed in late April and will be out of service until late May.
- A turbine performance page has been created in EtaPro to better facilitate the tracking of turbine performance on the Unit. Many of the parameters presented in the new screen are not yet being archived since the corresponding PI tags have not been created. Performance Engineering will schedule a meeting with the plant to discuss the creation of the corresponding PI tags.

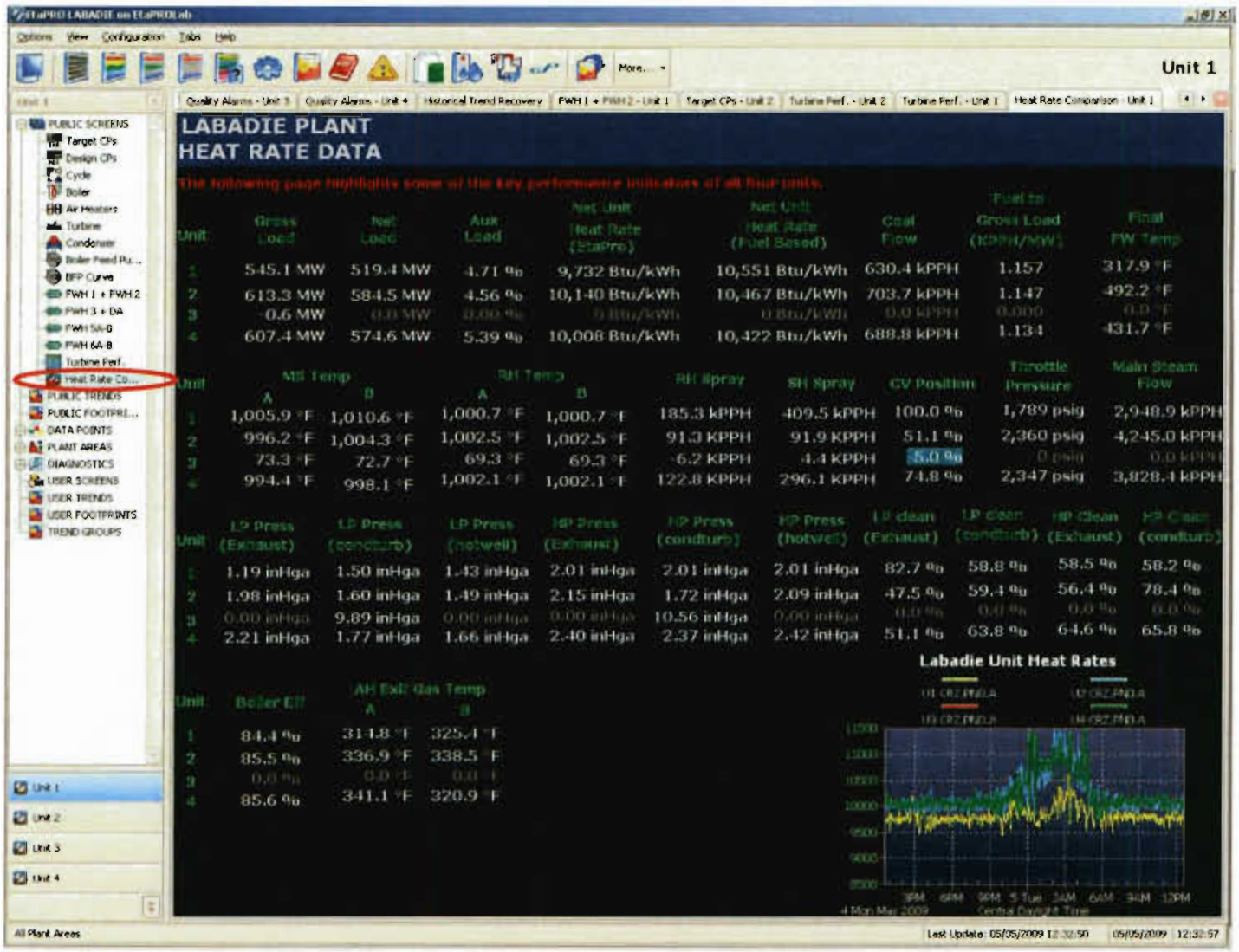
Summary of Performance Report for:

Plant	Labadie				
Unit	1				
Period	4/1/09	to	5/1/09		
			Apr-09	Mar-09	Apr-08
Full Load Performance					
Hours of Data (>90% Monthly Capability)			355	411	MBO
			Averages	**Averages**	
GENERATOR MEGAWATTS	MW		637.8	623.3	
AUX POWER	MW		27.9	26.5	
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		9370.0	9511.4	
Boiler Efficiency Actual	%		84.1	84.3	
CONTROL VALVE POSITION LVDT	%		88.1	71.9	
FEEDWATER TEMP TO ECON	degF		492.2	491.4	
FEEDWATER TEMP TO HTR 1	degF		437.6	436.8	
HP Turbine Efficiency Actual	%		87.3	86.5	
IP Turbine Efficiency Corrected	%		91.1	91.4	
Condenser Pressure HP	inHga		1.9	3.0	
Condenser Pressure LP	inHga		1.3	1.6	
AIRHTR-A GAS OUTLET TEMP	degF		335.6	331.8	
AIRHTR-B GAS OUTLET TEMP	degF		318.0	327.9	
AMBIENT AIR TEMP	degF		51.5	50.2	
CIRC WTR TEMP TO LP CONDB	degF		50.2	44.6	
CIRC WTR TEMP TO LP CONDB	degF		52.9	47.9	
CIRC WTR TEMP TO LP CONDB	degF		54.0	45.6	
CIRC WTR TEMP TO LP CONDB	degF		50.7	44.9	
Minimum River Temperature	degF		50.2	44.6	
FWH 1 Temperature Rise	degF		54.6	54.6	
Net Load	MW		609.9	596.8	
Average Cond Press	inHga		1.6	2.3	
Average Exit Gas Temperature	degF		326.8	329.9	
Aux Power	%		4.4	4.3	
Gross Unit Heat Rate	BTU/KW-HR		8960.6	9106.9	
Gross Turbine Heat Rate	BTU/KW-HR		7537.1	7674.5	
Feedwater Flow	KPPH		3874.7	3857.5	

As stated above, the net unit heat rate improved from March. The main contributors to the improved heat rate were the lower backpressure and the control valves being more open. One can see that the gross load on the unit went up about 14 MWs in April for virtually the same amount of feedwater flow.



The above page was created in EtaPro to monitor turbine performance. The page displays Corrected load (measured load corrected back to standard heat balance conditions), measured and corrected stage pressures, and other performance indicators. Note that the screen shot above is for a time when the 1B HPBFPT was out of service. For significantly off-normal conditions, as is the case with the BFP out-of-service, the corrected load and stage pressures may not be reliable. The page is labeled Turbine Perf. (circled in red above) and a similar page is available for all four units.



The above page was created in EtaPro (under Unit 1) to display some key performance indicators for all four units. The page is labeled as Heat Rate Comparison (circled in red above).

Unit 2 Observations

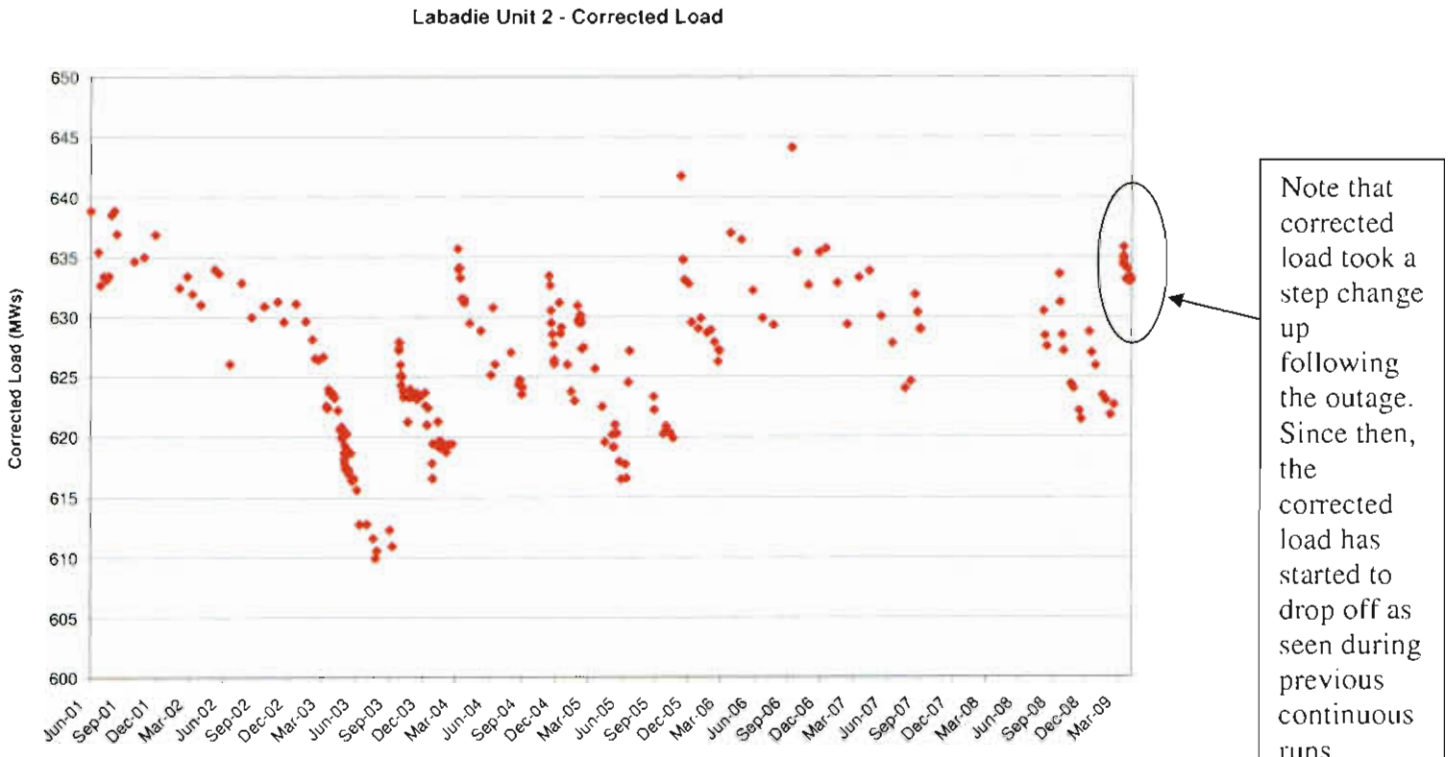
The following observations were made regarding Unit 2 operation and performance:

- Unit 2 had an outage from 3/27/09 until 4/8/09. Heat rate on the unit has improved by about 1.5% following the outage. HP and IP efficiencies were also up following the outage as well as corrected load. In addition, auxiliary power was down about 0.2%. Finally, the air heater gas side pressure drop was reduced about 4 inches due to the air heater wash.
- Prior to the outage, the most efficient running strategy for the unit was with control valves pinched back. A review of data after the outage now indicates that VWO is now the most efficient configuration for the unit (see plots below). However, the valves may still need to be pinched down for reheat steam temperature control. The new valve trims that would allow for more reheat spray did not arrive in time to be installed during the outage. These new valve trims will be installed in the next available window.
- A condenser cleaning was performed during the spring outage. The condenser cleanliness factor did increase due to this cleaning but not as much as expected (the cleanliness factor improved by only 5-10%, see plot below). Data from previous condenser cleanings was reviewed to determine what the typical improvement has been. This review showed that the HP cleanliness factor typically increased by 10-15% while the LP cleanliness factor typically increased by about 5-10%. In addition, the review showed that the typical cleanliness factor for Labadie is low in the winter and increases as the river temperature increases. This same trend is observed at other plants as well. An exact cause of this trend is not known. Finally, sensitivity studies showed that the cleanliness factor is highly dependent on the measured condenser pressure as expected. For example, a 0.1 in HgA error in pressure could change the calculated cleanliness factor by 7% or more. EtaPro was determining a cleanliness factor using the LP exhaust pressure taps. These were selected because they were believed to be the most reliable. However, the exhaust pressure of the turbine is at a slightly higher pressure than the pressure at the top of the tube sheet and thus indicates a lower cleanliness factor. In order to determine a more representative value for condenser cleanliness, additional cleanliness calculations were added in EtaPro that use the pressure indications at the top of the tube sheets (xCOND-16026 and xCOND-16028) and the pressure estimated from the hotwell temperatures. These cleanliness values are all displayed on the condenser pages in EtaPro for all four units (highlighted in the screen shot below).

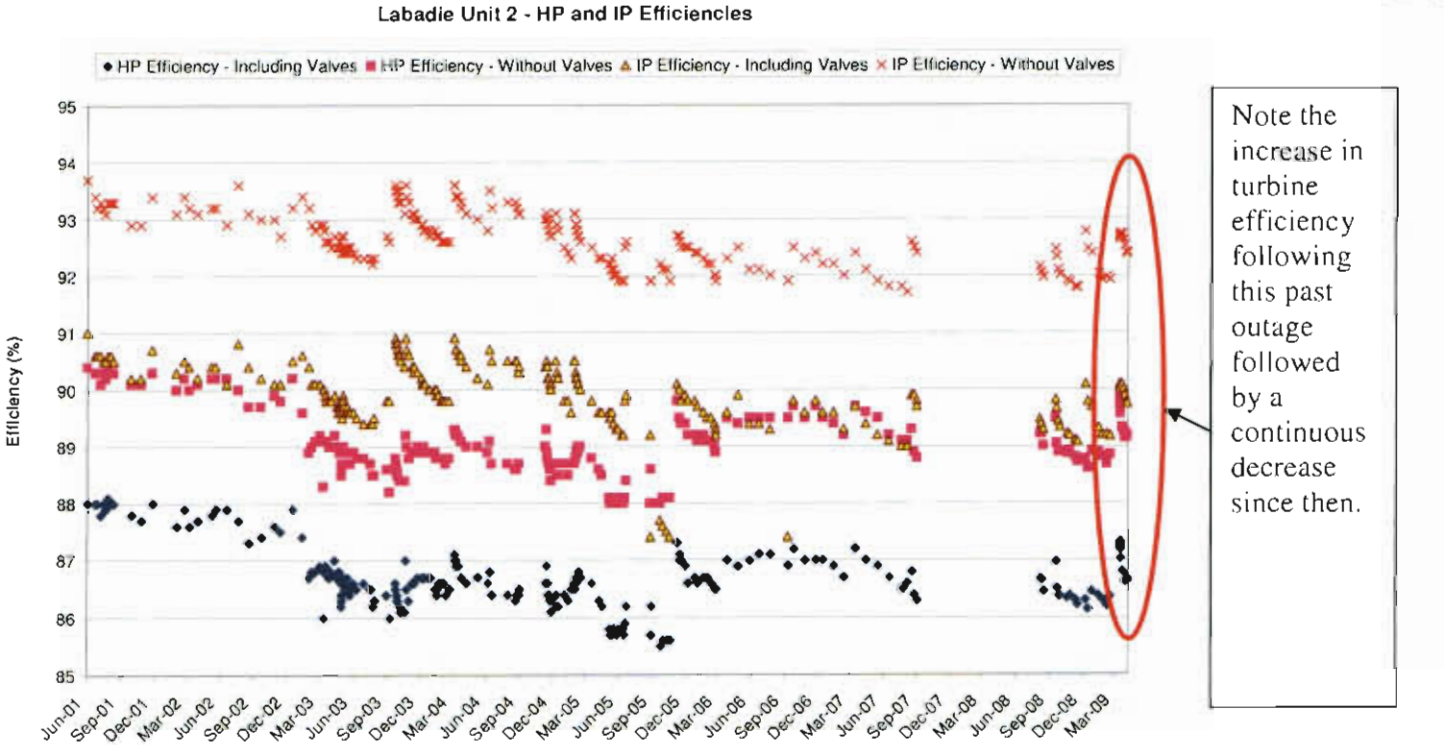
Summary of Performance Report for:

Plant	Labadie					
Unit	2					
Period	4/1/09	to	5/1/09			
Full Load Performance			Apr-09		Mar-09	Apr-08
Hours of Data (>90% Monthly Capability)			395		467	190
			Averages		Averages	Averages
GENERATOR MEGAWATTS	MW		613.5		587.8	620.6
AUX POWER	MW		28.6		29.0	30.5
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		10045.8		10200.4	10366.0
Boiler Efficiency Actual	%		85.3		85.1	84.9
CONTROL VALVE POSITION LVDT	%		68.1		43.6	99.9
FEEDWATER TEMP TO ECON	degF		491.7		490.0	494.6
FEEDWATER TEMP TO HTR 1	degF		442.1		442.5	446.6
HP Turbine Efficiency Actual	%		85.3		83.0	86.2
IP Turbine Efficiency Corrected	%		90.8		90.2	90.4
Condenser Pressure HP	inHga		2.1		2.2	2.5
Condenser Pressure LP	inHga		1.8		1.8	1.8
AIRHTR-A GAS OUTLET TEMP	degF		335.9		330.6	325.2
AIRHTR-B GAS OUTLET TEMP	degF		327.5		334.9	340.6
AMBIENT AIR TEMP	degF		60.6		52.0	59.7
CIRC WTR TEMP TO LP CONDB	degF		55.1		46.2	61.6
CIRC WTR TEMP TO LP CONDB	degF		55.7		46.5	51.9
CIRC WTR TEMP TO LP CONDB	degF		62.2		46.6	51.8
CIRC WTR TEMP TO LP CONDB	degF		55.6		46.0	51.4
Minimum River Temperature	degF		55.1		46.0	51.4
FWH 1 Temperature Rise	degF		49.6		47.6	48.1
Net Load	MW		584.8		558.8	590.1
Average Cond Press	inHga		1.9		2.0	2.2
Average Exit Gas Temperature	degF		331.7		332.7	332.9
Aux Power	%		4.7		4.9	4.9
Gross Unit Heat Rate	BTU/KW-HR		9676.8		9697.1	9846.8
Gross Turbine Heat Rate	BTU/KW-HR		8170.5		8256.3	8362.9
Feedwater Flow	KPPH		3996.9		3863.4	

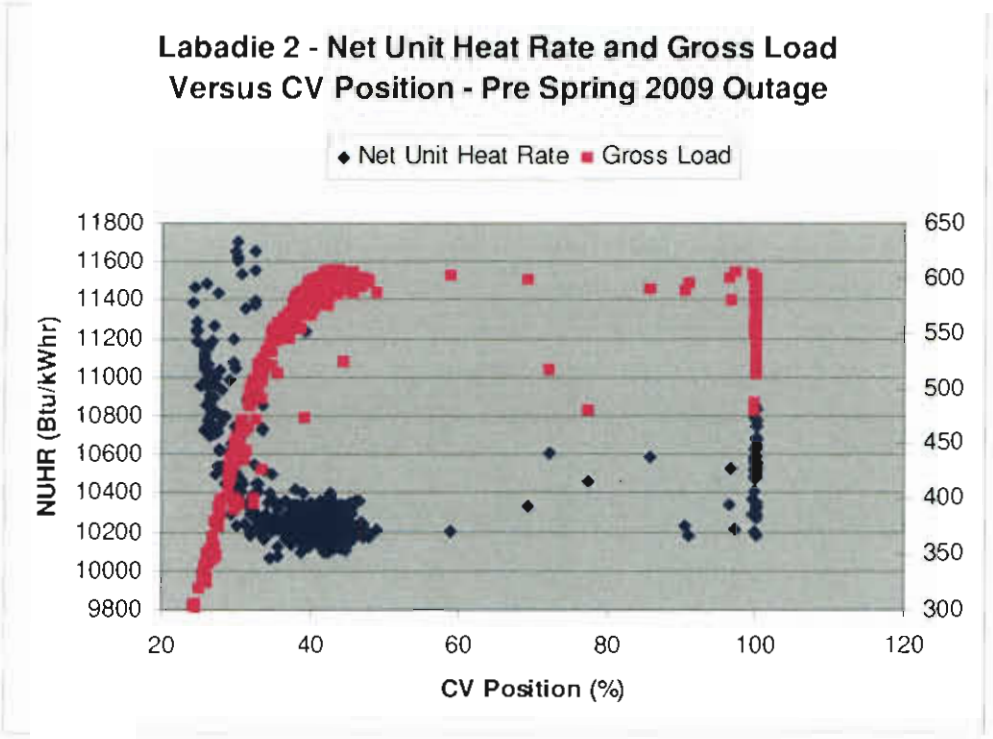
As shown, the heat rate has decreased by about 1.5%. Since the unit is no longer duct pressure limited, the gross load was up significantly in April as compared to March.

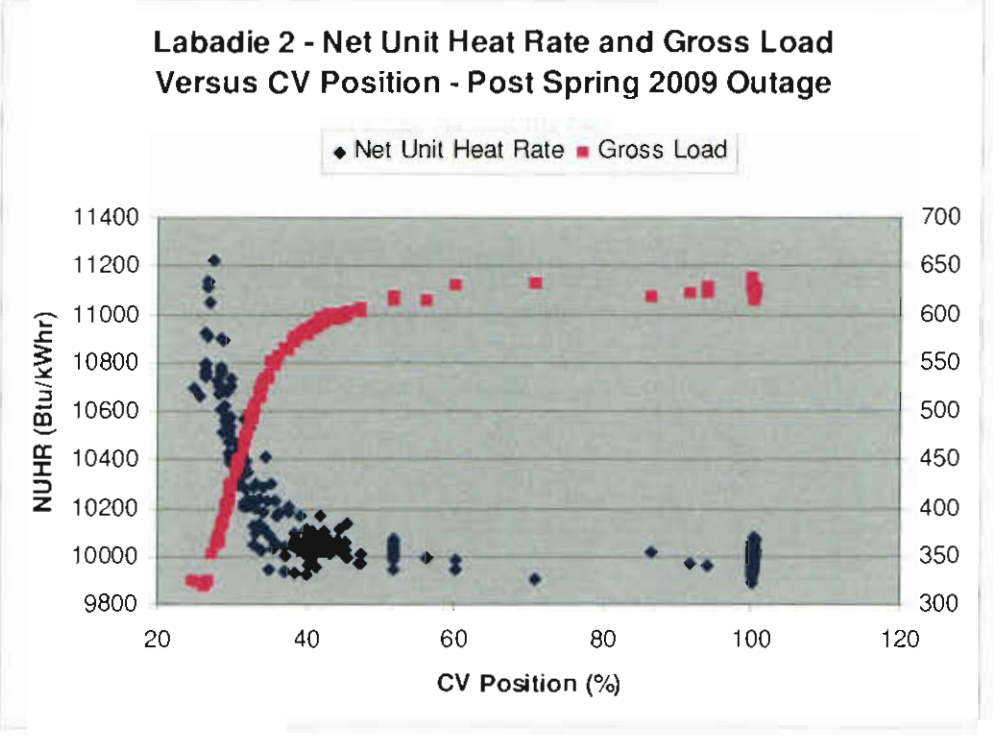


Note that corrected load took a step change up following the outage. Since then, the corrected load has started to drop off as seen during previous continuous runs.

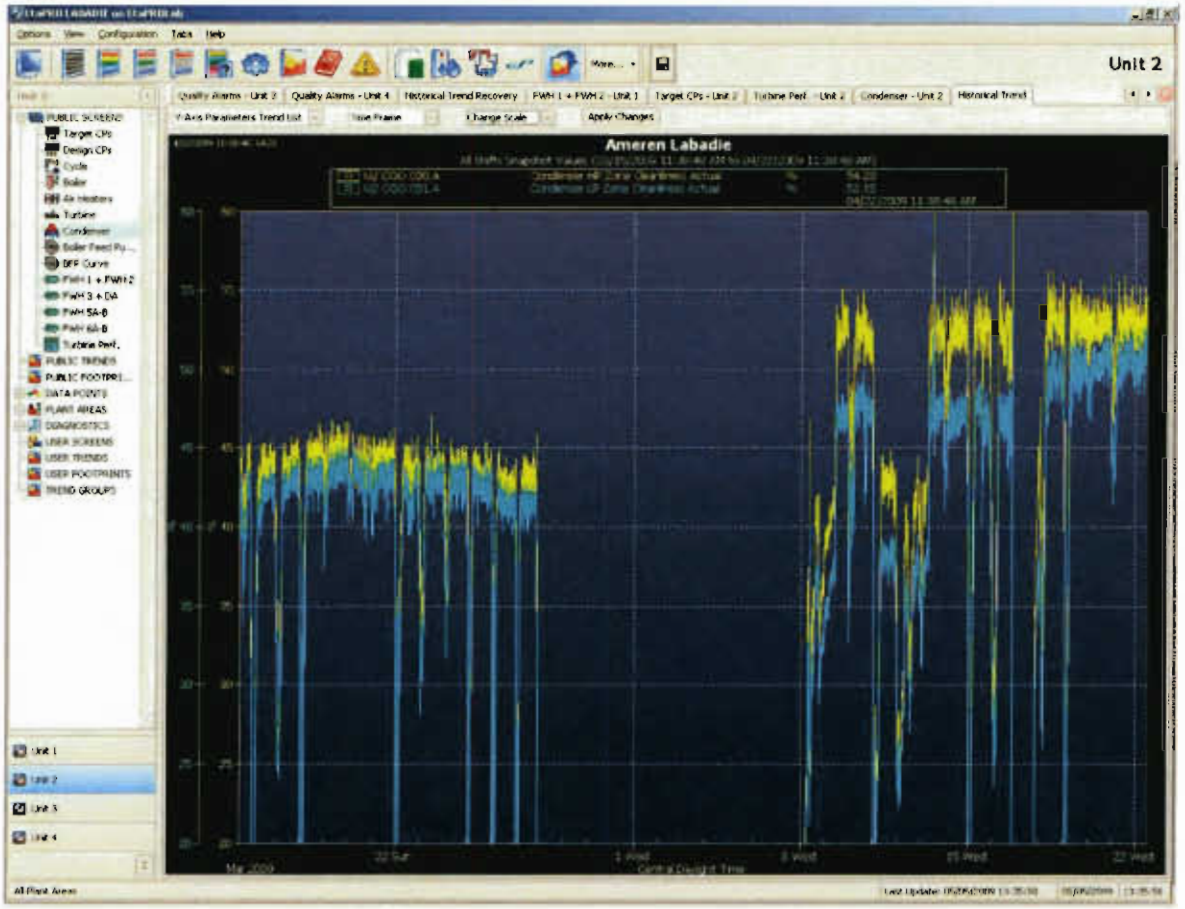


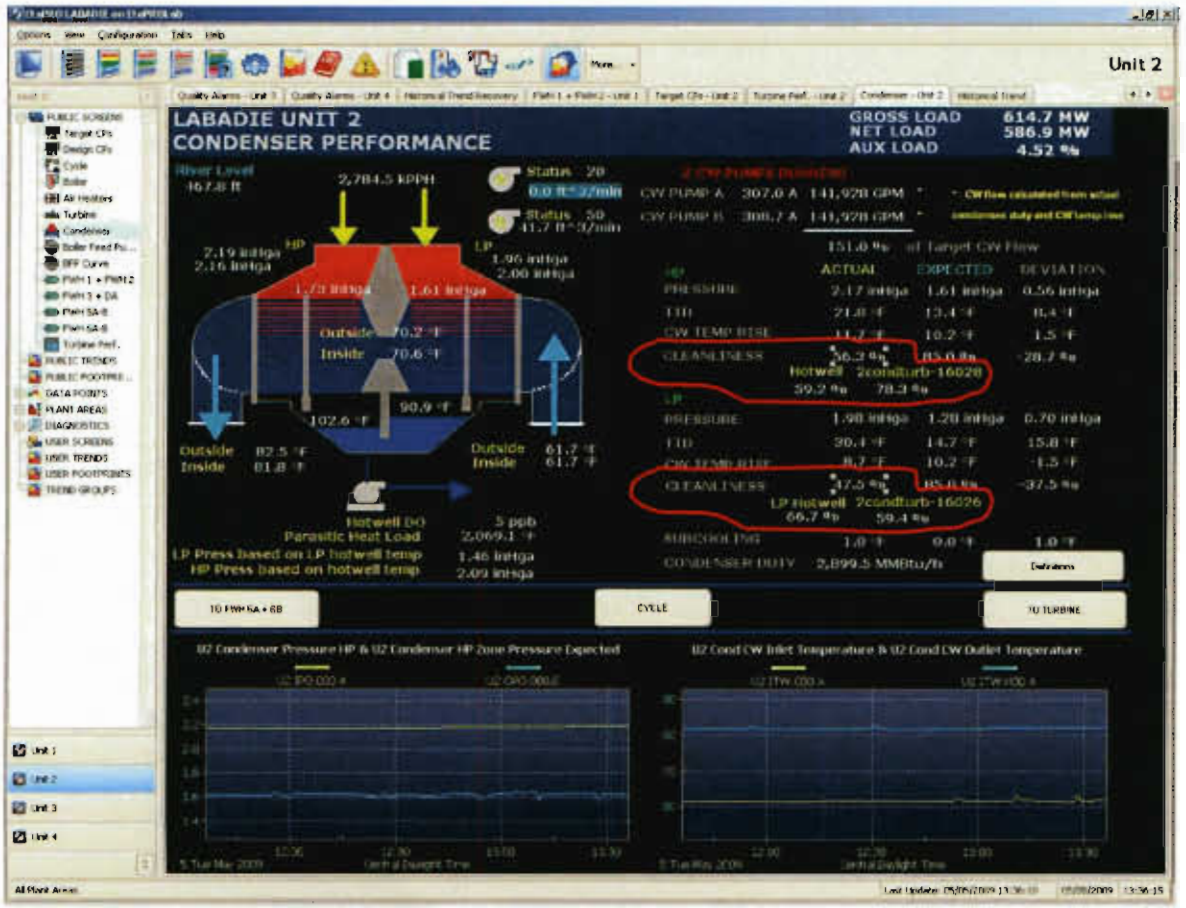
Note the increase in turbine efficiency following this past outage followed by a continuous decrease since then.





Both plots show the Net Unit Heat Rate and Gross Load versus control valve position. The top plot shows data prior to the spring outage and the bottom graph shows data after the spring outage. The top plot shows that the most efficient configuration prior to the outage was with the control valves pinched back to between 40 and 50% open. The bottom plot shows that VWO is now the most efficient configuration on the unit.





The top plot shows the condenser cleanliness values before and after the outage. The bottom plot shows the three condenser cleanliness calculations available in EtaPro. As shown for Unit 2, the cleanliness factor is highly dependent on which pressure indication is used in the calculation. If the xcond-16026 and xcond-16028 tags are reliable, these should provide the best indication of condenser cleanliness and should be close to that estimated using the hotwell temperatures. The various pressure indications will be reviewed to determine if any instrument issues exist.

Unit 3 Observations

The following observations were made regarding Unit 3 operation and performance:

- Unit 3 came offline on April 16th for a spring outage. Prior to that shutdown, there were no major changes in performance on the unit as compared to March. The unit was duct pressure limited which kept the gross load on the unit down.
- A review of performance will be conducted after startup of the unit.

Summary of Performance Report for:						
Plant	Labadie					
Unit	3					
Period	4/1/09	to	5/1/09			
Full Load Performance			Apr-09		Mar-09	Apr-08
Hours of Data			275		587	600.0
			Averages		Averages	Averages
GENERATOR MEGAWATTS	MW		591.1		600.3	643.3
AUX POWER	MW		28.9		29.7	29.7
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		9877.9		9869.3	10053.4
Boiler Efficiency Actual	%		85.4		85.4	85.2
CONTROL VALVE POSITION LVDT	%		94.0		98.1	104.8
FEEDWATER TEMP TO ECON	degF		479.2		480.6	487.2
FEEDWATER TEMP TO HTR 1	degF		430.0		431.1	438.6
HP Turbine Efficiency Actual	%		83.7		85.1	87.4
IP Turbine Efficiency Corrected	%		94.9		95.0	93.9
Condenser Pressure HP	inHga		2.4		2.4	3.0
Condenser Pressure LP	inHga		2.1		2.1	2.4
AIRHTR-A GAS OUTLET TEMP	degF		325.1		327.3	335.4
AIRHTR-B GAS OUTLET TEMP	degF		321.7		323.8	317.6
AMBIENT AIR TEMP	degF		49.7		51.6	56.8
CIRC WTR TEMP TO LP CONDB	degF		49.0		46.8	61.4
CIRC WTR TEMP TO LP CONDB	degF		52.2		49.8	53.9
CIRC WTR TEMP TO LP CONDB	degF		49.3		47.2	53.2
CIRC WTR TEMP TO LP CONDB	degF		48.9		46.8	52.8
Minimum River Temperature	degF		48.9		46.8	52.8
FWH 1 Temperature Rise	degF		49.2		49.5	48.7
Net Load	MW		562.2		570.5	613.6
Average Cond Press	inHga		2.3		2.2	2.7
Average Exit Gas Temperature	degF		323.4		325.5	326.5
Aux Power	%		4.9		4.9	4.6
Gross Unit Heat Rate	BTU/KW-HR		9394.6		9380.8	9589.2
Gross Turbine Heat Rate	BTU/KW-HR		8023.1		8012.8	8174.3
Feedwater Flow	KPPH		3660.2		3692.3	

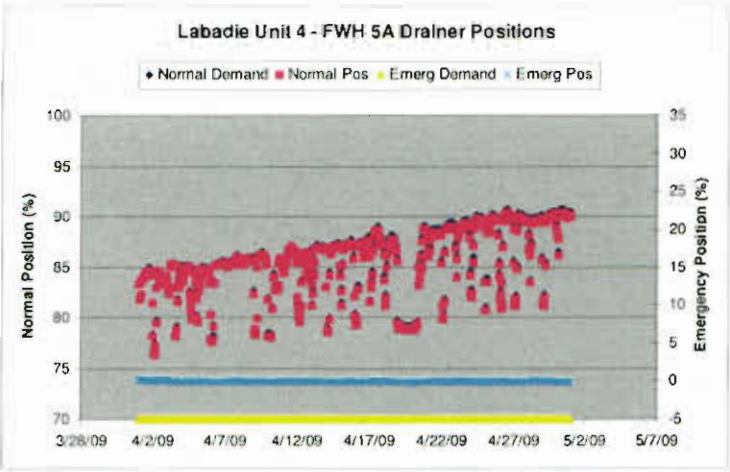
Unit 4 Observations

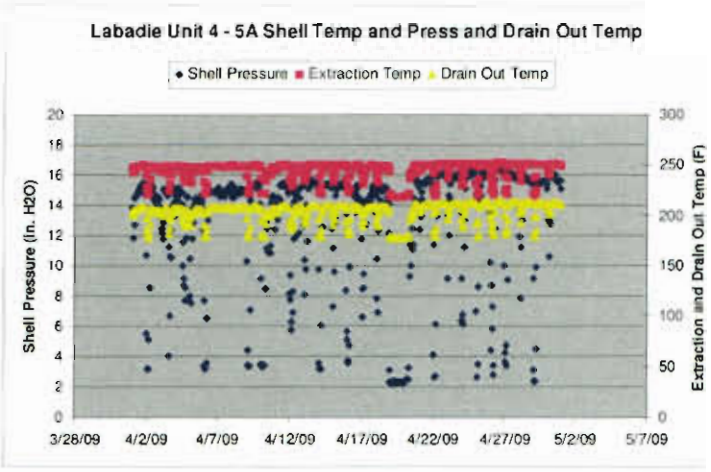
The following observations were made regarding Unit 4 operation and performance:

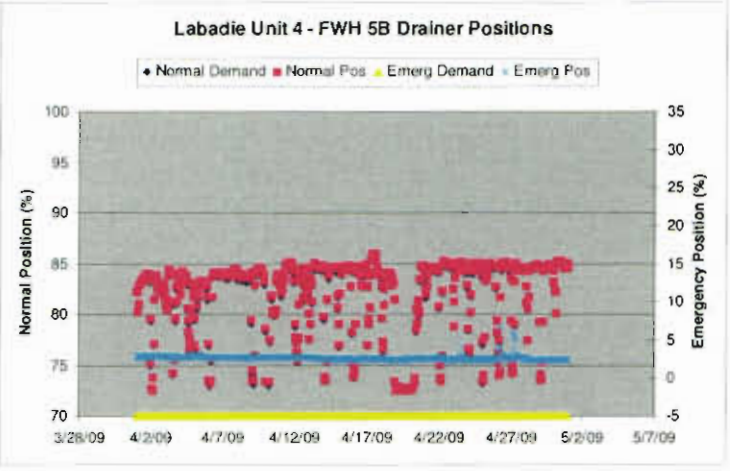
- The performance of the unit in April was similar to that of March. The most noticeable changes were a drop in HP efficiency (due in part to the control valves being pinched down more) and the lower backpressure due to having both circulating water pumps available the entire month of April versus only half of March.
- The #1 FWH was out of service for the entire month of April and will be repaired during the outage this spring. It is noted that operation without the top feedwater heater in service is about an 85 Btu/kWhr heat rate penalty and equates to a $50,000 per month increase in fuel costs (or about $150,000 since the heater was taken OOS for a tube leak back on Feb. 20).
- The 5A drainer position has been steadily increasing since the beginning of the year indicating additional tube leaks in the feedwater heater. The inlet section of the tubes will be sleeved during the spring outage (JR164096). A leak check will be performed following this work to ensure no tubes are leaking.
- The 5B drainer position has been increasing since the beginning of April. In addition, the shell side pressure has also increased since the beginning of the month. A leak check will be performed during the spring outage (JR164100).

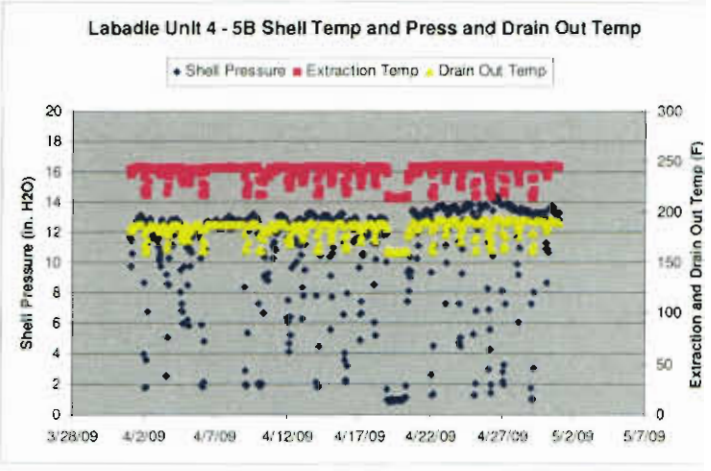
Summary of Performance Report for:

Plant	Labadie				
Unit	4				
Period	4/1/09	to	5/1/09		
Full Load Performance			Apr-09	Mar-09	Apr-08
Hours of Data (>90% Monthly Capability)			510	549	79
			Averages	Averages	Averages
GENERATOR MEGAWATTS	MW		601.2	606.2	640.1
AUX POWER	MW		29.2	28.4	30.0
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		10063.5	10099.9	10208.4
Boiler Efficiency Actual	%		85.2	85.2	85.0
CONTROL VALVE POSITION LVDT	%		74.5	78.3	98.7
FEEDWATER TEMP TO ECON	degF		431.3	433.5	431.5
FEEDWATER TEMP TO HTR 1	degF		432.3	434.5	432.6
HP Turbine Efficiency Actual	%		81.9	82.9	87.6
IP Turbine Efficiency Corrected	%		95.0	94.6	93.2
Condenser Pressure HP	inHga		2.6	3.1	2.4
Condenser Pressure LP	inHga		2.3	2.4	2.2
AIRHTR-A GAS OUTLET TEMP	degF		337.1	336.0	331.1
AIRHTR-B GAS OUTLET TEMP	degF		324.8	318.7	311.9
AMBIENT AIR TEMP	degF		59.7	52.5	51.3
CIRC WTR TEMP TO LP CONDB	degF		53.2	46.0	58.2
CIRC WTR TEMP TO LP CONDB	degF		55.4	49.0	51.1
CIRC WTR TEMP TO LP CONDB	degF		58.0	46.4	50.8
CIRC WTR TEMP TO LP CONDB	degF		53.2	45.7	50.0
Minimum River Temperature	degF		53.2	45.7	50.0
FWH 1 Temperature Rise	degF		-1.0	-1.0	-1.1
Net Load	MW		572.0	577.8	610.2
Average Cond Press	inHga		2.4	2.7	2.3
Average Exit Gas Temperature	degF		331.0	327.4	321.5
Aux Power	%		4.9	4.7	4.7
Gross Unit Heat Rate	BTU/KW-HR		9574.5	9626.4	9730.6
Gross Turbine Heat Rate	BTU/KW-HR		8161.1	8203.2	8268.8
Feedwater Flow	KPPH		3489.1	3566.2	









The top left and bottom left graphs show the drainer positions for the 5A and 5B FWHs respectively. As shown, the drainer has been going more open on both FWHs during the month of April. The top right and bottom right graphs show the shell side pressure of the 5A and 5B FWHs respectively. As shown, the shell pressure on both heaters has also gone up in April.

April 9, 2009

To: David Fox
From: Jeff Shelton
Cc: Bob Meiners, Mark Litzinger, Kevin Stumpe, Paul Piontek, Brian Griffen, Russ Hawkins, Greg Gurnow, Tony Balestreri, Greg Bolte, Chris Hegger, Scott McCormack, Ken Stuckmeyer, Don Clayton, Joe Sind, Matt Wallace, Scott Hixson, Jim Barnett, Glenn Tiffin

Subject: Labadie March 2009 Performance Report

Executive Summary

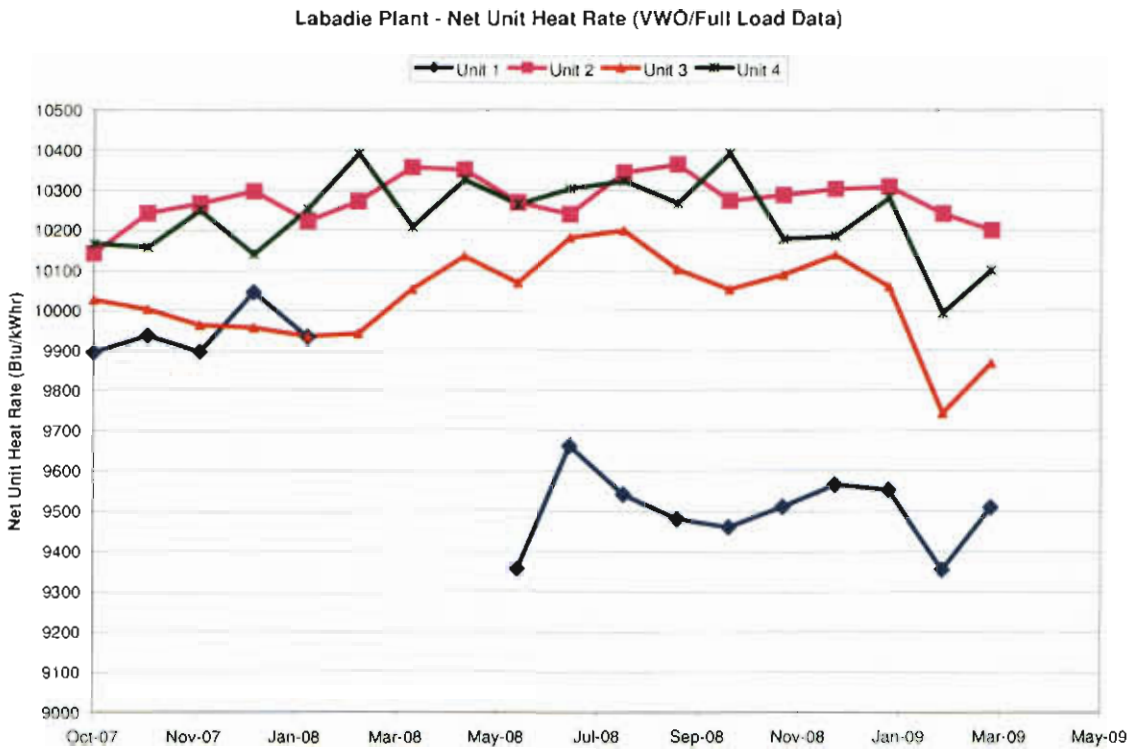
The most notable items regarding Labadie unit performance were:

- Increased water cannon use on Unit 1 has led to a decrease in boiler efficiency of about 2%.
- Operating without the top heater in service on Unit 4 is costing about $50,000/month in fuel related costs.
- A detailed review of performance will be conducted following each of the spring outages on Units 2, 3, and 4.

The following table shows the instrument deficiencies for all four units (no new items were added from the last report):

Tag	Unit	Issue	Resolution	Carryover or New
3BFWSTM-08321, EXTRACT PRESS HTR 4B	3	Has only had valid data from Nov. 2003 to Jan. 2004	JR164407 to investigate and correct	Carryover
1BFWSTM-08318, EXTRACT PRESS HTR 4A	1	Flat-lined on 1/29	JR164611	Carryover

A plot of monthly unit heat rates for all four units is included on the following page.



Heat Rate KPI

A trend only heat rate KPI has been created for 2009 with the intent of having a pay heat rate KPI in 2010. Below is a table showing the actual performance of the plant through March.

Plant	2009 Actual	Threshold	Target	Stretch
Labadie	9878	9888	9807	9764

A separate e-mail was sent to the plant describing how the trend only KPI targets were derived for 2009. Performance engineering intends to do more work in this area and present the proposed methodology for the heat rate KPI at our quarterly heat rate meeting in the summer (to be scheduled).

Action Items:

- Performance Engineering will review performance on each unit following the spring outages on Units 2, 3, and 4.

Unit 1 Observations

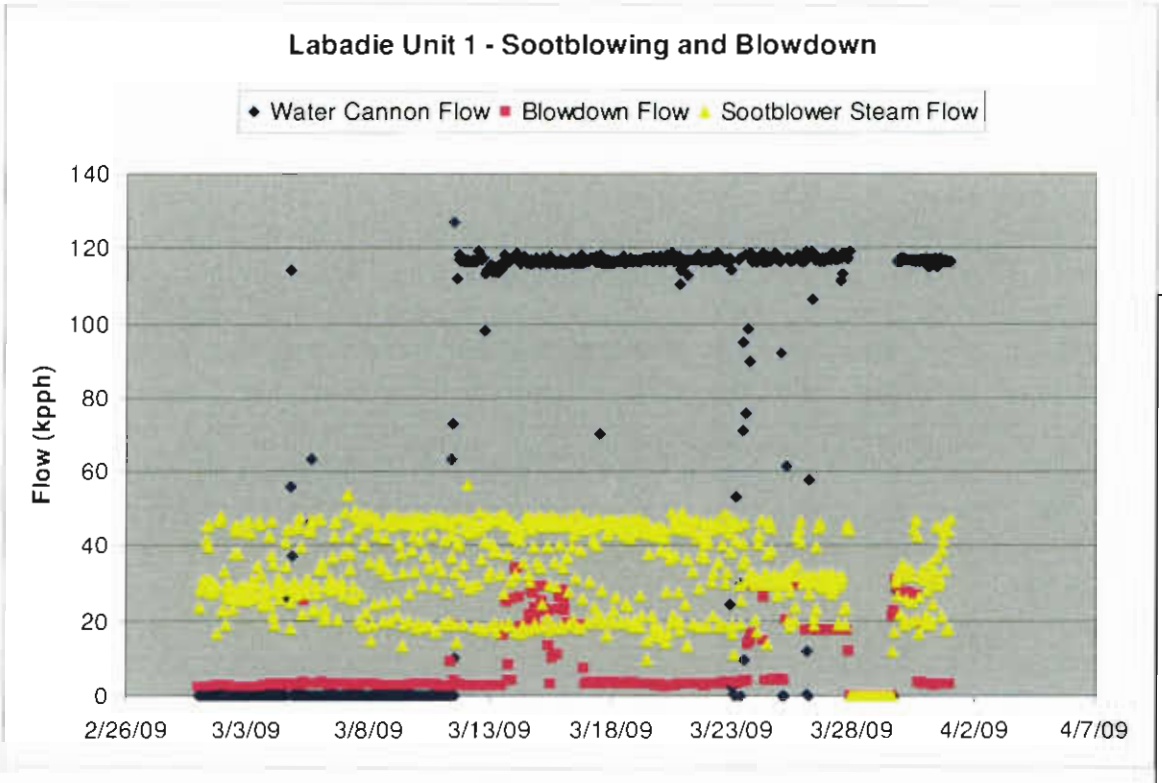
The following observations were made regarding Unit 1 operation and performance:

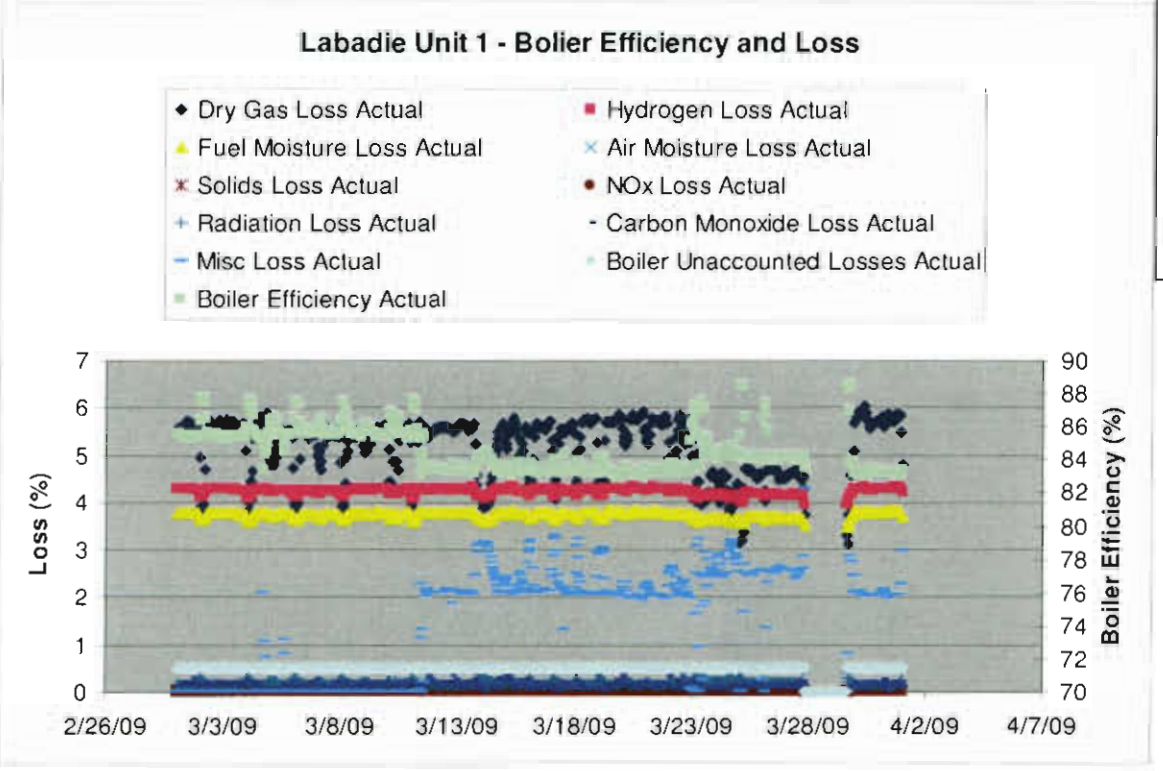
- The increased water cannon use caused a step decrease in boiler efficiency for the last part of March. A plot of water cannon use shows a change from no flow to approximately 120,000 lb/hr flow in the middle of the month. This amount of water flow to the boiler equates to about a 2% decrease in boiler efficiency (which equates to about a 2% increase in heat rate). The water cannon use on Unit 1 appears to be different than the other Units in that it is a constant flow versus a periodic flow for the other units.
- Unit 1 always seems to have some amount of blowdown flow whereas the other units typically have intermittent blowdown. Does Unit 1 have chemistry issues requiring continuous blowdown or is there a potential leaking blowdown valve?

Summary of Performance Report for:

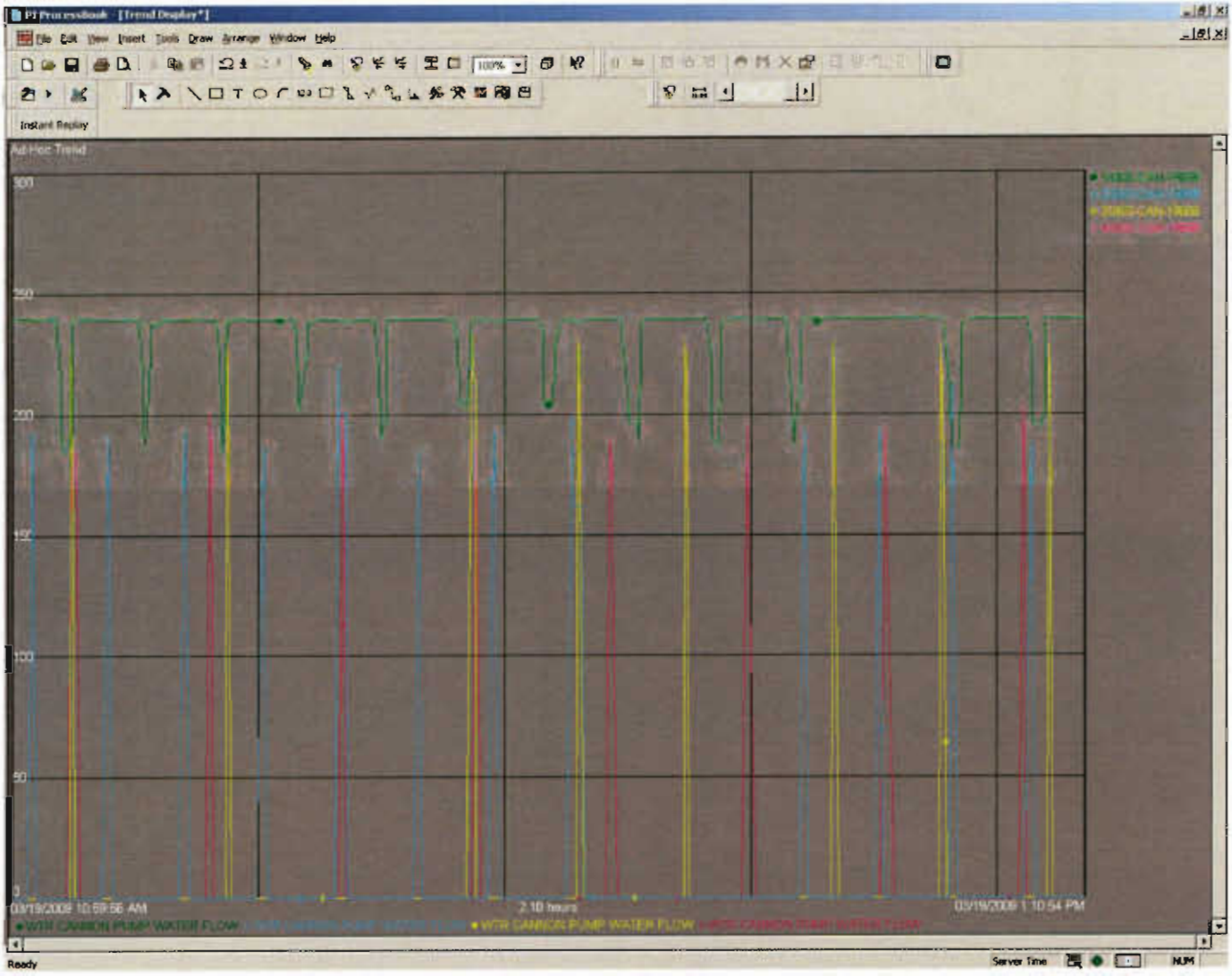
Plant	Labadie					
Unit	1					
Period	3/1/09	to	4/1/09			
			Mar-09		Feb-09	Mar-08
Full Load Performance						
Hours of Data (>90% Monthly Capability)			411		461	MBO
			Averages		**Averages**	
GENERATOR MEGAWATTS	MW		623.3		636.1	
AUX POWER	MW		26.5		25.9	
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		9511.4		9356.3	
Boiler Efficiency Actual	%		84.3		85.4	
CONTROL VALVE POSITION LVDT	%		71.9		82.7	
FEEDWATER TEMP TO ECON	degF		491.4		485.9	
FEEDWATER TEMP TO HTR 1	degF		436.8		439.0	
HP Turbine Efficiency Actual	%		86.5		87.1	
IP Turbine Efficiency Corrected	%		91.4		91.6	
Condenser Pressure HP	inHga		3.0		3.1	
Condenser Pressure LP	inHga		1.6		1.3	
AIRHTR-A GAS OUTLET TEMP	degF		331.8		329.4	
AIRHTR-B GAS OUTLET TEMP	degF		327.9		327.6	
AMBIENT AIR TEMP	degF		50.2		40.0	
CIRC WTR TEMP TO LP CONDB	degF		44.6		39.0	
CIRC WTR TEMP TO LP CONDB	degF		47.9		41.4	
CIRC WTR TEMP TO LP CONDB	degF		45.6		40.5	
CIRC WTR TEMP TO LP CONDB	degF		44.9		39.7	
Minimum River Temperature	degF		44.6		39.0	
FWH 1 Temperature Rise	degF		54.6		46.9	
Net Load	MW		596.8		610.2	
Average Cond Press	inHga		2.3		2.2	
Average Exit Gas Temperature	degF		329.9		328.5	
Aux Power	%		4.3		4.1	
Gross Unit Heat Rate	BTU/KW-HR		9106.9		8974.9	
Gross Turbine Heat Rate	BTU/KW-HR		7674.5		7664.3	
Feedwater Flow	KPPH		3857.5			

As stated above, the boiler efficiency dropped from February to March due to the increased water cannon use. The HP turbine efficiency was also slightly lower and is due in part to the average control valve position over the month.

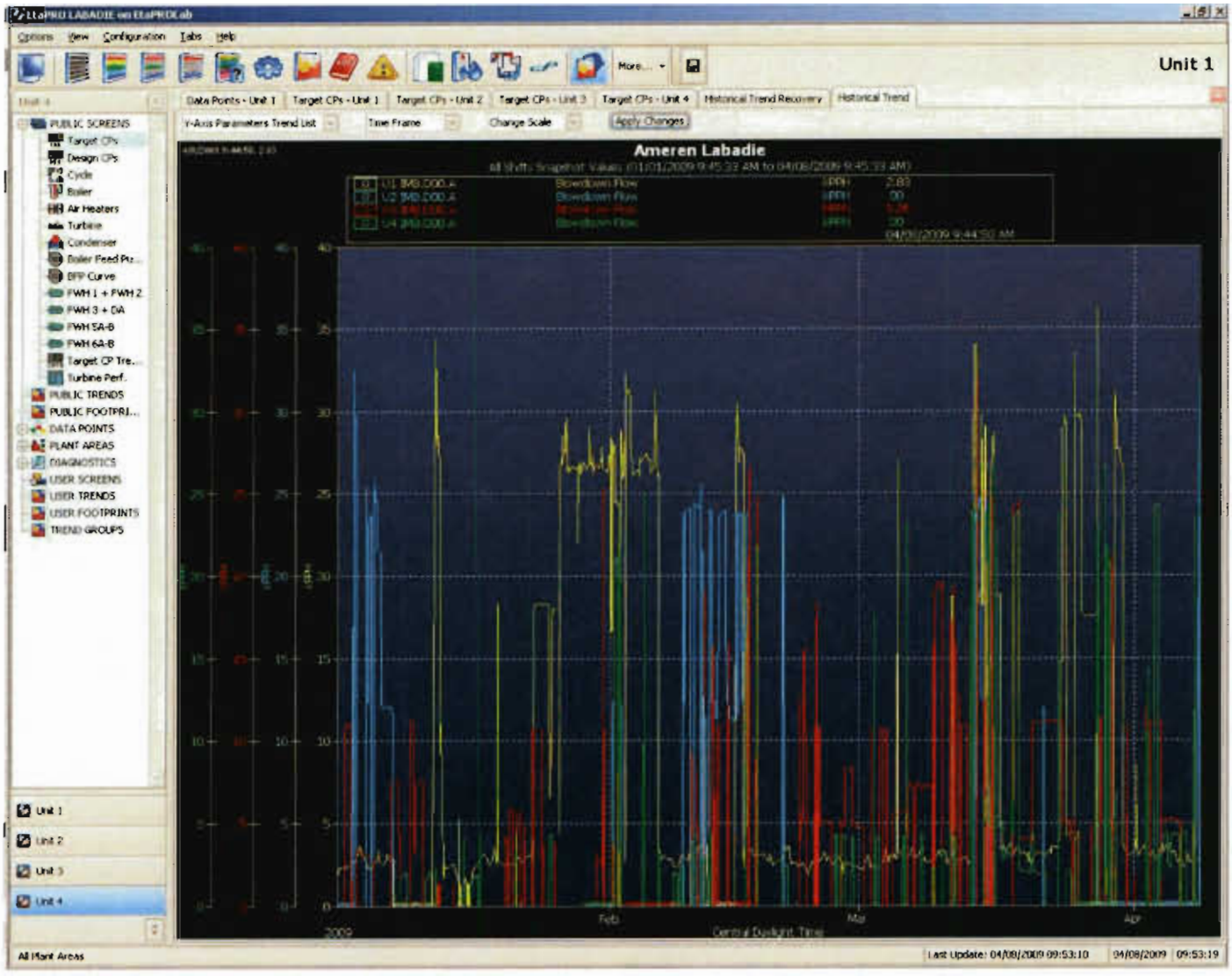




The top plot shows the change in water cannon flow in mid-March. The impact of water cannon flow is included in the Misc. loss category of the second plot. As shown in the second plot, the Misc. loss went from 0% to about 2% at the time water cannon flow was introduced in mid-March.



The above plot shows water cannon flow for all four units for a 2 hour period on 3/19/2009. As shown, cannon flow on Unit 1 never drops back to zero as seen on all of the other units.



The above plot shows blowdown flow for all four units since the beginning of the year. As shown above, the blowdown flow Unit 1 never goes to 0. The other units all show periodic blowdown flow but eventually go back to no indicated flow.

Unit 2 Observations

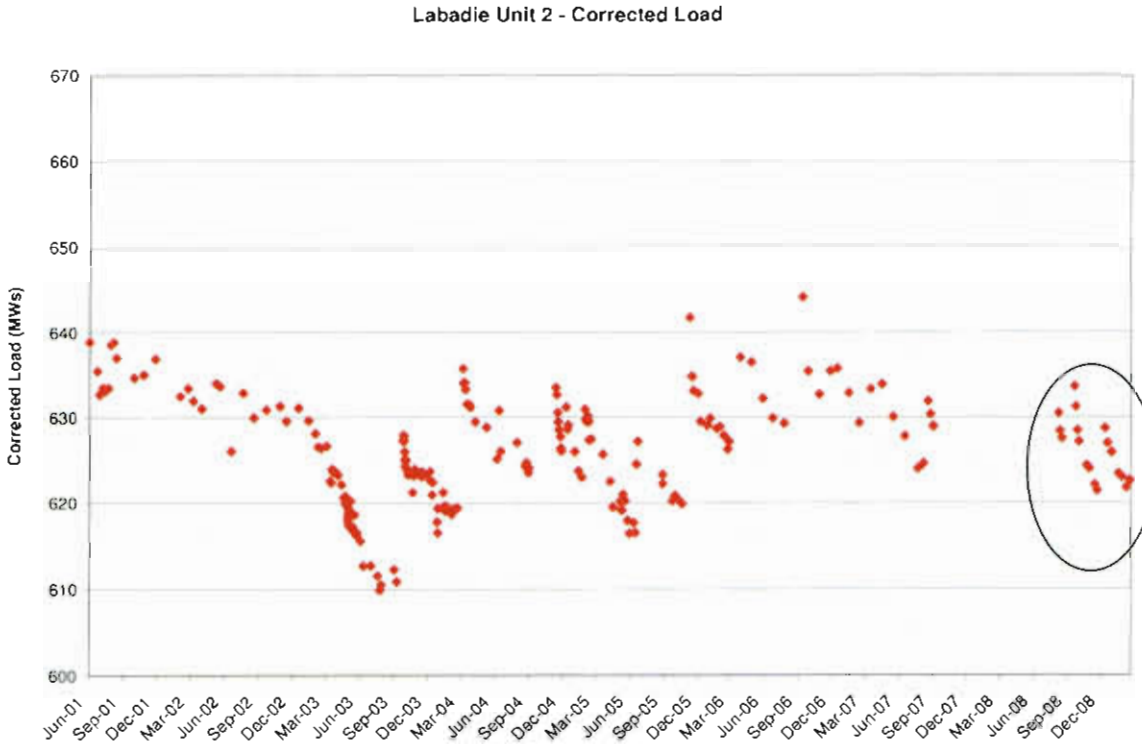
The following observations were made regarding Unit 2 operation and performance:

- HP/IP/LP turbine efficiencies steadily decline during continuous runs. Following SBOs, a step increase in efficiency is seen. This topic has been discussed before with regard to potential water soluble deposits with no known resolution. This will continue to be monitored.

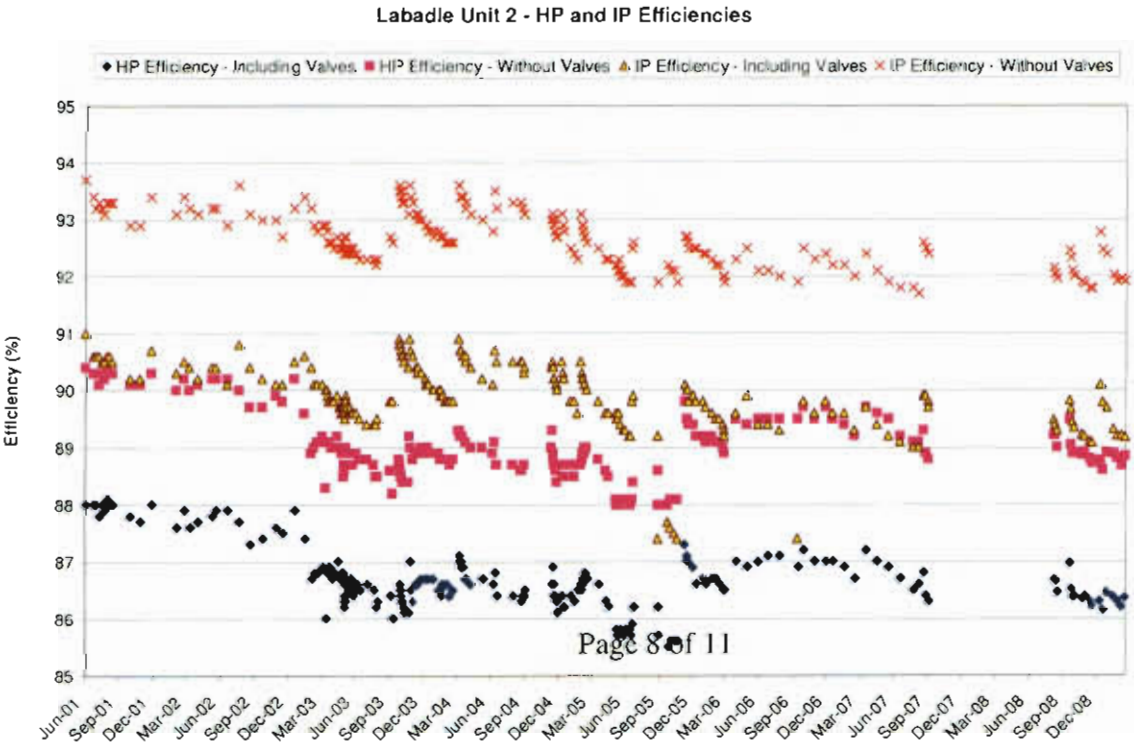
Summary of Performance Report for:

Plant	Labadie					
Unit	2					
Period	3/1/09	to	4/1/09			
Full Load Performance			Mar-09		Feb-09	Mar-08
Hours of Data (>90% Monthly Capability)			467		545	249
			Averages		Averages	Averages
GENERATOR MEGAWATTS	MW		587.8		592.8	623.9
AUX POWER	MW		29.0		29.6	31.3
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		10200.4		10241.1	10271.5
Boiler Efficiency Actual	%		85.1		85.1	85.2
CONTROL VALVE POSITION LVDT	%		43.6		45.7	100.0
FEEDWATER TEMP TO ECON	degF		490.0		490.6	494.1
FEEDWATER TEMP TO HTR 1	degF		442.5		442.7	446.1
HP Turbine Efficiency Actual	%		83.0		83.4	86.2
IP Turbine Efficiency Corrected	%		90.2		90.4	90.7
Condenser Pressure HP	inHga		2.2		2.0	2.2
Condenser Pressure LP	inHga		1.8		1.7	1.8
AIRHTR-A GAS OUTLET TEMP	degF		330.6		330.4	320.1
AIRHTR-B GAS OUTLET TEMP	degF		334.9		335.2	334.1
AMBIENT AIR TEMP	degF		52.0		40.7	47.2
CIRC WTR TEMP TO LP CONDB	degF		46.2		39.8	57.4
CIRC WTR TEMP TO LP CONDB	degF		46.5		40.7	42.1
CIRC WTR TEMP TO LP CONDB	degF		46.6		41.2	42.1
CIRC WTR TEMP TO LP CONDB	degF		46.0		40.3	44.2
Minimum River Temperature	degF		46.0		39.8	42.1
FWH 1 Temperature Rise	degF		47.6		47.9	48.0
Net Load	MW		558.8		563.2	592.7
Average Cond Press	inHga		2.0		1.9	2.0
Average Exit Gas Temperature	degF		332.7		332.8	327.1
Aux Power	%		4.9		5.0	5.0
Gross Unit Heat Rate	BTU/KW-HR		9697.1		9730.0	9756.7
Gross Turbine Heat Rate	BTU/KW-HR		8256.3		8282.7	8316.2
Feedwater Flow	KPPH		3863.427			

No significant changes were noted for Unit 2 in March.



Note the decrease in corrected load during the last several online runs on the Unit.



Note the decrease in turbine efficiencies over the same time periods.

Unit 3 Observations

The following observations were made regarding Unit 3 operation and performance:

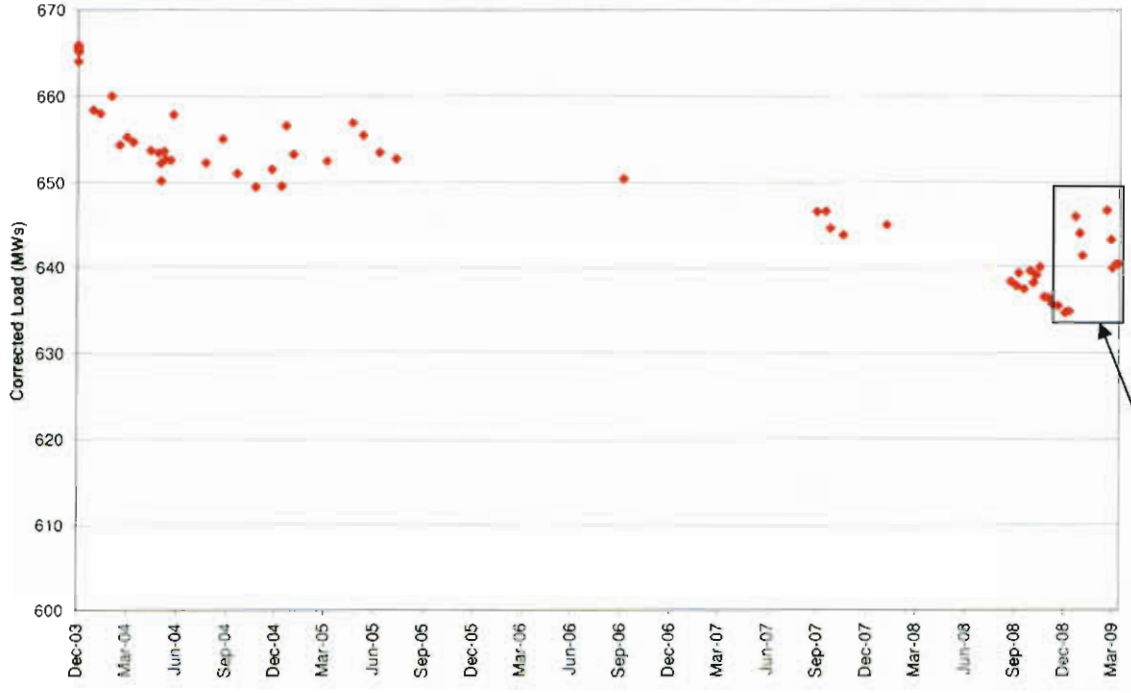
- Condenser vacuum pump flow was about 100 scfm at the end of March (down from 120 scfm at the end of February). This unit has the highest inleakage of all the Labadie Units. The plant goal is to be below 40 scfm and running on one vacuum pump.
- HP/IP/LP turbine efficiencies steadily decline during continuous runs. Following SBOs, a step increase in efficiency is seen. This topic has been discussed before with regard to potential water soluble deposits with no known resolution. This will continue to be monitored.

Summary of Performance Report for:

Plant	Labadie					
Unit	3					
Period	3/1/09	to	4/1/09			
Full Load Performance			Mar-09		Feb-09	Mar-08
Hours of Data			587		379	198.0
			Averages		Averages	Averages
GENERATOR MEGAWATTS	MW		600.3		608.9	636.4
AUX POWER	MW		29.7		28.8	29.9
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		9869.3		9744.9	9942.8
Boiler Efficiency Actual	%		85.4		85.6	85.4
CONTROL VALVE POSITION LVDT	%		98.1		95.6	103.1
FEEDWATER TEMP TO ECON	degF		480.6		481.8	485.4
FEEDWATER TEMP TO HTR 1	degF		431.1		432.1	436.5
HP Turbine Efficiency Actual	%		85.1		84.9	87.3
IP Turbine Efficiency Corrected	%		95.0		95.0	94.1
Condenser Pressure HP	inHga		2.4		2.1	2.4
Condenser Pressure LP	inHga		2.1		2.0	2.1
AIRHTR-A GAS OUTLET TEMP	degF		327.3		322.9	332.9
AIRHTR-B GAS OUTLET TEMP	degF		323.8		321.4	304.1
AMBIENT AIR TEMP	degF		51.6		41.7	51.2
CIRC WTR TEMP TO LP CONDB	degF		46.8		40.1	57.7
CIRC WTR TEMP TO LP CONDB	degF		49.8		42.5	46.8
CIRC WTR TEMP TO LP CONDB	degF		47.2		40.6	46.2
CIRC WTR TEMP TO LP CONDB	degF		46.8		40.2	46.7
Minimum River Temperature	degF		46.8		40.1	46.2
FWH 1 Temperature Rise	degF		49.5		49.7	48.9
Net Load	MW		570.5		580.2	606.5
Average Cond Press	inHga		2.2		2.1	2.3
Average Exit Gas Temperature	degF		325.5		322.1	318.5
Aux Power	%		4.9		4.7	4.7
Gross Unit Heat Rate	BTU/KW-HR		9380.8		9284.7	9476.0
Gross Turbine Heat Rate	BTU/KW-HR		8012.8		7944.0	8090.7
Feedwater Flow	KPPH		3692.345			

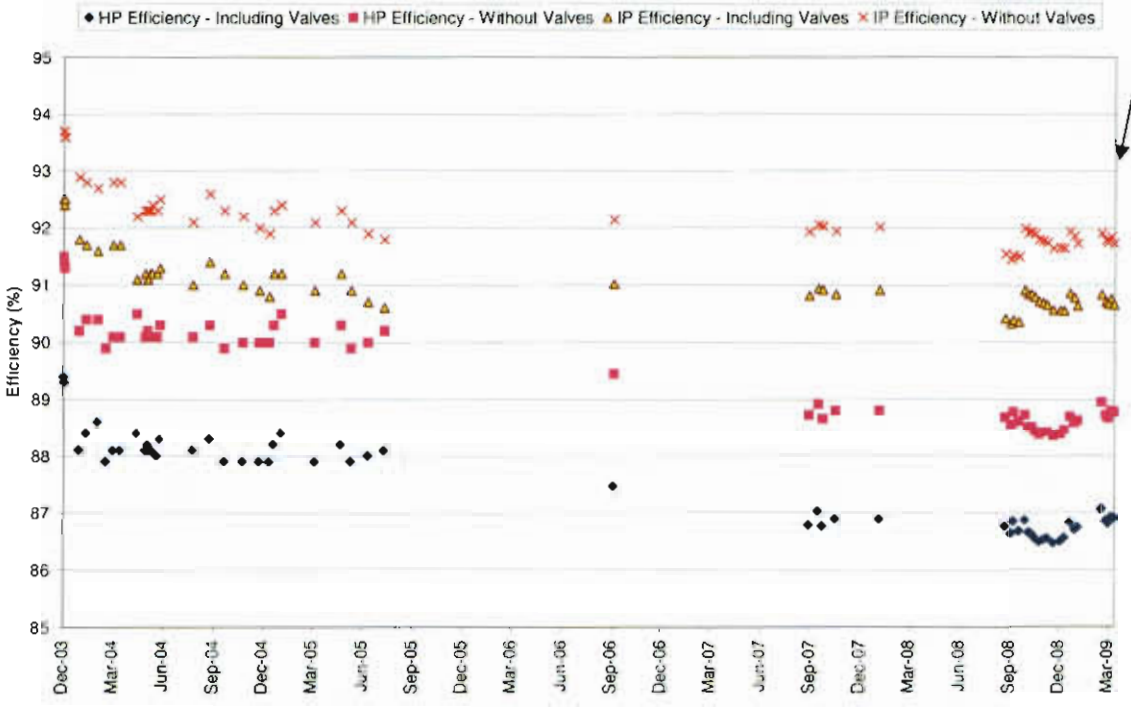
The duct pressure limitations continue to limit load on the unit. The combination of lower generation and increased aux. load contributed to a higher heat rate in March. The increased river temperature also led to a higher backpressure which in turn leads to a higher heat rate.

Labadie Unit 3 - Corrected Load



Note the decrease in load and turbine efficiencies followed by the step change up following recent SBOs

Labadie Unit 3 - HP and IP Efficiencies



Unit 4 Observations

The following observations were made regarding Unit 4 operation and performance:

- The #1 FWH was out of service for the entire month of March and will be repaired during the outage this spring. It is noted that operation without the top feedwater heater in service is about a 95 Btu/kWhr heat rate penalty and equates to about a $50,000 per month increase in fuel costs.
- HP efficiency was down about 2% and was due to pinching back on the control valves in March.

Summary of Performance Report for:

Plant	Labadie				
Unit	4				
Period	3/1/09	to	4/1/09		
Full Load Performance			Mar-09	Feb-09	Mar-08
Hours of Data (>90% Monthly Capability)			549	595	172
			Averages	Averages	Averages
GENERATOR MEGAWATTS	MW		606.2	625.2	641.1
AUX POWER	MW		28.4	30.6	30.0
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		10099.9	9993.5	10390.7
Boiler Efficiency Actual	%		85.2	85.0	85.0
CONTROL VALVE POSITION LVDT	%		78.3	85.4	98.6
FEEDWATER TEMP TO ECON	degF		433.5	468.0	431.5
FEEDWATER TEMP TO HTR 1	degF		434.5	433.9	432.5
HP Turbine Efficiency Actual	%		82.9	84.9	87.8
IP Turbine Efficiency Corrected	%		94.6	94.7	93.3
Condenser Pressure HP	inHga		3.1	2.2	2.1
Condenser Pressure LP	inHga		2.4	1.9	1.9
AIRHTR-A GAS OUTLET TEMP	degF		336.0	344.5	327.6
AIRHTR-B GAS OUTLET TEMP	degF		318.7	316.9	309.9
AMBIENT AIR TEMP	degF		52.5	43.5	46.2
CIRC WTR TEMP TO LP CONDB	degF		46.0	39.8	56.5
CIRC WTR TEMP TO LP CONDB	degF		49.0	41.9	44.0
CIRC WTR TEMP TO LP CONDB	degF		46.4	41.1	44.0
CIRC WTR TEMP TO LP CONDB	degF		45.7	40.0	43.3
Minimum River Temperature	degF		45.7	39.8	43.3
FWH 1 Temperature Rise	degF		-1.0	34.1	-1.0
Net Load	MW		577.8	594.6	611.1
Average Cond Press	inHga		2.7	2.0	2.0
Average Exit Gas Temperature	degF		327.4	330.7	318.8
Aux Power	%		4.7	4.9	4.7
Gross Unit Heat Rate	BTU/KW-HR		9626.4	9504.0	9905.0
Gross Turbine Heat Rate	BTU/KW-HR		8203.2	8077.9	8422.2
Feedwater Flow	KPPH		3566.229		

As noted above, heat rate in March was up and was due to several reasons. First, the top heater was out of service the entire month of March and just part of the month of February. In addition, a Circ. pump was taken off line for repairs in March and led to an increase in the average backpressure. In addition, the HP efficiency was down about 2% due to pinching back on the control valves more in March. These three changes were the main contributors to the increased heat rate in March.

March 12, 2009

To: David Fox
From: Jeff Shelton
Cc: Bob Meiners, Mark Litzinger, Kevin Stumpe, Paul Piontek, Brian Griffen, Russ Hawkins, Greg Gurnow, Tony Balestreri, Greg Bolte, Chris Hegger, Scott McCormack, Ken Stuckmeyer, Don Clayton, Joe Sind, Matt Wallace, Scott Hixson, Jim Barnett, Glenn Tiffin

Subject: Labadie February 2009 Performance Report

Executive Summary

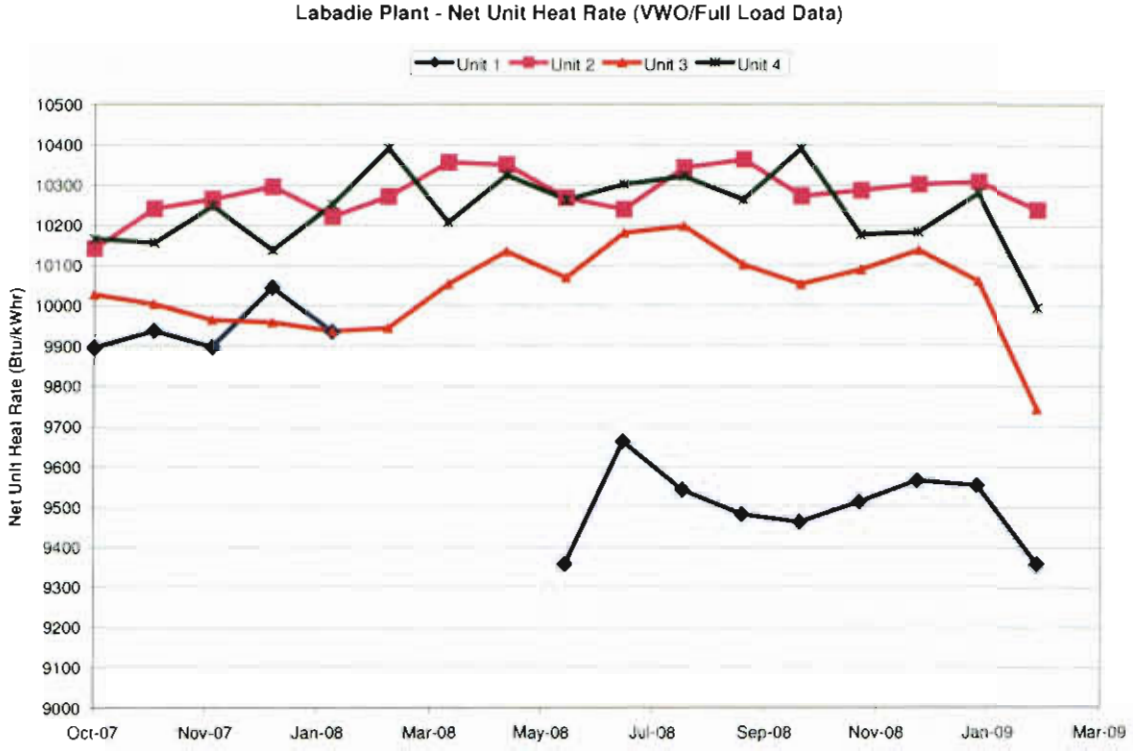
The most notable items regarding Labadie unit performance were:

- All units exhibit some form of turbine efficiency degradation over time that is recovered following SBOs. The suspected cause is water soluble deposits and will continue to be monitored.
- Unit 3 operation with valves pinched backed appears to be slightly more efficient than operating in VWO with the current duct pressure limitations on the unit. Observations on control valve position and its impact on load and heat rate for all four units are presented in the Unit 3 section of this report.
- Unit 3 6B FWH has an issue that is limiting performance. The plant has checked temperature readings and looked for leaks on both the steam side and feedwater side of the heater. It is recommended that the plant inspect the expansion joints on the heater during the spring outage on Unit 3.

The following table shows the instrument deficiencies for all four units (no new items were added from the last report):

Tag	Unit	Issue	Resolution	Carryover or New
3BFWSTM-08321, EXTRACT PRESS HTR 4B	3	Has only had valid data from Nov. 2003 to Jan. 2004	JR164407 to investigate and correct	Carryover
1BFWSTM-08318, EXTRACT PRESS HTR 4A	1	Flat-lined on 1/29	JR164611	Carryover

A plot of monthly unit heat rates for all four units is included on the following page. As discussed in the last performance report, the heat rate calculation in EtaPro was modified at the end of January. An incorrect temperature was previously being used in EtaPro and correcting this caused an approximate 2% to 3% decrease in heat rate across all four units.



Action Items:

- Labadie should search for air inleakage sources on the Unit 3 condenser.
- Labadie should inspect the expansion joints on the 6B FWH on Unit 3 during the spring outage. If nothing is found on that inspection, it may be prudent to once again inspect the partition plate of the feedwater heater looking for sources of bypass flow.
- Performance Engineering will check the EtaPro heat rate calculations to ensure they are as accurate as possible.
- Performance Engineering will develop a "best-achievable" heat rate for each unit to determine the potential improvement available on each unit. This will also be used in the determination of the heat rate KPI for the plant.
- Performance Engineering will develop plans and help conduct a cycle isolation check on all four units in 2009/2010. The intent is to have a Coop student in Performance Engineering perform this task on the entire UE fleet.
- Performance Engineering will create screens in EtaPro that better monitor turbine performance. Calculations will include corrected load, corrected turbine stage pressures, and more detailed turbine efficiencies (internal and external). A working example for Unit 3 is currently available and is labeled "Turbine Perf."
- Performance Engineering will be phasing out the use of OPM.

Unit 1 Observations

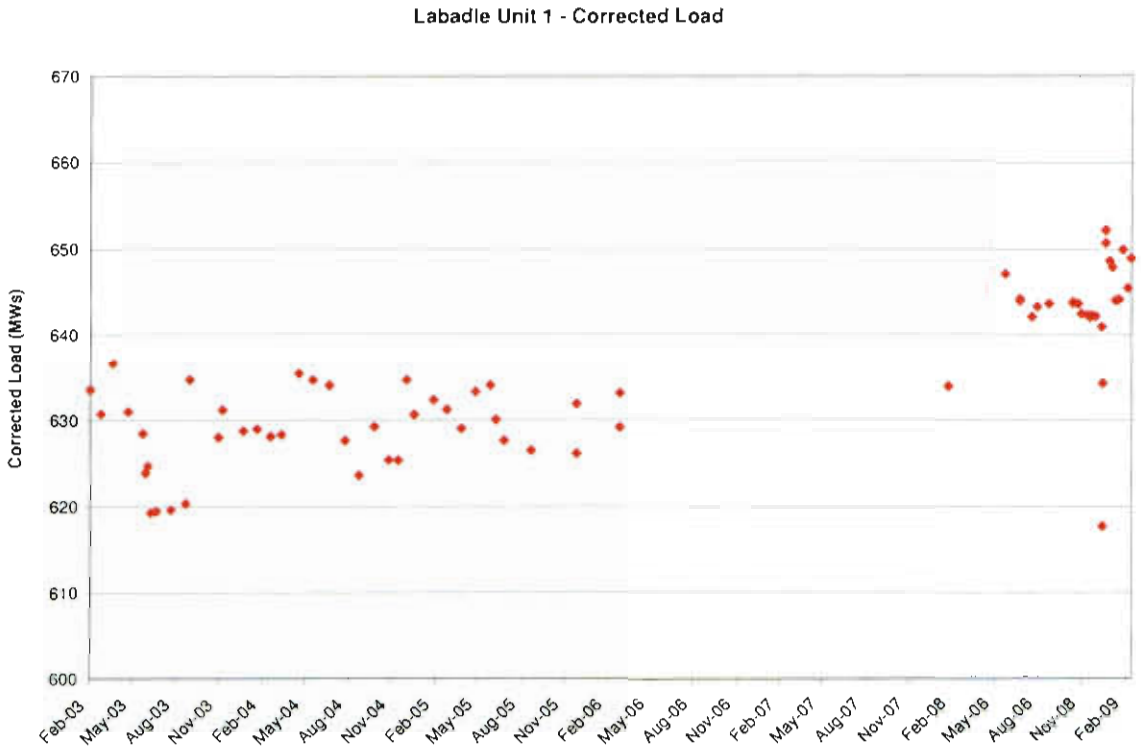
The following observations were made regarding Unit 1 operation and performance:

- The performance reports are being changed such that all data from hours in which the gross load is greater than 90% of the monthly capability will be compiled (previously VWO data was used in the reports).
- Condenser Cleanliness (both HP and LP) dropped approximately 20% (gradual decrease not instantaneous) in the last week of February. The HP cleanliness factor has leveled off at approximately 45%. The LP condenser cleanliness continues to drop and is currently at approximately 60%. The average HP condenser pressure increased from 1.6 in Hga in January to 3.1 in HgA in February due to having only one circulating water pump running.

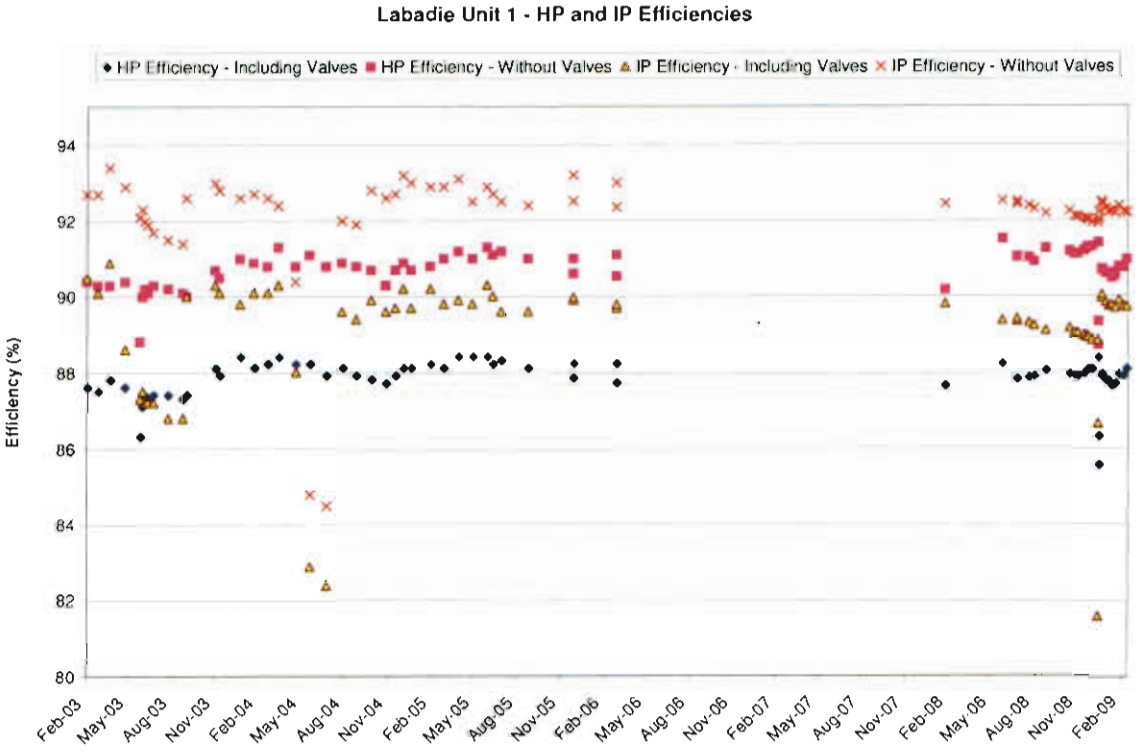
Summary of Performance Report for:

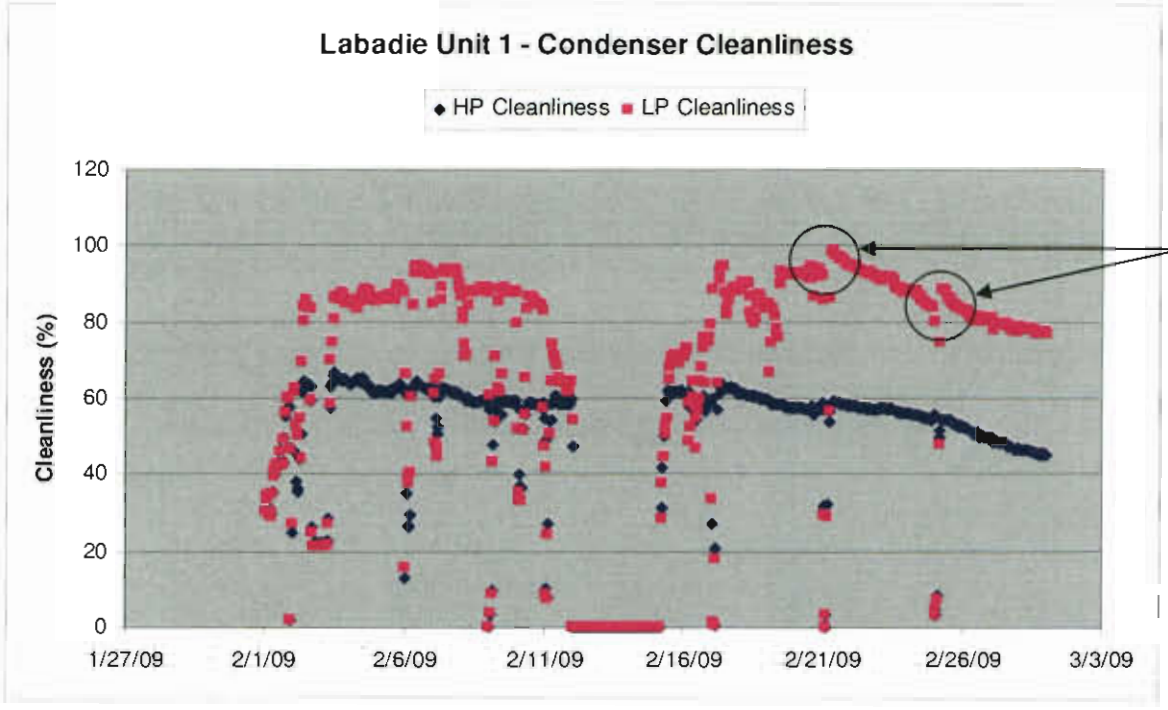
Plant	Labadie				
Unit	1				
Period	2/1/09	to	3/1/09		
			Feb-09	Jan-09	Feb-08
Full Load Performance					
Hours of Data (>90% Monthly Capability)			461	397	257
			Averages	**Averages**	**Averages**
GENERATOR MEGAWATTS	MW		636.1	640.5	628.1
AUX POWER	MW		25.9	28.3	27.5
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		9356.3	9553.6	9936.0
Boiler Efficiency Actual	%		85.4	85.2	85.2
CONTROL VALVE POSITION LVDT	%		82.7	100.0	100.4
FEEDWATER TEMP TO ECON	degF		485.9	492.6	491.0
FEEDWATER TEMP TO HTR 1	degF		439.0	437.6	439.4
HP Turbine Efficiency Actual	%		87.1	87.8	90.7
IP Turbine Efficiency Corrected	%		91.6	91.3	92.9
Condenser Pressure HP	inHga		3.1	1.6	2.8
Condenser Pressure LP	inHga		1.3	1.2	1.9
AIRHTR-A GAS OUTLET TEMP	degF		329.4	330.2	331.8
AIRHTR-B GAS OUTLET TEMP	degF		327.6	329.2	296.3
AMBIENT AIR TEMP	degF		40.0	28.4	34.4
CIRC WTR TEMP TO LP CONDB	degF		39.0	35.7	37.1
CIRC WTR TEMP TO LP CONDB	degF		41.4	38.5	38.2
CIRC WTR TEMP TO LP CONDB	degF		40.5	37.4	37.8
CIRC WTR TEMP TO LP CONDB	degF		39.7	37.8	36.6
Minimum River Temperature	degF		39.0	35.7	36.6
FWH 1 Temperature Rise	degF		46.9	55.0	51.6
Net Load	MW		610.2	612.2	600.6
Average Cond Press	inHga		2.2	1.4	2.4
Average Exit Gas Temperature	degF		328.5	329.7	314.0
Aux Power	%		4.1	4.4	4.4
Gross Unit Heat Rate	BTU/KW-HR		9974.9	9131.5	9500.3
Gross Turbine Heat Rate	BTU/KW-HR		7664.3	7777.8	8093.1

The average final feedwater temperature was lower in February than in January due to the top heater being out of service during parts of February. The HP efficiency dropped by 0.7% and is due in part to including data in which the valves were pinched down (note the average CV position for the February data is 82.7% while the average CV position for January was 100.0%). Note also that heat rate is lower by about 2% due to the EtaPro heat rate calculation change made in late January.



The plots of corrected load and turbine efficiencies for all four units use only VWO data. As with the other units, the corrected load and turbine efficiencies tend to decrease during long runs with no outages.



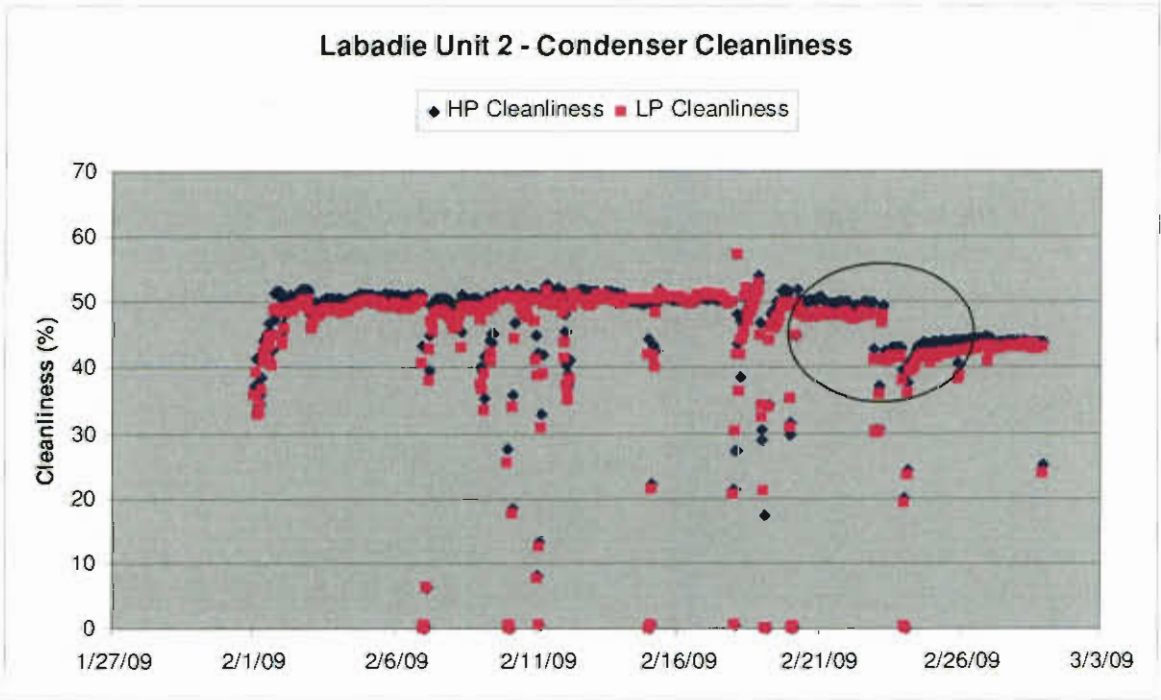


These two step increases in LP cleanliness correspond to condenser backwashes.

Unit 2 Observations

The following observations were made regarding Unit 2 operation and performance:

- The performance reports are being changed such that all data from hours in which the gross load is greater than 90% of the monthly capability will be compiled (previously VWO data was used in the reports).
- HP/IP/LP turbine efficiencies steadily decline during continuous runs. Following SBOs, a step increase in efficiency is seen. This topic has been discussed before with regard to potential water soluble deposits with no known resolution. This will continue to be monitored.
- In late February, there was a step change in the calculated condenser cleanliness due to a change made in EtaPro in the calculation of circulating water flow (see plot below). Previously, EtaPro capped the circulating water flow at the design condenser flow value of 188,000 gpm. This cap was removed on 2/23/09 and the circulating water flow estimate increased above 188,000 gpm. Since the measured condenser pressure and temperature rise across the condenser did not change, the increase in estimated circulating water flow reduced the apparent cleanliness of the condenser. This same change was made on all four units at Labadie. Unit 1 was running only one circ. pump at the time the change was made. No change in condenser cleanliness was observed since the estimated flow from one pump was below the condenser design flow of 188,000 gpm.

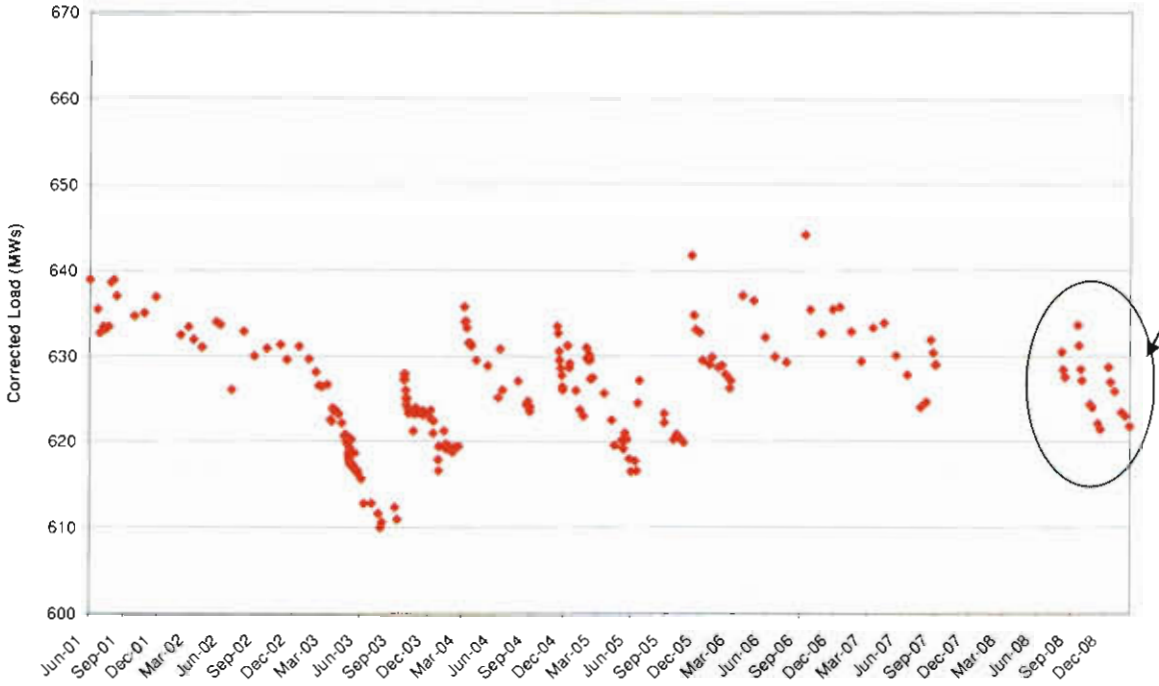


Summary of Performance Report for:

Plant	Labadie					
Unit	2					
Period	2/1/09	to	3/1/09			
Full Load Performance			Feb-09		Jan-09	Feb-08
Hours of Data (>90% Monthly Capability)			545		63	150
			Averages		Averages	Averages
GENERATOR MEGAWATTS	MW		592.8		610.1	627.8
AUX POWER	MW		29.6		29.6	30.6
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		10241.1		10307.8	10222.4
Boiler Efficiency Actual	%		85.1		85.3	85.5
CONTROL VALVE POSITION LVDT	%		45.7		99.9	99.4
FEEDWATER TEMP TO ECON	degF		490.6		492.3	495.4
FEEDWATER TEMP TO HTR 1	degF		442.7		443.8	447.0
HP Turbine Efficiency Actual	%		83.4		86.1	86.3
IP Turbine Efficiency Corrected	%		90.4		90.8	90.8
Condenser Pressure HP	inHga		2.0		1.9	2.0
Condenser Pressure LP	inHga		1.7		1.8	1.8
AIRHTR-A GAS OUTLET TEMP	degF		330.4		332.7	321.5
AIRHTR-B GAS OUTLET TEMP	degF		335.2		336.2	338.2
AMBIENT AIR TEMP	degF		40.7		34.1	40.2
CIRC WTR TEMP TO LP CONDB	degF		39.8		36.3	37.0
CIRC WTR TEMP TO LP CONDB	degF		40.7		36.9	37.4
CIRC WTR TEMP TO LP CONDB	degF		41.2		37.9	37.6
CIRC WTR TEMP TO LP CONDB	degF		40.3		38.8	36.4
Minimum River Temperature	degF		39.8		36.3	36.4
FWH 1 Temperature Rise	degF		47.9		48.5	48.4
Net Load	MW		563.2		580.5	597.2
Average Cond Press	inHga		1.9		1.9	1.9
Average Exit Gas Temperature	degF		332.8		334.5	329.8
Aux Power	%		5.0		4.8	4.9
Gross Unit Heat Rate	BTU/KW-HR		9730.0		9808.0	9724.1
Gross Turbine Heat Rate	BTU/KW-HR		8282.7		8367.7	8318.9

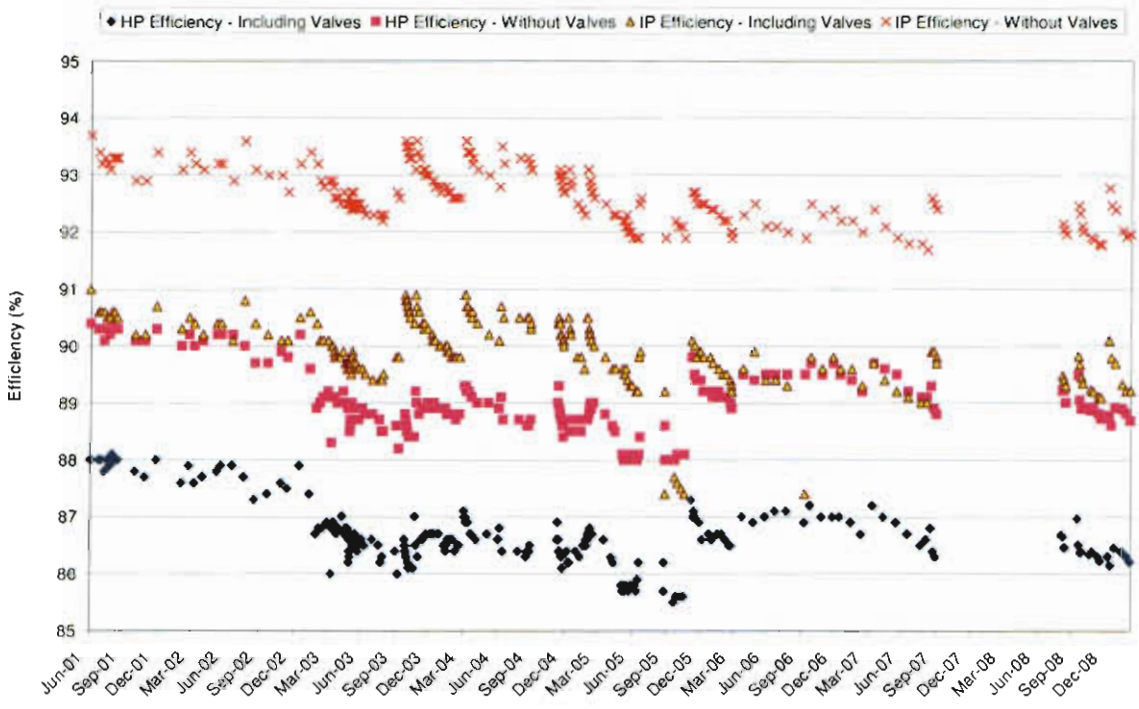
The most notable changes here were due mostly to calculation changes in EtaPro (heat rate drop from January to February) and the inclusion of data other than just VWO data (HP efficiency drop from January to February).

Labadie Unit 2 - Corrected Load



Note the decrease in corrected load during the last several online runs on the Unit

Labadie Unit 2 - HP and IP Efficiencies



Note the decrease in turbine efficiencies over the same time periods

Unit 3 Observations

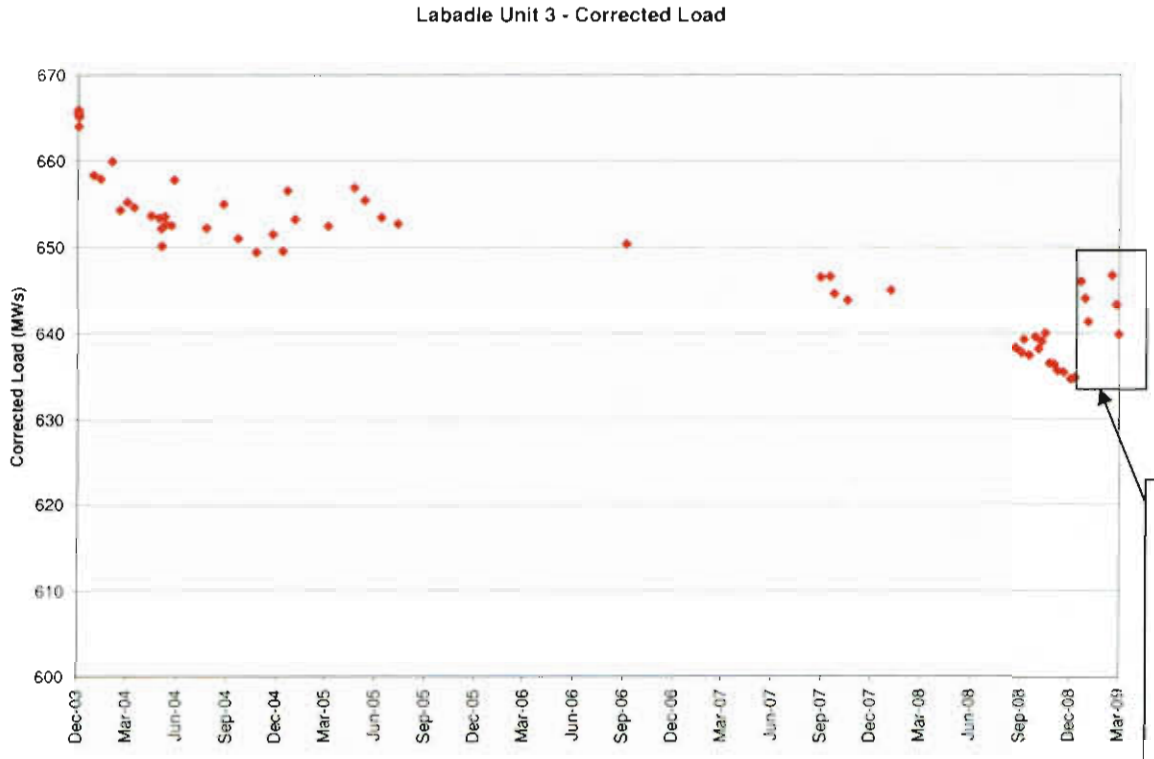
The following observations were made regarding Unit 3 operation and performance:

- The performance reports are being changed such that all data from hours in which the gross load is greater than 90% of the monthly capability will be compiled (previously VWO data was used in the reports).
- The plant asked Performance engineering to review VWO operation on the unit. There was an event in early March in which the unit went from valves pinched back to fully open. The unit was duct pressure limited so no additional fuel could be added. Throttle pressure dipped and the unit lost MWs. This event, along with several other time periods in which the unit went to VWO was reviewed. The other events did not show as big an impact, if any, on MWs. Plots were generated of heat rate and gross load versus control valve position. These plots (using data since Feb. 1, 2009) showed that in general, the unit maximizes output and minimizes heat rate with the valves pinched back to an indicated position of 95-96% (PI tag 3load-00550). This is believed to be impacted by the current limitations on the unit and not an indication that valves fully open is a less efficient mode of operation. In fact, the same plots for Unit 4 which is not duct pressure limited shows that the unit is more efficient at VWO. Plots for all four units, as well as further discussion, are provided below. This information will be reviewed again following the spring outages on the units.
- Condenser vacuum pump flow was about 120 scfm at the end of February. This unit has the highest inleakage of all the Labadie Units. The plant goal is to be below 40 scfm and running on one vacuum pump.
- Temperature rise of the 6B heater is much less than the 6A heater. This has been the case since January 2007. The difference in the temperature rise has gotten larger over time. The plant has inspected the tube side of the heater and has looked for air inleakage sources but have not found any obvious problems. The outlet thermocouple has also been checked. The available venting on the FWH has also been cycled. Since other causes have been investigated, performance engineering looked at the possibility of an expansion joint failure. Data from an expansion joint failure on the 5A FWH on Unit 2 in 2003 was compared to the current data from the 6B heater on Unit 3. In the 5A expansion joint failure, the FWH pressure dropped (got closer to condenser pressure) in addition to the feedwater outlet temperature decreasing. The 6B FWH pressure does not seem to be getting any lower although it is acknowledged that the 6B heater operates much more closely to the condenser pressure and thus there is a lower pressure head from the heater to the condenser. However, since other potential performance issues have already been investigated, it is recommended that the expansion joints be inspected during the spring outage. If the expansion joint inspection does not reveal any findings, it may be prudent to open the FWH and inspect the partition plate for any potential bypass flow on the tube side of the heater.
- HP/IP/LP turbine efficiencies steadily decline during continuous runs. Following SBOs, a step increase in efficiency is seen. This topic has been discussed before with regard to potential water soluble deposits with no known resolution. This will continue to be monitored.

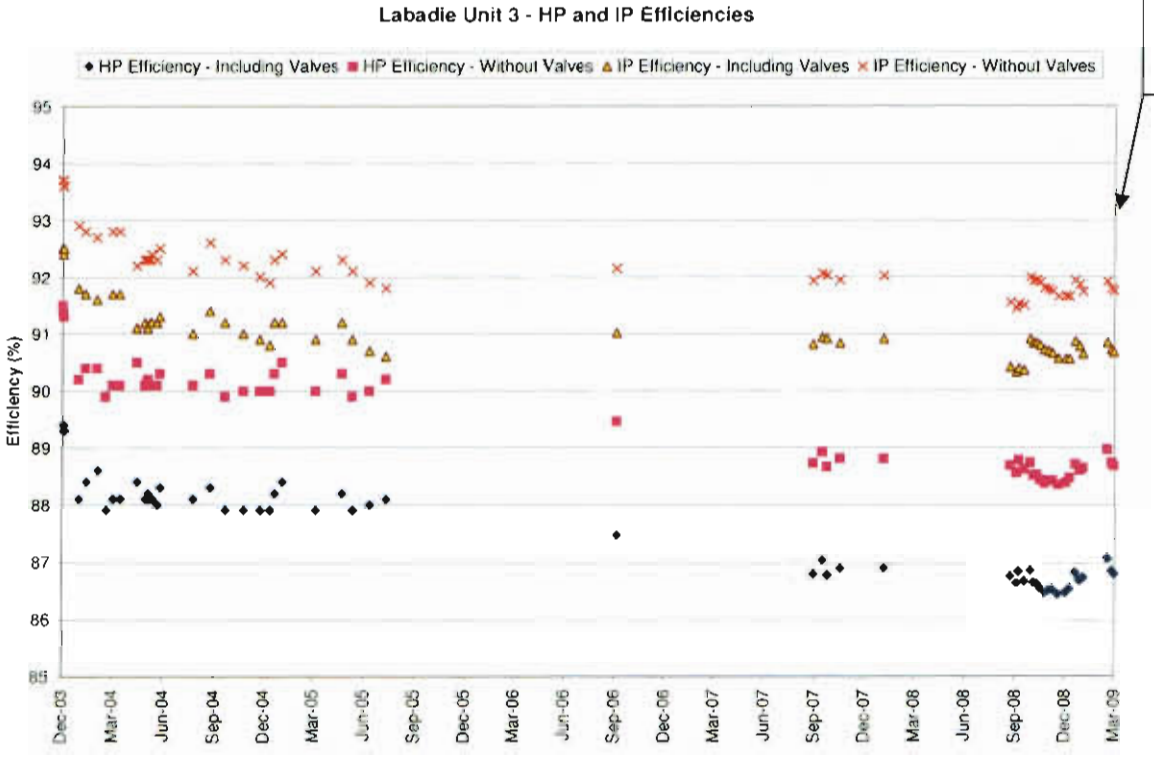
Summary of Performance Report for:

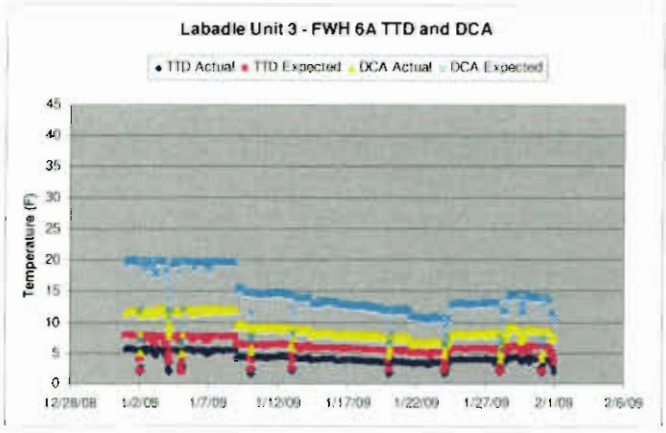
Plant	Labadie					
Unit	3					
Period	2/1/09	to	3/1/09			
Full Load Performance			Feb-09		Jan-09	Feb-08
Hours of Data			379		65	636.0
			Averages		Averages	Averages
GENERATOR MEGAWATTS	MW		608.9		617.2	645.3
AUX POWER	MW		28.8		29.5	29.2
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		9744.9		10060.0	9935.9
Boiler Efficiency Actual	%		85.6		85.3	85.3
CONTROL VALVE POSITION LVDT	%		95.6		103.4	101.8
FEEDWATER TEMP TO ECON	degF		481.8		482.4	487.2
FEEDWATER TEMP TO HTR 1	degF		432.1		433.2	438.3
HP Turbine Efficiency Actual	%		84.9		86.4	87.0
IP Turbine Efficiency Corrected	%		95.0		94.9	93.9
Condenser Pressure HP	inHga		2.1		2.0	2.2
Condenser Pressure LP	inHga		2.0		1.9	2.3
AIRHTR-A GAS OUTLET TEMP	degF		322.9		327.0	321.2
AIRHTR-B GAS OUTLET TEMP	degF		321.4		317.5	304.2
AMBIENT AIR TEMP	degF		41.7		33.8	34.2
CIRC WTR TEMP TO LP CONDB	degF		40.1		36.1	37.3
CIRC WTR TEMP TO LP CONDB	degF		42.5		37.6	37.7
CIRC WTR TEMP TO LP CONDB	degF		40.6		36.1	37.2
CIRC WTR TEMP TO LP CONDB	degF		40.2		35.4	36.6
Minimum River Temperature	degF		40.1		35.4	36.6
FWH 1 Temperature Rise	degF		49.7		49.3	48.9
Net Load	MW		580.2		587.7	616.1
Average Cond Press	inHga		2.1		2.0	2.3
Average Exit Gas Temperature	degF		322.1		322.3	312.7
Aux Power	%		4.7		4.8	4.5
Gross Unit Heat Rate	BTU/KW-HR		9284.7		9579.0	9486.4
Gross Turbine Heat Rate	BTU/KW-HR		7944.0		8167.8	8088.8

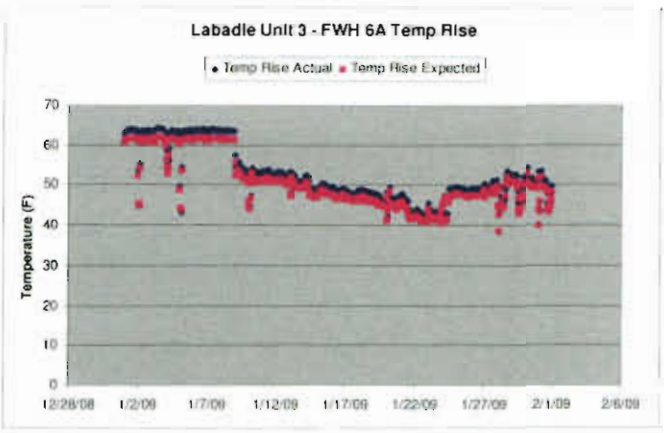
The HP efficiency dropped by 1.5% and is due in part to including data in which the valves were pinched down (note the average CV position for the February data is 95.6% while the average CV position for January was 103.4%). Note also that heat rate is down by almost 3% due to the EtaPro heat rate calculation change made in late January.

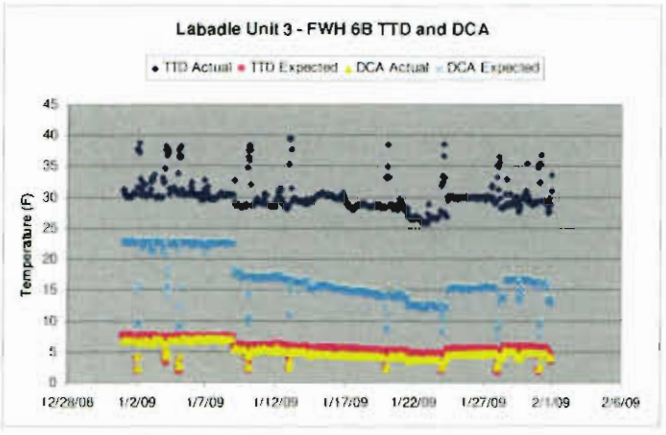


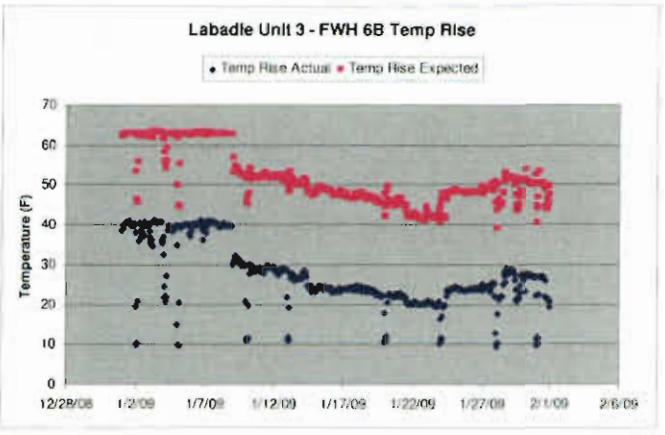
Note the decrease in load and turbine efficiencies followed by the step change up following recent SBOs

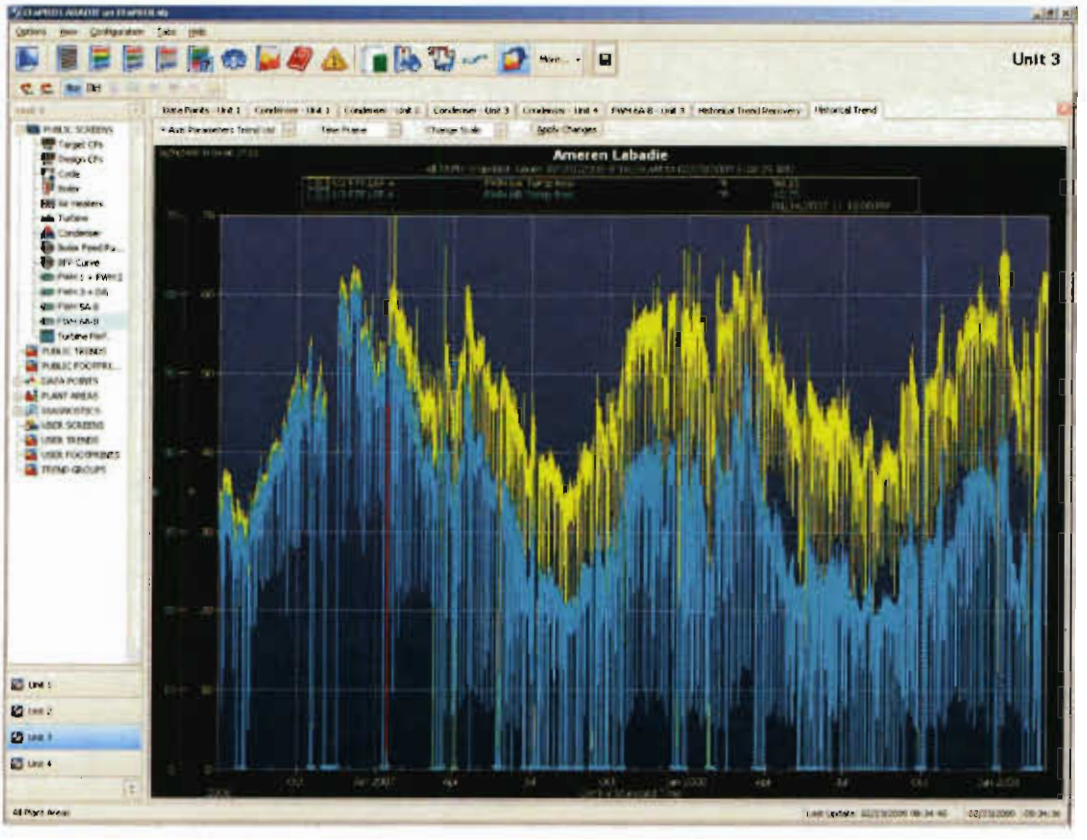




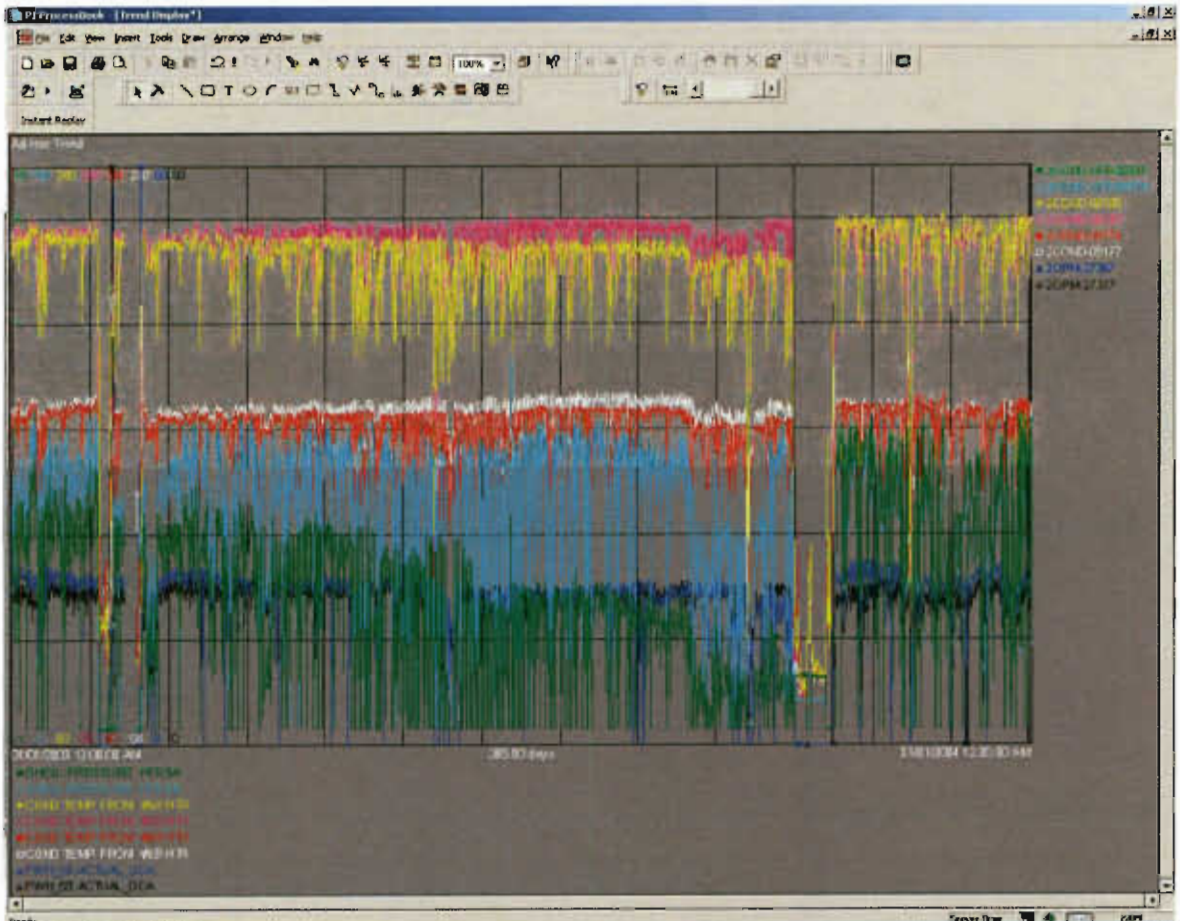


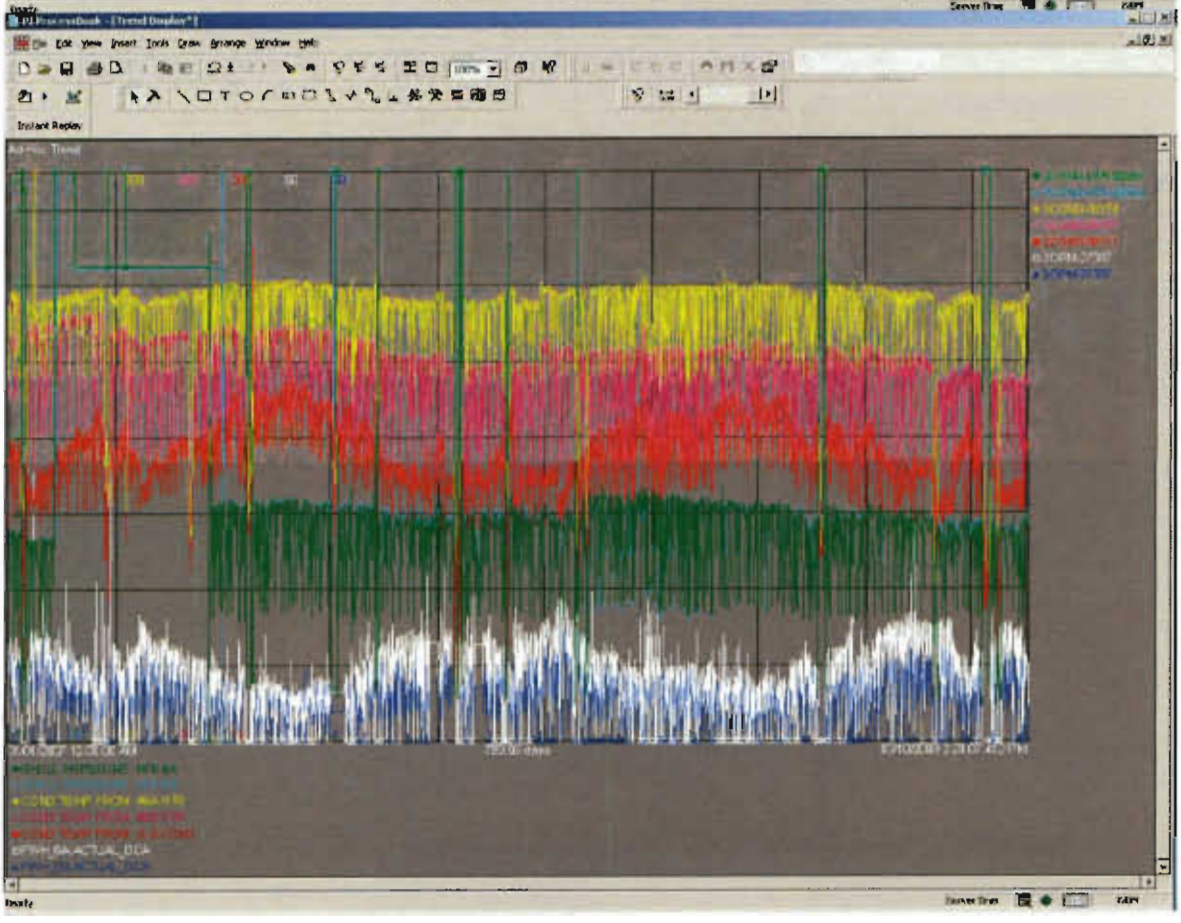






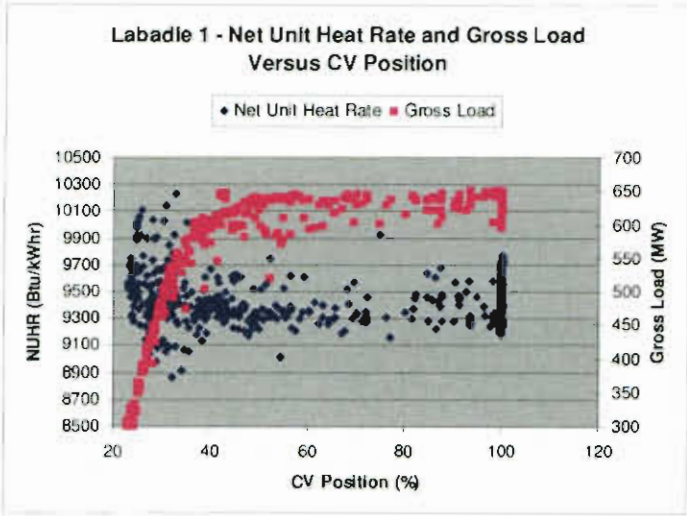
Temperature rise of the 6A and 6B heaters on Unit 3 since January 2007.

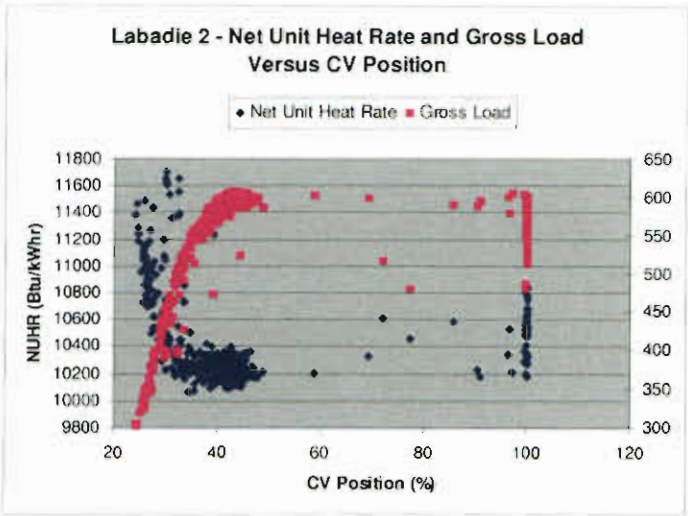


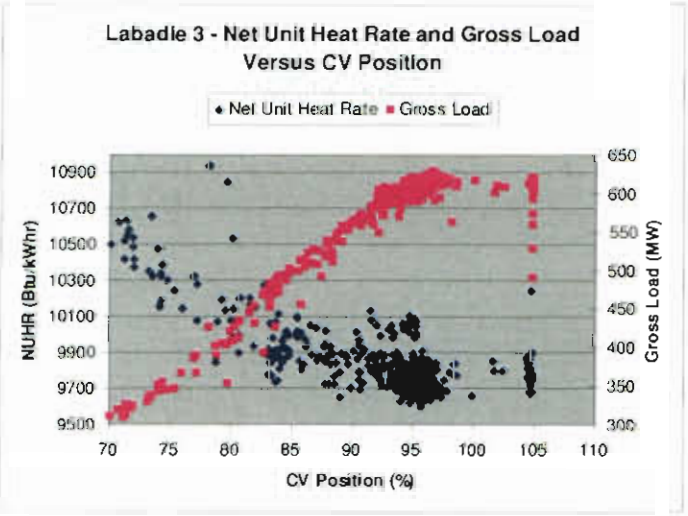


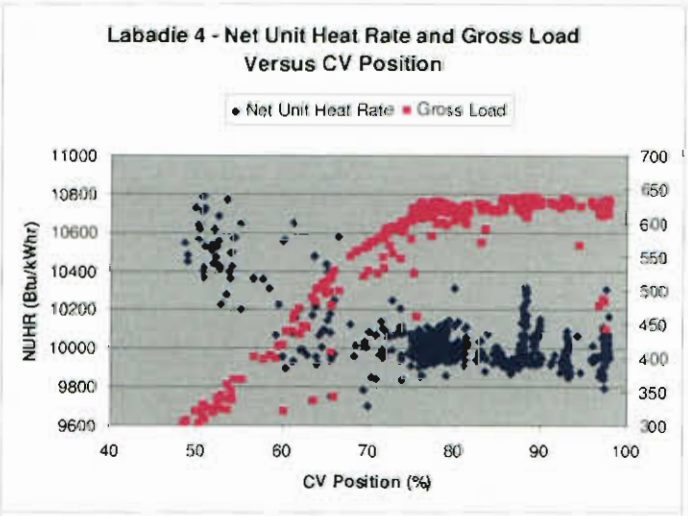
The top plot shows data from the 5A and 5B heater during a time period when an expansion joint failed on the 5A heater on Unit 2. Green is the 5A shell pressure, Blue is the 5B shell pressure, Yellow is the 5A feedwater outlet temp, and Pink is the 5B feedwater outlet temp. As shown, the pressure of the 5A heater dropped off during 2003 as did the outlet temperature.

The bottom plot shows data from the #6 heaters on Unit 3. Green is the 6A shell pressure, Blue is the 6B shell pressure, Yellow is the 6A feedwater outlet temperature, and Pink is the 6B feedwater outlet temperature. Note that the gap in outlet temperatures between the two heaters has gotten larger over time. However, there does not appear to be any difference in shell pressure between the two FWHs.









Above are plots of Net Unit Heat Rate and Gross Load versus control valve position for each unit since Feb. 1, 2009. As discussed above, Unit 3 seems to get the most MWs and lowest heat rate for a control valve position around 95-96% (Pi tag 3load-00550). Unit 1 heat rate levels off above about 50% (Pi tag 1turb-17508) open but continues to get more MWs as the valves go more open. Unit 2 seems to be the most efficient and generate the most MWs between 40 and 50% (Pi tag 2turb-17508) open. Unit 4 load seems to peak between 85 to 90% (Pi tag 4load-00550) open while heat rate, in general, continues to trend down all the way to VWO. Obviously there are many other factors that influence load and heat rate other than control valve position. From this review, it would appear that operating at VWO is the best efficiency approach for Units 1 and 4 while having the valves pinched back is the most efficient for Unit 2 (40-50% open) and Unit 3 (95-95% open). This will be looked at again following the spring outages on Units 2, 3, and 4. Performance Engineering still requests VWO operation for a minimum of 4 hours each month in order to look at VWO turbine performance.

Unit 4 Observations

The following observations were made regarding Unit 4 operation and performance:

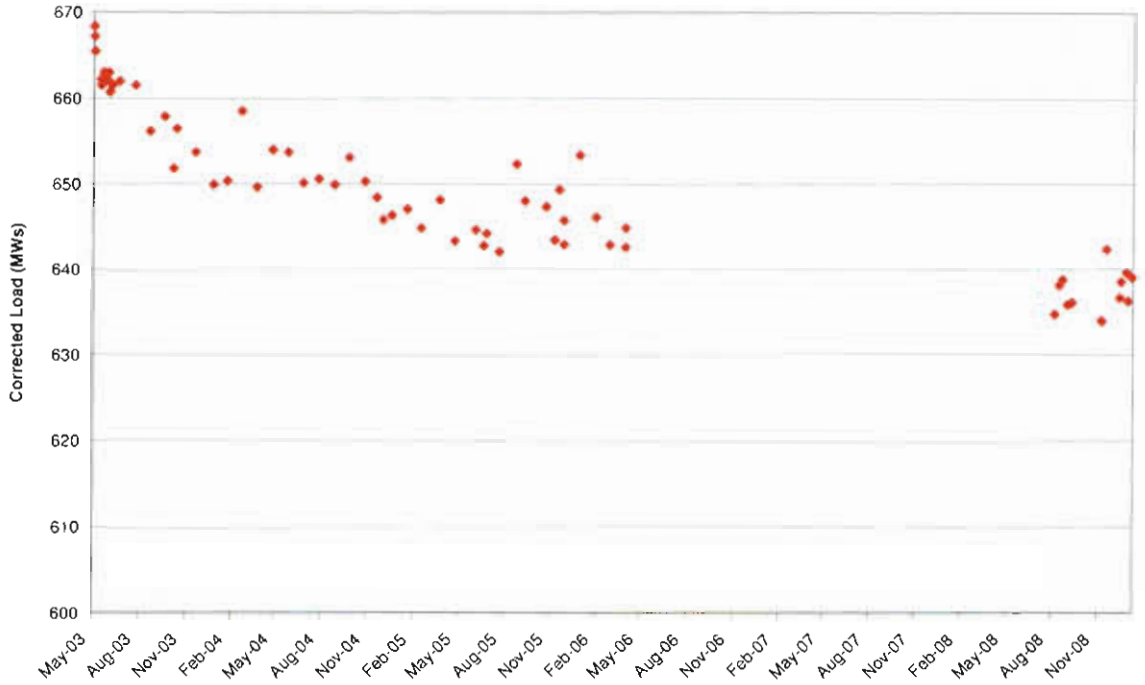
- The performance reports are being changed such that all data from hours in which the gross load is greater than 90% of the monthly capability will be compiled (previously VWO data was used in the reports).
- HP/IP/LP turbine efficiencies steadily decline during continuous runs. Following SBOs, a step increase in efficiency is seen. This topic has been discussed before with regard to potential water soluble deposits with no known resolution. This will continue to be monitored.

Summary of Performance Report for:

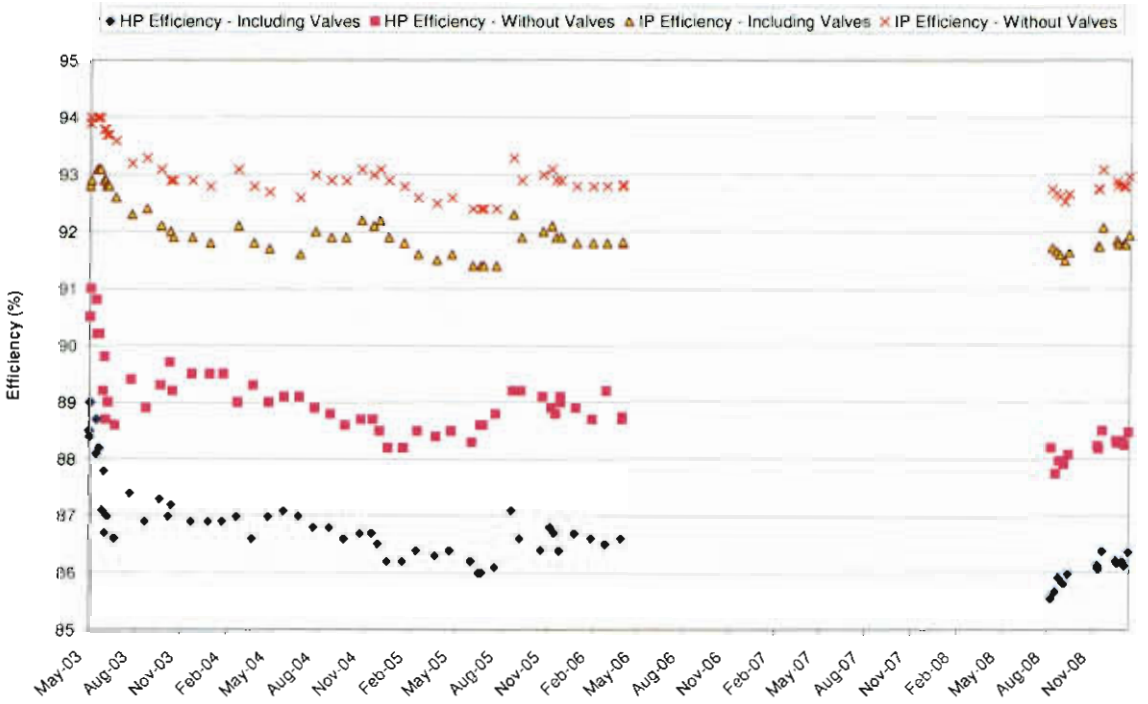
Plant	Labadie				
Unit	4				
Period	2/1/09	to	3/1/09		
Full Load Performance			Feb-09	Jan-09	Feb-08
Hours of Data (>90% Monthly Capability)			595	633	433
			Averages	Averages	Averages
GENERATOR MEGAWATTS	MW		625.2	621.3	644.1
AUX POWER	MW		30.6	27.9	31.0
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		9993.5	10279.0	10251.8
Boiler Efficiency Actual	%		85.0	84.8	85.0
CONTROL VALVE POSITION LVDT	%		85.4	88.5	98.6
FEEDWATER TEMP TO ECON	degF		468.0	484.1	482.9
FEEDWATER TEMP TO HTR 1	degF		433.9	433.7	429.8
HP Turbine Efficiency Actual	%		84.9	86.6	87.7
IP Turbine Efficiency Corrected	%		94.7	93.6	93.6
Condenser Pressure HP	inHga		2.2	3.1	2.0
Condenser Pressure LP	inHga		1.9	2.1	2.1
AIRHTR-A GAS OUTLET TEMP	degF		344.5	349.8	328.0
AIRHTR-B GAS OUTLET TEMP	degF		316.9	311.2	310.2
AMBIENT AIR TEMP	degF		43.5	35.2	33.1
CIRC WTR TEMP TO LP CONDB	degF		39.8	36.1	37.3
CIRC WTR TEMP TO LP CONDB	degF		41.9	37.9	37.8
CIRC WTR TEMP TO LP CONDB	degF		41.1	37.3	37.4
CIRC WTR TEMP TO LP CONDB	degF		40.0	37.1	36.4
Minimum River Temperature	degF		39.8	36.1	36.4
FWH 1 Temperature Rise	degF		34.1	50.4	53.0
Net Load	MW		594.6	593.4	613.1
Average Cond Press	inHga		2.0	2.6	2.0
Average Exit Gas Temperature	degF		330.7	330.5	319.1
Aux Power	%		4.9	4.5	4.8
Gross Unit Heat Rate	BTU/KW-HR		9504.0	9817.8	9758.8
Gross Turbine Heat Rate	BTU/KW-HR		8077.9	8321.1	8299.0

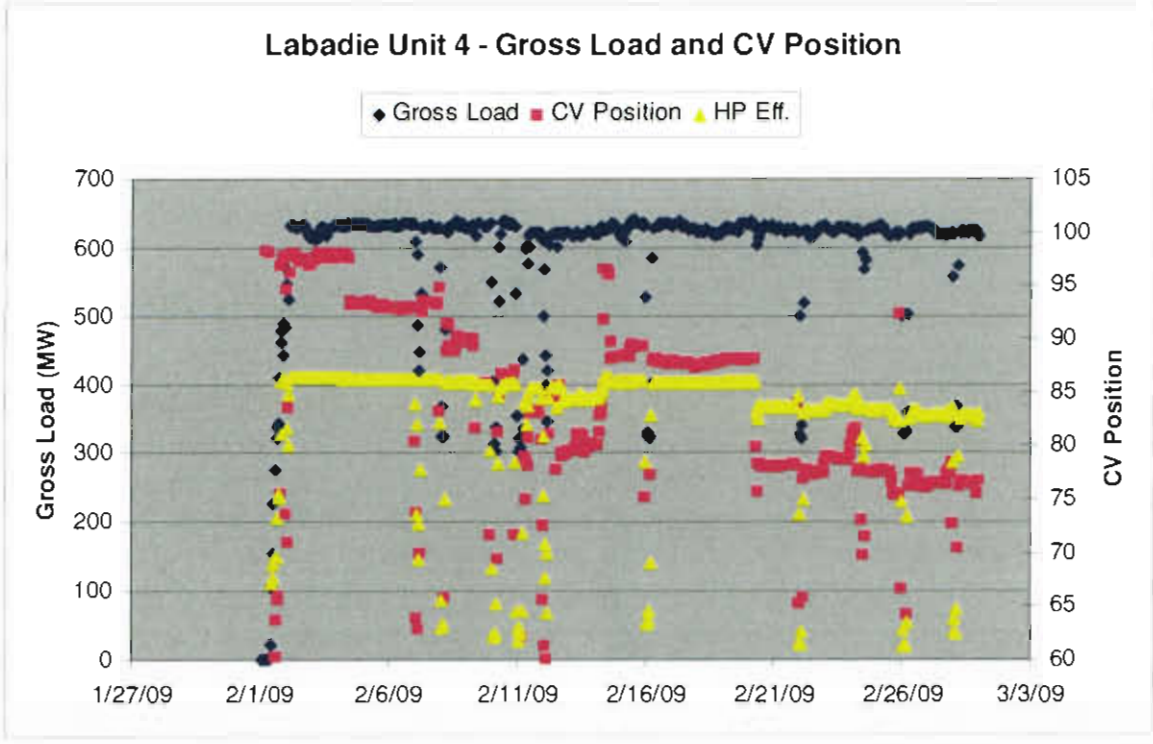
The HP efficiency dropped by 1.7% and is due in part to including data in which the valves were pinched down (note the average CV position for the February data is 85.4% while the average CV position for January was 88.5%). The change in IP efficiency was due to the inclusion of several water leg corrections in EtaPro. Note also that heat rate is down by almost 3% due to the EtaPro heat rate calculation change made in late January. Condenser pressure is down due to having two circ. water pumps running.

Labadie Unit 4 - Corrected Load



Labadie Unit 4 - HP and IP Efficiencies





The plot above shows the general trend down in HP efficiency as the control valves are pinched down. Note that the change is small near VWO open but the impact becomes more pronounced as the valves go more and more closed.

February 26, 2009

To: David Fox
From: Jeff Shelton
Cc: Bob Meiners, Mark Litzinger, Kevin Stumpe, Paul Piontek, Brian Griffen, Russ Hawkins, Greg Gumow, Tony Balestreri, Greg Bolte, Chris Hegger, Scott McCormack, Ken Stuckmeyer, Don Clayton, Joe Sind, Matt Wallace, Scott Hixson, Jim Barnett, Glenn Tiffin

Subject: Labadie December 2008 and January 2009 Performance Report

Executive Summary

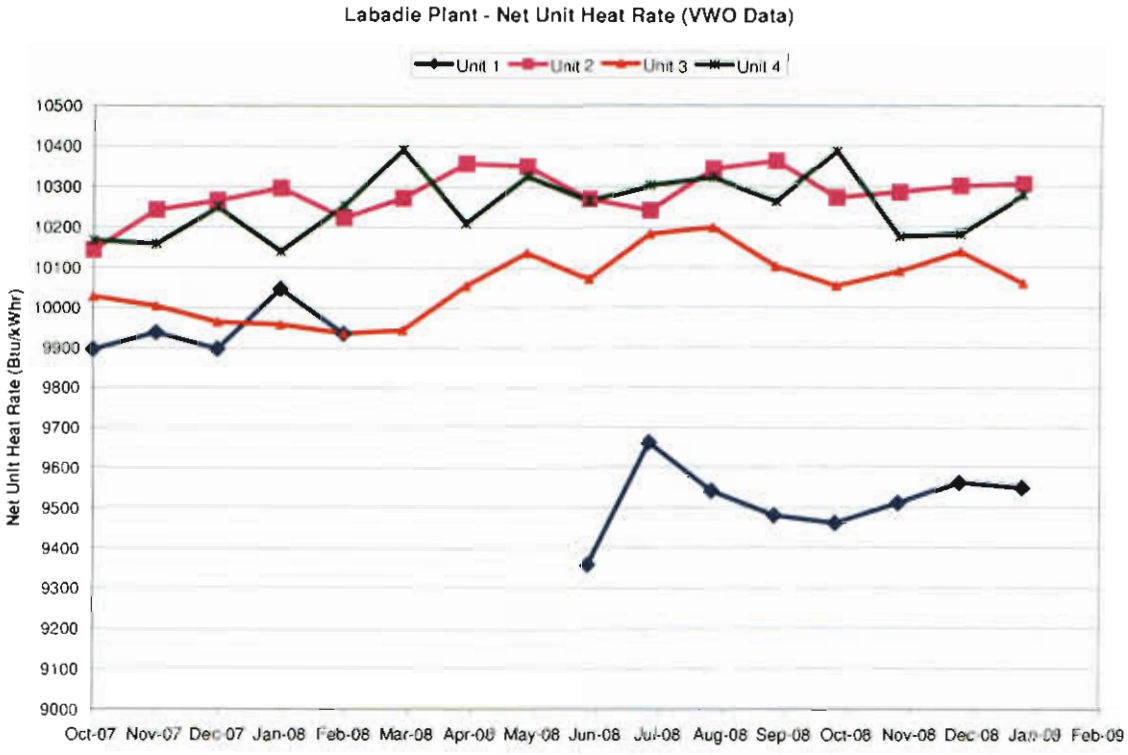
The most notable items regarding Labadie unit performance were:

- Unit 2 RH spray flow has been recovered due to work performed on the RH spray valve trim stack during an SBO in late December.
- All units exhibit some form of turbine efficiency degradation over time that is recovered following SBOs. The suspected cause is water soluble deposits and will continue to be monitored.
- A correction to the EtaPro heat rate calculation in late January reduced the calculated heat rate for all four units by 2 to 3%. The heat rate values from EtaPro now show better agreement with the values being calculated by OPM.

The following table shows the instrument deficiencies for all four units:

Tag	Unit	Issue	Resolution	Carryover or New
1TURB-08084, COLD RHT TEMP A AT TURBINE	1	Went bad at about 9:00 pm on 12/23/08	Corrected on 1/11/09 (to be removed)	Carryover
3BFWSTM-08321, EXTRACT PRESS HTR 4B	3	Has only had valid data from Nov. 2003 to Jan. 2004	JR164407 to investigate and correct	Carryover
3AUXSTM-00849, 3PT-289B COLD RH PRESSURE	3	Did not come back up to normal range following SBO this weekend	No issue (to be removed)	Carryover
1BFWSTM-08318 EXTRACT PRESS HTR 4A	1	Flat-lined on 1/29	JR164611	New

A plot of monthly unit heat rates for all four units is included on the following page.



The overall heat rate trend for Units 2, 3, and 4 is up over the time period shown above. Unit 1 had the benefit of an MBO as indicated by the step improvement in heat rate.

In checking the heat rate calculations in EtaPro on the Labadie units, it was discovered that an incorrect temperature was being used in the determination of the turbine cycle heat rate. Correcting these temperatures shifted the calculated net unit heat rate lower by 2 to 3%. The values calculated by EtaPro are now closer to those being calculated by OPM. The heat rate calculations are going to be reviewed in depth to ensure they are as accurate as possible.

Action Items:

- Labadie should search for air inleakage sources on the Unit 3 condenser (tentatively scheduled for next week).
- Performance Engineering will check the EtaPro heat rate calculations to ensure they are as accurate as possible.
- Performance Engineering will develop a "best-achievable" heat rate for each unit to determine the potential improvement in heat rate available on each unit.
- Performance Engineering will develop plans and help conduct a cycle isolation check on all four units in 2009. The intent is to have a Coop student in Performance Engineering perform this task on the entire UE fleet.
- Performance Engineering will create screens in EtaPro that better monitor turbine performance. Calculations will include corrected load, corrected turbine stage pressures, and more detailed turbine efficiencies (internal and external). A working example for Unit 3 is currently available and is labeled "Turbine Perf."

- Performance Engineering will be phasing out the use of OPM.

Unit 1 Observations

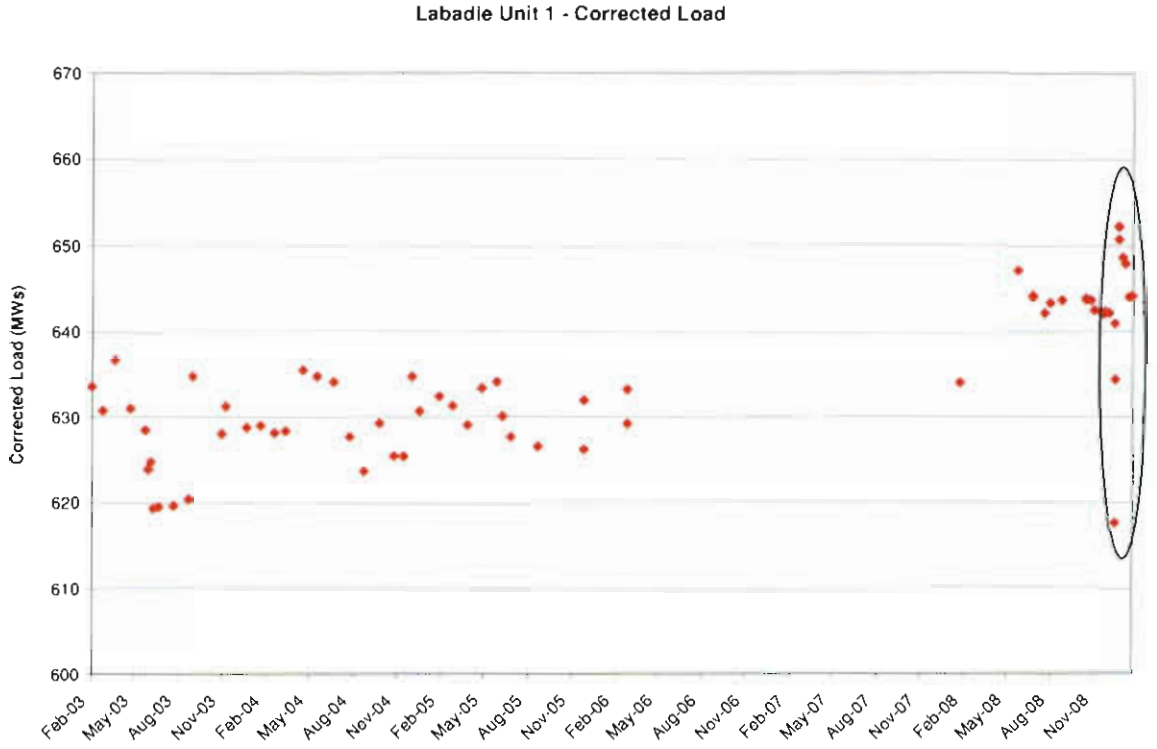
The following observations were made regarding Unit 1 operation and performance:

- There was 397 hours of VWO data for the unit in January.
- The unit had a forced outage in early January due to three failed intercept valves. Removal of the fine mesh screens from the throttle valves and intercept valves appears to have regained about 5-6 MWs due to reduced pressure drop across the valves.
- At the end of January, reheat temperature control became difficult due to reaching the upper limit on spray flows. During an SBO in February, debris believed to be from the 1A HPBFP failure last year was removed. Initial review by the plant indicates that flow was recovered following this valve cleaning.
- 2 tube leaks were repaired in the 1-1 FWH in January.

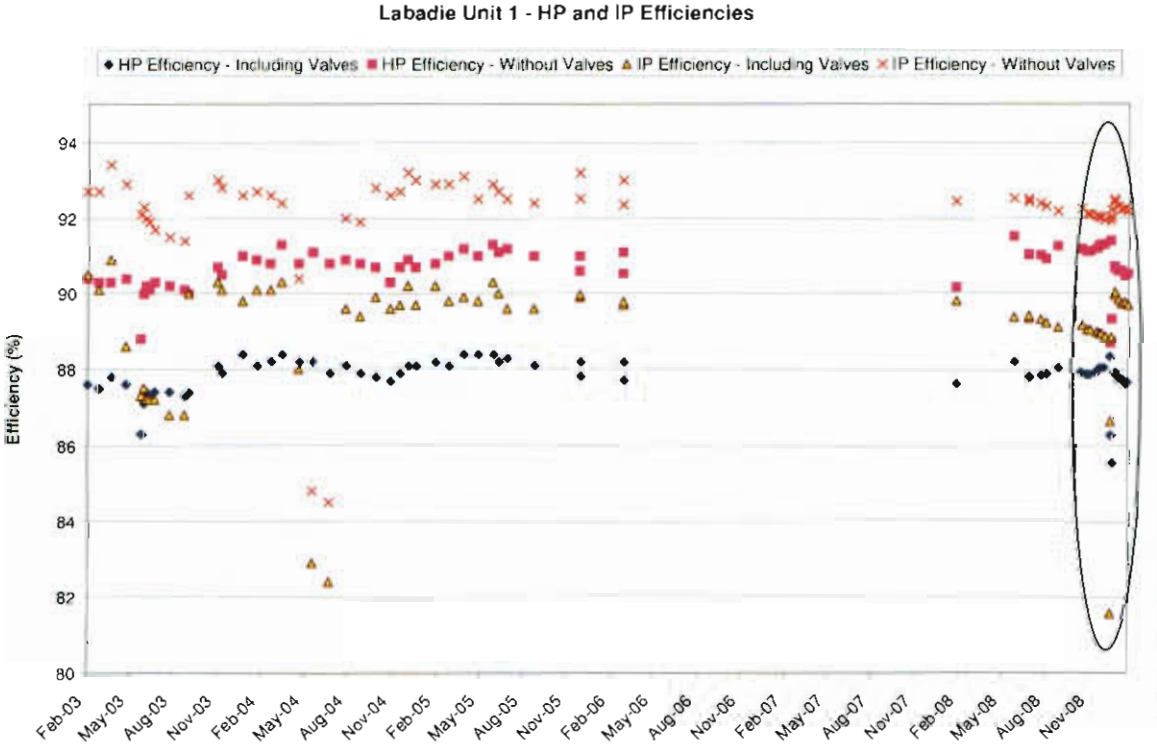
Summary of Performance Report for:

Plant	Labadie				
Unit	1				
Period	1/1/09	to	2/1/09		
			Jan-09	Dec-08	Jan-08
Full Load Performance					
Hours of Data			397	551	282
			Averages	**Averages**	**Averages**
GENERATOR MEGAWATTS	MW		640.5	636.3	628.8
AUX POWER	MW		28.3	28.0	29.7
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		9553.6	9566.0	10045.9
Boiler Efficiency Actual	%		85.2	85.2	85.0
CONTROL VALVE POSITION LVDT	%		100.0	99.9	100.5
FEEDWATER TEMP TO ECON	degF		492.6	491.7	490.8
FEEDWATER TEMP TO HTR 1	degF		437.6	436.9	439.0
HP Turbine Efficiency Actual	%		87.8	87.5	91.0
IP Turbine Efficiency Corrected	%		91.3	90.7	92.9
Condenser Pressure HP	inHga		1.6	1.6	2.0
Condenser Pressure LP	inHga		1.2	1.2	1.7
AIRHTR-A GAS OUTLET TEMP	degF		330.2	337.2	333.1
AIRHTR-B GAS OUTLET TEMP	degF		329.2	329.5	299.1
AMBIENT AIR TEMP	degF		28.4	33.7	30.9
CIRC WTR TEMP TO LP CONDB	degF		35.7	36.9	36.3
CIRC WTR TEMP TO LP CONDB	degF		38.5	38.3	39.3
CIRC WTR TEMP TO LP CONDB	degF		37.4	37.9	37.9
CIRC WTR TEMP TO LP CONDB	degF		37.8	38.2	36.8
Minimum River Temperature	degF		35.7	36.9	36.3
FWH 1 Temperature Rise	degF		55.0	54.8	51.9
Net Load	MW		612.2	608.3	599.1
Average Cond Press	inHga		1.4	1.4	1.9
Average Exit Gas Temperature	degF		329.7	333.3	316.1
Aux Power	%		4.4	4.4	4.7
Gross Unit Heat Rate	BTU/KW-HR		9131.5	9144.9	9571.5
Gross Turbine Heat Rate	BTU/KW-HR		7777.8	7792.9	8135.9

The current HP turbine efficiency is lower than the Jan. 2008 value due to an erroneous main steam temperature indication that was fixed during the 2008 MBO. The HP and IP efficiencies are both up from December due to the removal of the fine mesh screens during an SBO in early January. Note that the efficiencies given in this table (calculated by EtaPro) differ from those shown on the following graphs. Performance Engineering plans to update EtaPro this year so that all efficiencies are calculated in a consistent manner.



The two lower loads correspond to the first two IV failures. The increased corrected load following the SBO shows the increased capability with the fine mesh screens removed as well as removal of any water soluble deposits. Note the steady decline in corrected load since coming back from the SBO (water soluble deposits suspected).



The two sets of lower efficiency values correspond to the first two IV failures. The HP efficiency after the SBO shows a decrease from prior to the IV failures. This is due to installation and recalibration of two thermocouples (the efficiency calculations are highly sensitive to temperature). Following removal of the screens, the IP efficiency (including the valves) went up as expected.

Unit 2 Observations

The following observations were made regarding Unit 2 operation and performance:

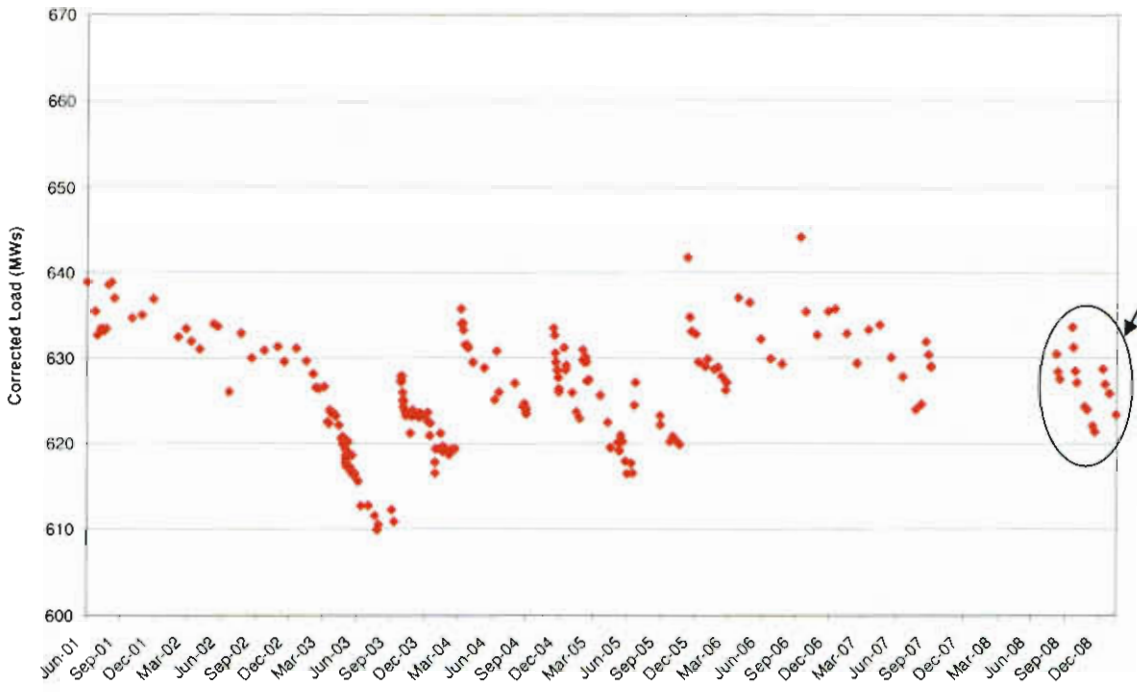
- There were only 63 hours of VWO data for the unit in January and only 19 hours in December. A switch to using all data for which gross load is greater than 90-95% of the monthly capability value will be used in future reports.
- HP/IP/LP turbine efficiencies steadily decline during continuous runs. Following SBOs, a step increase in efficiency is seen. This topic has been discussed before with regard to potential water soluble deposits with no known resolution. This will continue to be monitored.
- The work on reheat spray valve trims during a late December SBO has regained reheat spray flow capability.

Summary of Performance Report for:

Plant	Labadie				
Unit	2				
Period	1/1/09	to	2/1/09		
Full Load Performance			Jan-09	Dec-08	Jan-08
Hours of Data			63	19	173
			Averages	Averages	Averages
GENERATOR MEGAWATTS	MW		610.1	617.8	623.3
AUX POWER	MW		29.6	29.4	29.4
Net Unit Heat Rate Actual (GPHI)	BTU/KW-HR		10307.8	10302.1	10295.7
Boiler Efficiency Actual	%		85.3	85.5	85.4
CONTROL VALVE POSITION LVDT	%		99.9	99.9	99.9
FEEDWATER TEMP TO ECON	degF		492.3	494.5	495.4
FEEDWATER TEMP TO HTR 1	degF		443.8	446.3	447.1
HP Turbine Efficiency Actual	%		86.1	86.1	86.4
IP Turbine Efficiency Corrected	%		90.8	90.2	90.5
Condenser Pressure HP	inHga		1.9	1.8	2.2
Condenser Pressure LP	inHga		1.8	1.6	1.7
AIRHTR-A GAS OUTLET TEMP	degF		332.7	331.3	322.5
AIRHTR-B GAS OUTLET TEMP	degF		336.2	338.0	340.7
AMBIENT AIR TEMP	degF		34.1	40.7	33.2
CIRC WTR TEMP TO LP CONDB	degF		36.3	37.3	37.6
CIRC WTR TEMP TO LP CONDB	degF		36.9	38.1	38.2
CIRC WTR TEMP TO LP CONDB	degF		37.9	41.7	38.8
CIRC WTR TEMP TO LP CONDB	degF		38.8	37.6	37.6
Minimum River Temperature	degF		36.3	37.3	37.6
FWH 1 Temperature Rise	degF		48.5	48.1	48.3
Net Load	MW		580.5	588.5	593.9
Average Cond Press	inHga		1.9	1.7	2.0
Average Exit Gas Temperature	degF		334.5	334.7	331.6
Aux Power	%		4.8	4.8	4.7
Gross Unit Heat Rate	BTU/KW-HR		9808.0	9812.7	9810.1
Gross Turbine Heat Rate	BTU/KW-HR		8367.7	8387.9	8380.2

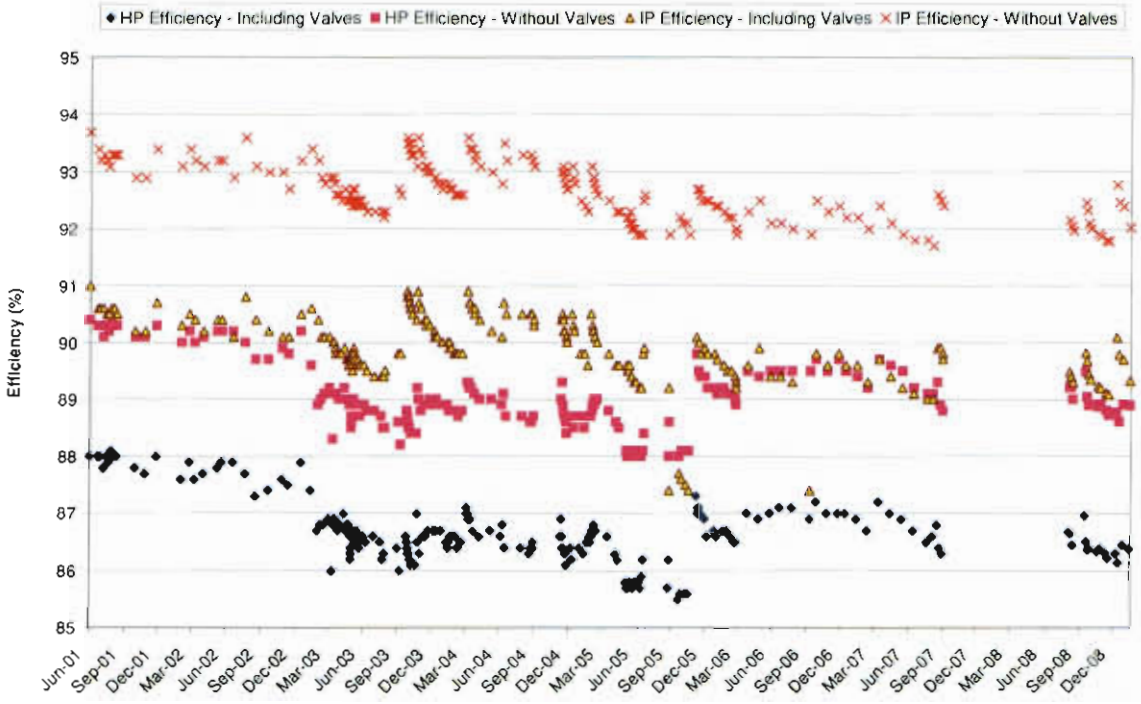
There were no significant changes in performance from December to January. Condenser pressure was up slightly even though river temperatures dropped slightly. Condenser vacuum pump flow was higher in January following the SBO in late December.

Labadie Unit 2 - Corrected Load

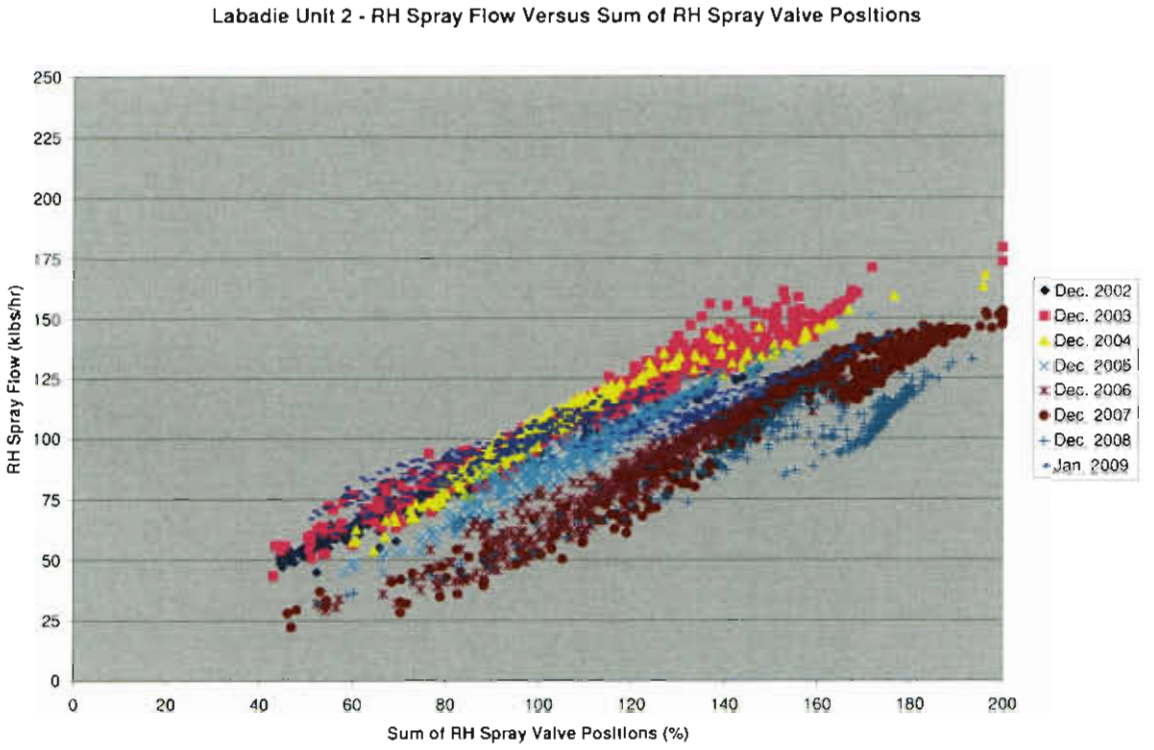


Note the decrease in load during the latest steady run on the Unit

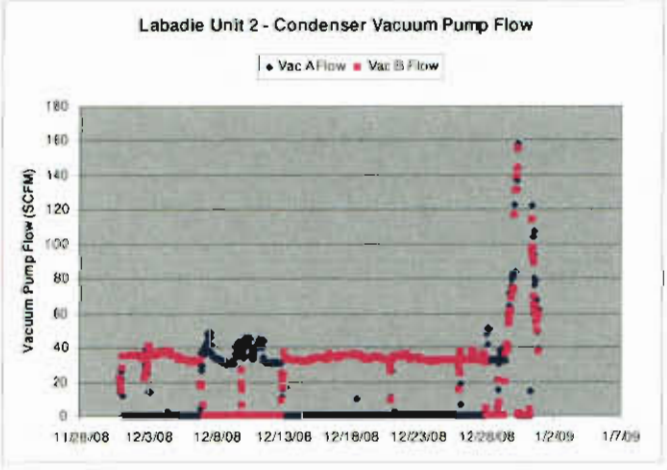
Labadie Unit 2 - HP and IP Efficiencies

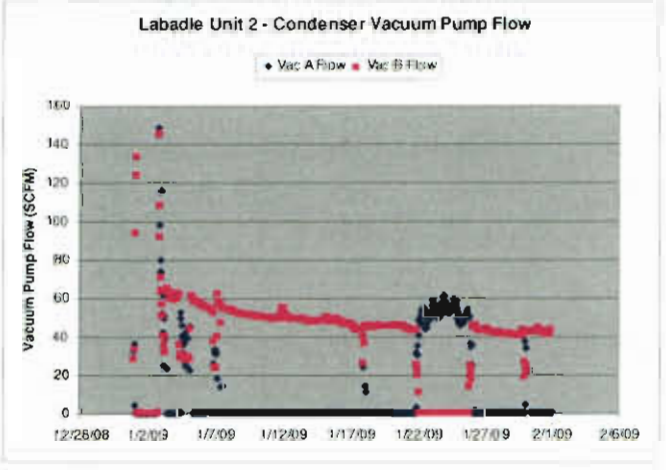


Note the decrease in turbine efficiencies over the same time periods



Note the increase in spray flow at the same valve position from December (+) to January (-).





Condenser vacuum pump flow was consistently below 40 scfm in December. Flow went above 60 scfm following a late December SBO and has gradually declined to about 40 scfm.

Unit 3 Observations

The following observations were made regarding Unit 3 operation and performance:

- There were only 65 hours of VWO data for January compared to 370 in December and 564 in January 2008. A switch to using all data for which gross load is greater than 90-95% of the monthly capability value will be used in future reports.
- Hot water flow appears to be going to the B side preheat coils only. According to the plant, the A side froze up a couple of winter's ago and will not be repaired until the next MBO on the unit.
- Condenser vacuum pump flow was about 100 scfm at the end of January. This unit has the highest inleakage of all the Labadie Units. The plant goal is to be below 40 scfm and running on one vacuum pump.
- Temperature rise of the 6B heater is much less than the 6A heater. This has been the case since January 2007. The difference in the temperature rise has gotten larger over time. The plant has inspected the tube side as well as look for air inleakage sources but have not found any obvious problems. This issue will be investigated further.
- HP/IP/LP turbine efficiencies steadily decline during continuous runs. Following SBOs, a step increase in efficiency is seen. This topic has been discussed before with regard to potential water soluble deposits with no known resolution. This will continue to be monitored.