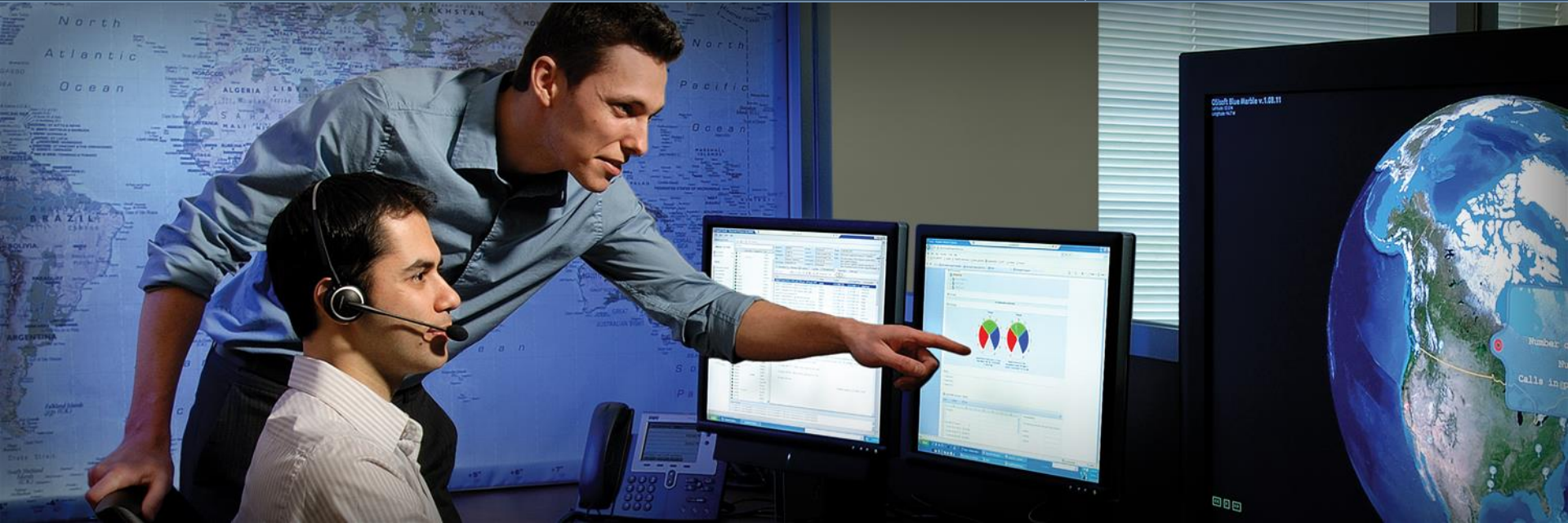




Regional Seminar Series Cincinnati



Asset Optimization using PI and AF

Nancy Shifflet
Optimization Analyst
NiSource Gas Transmission and Storage

Charles Harrison
Optimization Team Leader
NiSource Gas Transmission and Storage

October 7, 2009

NiSource Gas Transmission & Storage



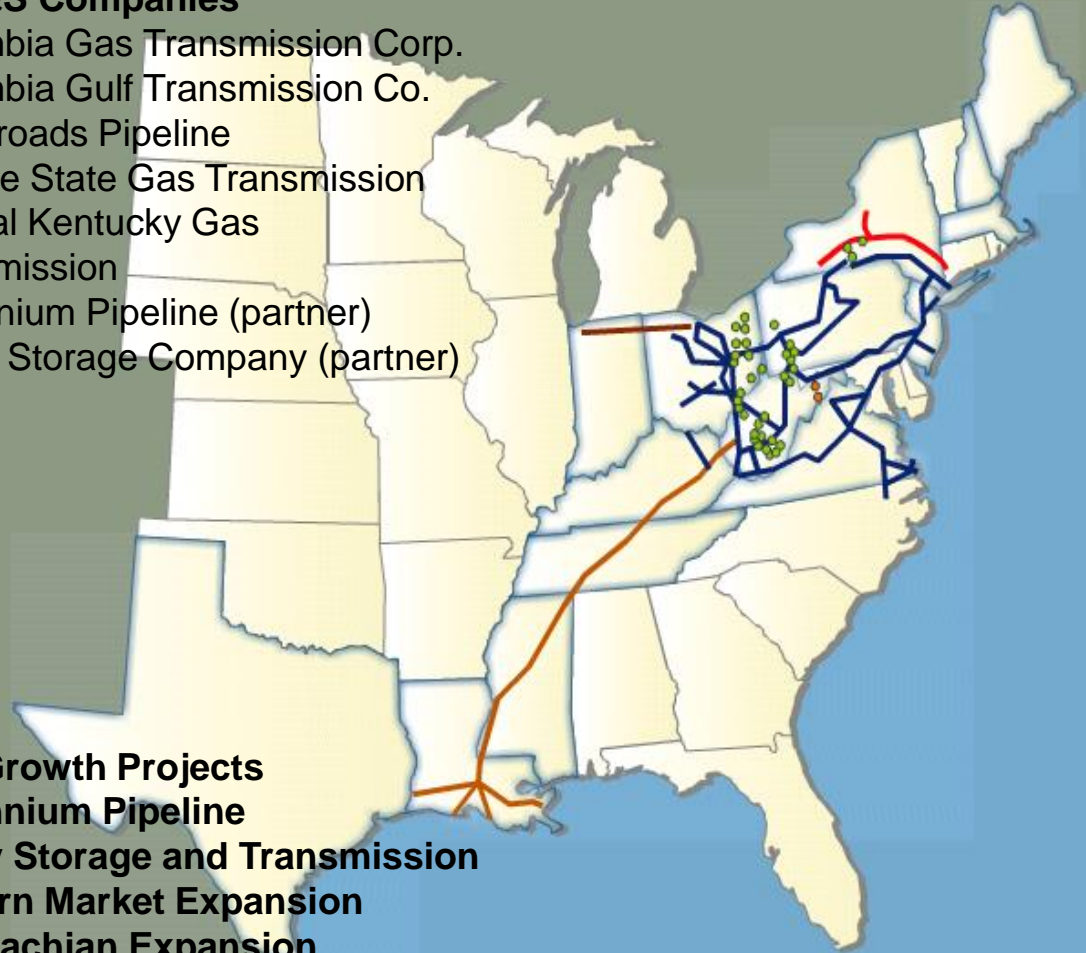
Employees: 1,571
Total Payroll: \$98 million
Operating States: 17
Miles of Pipe: approximately 14,000
Compressor Stations: 100
Total Horsepower: About 1.1 million
Annual Deliveries: About 1 trillion cubic feet
Number of customers: 72 LDCs and a variety of commercial users
Storage Fields: 37 in four states
Total Storage Capacity: 590 billion cubic feet
Total Working Gas: 253 billion cubic feet
Peak Day Deliveries: 7.4 billion cubic feet (4.5 bcf from storage)
State taxes paid annually: \$58.6 million

NGT&S Companies

Columbia Gas Transmission Corp.
Columbia Gulf Transmission Co.
Crossroads Pipeline
Granite State Gas Transmission
Central Kentucky Gas
Transmission
Millennium Pipeline (partner)
Hardy Storage Company (partner)

Key Growth Projects

Millennium Pipeline
Hardy Storage and Transmission
Eastern Market Expansion
Appalachian Expansion
Ohio Storage Expansion Project

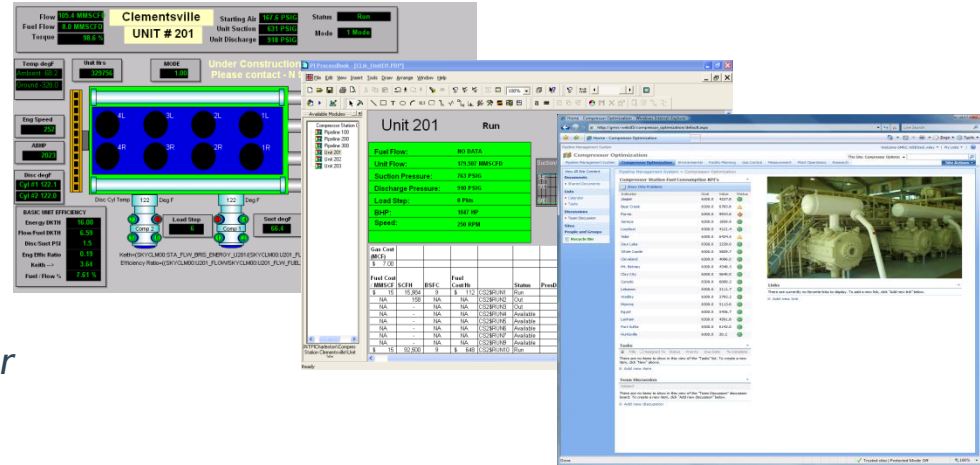


Business Value – Asset optimization using PI and AF



The Challenge: Optimizing the performance of our fleet of gas compressors in service at 100 stations over 14,000 miles of pipeline

“Never in the history of our business have we needed to optimize how our assets perform as much as we do in today’s business environment. At \$10 an MCF for gas for fuel for our compressor stations we spend \$600MM US Dollars a year.”



Customer Business Challenge

- Performance Measurement
- Real Time Discovery of Performance Degradation
- Unit to Unit Comparison

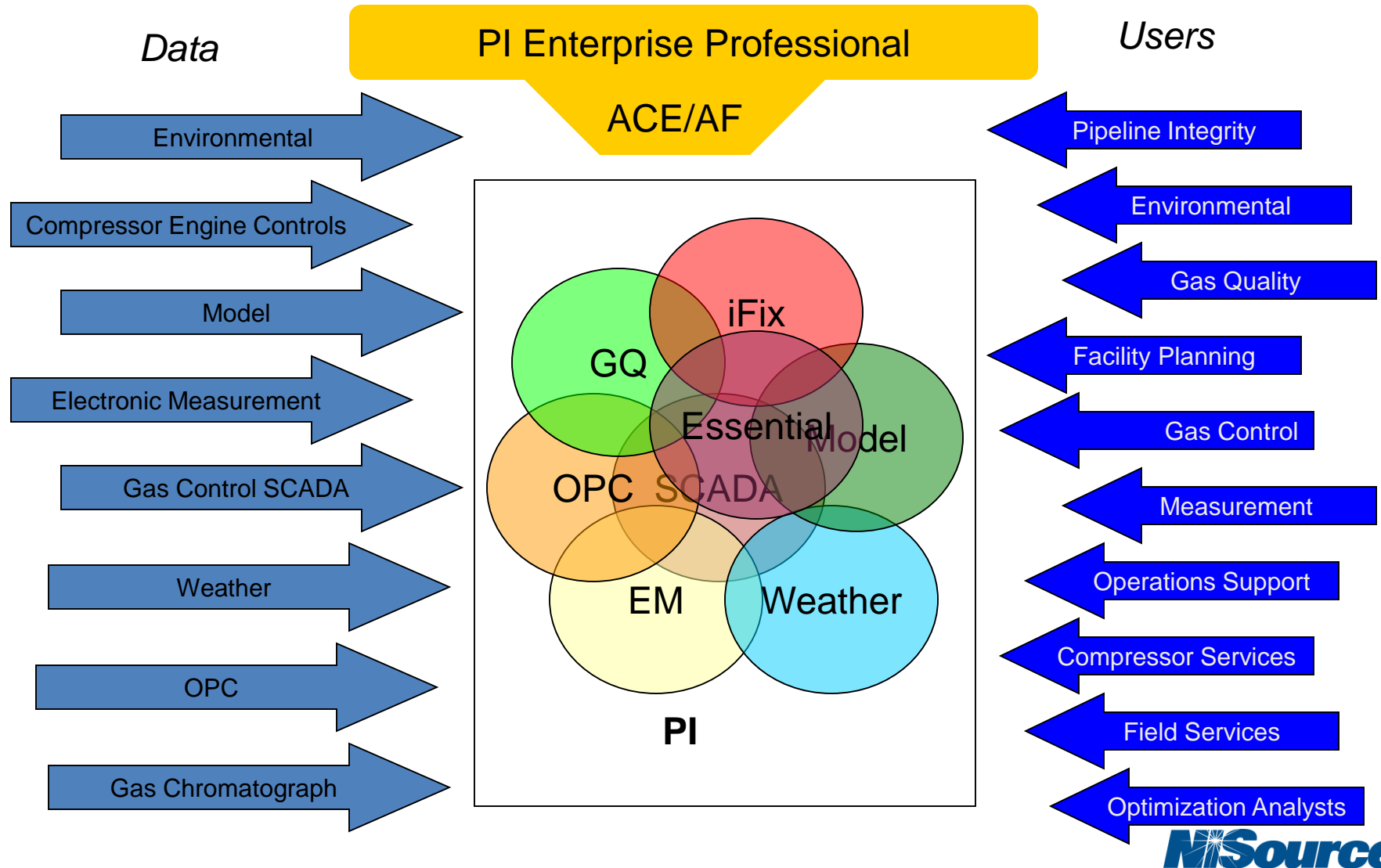
Central Diagnostic Monitoring and Analytics

- Centralized Diagnostic Monitoring
- Transform NGT&S Operating Expertise into PI Analytics
- KPI Dashboards

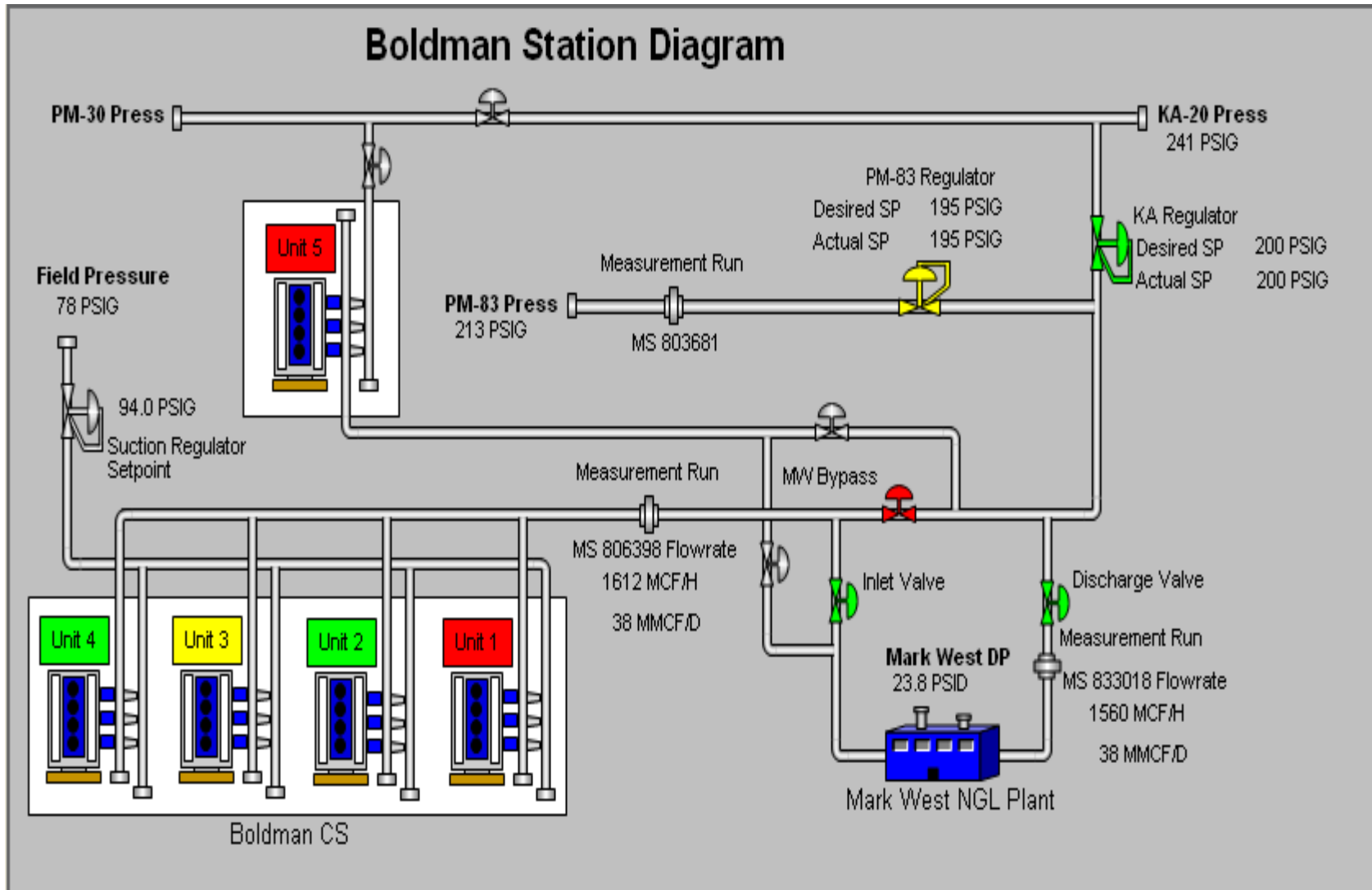
Results / Benefits

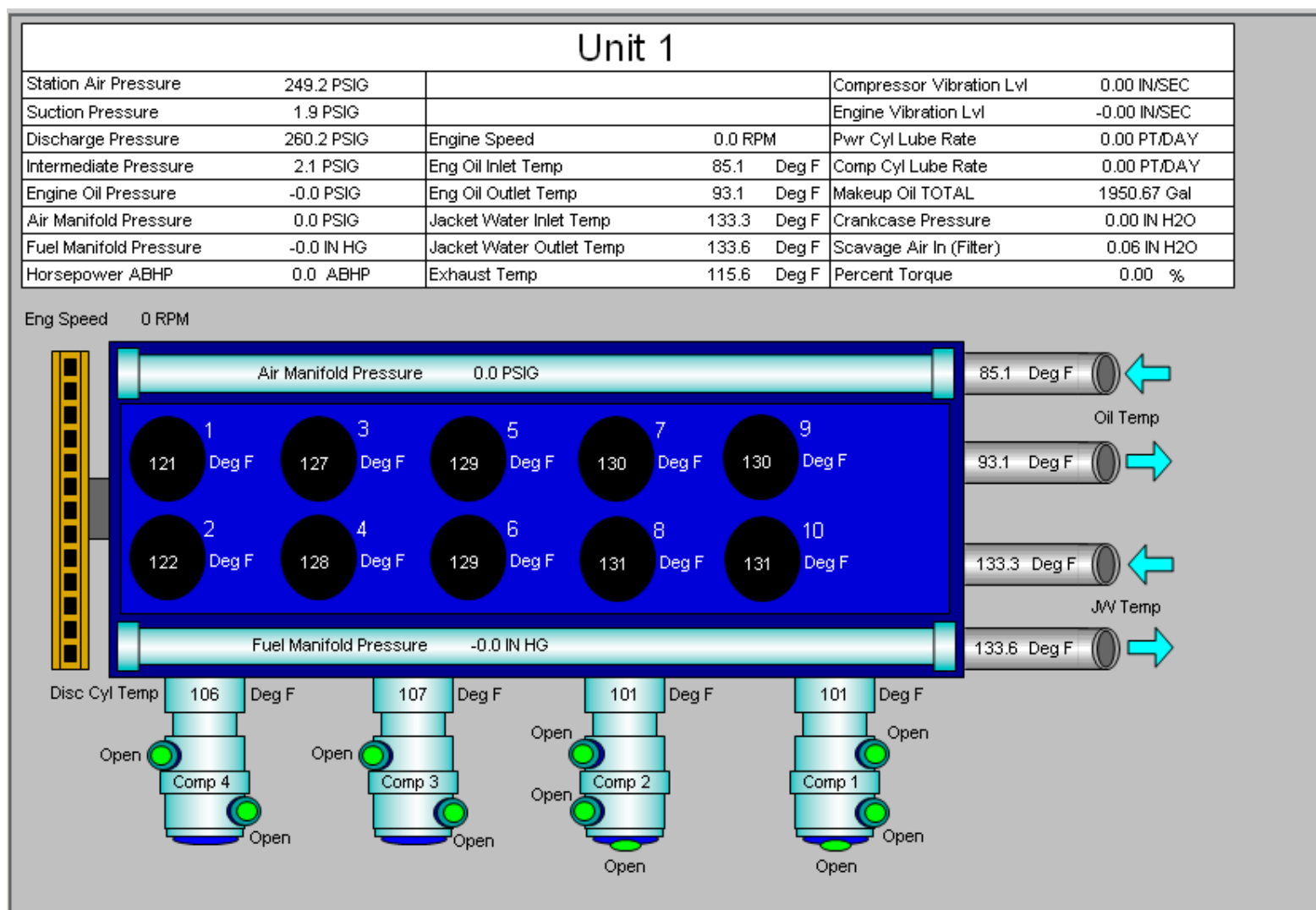
- Reduction in Compressor Engine Fuel Consumption
- Increase in Compressor Engine Operating Range
- Improved Compressor Engine Reliability

How PI Stretches



Boldman Station Diagram





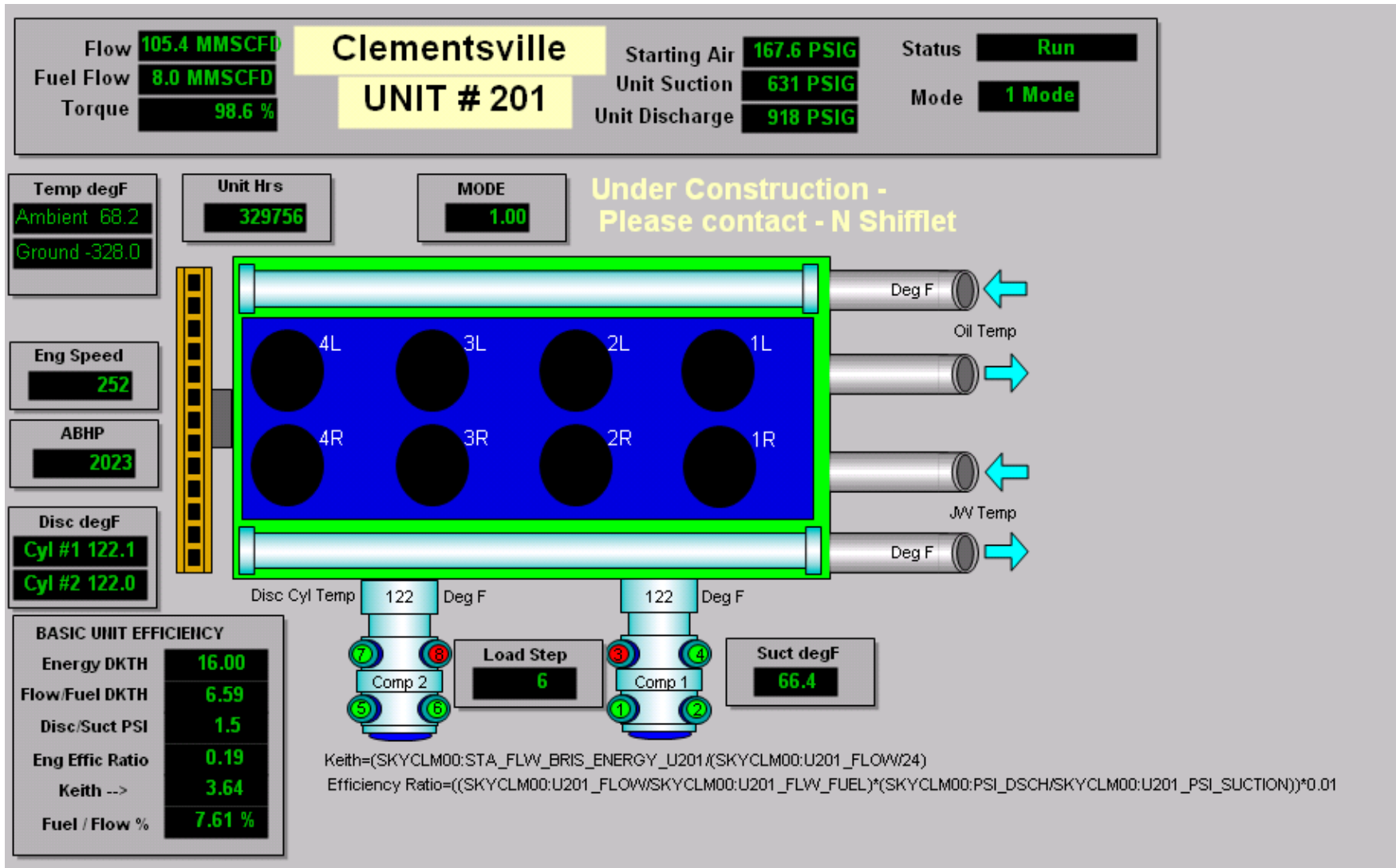
Clementsville Station Overview

Station Flow : 1226.0 MMSCFD
Stanton Flow : 1151.0 MMSCFD

Unit	Flow	Suct psig	Disc psig	Suct F	Disc F
1-7	425.3	682	873	67.2	104.2
209	0.0	-2	0	84.9	88.3
210	801.0	683	880	68.1	105.7

	100	200	300		Barom Pres	30.2 In Hg	
Suct	688.0	924.0	688.0	PT 100 (Stanton)	875.8	Ambient	82.3 DegF
Disc	880.0	880.0	881.0	PT 200 (TETCO)	924.5	Starting Air	168.6 psig

GMW Engine Unit #	Tot Hrs	Mode	Status	Speed RPM	Suct psig	Disc psig	Horse Power	Torque	Fuel Flow	Suct Temp	Disc Temp C#1	Disc Temp C#2			Load Step	Unit Flow
Unit #1	329446	2	Available	0.0	200.8	201.8	0.0	0.00	0.2	88.1	88.0	88.4			8	0.0
Unit #2	328816	2	Out	0.0	-1.1	0.1	0.0	0.00	0.0	86.8	-328.0	-328.0			8	0.0
Unit #3	325592	1	Run	242.0	682.8	927.9	1950.9	98.63	7.8	67.8	113.1	113.0			5	124.7
Unit #4	302133		Run	250.9	682.8	877.1	2016.7	98.37	7.8	67.7	105.0	104.6			0	153.5
Unit #5	307976		Available	0.0	190.6	191.8	0.0	0.00	0.0	91.6	89.2	89.1			8	0.0
Unit #6	290872		Run	241.7	682.9	878.1	1930.6	97.40	7.6	68.0	105.9	104.6			0	147.7
Unit #7	316301		Available	0.0	209.9	211.0	0.0	0.00	0.0	90.6	89.4	89.2			8	0.0
Turbine Unit #	Tot Hrs		Status	Speed RPM	Suct psig	Disc psig	Horse Power		Fuel Flow	Suct Temp	Disc Temp	N1	N2	N3		Unit Flow
Unit #9			Available	-2.0	-2.0	0.0	-5.0		0.0	84.9	88.3	14.0	1.0	4.0		0.0
Turbine Unit #	Unit Hrs	Unit Starts	Status	PT RPM	Suct psig	Disc psig	Horse Power	GP RPM	Fuel Flow	Suct Temp	Disc Temp	Act T5	T5 Avg	PCD psig	%from Surge	Unit Flow
Unit #10	6823	27	Run	7653.1	683.1	880.0	10224.0	10313.1	809.0	68.1	105.7	10.0	1275.2	184.8	53.40	801.0



Compressor Station Fuel - KPIs (Concept)



Home - Compressor Optimization - Windows Internet Explorer

http://gmrc-web:85/compressor_optimization/default.aspx

Home - Compressor Optimization

Welcome GMRC-WEB\jick.wiley | My Links | Site Actions

Pipeline Management System > Compressor Optimization

Compressor Station Fuel Consumption KPI's

Show Only Problems

Indicator	Goal	Value	Status
Jasper	6300.0	4227.8	Green
Bear Creek	6300.0	6783.8	Yellow
Purvis	6300.0	9933.6	Red
Seneca	6300.0	1859.9	Green
Loudoun	6300.0	4121.4	Green
Vidor	6300.0	6424.5	Yellow
Sour Lake	6300.0	3239.0	Green
White Castle	6300.0	5809.7	Green
Cleveland	6300.0	4096.0	Green
Mt. Belvieu	6300.0	4348.3	Green
Clay City	6300.0	5640.0	Green
Ceredo	6300.0	6089.2	Green
Lebanon	6300.0	2111.7	Green
Wadley	6300.0	2792.2	Green
Monroe	6300.0	5113.6	Green
Egypt	6300.0	5436.7	Green
Lanham	6300.0	4591.8	Green
Port Sulfur	6300.0	6142.0	Green
Huntsville	6300.0	20.2	Green

Tasks

Title Assigned To Status Priority Due Date % Complete

There are no items to show in this view of the "Tasks" list. To create a new item, click "New" above.


Add new item

Team Discussion

Subject

There are no items to show in this view of the "Team Discussion" discussion board. To create a new item, click "Add new discussion" below.

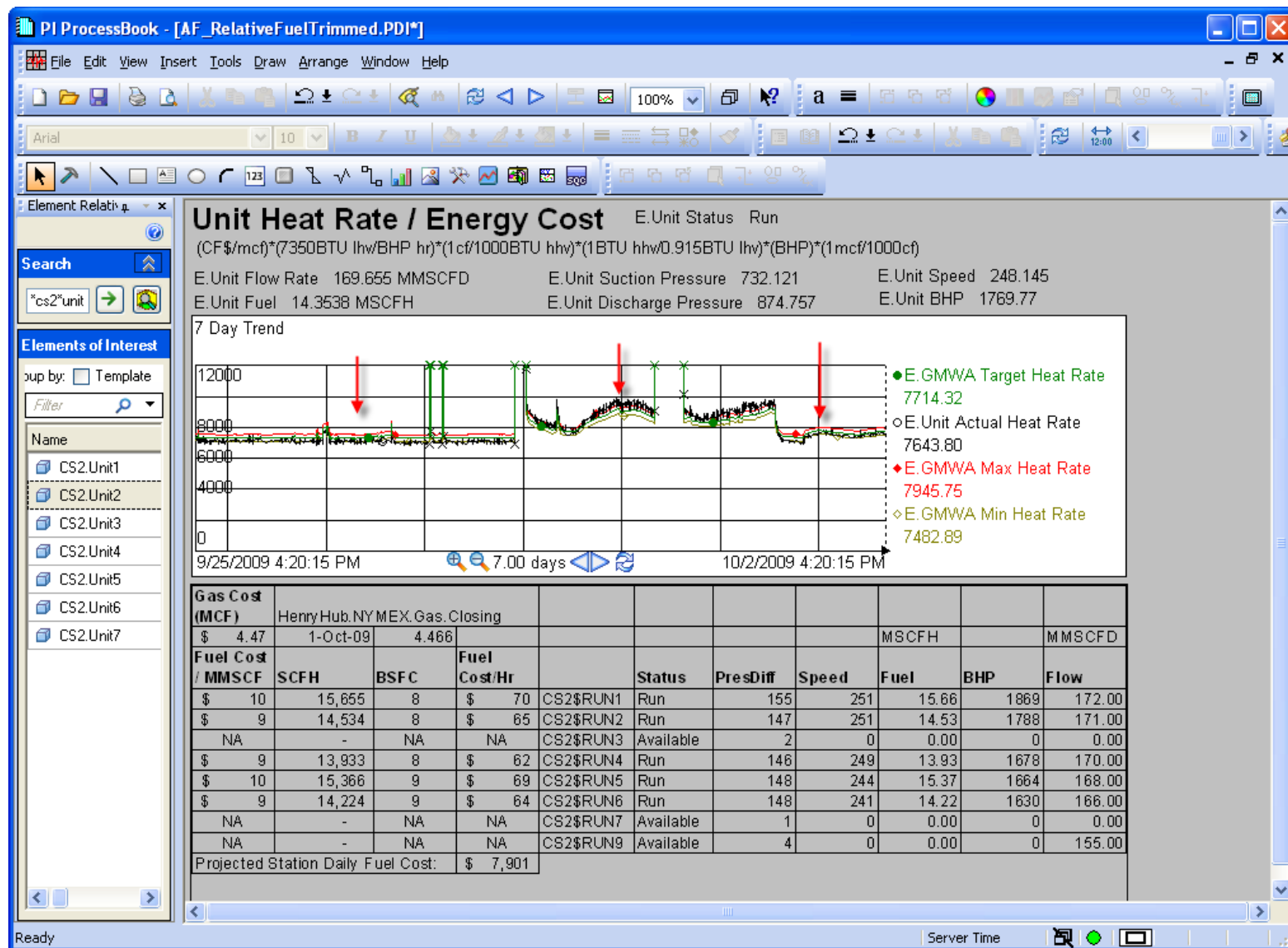
Add new discussion



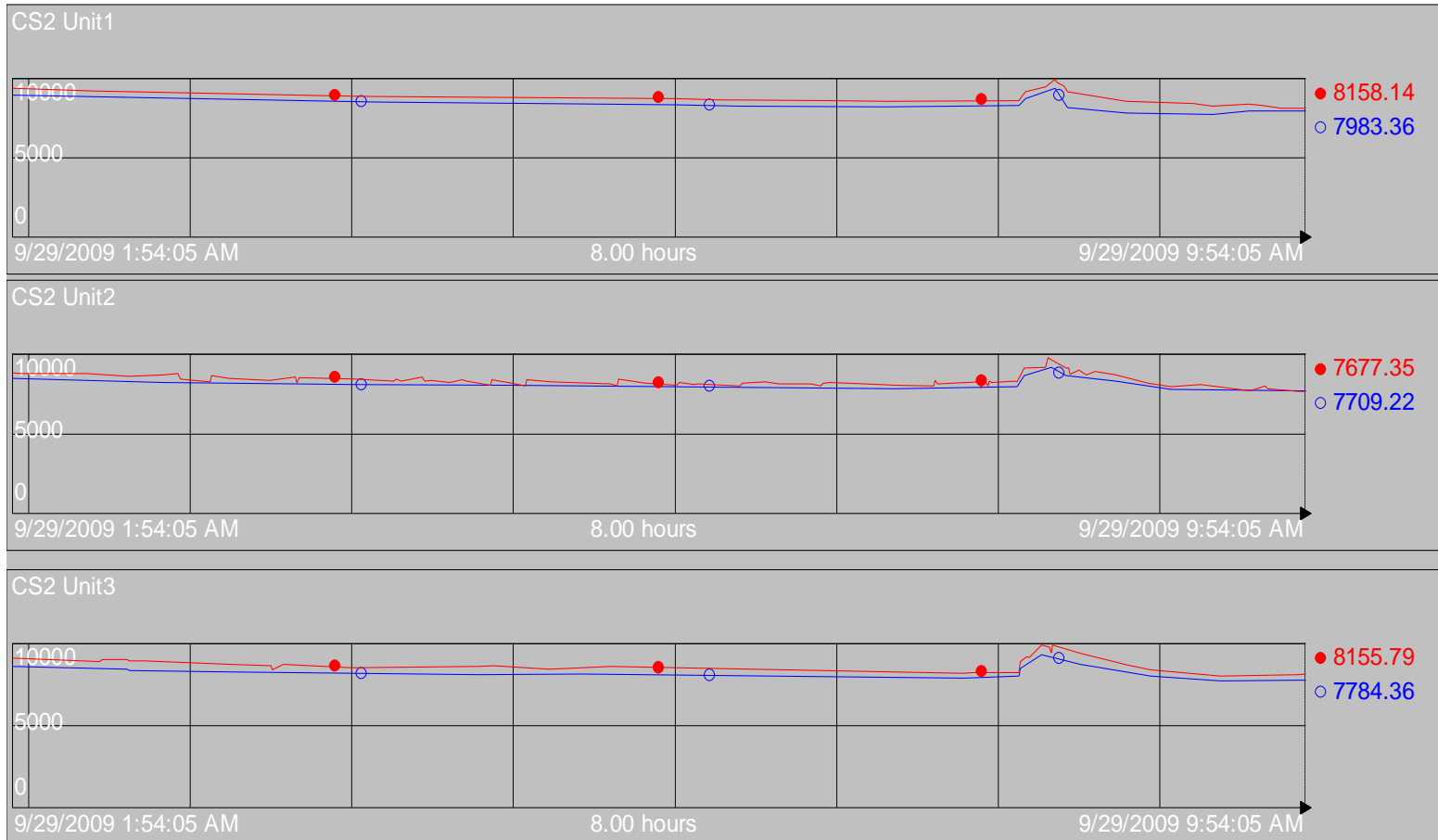
Links

There are currently no favorite links to display. To add a new link, click "Add new link" below.

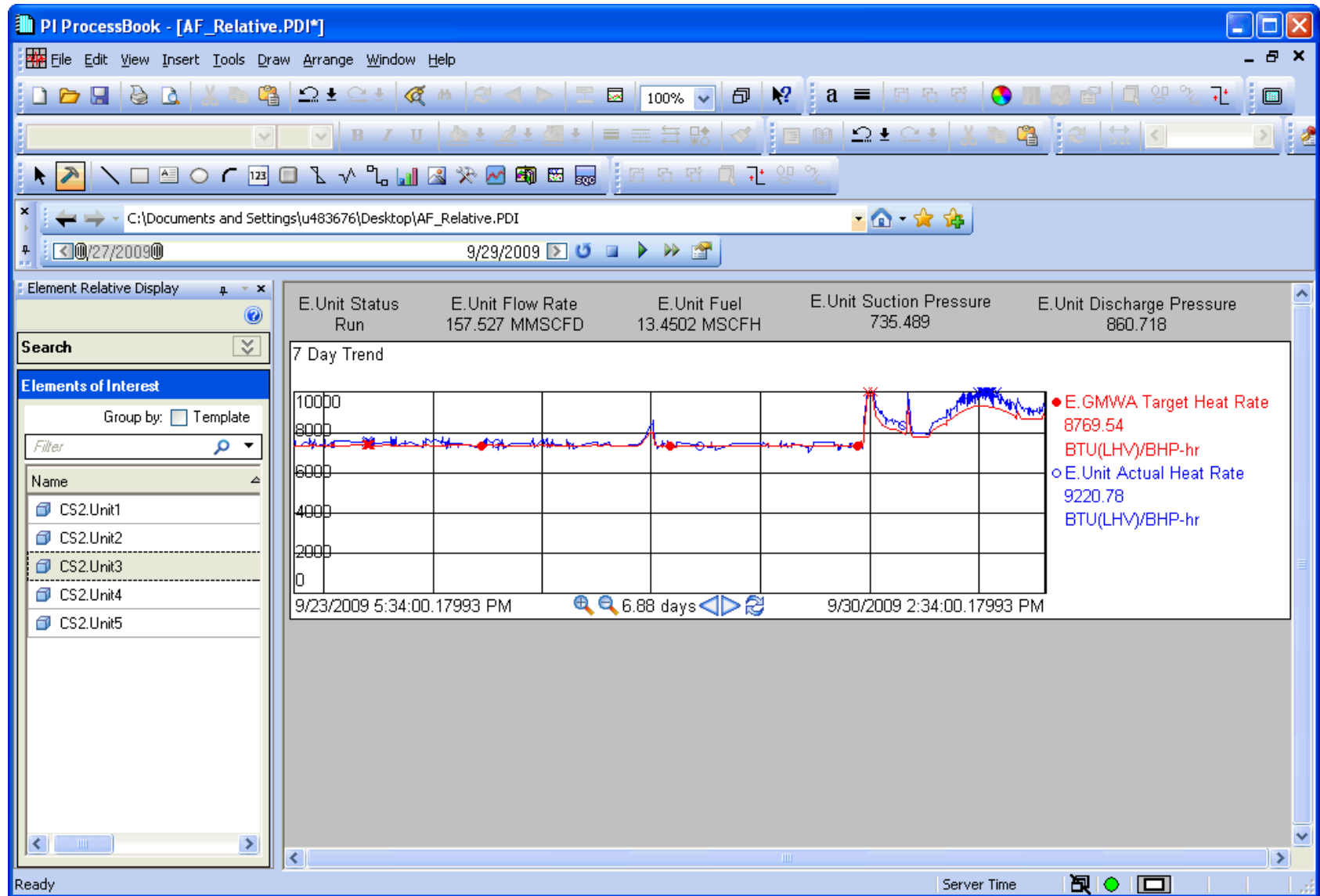
Add new link

$$\begin{aligned} & (\text{CF}\$/\text{mcf}) * (7350 \text{ BTU lhv} / \text{BHP hr}) * (1 \text{ cf} / 1000 \text{ BTU hhv}) * (1 \text{ BTU hhv} / 0.915 \text{ BTU lhv}) \\ & * (\text{BHP}) * (1 \text{ mcf} / 1000 \text{ cf}) \end{aligned}$$


KPI - Model Heat Rate/Actual (PI-AF)



KPI - Model Heat Rate/Actual (PI-AF Element Relative Display)



	Unit1			
BHPHrs	CurrentHeatRate	Fuel		%
1726.32	8525.901392	14.9	OverRate by	9.02
	Heat Rate			
	7820.374118			

	Unit1			
BHPHrs	CurrentHeatRate	Fuel		%
1667.72	8276.85122	14.6	OverRate by	3.68
	Heat Rate			
	7983.359974			



Thank you

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