Williams WE MAKE ENERGY HAPPEN

Williams' Digital Transformation

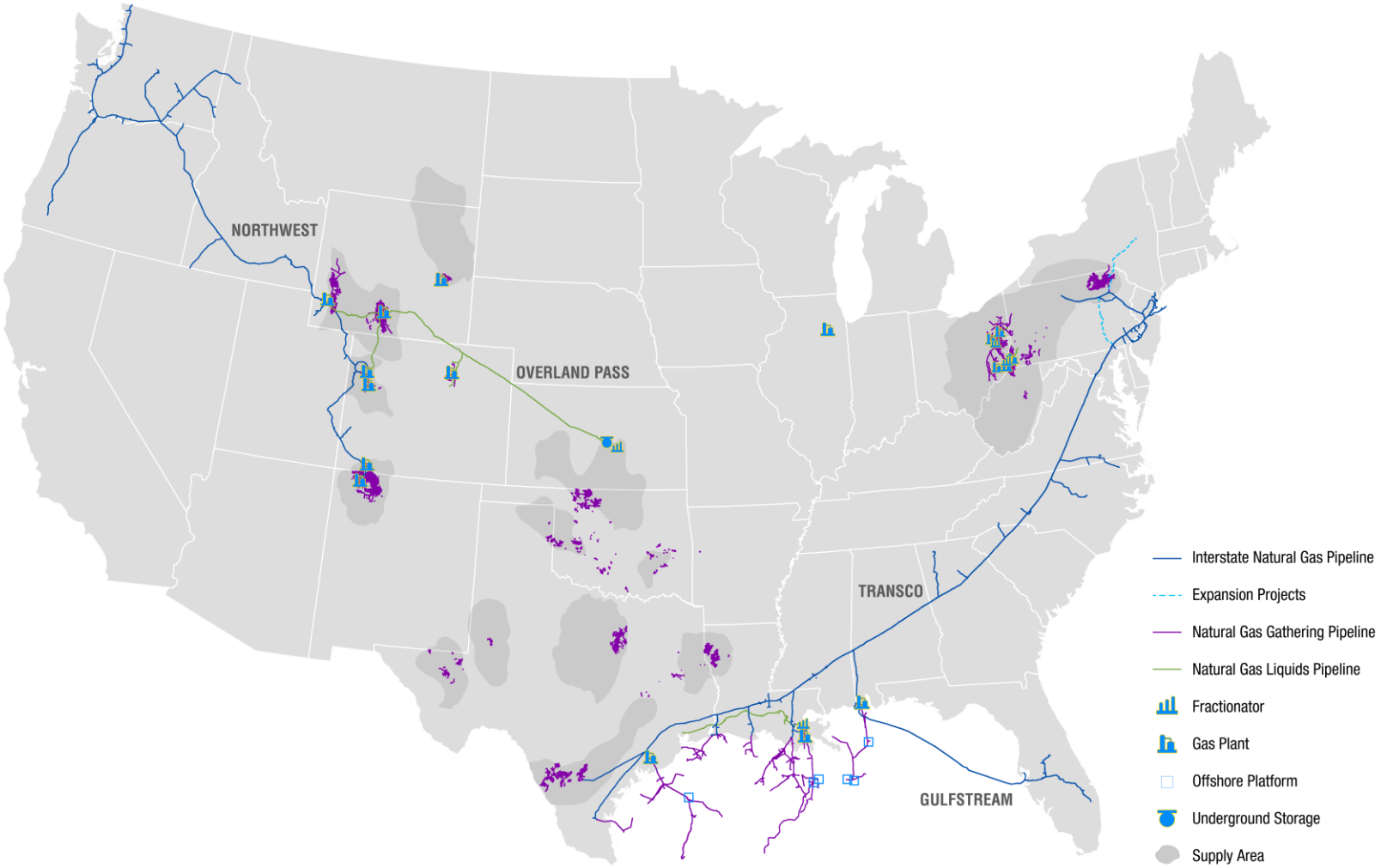
Gas and Electric Partnership Conference/ Feb 6, 2020 / Mike Teter / Houston Tx

VIRGINIA SOUTHSIDE II CONSTRUCTION

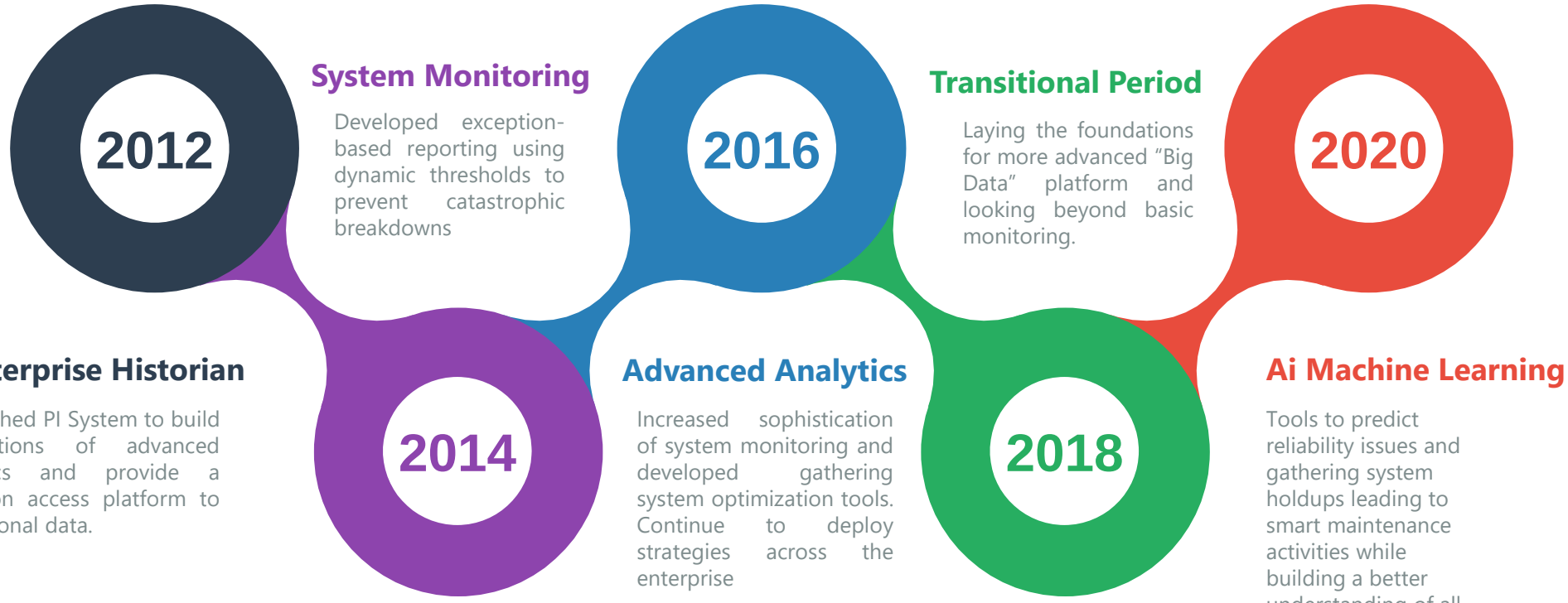
KENSINGTON GAS PROCESSING PLANT

SUMAS COMPRESSOR STATION

Williams' Assets



Williams' Journey of Digital Transformation



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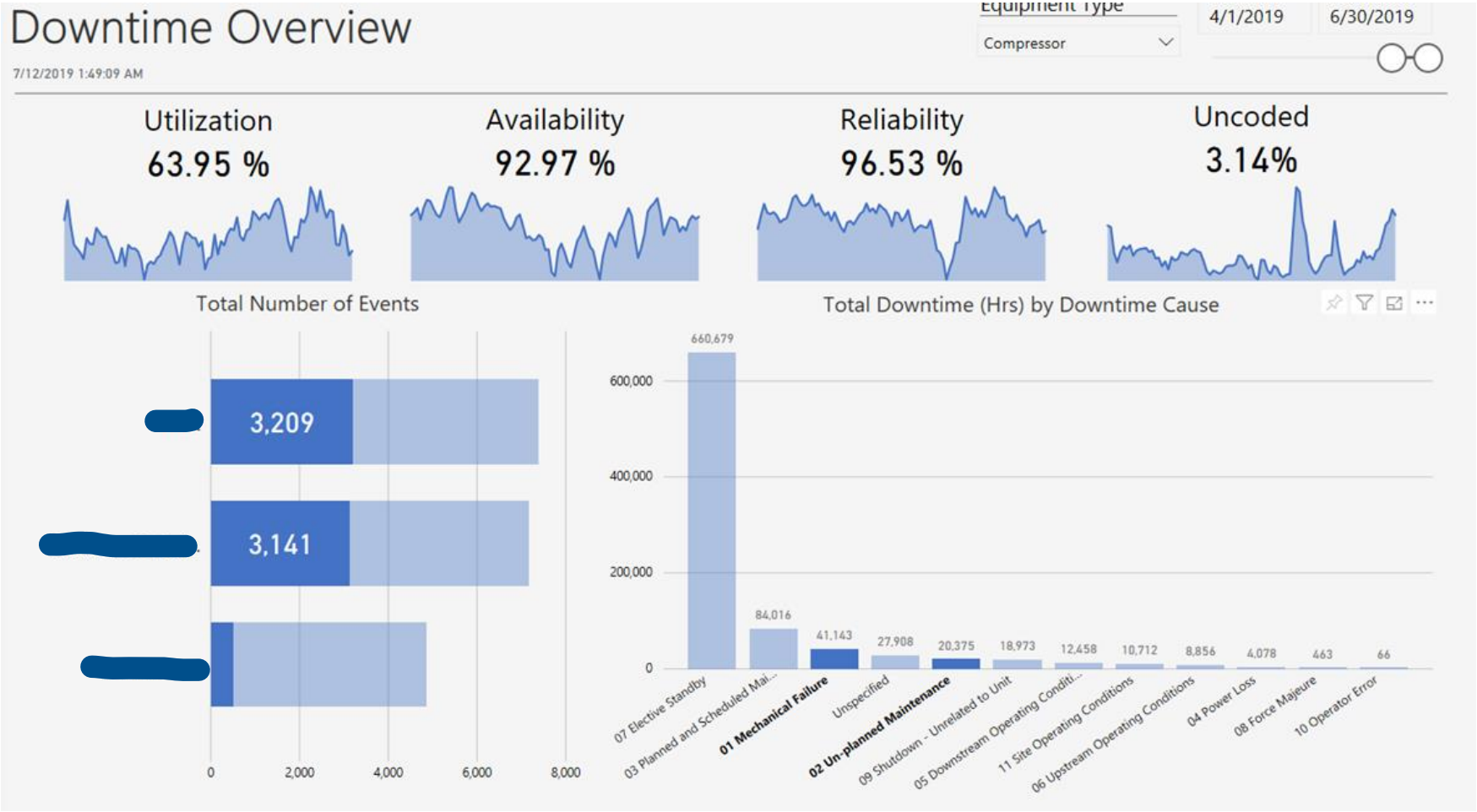
Reliability Programs

- **Downtime tracking**
  - Utilization, Reliability, Availability
    - Reporting, Power BI, Custom Application for event Coding
- **Equipment Dashboards**
  - Access to Equipment visualization and trending Graphics, Reports, Custom Trends
- **Data Mining**
  - Deviation from defined Normal operations Reports and Analysis
- **Turbine Specific Analysis**
  - T5 Spread, T5 Vector, Performance Calculations
- **Equipment Comparisons**
  - Like equipment under like operations, Looking for statistical anomalies
- **Custom Notifications**
  - for deviations from define limits
- **Integration with Maintenance Management**
  - Operating Run Hours and Automatic work request generation

Downtime



Dashboards

Turbine Dashboard

Last Refreshed at: 2/3/2020 7:40:03 AM

- Click on any unit, and links to additional views will be available on the right side of the screen
- Units that are highlighted are not currently running
- Report data refreshes every five minutes

Unit	Equipment Number	Model	Run Status	Starts (30 Days)	Utilization % (30 Days)
Discovery-Larose: Unit 01	CAX320	Mars100	ON	2	45.1
Discovery-Larose: Unit 02	CAX220A	Mars100	ON	1	94
Discovery-Larose: Unit 03	CAX220B	Mars100	OFF	1	54.7
Gulf East-Mobile Bay: Unit 01	CG3201	Mars100	ON	3	97.6
Gulf East-Mobile Bay: Unit 02	CG3301	Mars100	OFF	1	2.2
Gulf East-Mobile Bay: Unit 03	CG3401	Mars100	ON	3	99.4
Gulf West-Markham: C1100	C1100	Saturn10	OFF	2	1.7
Gulf West-Markham: C1200	C1200	Saturn10	OFF	13	38.5
Gulf West-Markham: C140	C140	Mars100	ON	0	99.9
Gulf West-Markham: C240	C240	Taurus70	OFF	0	0
LMM-Shamrock: Mars	GT2011	Mars100	ON	8	70.3
NWP-Albany: Unit 01	Unit 01	Saturn10	OFF	21	80.6
NWP-Boise: Unit 01	Unit 01	Taurus60	ON	4	92.5
NWP-Boise: Unit 02	Unit 02	Taurus60	OFF	1	1.1
NWP-Buhl: Unit 01	Unit 01	Centaur50	OFF	4	3.8
NWP-Buhl: Unit 02	Unit 02	Centaur40	OFF	1	3.6
NWP-Burley: Unit 01	Unit 01	Taurus60	OFF	1	22.6
NWP-Burley: Unit 02	Unit 02	Taurus70	ON	3	56.1
NWP-Chehalis: Unit 02	Unit 02	Taurus70	OFF	5	7.4
NWP-Cisco: Unit 01	Unit 01	Centaur50	OFF	0	0
NWP-Cisco: Unit 02	Unit 02	Centaur50	OFF	0	0
NWP-Eugene: Unit 01	Unit 01	Saturn10	OFF	6	2.1

LMM-Shamrock: Mars
Ad Hoc / Vision
Alarm Shutdown
Compressor Map
Compressor Trends
Fleet Comparison
Fuel PCD Flow Trends
Ignition Report
Operations Overview
Performance Overview
T5 Profile
T5 Radar Plot Comparison
T5 Spread (Fleet Exceptions)
T5 Spread Trend
Turbine Trends

Recip Dashboard

Last Refreshed at:

- Click on any unit, and links to additional views will be available on the right side of the screen
- Units that are highlighted are not currently running
- Report data refreshes every five minutes

Unit	Model	Run Status	Starts (30 Days)	Utilization % (30 Days)
ABA-Central: Elec North	EM | ICD-CHCNW	2		
ABA-Central: Elec South	EM | ICD-CHCNW	2		
ABA-Central: Recip 01	Caterpillar | G3612LE	0		
ABA-Central: Recip 02	Caterpillar | G3612LE	1	6	49
ABA-Central: Recip 03	Caterpillar | G3612LE	0	8	15
ABA-Central: Turb 02	Solar | Taurus60	2		
ABA-Church: Recip 01	Caterpillar | G3516B ULB	1	7	97
ABA-Church: Recip 02	Caterpillar | G3516B ULB	1	1	100
ABA-Church: Recip 03	Caterpillar | G3516B ULB	1	7	98
ABA-Church: Recip 04	Caterpillar | G3516B ULB	1	2	99
ABA-Church: Recip 05	Caterpillar | G3608LE	1	0	100
ABA-Church: Recip 06	Caterpillar | G3608LE	1	2	99
ABA-Church: Recip 07	Caterpillar | G3612LE	1	0	100
ABA-Church: Recip 08	Caterpillar | G3612LE	1	1	100
ABA-Dunbar: Recip 01	Caterpillar | G3606LE	0	5	37

ABA-Church: Recip 03
Catalyst Trend
Compressor Temp Dev Trend
Compressor Temp Trend
Ignition Voltage Trend
Efficiency Parameter Trend
Engine Operation Trend
Exhaust Temp Trend
Overview Display

Data Mining

Baseline Maintenance Report

Franchise:
Start Date: 8/7/2019 12:00:00 AM
End Date: 8/15/2019 12:00:00 AM
Last Refreshed at: 2/3/2020 7:11:47 AM

Excursions / Status:

[redacted]

Process Value	Status Tracker	Low Excursions (Hours)	High Excursions (Hours)	Low Threshold	Min Value During Excursions	High Threshold	Max Value During Excursions	Number of Events	Last Excursion Time (Click to view in BLM DM Orange indicates still in of report
Comp Vib Cyl 1		0	80	0.001	.5	0.5	1.6	22	
Stg 2 Comp Cyl Discharge Temp Spread		0	34	-0.001	13.2	13	24.3	4	
Stg 2 Cyl 4 Discharge Temp		0	2	100	241.0	240	241.5	1	
Stg 2 Cyl 6 Discharge Temp		0	17	100	240.0	240	252.0	3	

Comparison Reports

Caterpillar G3600 Driver Comparison

Time: * Interval: 1h Report Execution Time: 2/3/2020 7:23:06 AM

0 - 1000 RPM and Selected Load Range: 90 - 100%

t Aggregates all the available data records that meet the RPM and Load Criteria for the time period and interval selected and displays 1 Average record for each unit
ent Data values below 1.25* StdDev and Red backfill represent values greater than 1.25* StdDev
e Left Column (Franchise\Station\Unit) will link to the Overview display if active
underlined and shown in Blue Links to Coresight for data trending

orting	Model	RPM	Load	JW Outlet Temp	JW to Oil Diff Temp	Engine Oil Pres	Engin e Oil Temp	Engine Oil Filter Dp	Comp Oil Pres	Comp Oil Temp	Fuel Flow	Fuel Flow Offski	Fuel Temp	Fuel Cor Fct	Fuel LHV Quality	Air Man Pres	Air Man Temp	Air to Fuel Ratio	Burn Time Sp	Burn Time Avg	Burn Time Dev	Timing	Exhaust Temp Avg	Catalyst Inlet Temp	Catalyst Out Temp	Catalyst Dp	Turbo LB Inlet Temp	Turbo LB Out Temp	Turbo RB Inlet Temp	Turbo RB Out Temp	Ign Volt Avg	Ign Volt Dev	Bat y V
	G3616LE	955	97	178	-	80.9	177.0	6.94	60.6	149.3	32.6	31.9	55	100.0	908	32.9	130.2	19.06	4.31	4.3	0.4	16.3	989	820	837	0.0	1.093	851	1.059	996	76.3	5.0	23
	G3616LE	985	91	181	-	81.3	177.0	4.97	58.4	153.6	29.7	29.9	49	100.0	967	30.9	129.5	20.14	4.20	4.2	0.1	16.3	975	873	886	0.0	1.073	828	1.068	979	68.5	4.3	25
	G3616LE	997	93	180	-	80.2	176.0	4.78	73.8	158.9	31.1	29.0	40	100.0	958	31.9	129.3	20.20	4.16	4.2	0.7	16.5	975	872	856	2.6	1.068	843	1.064	964	78.0	5.1	24
	G3616LE	997	92	180	-	80.1	176.2	7.77	60.1	163.9	31.6	26.8	38	99.7	931	32.1	129.1	19.89	4.26	4.3	0.6	18.4	995	871	882	2.6	1.082	845	1.072	981	74.2	7.3	24
	G3616LE	998	100	181	-	75.1	172.0	4.92	64.7	168.4	34.7	34.7	73	100.0	918	34.8	129.8	19.46	4.20	4.1	0.8	16.5	985	762	770	2.6	1.067	817	1.055	920	65.3	3.7	23
	G3616LE	999	91	181	7.0	82.1	174.3	7.99	68.9	166.1	30.5	36.9	37	100.2	955	31.5	132.7	20.06	4.15	4.1	0.5	16.4	973	872	875	1.3	1.061	837	1.058	954	73.1	3.9	24
viation		17	4	1.2		2.50	1.9	1.51	5.96	7.47	1.77	3.79	14	0.2	24	1.38	1.3	0.45	0.06	0.1	0.3	0.8	9	46	44	0.6	12	12	7	27	4.8	1	0.
verage		988	93.9	180.2	7.0	79.9	175.4	6.23	64.4	160.0	31.7	31.5	49	100.0	940	32.34	130.1	19.80	4.21	4.2	0.5	16.7	982	845	851	2.3	1.074	837	1.063	966	72.6	4.91	24

Turbine Fleet Comparison

Scope
* 1/27/2020 - 2/3/2020
Data Interval: 1 Hour
Models: Centaur40, Centaur50, Electric, Mars100, Mars90, Saturn10, Saturn20, Taurus60, Taurus70, Titan130, Titan250
Franchises: Discovery, Gulf East, Gulf West, Piceance, SWW, Transco, Wamsutter

Compressor
RPM: 0 - 50000

Operating Mode
TS Topped: Ignore
NGP Topped: Ignore
Full Load: Ignore
NPT: Ignore

Status
On Load: Yes / On Load (>30m): Ignore

	Running	Battery Voltage	T1 Temp	Inlet dP	Fuel Consumption Specific	Fuel Flow Corrected	Fuel Flow Predicted	Fuel Flow Delta	NPT	NGP	NGP Predicted	NGP Delta	Oil Header Press	Oil Header Temp	PCD	PCD Predicted	PCD Delta	Bleed Valve Cmd	Bleed Valve Pos	Bleed Valve Duct Temp	Power Shaft	Power Shaft Predicted
Unit 01	1	27.37	60.6	7.15	7.869	109.49	109.73	-0.22	99.88	101.47	103.59	-2.12	41.97	136.2	225.7	235.4	-4.1	10.47	10.68		13.913	14.020
-8	1	27.55	34.3	2.83	7.771	92.24	92.04	0.23	86.61	102.09	103.60	-1.50	34.98	130.8	186.5	196.6	-4.9	13.79	13.86	663.4	11.877	11.899
0: Unit 18	1	27.47	48.8	4.92	7.850	110.90	112.57	-1.48	98.39	101.86	103.60	-1.71	41.95	124.8	235.4	240.9	-2.1				14.128	14.487
0: Unit 18	1	26.85	60.8	4.21	7.544	103.03	109.49	-5.89	98.44	100.56	103.59	-3.03	34.12	129.4	219.3	234.8	-6.6			687.8	13.663	13.923
0: Unit 09	1	26.37	48.0	5.07	7.683	108.19	112.57	-3.89	93.14	102.26	103.60	-1.34	47.11	115.5	231.7	240.8	-3.0				14.090	14.554
5: Unit 01	1	25.36	29.8	71.18	12.261	60.41	97.53	-38.07	96.87	101.49	103.60	-2.18	68.04	112.2	184.2	207.3	-46.9				4.936	11.164
5: Unit 03	1	27.33	46.2	4.44	7.864	102.92	113.01	-8.93	93.98	102.01	103.60	-1.59	36.47	125.1	226.2	241.7	-6.4			723.0	14.583	14.653
0: Unit 18	1	27.53	55.8	5.55	0	0.00	100.95	-100.95	96.96	103.21	103.60	-0.39	41.96	138.9	229.1	233.4	-5.7				14.138	14.010
0: Unit 18	1	27.72	44.8	4.68	7.939	107.85	112.17	-3.86	99.71	103.00	103.60	-0.60	38.73	129.8	229.6	239.8	-4.3	0.04	0.06	270.6	13.995	14.554
0: Unit 15	1	27.58	49.9	4.79	7.868	104.94	110.66	-5.16	92.27	103.25	103.60	-0.65	38.72	107.4	222.6	236.8	-6.3	0.00	-0.76	194.5	13.337	14.273
5: Unit 06	1	27.76	27.9	4.51	7.942	105.82	111.19	-4.84	92.31	102.36	103.60	-1.25	37.51	117.3	226.0	237.0	-4.6	1.52	1.58	401.7	13.329	14.506
	1.00	27.17	45.94	10.85	8179.17	100.58	108.17	-15.65	93.14	102.14	103.60	-1.49	41.96	124.18	211.58	231.26	-8.94	5.16	5.09	490.15	12871.80	13821.16
on	0.00	0.72	11.39	20.04	1458.19	15.05	6.87	29.92	4.60	0.82	0.00	0.78	9.42	9.94	37.86	15.09	13.55	6.50	6.71	230.96	2724.29	1173.06
	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	5	5	6	11	11

Caterpillar G3500 Driver Comparison

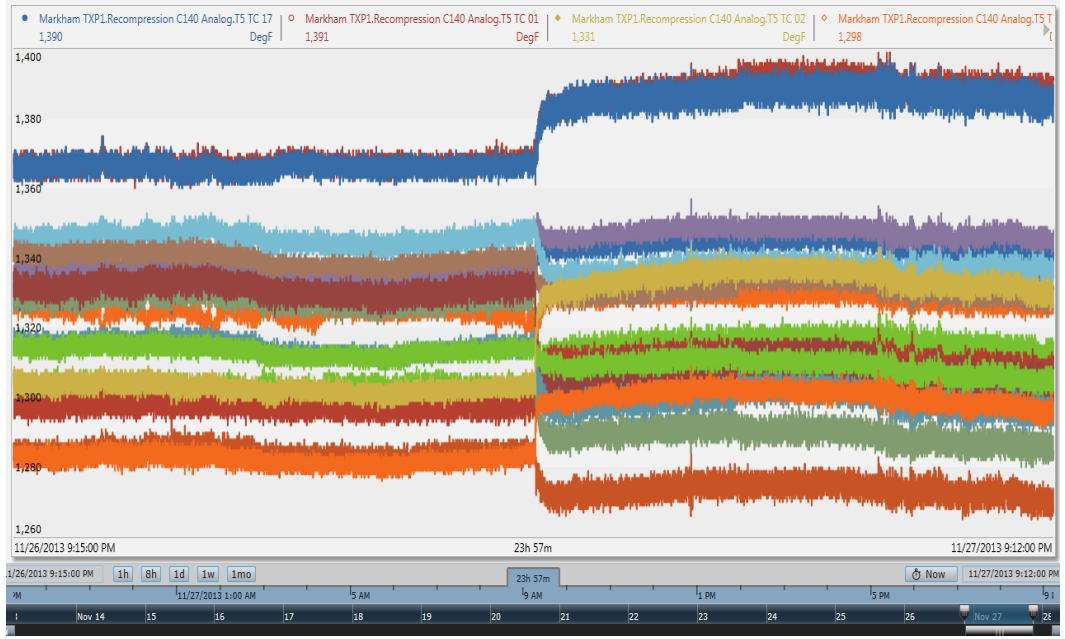
1w End Time: * Interval: 1h Report Execution Time: 2/3/2020 7:25:59 AM

Selected Speed Range: 1350 - 1400 RPM and Selected Load Range: 90 - 100% StdDev Threshold: 1.25

gates all the available data records that meet the RPM and Load Criteria for the time period and interval selected and displays 1 Average record for each unit
ta values below 1.25* StdDev and Red backfill represent values greater than 1.25* StdDev
Column (Franchise\Station\Unit) will link to the Overview display if active
ined and shown in Blue Links to Coresight for data trending

Model	RPM	Load	JW Outlet Temp	JW to Oil Diff Temp	Engine Oil Pres	Engine Oil Temp	Engine Oil Filter Dp	Comp Oil Pres	Comp Oil Temp	Fuel Flow	Fuel Flow Offskid	Fuel Temp	Fuel Cor Fct	Fuel LHV Quality	Throttle Pos	Air Man Pres	Air Man Temp	Air to Fuel Ratio	Exhaust Nox	Exhaust Nox Sp	Timing	Exhaust Temp Avg	Exhaust Temp Dev	Catalyst Inlet Temp	Catalyst Out Temp	Catalyst Dp	Turbo LB Inlet Temp	Turbo LB Out Temp	Turbo RB Inlet Temp	Turbo RB Out Temp	Ign Volt Avg	Ign Volt Dev	Battery Volt	Values In Avg
G3516B ULB	1,352	91.0	189	-1.7	69.3	191.0	11.07	60.67	168.2	10.2	10.29	64	99.0	907	52.7	44.98	124.6	28.19	55.1	55.0	28.2	1,155	20.7	904	898	0.0	1,267	928	1,286	959	47.8	5.6	23.0	53
G3516B ULB	1,353	91.6	188	-2.0	68.5	189.7	11.20	61.12	167.3	10.4	10.56	69	99.0	900	53.1	45.19	122.4	28.08	54.9	55.0	28.3	1,172	19.6	887	903	0.0	1,274	936	1,308	951	46.4	4.3	23.0	93
G3516B ULB	1,353	93.4	190	-0.6	66.9	190.3	11.05	58.34	167.6	10.4	10.50	51	100.8	913	54.2	44.09	125.6	28.04	57.4	55.0	28.5	1,183	17.0	973	957	0.0	1,320	994	1,319	1,004	39.9	3.2	22.6	116
G3516B ULB	1,354	91.1	190	-2.6	67.6	192.3	10.70	60.20	166.3	10.2	10.16	49	100.0	910	53.1	43.12	117.4	28.06	52.1	52.0	28.3	1,138	16.2	901	916	0.0	1,259	938	1,288	971	39.7	4.2	23.0	52
G3516B ULB	1,354	91.7	185	-4.4	68.2	189.7	11.35	60.75	167.6	10.4	10.56	67	101.9	900	52.2	44.67	119.0	27.28	57.0	53.0	28.4	1,161	18.5	1,005	999	0.0	1,294	989	1,303	1,015	33.7	5.1	23.5	76
G3516B ULB	1,354	95.2	189	-1.3	68.4	190.4	10.91	59.18	166.7	10.7	10.52	56	99.0	906	55.5	46.10	119.6	28.48	52.0	52.0	28.7	1,119	16.0	894	912	0.0	1,244	920	1,261	928	45.1	4.9	23.0	166
G3516B ULB	1,355	93.1	186	-2.8	66.9	189.0	10.74	59.93	169.2	10.7	10.62	61	100.1	885	53.4	46.20	121.0	27.31	49.9	50.0	28.5	1,135	15.2	900	909	0.0	1,277	947	1,256	926	46.8	4.4	23.0	156
G3516B ULB	1,370	92.8	191	-0.1	67.2	191.0	9.90	58.68	160.7	10.5	10.29	66	101.5	912	54.0	44.12	125.8	27.74	57.1	55.0	28.9	1,147	12.6	968	968	0.0	1,274	956	1,287	970	20.7	5.3	24.7	129
G3516B ULB	1,376	99.0	193	-0.4	64.8	193.0	10.65	60.26	167.8	11.5	11.50	48	101.9	887	57.2	49.12	134.7	27.14	53.3	53.8	29.4	1,204	20.7	925	935	0.0	32	917	32	990	41.8	5.1	27.4	91
G3516B ULB	1,377	98.8	189	-2.5	68.7	191.6	11.26	60.10	153.9	11.3	11.35	73	100.0	898	57.8	47.25	135.3	27.93	49.4	45.0	29.4	1,184	24.8	946	940	0.0	1,311	954	1,311	973	33.5	3.6	27.5	34
G3516B ULB	1,387	90.2	188	-4.0	68.4	192.0	11.46	59.58	167.6	10.4	10.48	44	99.0	910	53.5	44.13	128.0	28.30	55.9	55.0	29.3	1,157	22.2	904	904	0.0	1,296	973	1,297	969	38.6	3.4	22.5	6
G3516B ULB	1,387	93.0	189	-2.5	68.4	192.0	10.74	56.56	170.6	11.3	11.17	56	99.0	862	55.2	45.48	129.9	27.01	52.1	52.0	29.4	1,212	17.7	947	955	0.0	1,339	1,002	1,341	1,014	43.7	3.9	25.2	164
on	1,370	3	5.6	3,041.83	1.84	4.2	0.60	116.64	5.54	1.8	1.66	11	1.9	189	1.6	3.49	19.0	0.82	5.0	5.1	0.6	26	4.4	161	219		594	23	48	22	8.2	1	1.9	
ge		95.3	188.2	568.2	68.5	189.4	10.92	87.5	167.4	9.32	9.2	65	98.7	1,058	54.8	43.31	124.1	28.27	58.4	57.7	28.5	1,162	18.2	853	818		1,476	956	1,281	974	39.9	5.15	25.4	

T5 Monitoring



T5 temperature plot as it is shown in a Pi Vision trend. This actual graph of a step change in a Turbine temperature spread associated with further degradation of the insulation.

These photos are representative of the problems that can be identified by looking more closely at changes that occur within Manufacturer safe operating limits. Loosened insulation can lodge in fuel nozzles causing uneven burn.

Performance

[redacted] Taurus70 / T10802S_59_G

Summary

Elevation	0	ft
Compression Stages	1	

Driver Setup

Fuel Gas

Mole Fraction Total	100	%
Molecular Weight	16.33	g/mol
LHV	915	BTU/scf
HHV	1016	BTU/scf
Specific Gravity	0.56	

Gas Component	Mole Percent
Methane	98.05
Ethane	1.38
Propane	0.05
IButane	0.00
nButane	0.00
IPentane	0.00
nPentane	0.00
HexanePlus	0.00
Carbon Dioxide	0.07
Nitrogen	0.45

Driver Data

Process Data Values

Inlet Temperature	63.7	°F
GP Speed	98.0	%
PT Speed	75.7	%
T5 Average	1,355	°F
Air Inlet dP	2.57	InH2O
Exhaust Back Pressure	0.00	InH2O
PCD	145.7	psig
Fuel Mass Flow	No Data	lbm/hr

Calculated Values

Shaft Power	4,976	hp
Fuel Consumption	10,615	BTU/hp-hr
Fuel Standard Flow	57.74	MSCFH
Fuel Mass Flow	2,495	lbm/hr
Fuel Energy Rate	52.82	MMBTU/hr

Performance

Parameter	Value	Prediction	Dev (Pct)	
Inlet Temperature	63.70			°F
Air Inlet dP	2.57			InH2O
PT Speed	75.65			%
GP Speed	97.96	100.00	-2.0	%
T5 Average	1,355	1,400	-3.2	°F
Shaft Power	4,976	9,934	-49.9	hp
PCD	145.74	224.21	-35.0	psig
Fuel Energy Rate	52.82	78.41	-32.6	MMBTU/hr

Compressor Setup

Thru-put Gas

Mole Fraction Total	100	%
Molecular Weight	16.33	g/mol
LHV	915	BTU/scf
Specific Gravity	0.56	
Critical Pressure	695	psia
Critical Temperature	348	°R

Gas Component	Mole Percent
Methane	98.05
Ethane	1.38
Propane	0.05
IButane	0.00
nButane	0.00
IPentane	0.00
nPentane	0.00
HexanePlus	0.00
Carbon Dioxide	0.07
Nitrogen	0.45

Gas Properties

Suction Gas Density	1.65	lbm/ft^3
Discharge Gas Density	2.38	lbm/ft^3
Suction Gas Enthalpy	361	BTU/lbm
Discharge Gas Enthalpy	400	BTU/lbm
Suction Gas Compressibility	0.93	
Discharge Gas Compressibility	0.94	

HP Compressor Data

Process Data Values

Flow dP	135.6	InH2O
Suction Pressure	509.8	psig
Discharge Pressure	864.9	psig
Suction Temp	60.5	°F
Discharge Temp	140.6	°F
ASV Position	100	%CL

Calculated Values

	Value	Prediction	Dev (Pct)	
Isentropic Head	25,321			ft-lbf/lbm
Actual Flow	3,265			ACFM
Isentropic Efficiency	84.78	84.37	0.4	%
Mass Flow	323,290			lb/hr
Standard Flow	179.57			MMSCFD
Shaft Power	4,976			hp
Compressor Speed	0	3,263	-100.0	RPM
Pressure Ratio	1.68			

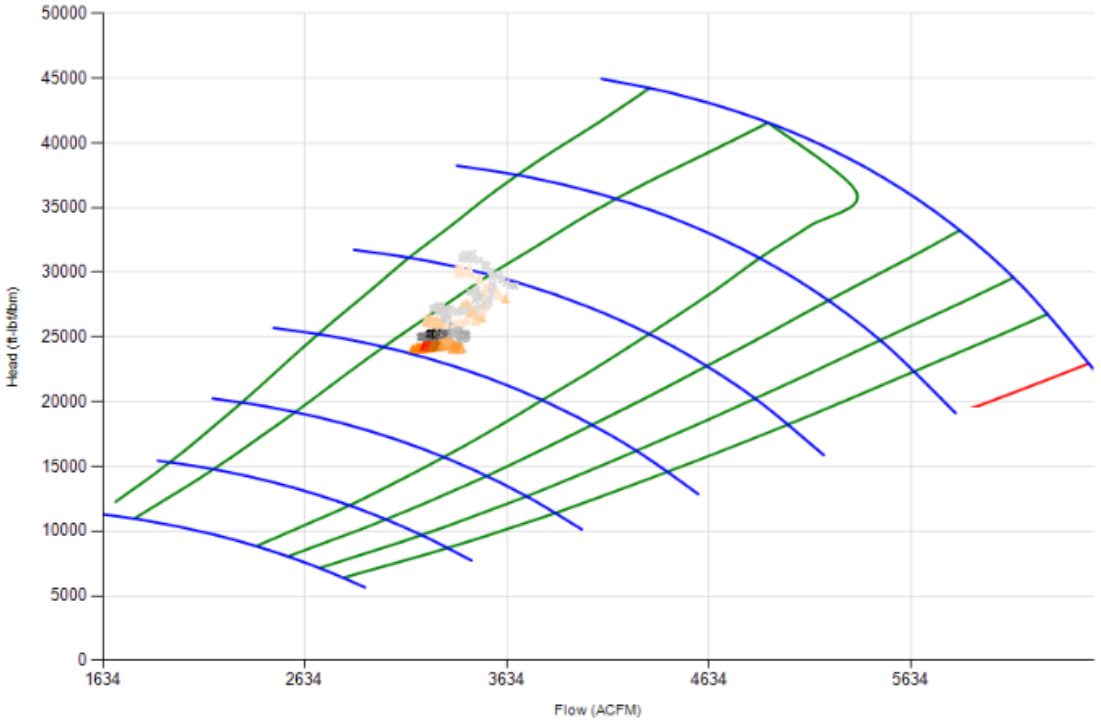
Williams

Centrifugal Compressor Map

[redacted]

2/1/2020 6:55:29 AM - 2/3/2020 7:55:29 AM

- Hover over speed and efficiency lines to see labels
- Darker operating points are more recent than lighter points (CentriperfRt Calculated Points - Grey to Black) (PLC Points - light Orange to Red)



Custom Analysis

> Event Frames to Capture and report Key Events

Turbine Startup and Shutdown and Out of SoloNox Duration

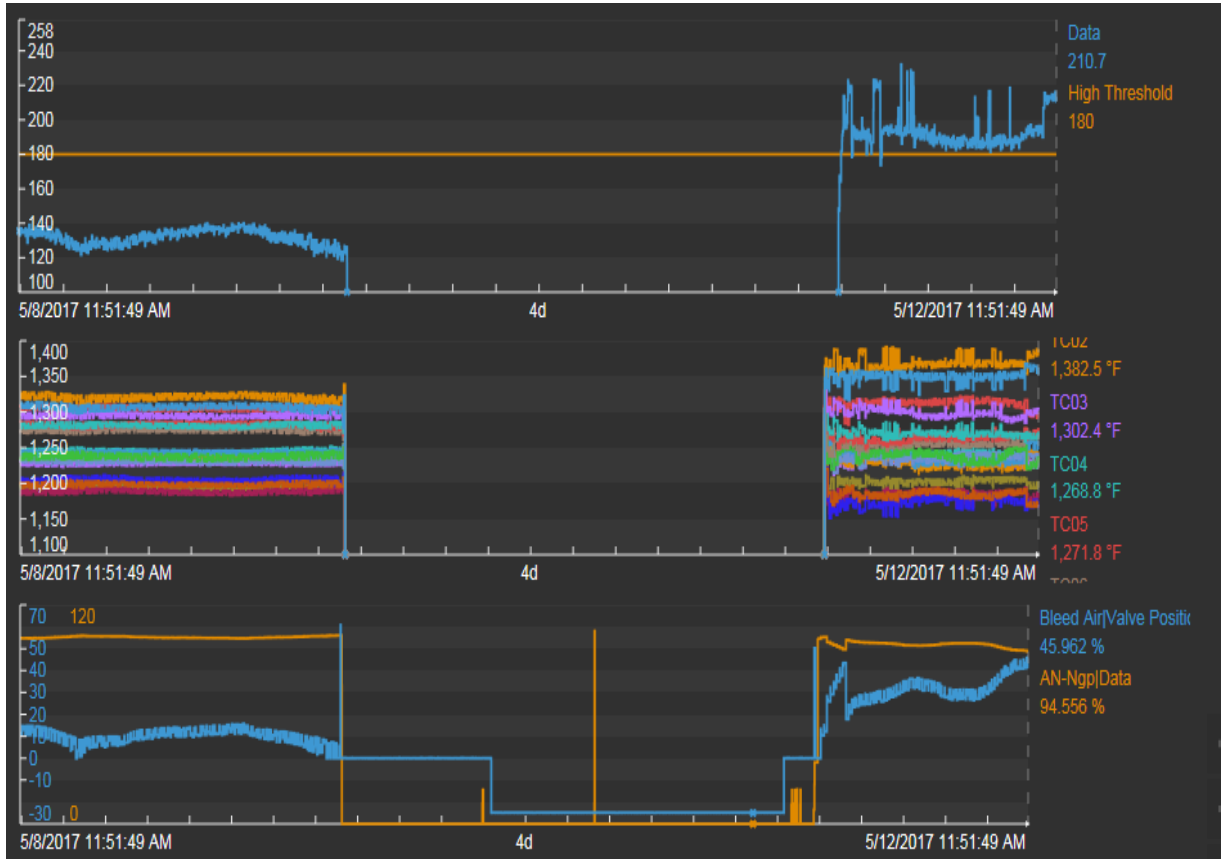
Note: Report Times Central Time

Last Refreshed at: 2/3/2020 7:16:59 AM

[redacted] MU01	Month	Start Time	End Time	Duration	On-Load	Mode	Pi Vision URL
Starts: 10 Stops: 10	November	11/4/2019 10:59:17 AM	11/4/2019 11:04:28 AM	00:05:11	0	Cooldown stop	Trends
Duration On-load/Solonox Off: 0.00	November	11/4/2019 3:26:04 PM	11/4/2019 3:30:44 PM	00:04:40	0	Starting	Trends
	November	11/5/2019 9:03:32 AM	11/5/2019 9:08:41 AM	00:05:09	0	Cooldown stop	Trends
	November	11/9/2019 9:30:00 AM	11/9/2019 9:35:00 AM	00:05:00	0	Starting	Trends
	November	11/9/2019 6:45:29 PM	11/9/2019 6:50:40 PM	00:05:12	0	Cooldown stop	Trends
	November	11/29/2019 7:51:39 PM	11/29/2019 7:55:50 PM	00:04:11	0	Starting	Trends
	November	11/30/2019 3:37:14 AM	11/30/2019 3:37:14 AM	00:00:00	0	Shutdown Stop	Trends
		Month HOURS		0.49			
	December	12/25/2019 12:39:25 PM	12/25/2019 12:43:41 PM	00:04:16	0	Starting	Trends
	December	12/26/2019 2:42:42 AM	12/26/2019 2:42:42 AM	00:00:00	0	Shutdown Stop	Trends
	December	12/26/2019 4:49:58 AM	12/26/2019 4:53:57 AM	00:03:59	0	Starting	Trends
	December	12/26/2019 11:04:16 AM	12/26/2019 11:04:16 AM	00:00:00	0	Shutdown Stop	Trends
	December	12/26/2019 3:16:23 PM	12/26/2019 3:20:15 PM	00:03:52	0	Starting	Trends
	December	12/26/2019 3:21:41 PM	12/26/2019 3:21:41 PM	00:00:00	0	Shutdown Stop	Trends
	December	12/26/2019 8:30:14 PM	12/26/2019 8:35:04 PM	00:04:50	0	Starting	Trends
	December	12/27/2019 7:14:15 AM	12/27/2019 7:19:24 AM	00:05:10	0	Cooldown stop	Trends
	December	12/29/2019 10:03:15 AM	12/29/2019 10:07:25 AM	00:04:10	0	Starting	Trends
	December	12/29/2019 1:50:20 PM	12/29/2019 1:55:31 PM	00:05:11	0	Cooldown stop	Trends
		Month HOURS		0.52			
	January	1/6/2020 12:30:25 PM	1/6/2020 12:35:31 PM	00:05:05	0	Starting	Trends
	January	1/9/2020 7:15:02 AM	1/9/2020 7:20:11 AM	00:05:09	0	Cooldown stop	Trends
	January	1/10/2020 2:59:51 PM	1/10/2020 3:04:52 PM	00:05:01	0	Starting	Trends
		Month HOURS		0.25			
		Total HOURS		1.26			

[redacted] MU02	Month	Start Time	End Time	Duration	On-Load	Mode	Pi Vision URL
Starts: 8 Stops: 7	November	11/10/2019 2:49:06 AM	11/10/2019 2:53:57 AM	00:04:52	0	Starting	Trends
Duration On-load/Solonox Off: 0.00	November	11/25/2019 11:45:28 PM	11/25/2019 11:50:38 PM	00:05:10	0	Cooldown stop	Trends
	November	11/28/2019 9:48:39 AM	11/28/2019 9:53:34 AM	00:04:55	0	Starting	Trends
	November	11/29/2019 7:57:39 PM	11/29/2019 8:02:45 PM	00:05:07	0	Cooldown stop	Trends
	November	11/30/2019 3:53:05 AM	11/30/2019 3:57:07 AM	00:04:02	0	Starting	Trends

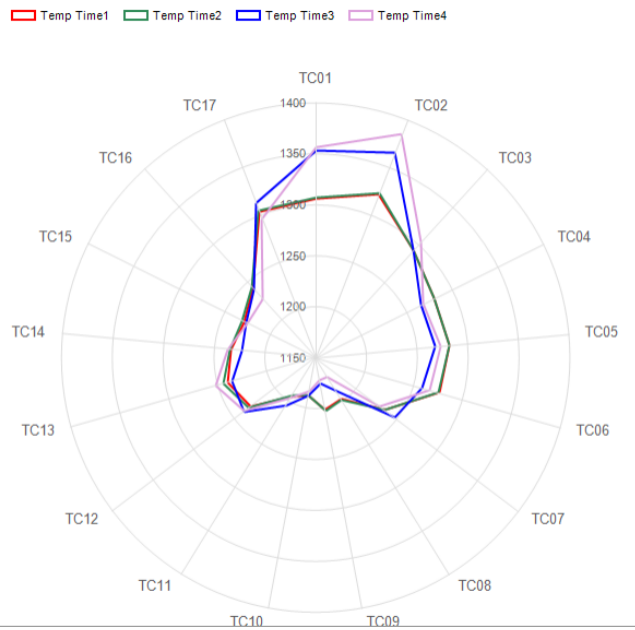
Equipment Performance Monitoring



T5 TC Temp Profile Comparison

Time 1: 5/8/2017 6:00:00 AM
Time 2: 5/8/2017 5:00:00 AM
Time 3: 5/12/2017 10:00:00 AM
Time 4: 5/12/2017 12:00:00 PM

Note: Time 1 will populate to Last Exchange date if available or default to current Time



TC	5/8/2017 6:00:00 AM	5/8/2017 5:00:00 AM	5/12/2017 10:00:00 AM	5/12/2017 12:00:00 PM
TC01	1306	1307	1353	1357
TC02	1322	1323	1366	1385
TC03	1293	1293	1292	1304
TC04	1280	1280	1266	1268
TC05	1282	1282	1269	1273
TC06	1276	1276	1259	1267
TC07	1235	1235	1247	1229
TC08	1198	1199	1189	1172
TC09	1202	1203	1176	1173
TC10	1188	1188	1188	1184
TC11	1196	1194	1205	1197
TC12	1230	1232	1238	1238
TC13	1240	1244	1235	1253
TC14	1233	1235	1222	1237
TC15	1229	1231	1227	1225
TC16	1241	1244	1241	1228
TC17	1303	1305	1313	1296
Max	**1322**	**1323**	**1366**	**1385**
Min	**1188**	**1188**	**1176**	**1172**
Spread	**135**	**135**	**190**	**212**
NGP	101.83	101.80	95.65	94.60