Monitoring Manufacturing Quality and Device Health

Russ Manson & Anna Kaplan

GENERAL ATOMICS AERONAUTICAL

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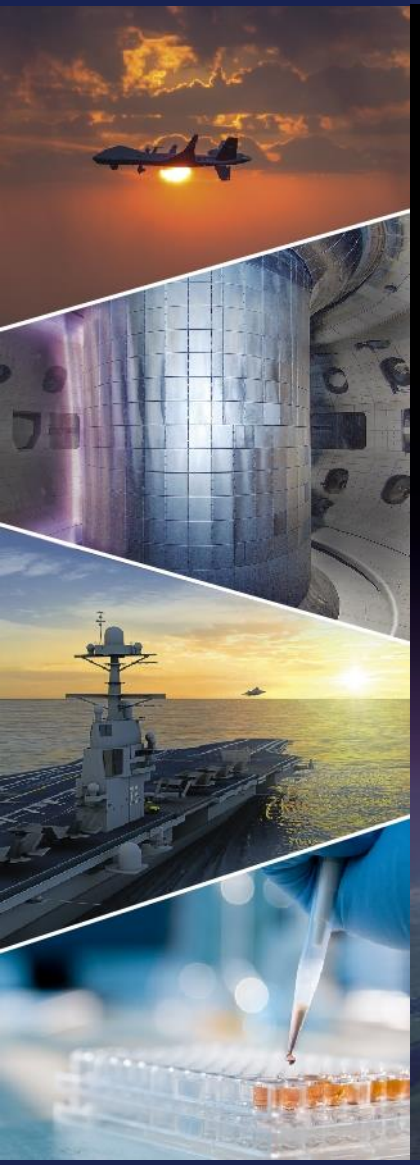

About General Atomics

General Atomics is a defense and diversified technologies company, founded in 1955 as a division of General Dynamics and acquired by the Blue family in 1986. GA and affiliated companies operate on five continents

The group occupies more than 8 million square feet of engineering, laboratory and manufacturing facilities and comprises over 14,000 employees

General Atomics History

TORREY PINES
GENERAL ATOMICS

Location: San Diego

Founded: 1955 by General Dynamics
Business: High-technology research, design, manufacturing and production for industry and government worldwide

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GA Global Locations

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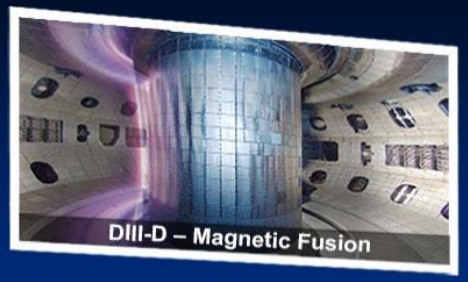
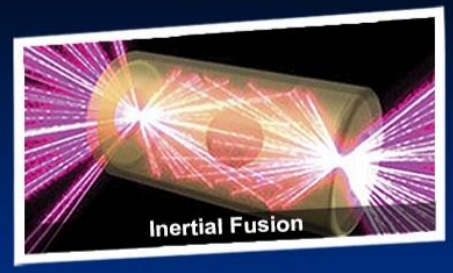
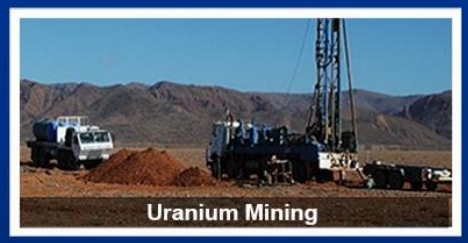
General Atomics Advanced Technologies







Leaders in Advanced Power and Energy Systems

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Business Segments

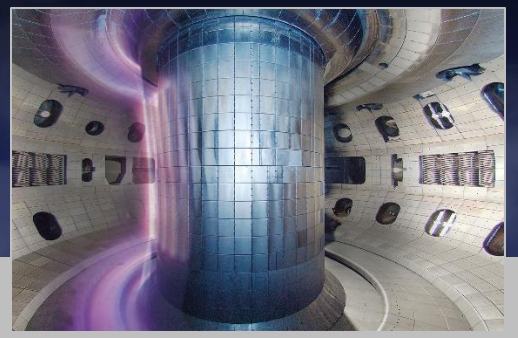
ASI

Leading designer and manufacturer of proven, reliable Remotely Piloted Aircraft (RPA) systems, radars, and electro-optic and related mission systems, including the Predator® RPA series and the Lynx® Multi-mode Radar.

EMS

Develops technologies for the Dept. of Defense, the Dept. of Energy, and commercial customers.

GA is a world leader in the application of electromagnetic technologies to aircraft launch and recovery, projectile launch, pulse power systems, lasers and advanced sensors.



ENERGY

Develops sustainable and alternative energy solutions and materials.

Operates the DIII-D National Fusion Facility.

Opportunity

- **Electrical Cable Harness Assemblies**
  - Numerous challenges presenting/capturing reality
  - PI System Explorer
  - Analysis's
  - Event Frames
  - Notifications
    - Email/texts
  - PI Vision
  - PI Web API
  - PI Manual Logger

PI System Explorer (PSE)

CableTemplate

General | Attribute Templates | Ports | Analysis Templates | Notification Rule Templates

Group by: Category Template

Filter

Name	Default Value	Displ...	Value Type	Data Reference	Settings...
Category: Limits					
CrimpHydraulicPressure1OverMaxLimit	[redacted]	-5	Int32	<None>	
CrimpHydraulicPressure2OverMaxLimit	[redacted]	-5	Int32	<None>	
CrimpPressureCountTrigger	[redacted]	-5	Int32	PI Point	\\%Server%\%Element...
ManifoldAirPressureHighLimit	[redacted]	-5	Int32	PI Point	\\%Server%\%Element...
ManifoldAirPressureHiHiLimit	[redacted]	-5	Int32	<None>	
ManifoldAirPressureHiLimit	[redacted]	-5	Int32	<None>	
ManifoldAirPressureLoLimit	[redacted]	-5	Int32	<None>	
ManifoldAirPressureLoLoLimit	[redacted]	-5	Int32	<None>	
ManifoldAirPressureLowLimit	[redacted]	-5	Int32	PI Point	\\%@PI Data Archive Na...
ManifoldAirPressureTargetLimit	[redacted]	-5	Int32	<None>	
Category: LiveData					
AirPressureFrontLeft	0 psi	-5	Int32	PI Point	\\%@PI Data Archive Na...
AirPressureFrontLeftPreviousValue	0 psi	-5	Int32	<None>	
AirPressureFrontRight	0 psi	-5	Int32	PI Point	\\%@PI Data Archive Na...
AirPressureRearLeft	0 psi	-5	Int32	PI Point	\\%@PI Data Archive Na...
AirPressureRearRight	0 psi	-5	Int32	PI Point	\\%@PI Data Archive Na...
CrimpPressure1	0 psi	-5	Int32	PI Point	\\%@PI Data Archive Na...
CrimpPressure2	0 psi	-5	Int32	PI Point	\\%@PI Data Archive Na...

Name: CrimpPressure2

Description: Air pressure on the cable crimp

Properties: <None>

Categories: LiveData

Default UOM: pound-force per square inc

Value Type: Int32

Default Value: 0 psi

Display Digits: -5

Data Reference: PI Point

Settings...

\\%@PI Data Archive Name%\%Element%.%Attribute%;ptclassname=classic;pointtype=Int32;compdev=3;convers=5.2429;exdesc="InstZero=[redacted]5";instrumenttag=%@Modbus DNS name %.[redacted].com;location1=%@Modbus Interface ID Number%;location2=%@Modbus Device PLC Node Number %;location3=[redacted];location4=[redacted];location5=[redacted];pointsource=%@Modbus Interface Point Source %;span=[redacted]

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PI System Explorer (Analysis)

Generation Mode: Explicit Trigger Event Frame Template: CablesManifoldAirPressureEvent

Add... | Evaluate

Name	Expression	True for	Severity
Start triggers			
StartTrigger1	'AirPressureFrontLeft' > 'ManifoldAirPressureHighLimit'	Not Set	Warning
StartTrigger2	'AirPressureFrontRight' > 'ManifoldAirPressureHighLimit'	Not Set	Warning
StartTrigger3	'AirPressureRearLeft' > 'ManifoldAirPressureHighLimit'	Not Set	Warning
StartTrigger4	'AirPressureRearRight' > 'ManifoldAirPressureHighLimit'	Not Set	Warning

Advanced Event Frame Settings...

Multiple start triggers are configured. Child event frames will be generated when the trigger changes. See documentation for more details.

Add a new variable | Evaluate

Name	Expression	Output Attribute
CurrentValue	'AirPressureFrontLeft'	Map
PreviousValue	PrevVal('AirPressureFrontLeft', '*')	Map

TrendDirection	if PreviousValue < CurrentValue then
	  //The value has risen.
	  3
	else if PreviousValue > CurrentValue then
	  //The value has declined.
	  2
	else
	  //The value has stayed the same.
	  1
		ManifoldAirPressureFrontLeftChangeTrend

Add a new variable | Evaluate

Name	Expression	Output Attribute
AllDataValuesAreGood	(Not BadVal('CrimpPressure2')) and (Not BadVal('CrimpPressure2CountInput'))	Map
PressureAboveLimit	'CrimpPressure2' > 'CrimpPressureCountTrigger'	Map
PrevPressureBelowOrEqualToLimit	PrevVal('CrimpPressure2', '*') <= 'CrimpPressureCountTrigger'	Map
CountTagIsNew	'CrimpPressure2CountInput' = "Pt Created"	Map

Result	if AllDataValuesAreGood and PressureAboveLimit and PrevPressureBelowOrEqualToLimit Then
	  ('CrimpPressure2CountInput' + 1)
	else if CountTagIsNew then
	  0
	else
	  NoOutput()
		CrimpPressure2Count

Add a new variable | Evaluate

Name	Expression	Output Attribute

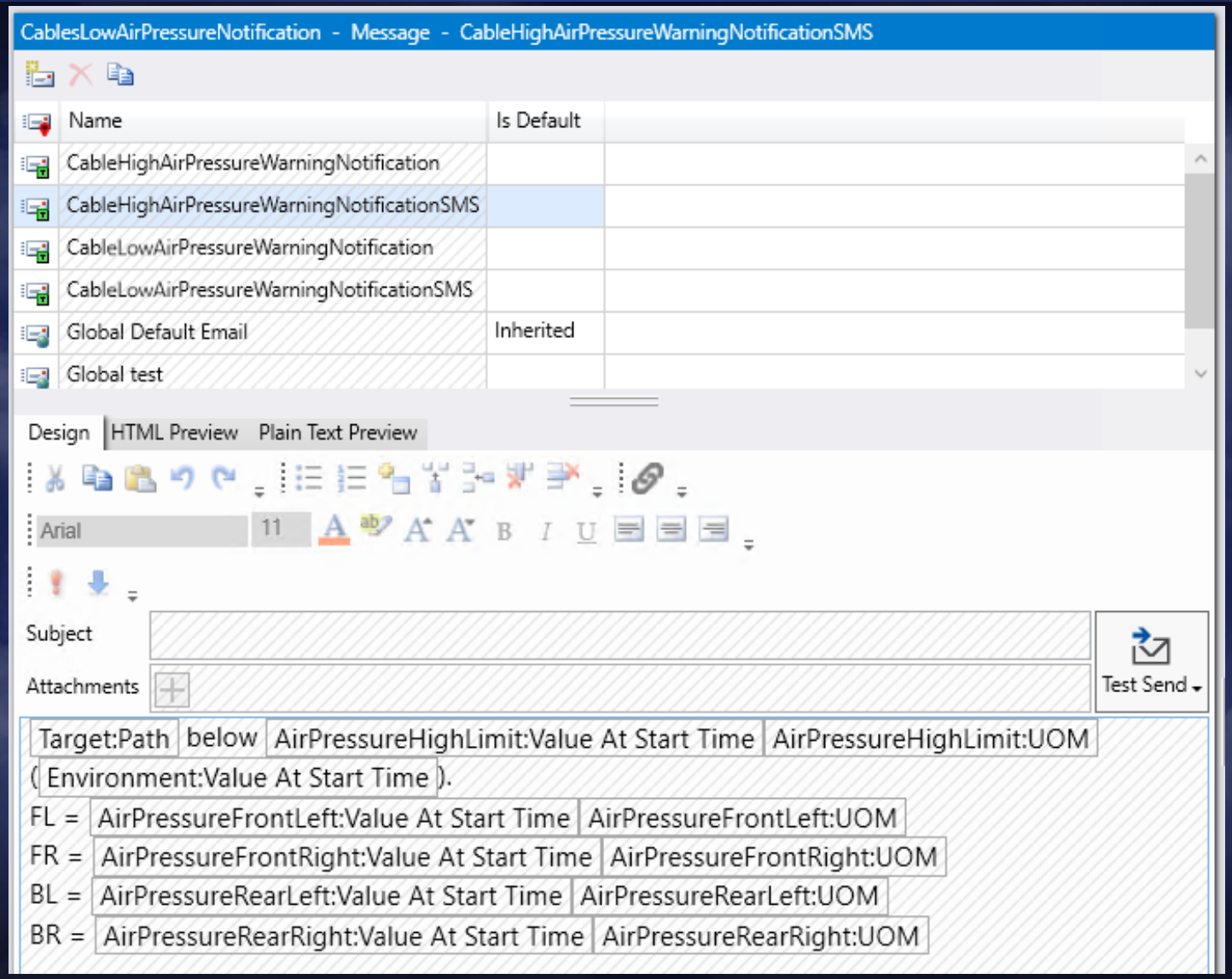
IsCrimpPressure1SensorPresent	if 'CrimpPressure1' < -20 then
	  "NSP"
	else if 'CrimpPressure1' >= -20 and 'CrimpPressure1' < 0 then
	  0
	else
	  Concat(String('CrimpPressure1'), " psi")
		CrimpPressure1PIVision

IsAirPressureFrontLeftSensorPresent	if 'AirPressureFrontLeft' < -20 then
	  "NSP"
	else if 'AirPressureFrontLeft' >= -20 and 'AirPressureFrontLeft' < 0 then
	  0
	else
	  Concat(String('AirPressureFrontLeft'), " psi")
		AirPressureFrontLeftPIVision

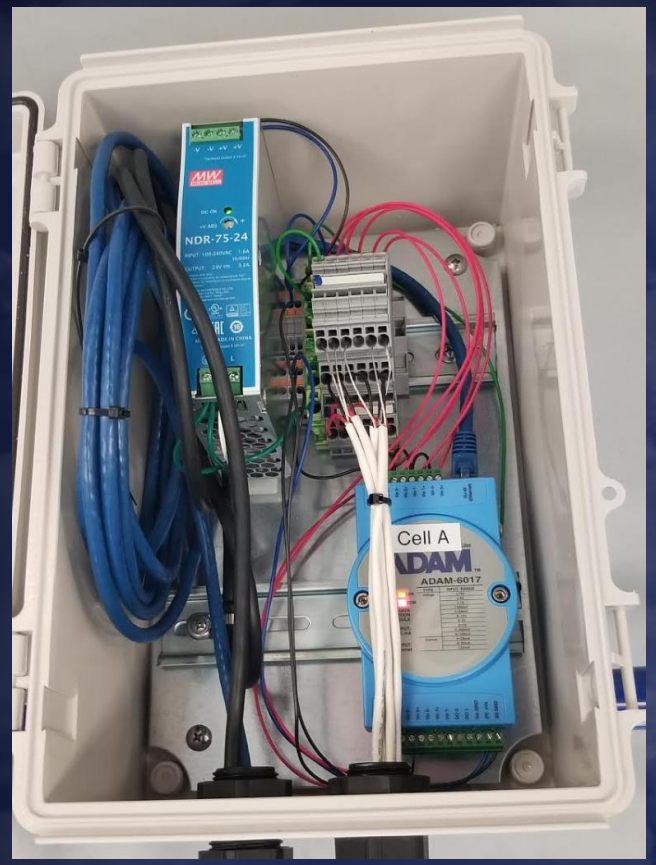
IsAirPressureFrontRightSensorPresent	if 'AirPressureFrontRight' < -20 then
	  "NSP"
	else if 'AirPressureFrontRight' >= -20 and 'AirPressureFrontRight' < 0 then
	  0
	else
	  Concat(String('AirPressureFrontRight'), " psi")
		AirPressureFrontRightPIVision

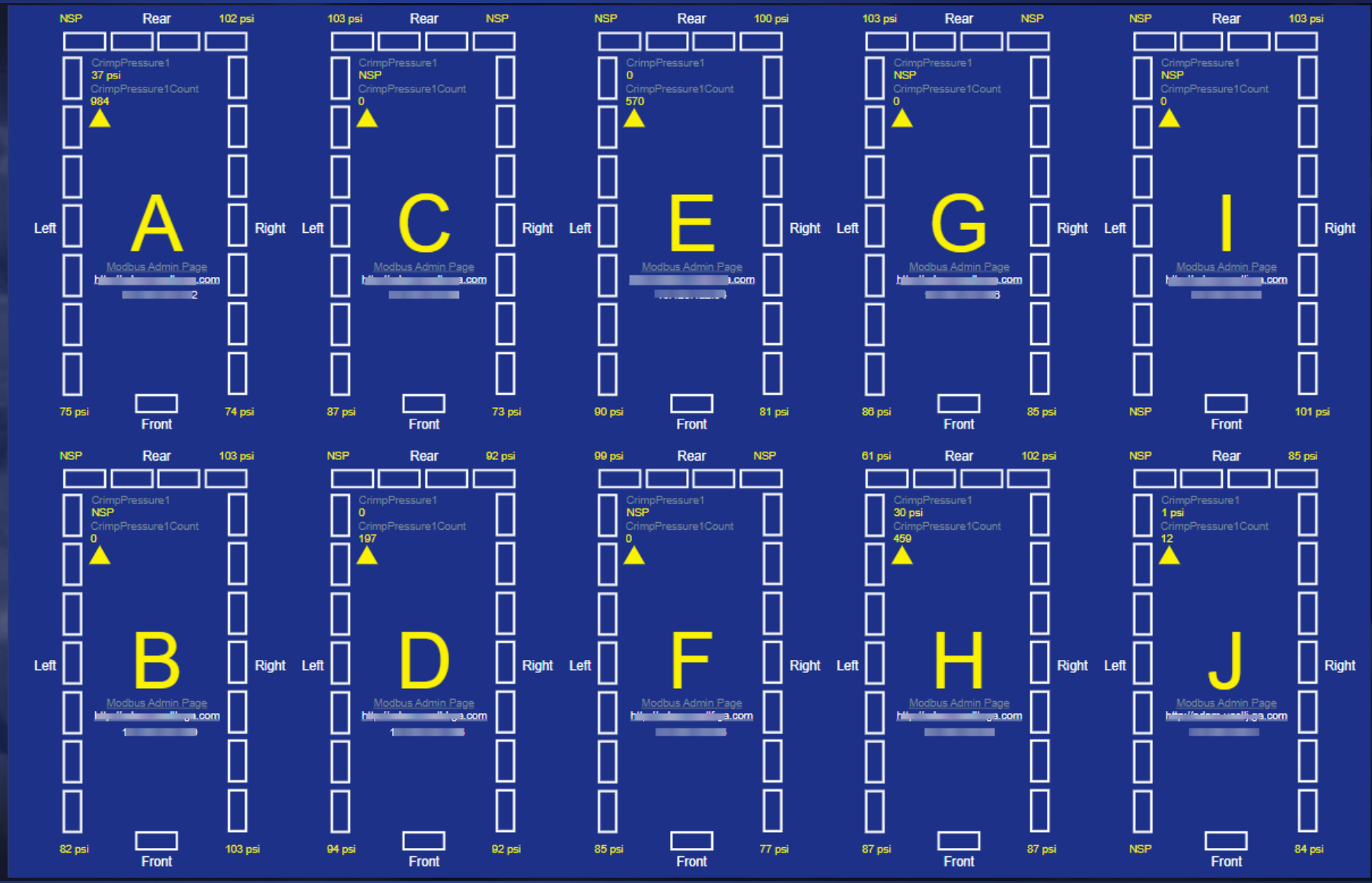
IsAirPressureRearLeftSensorPresent	if 'AirPressureRearLeft' < -20 then
	  "NSP"
	else if 'AirPressureRearLeft' >= -20 and 'AirPressureRearLeft' < 0 then
	  0
	else
		AirPressureRearLeftPIVision

PI System Explorer (Notifications)



PI Vision





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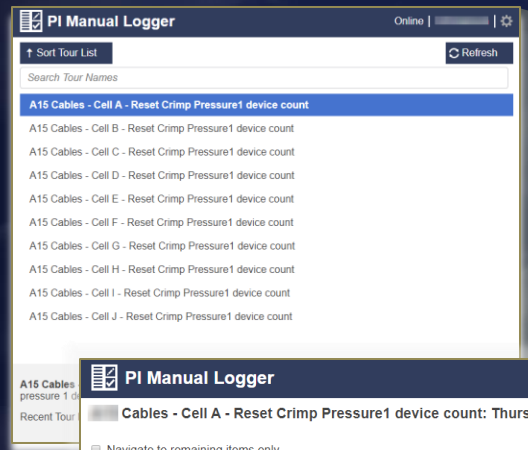
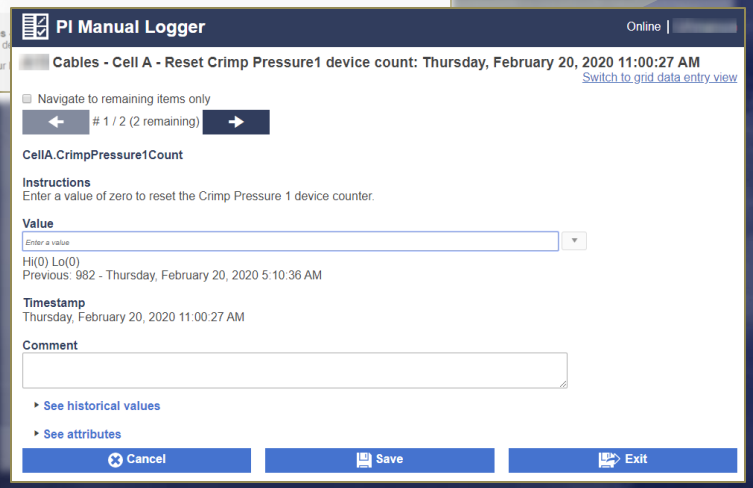
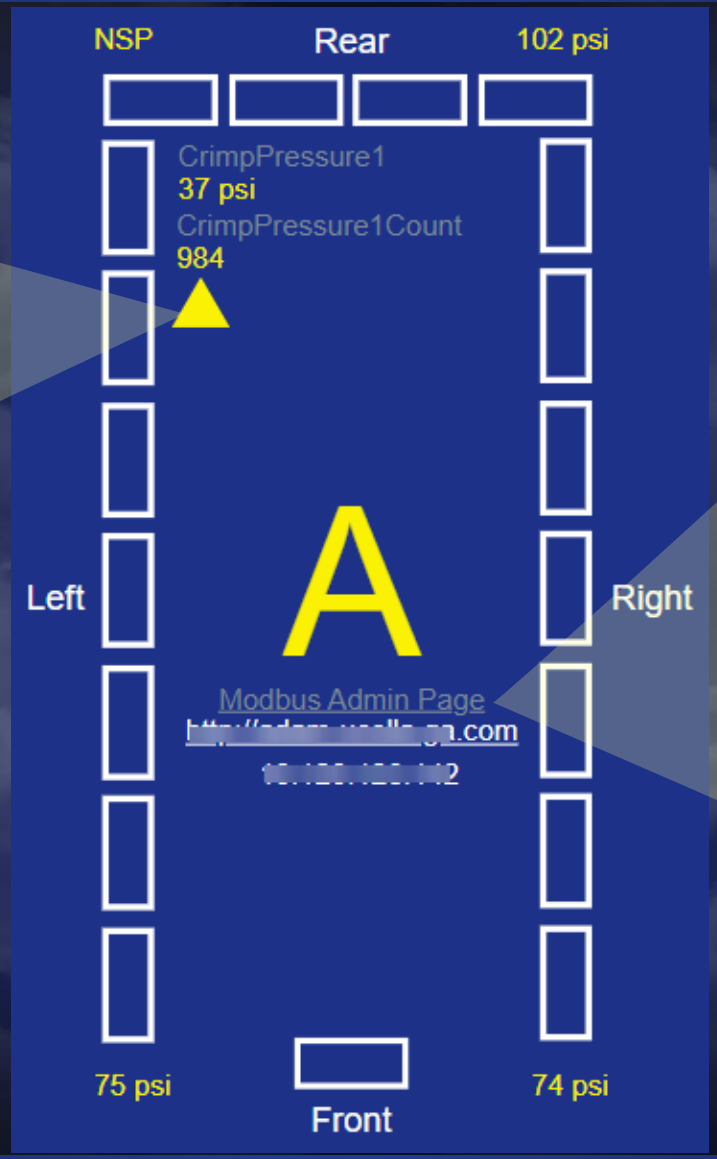
PI Vision Navigation Links/PI Manual Logger







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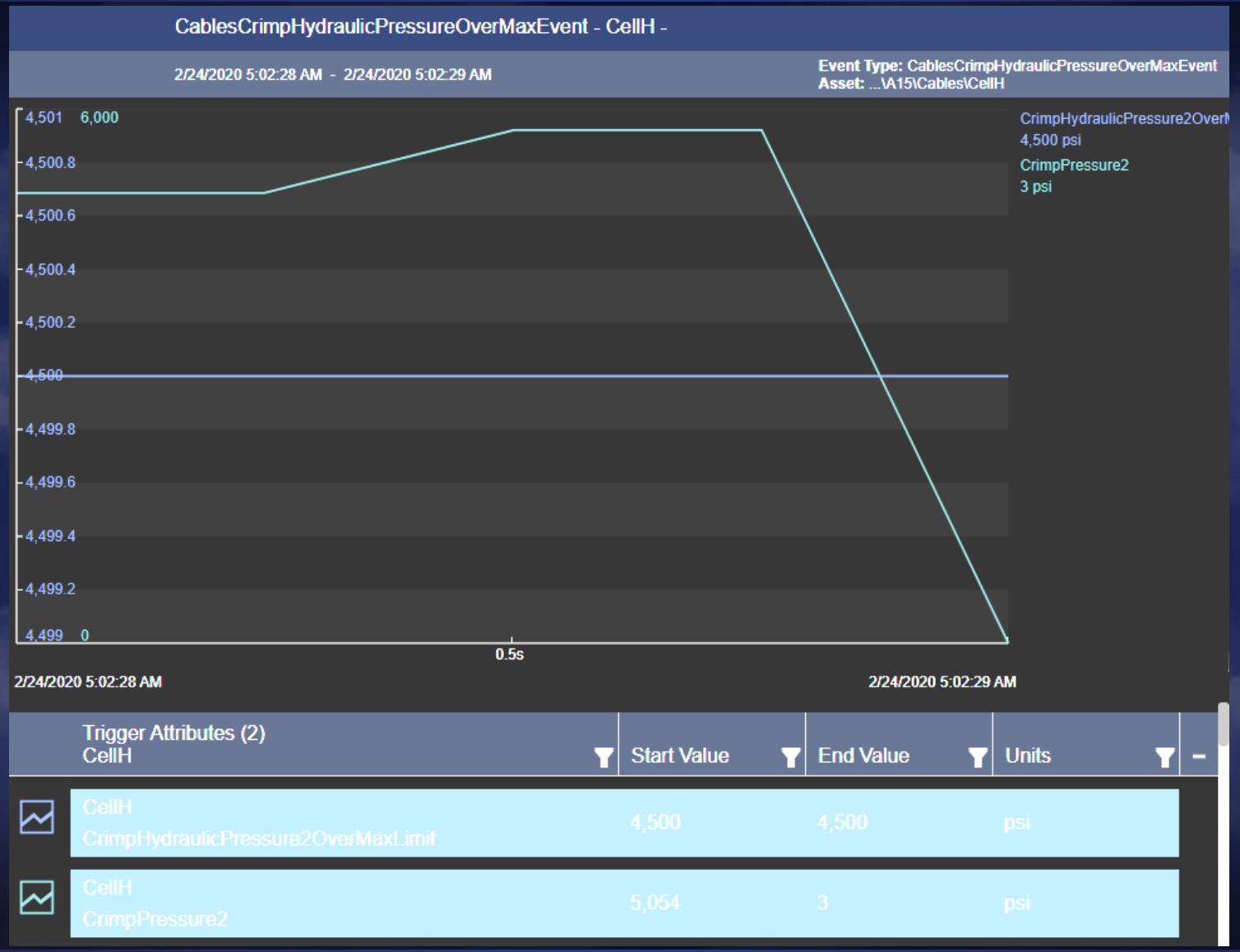
PI Vision Event Frame Display

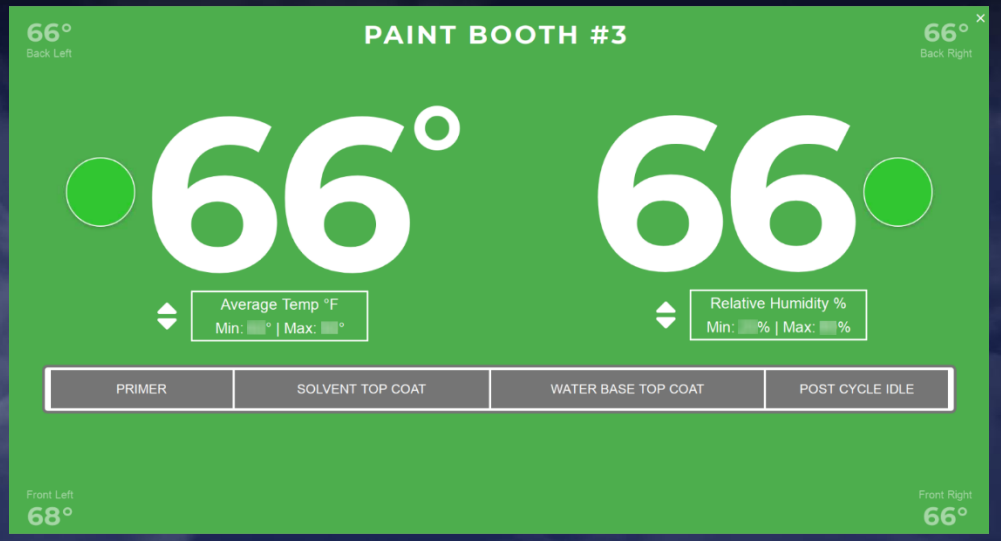
Event Name	Asset	Start Time	Duration	Acknowledgment
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 5:02:28 AM	1.001s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 6:27:21 AM	1.504s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 6:28:10 AM	1.499s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 6:46:48 AM	1.264s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 7:37:56 AM	3.25s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 7:40:06 AM	1.506s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 8:15:01 AM	1.751s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 8:15:24 AM	0.985s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 8:45:28 AM	1.25s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 8:45:46 AM	1.75s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 9:12:10 AM	2.75s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 9:12:52 AM	2.75s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 9:56:10 AM	2.25s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 9:57:12 AM	2.75s	Acknowledge
CablesCrimpHydraulicPressureOverMaxEvent - CellH -	CellH	2/24/2020 10:47:04 AM	1s	Acknowledge
CablesCrimpHydraulicPressu	CellH	2/24/2020 1:34:19 PM	2.25s	Acknowledge

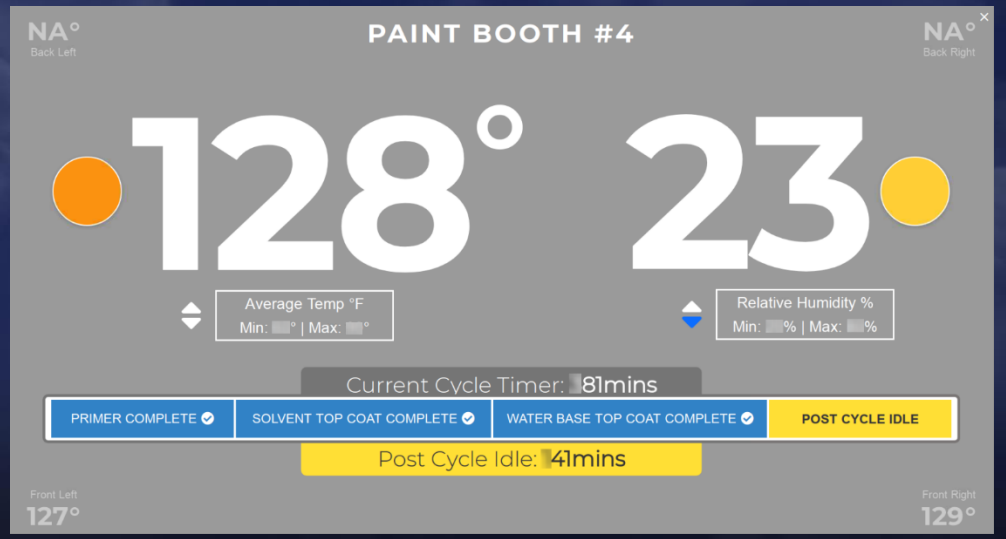
Event Frame Notifications



Updates (PI Vision > PI Web API)

- Paint booths





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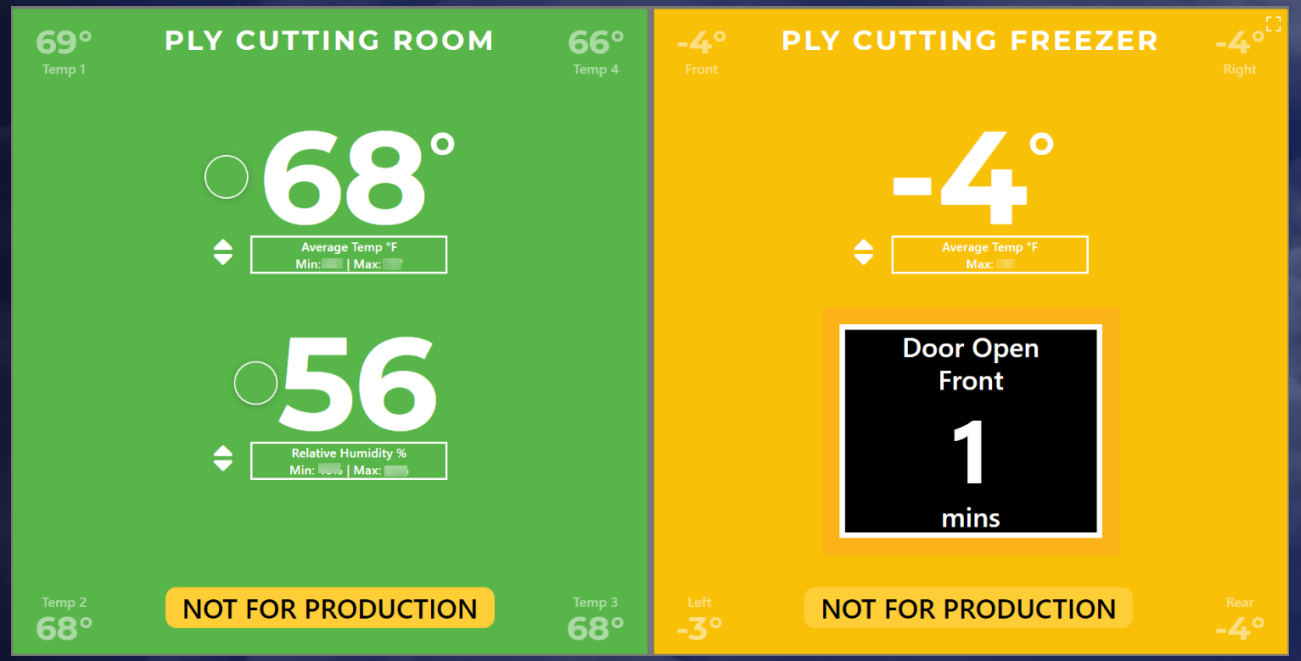
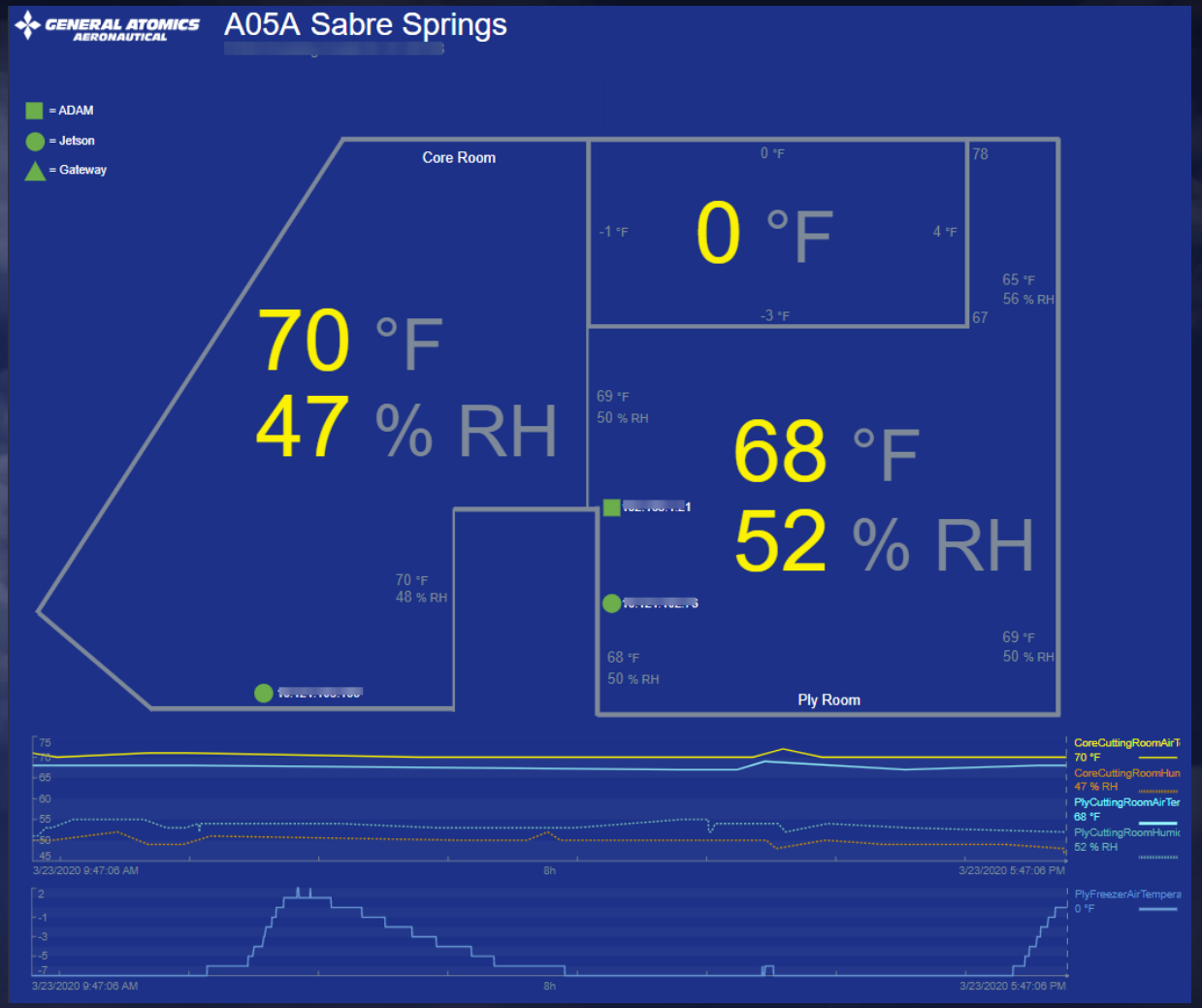
Bonus





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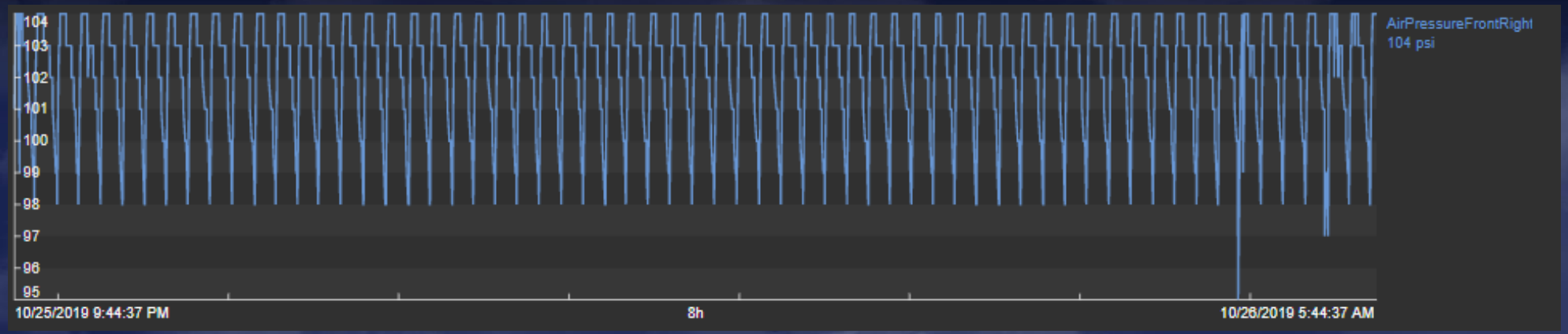
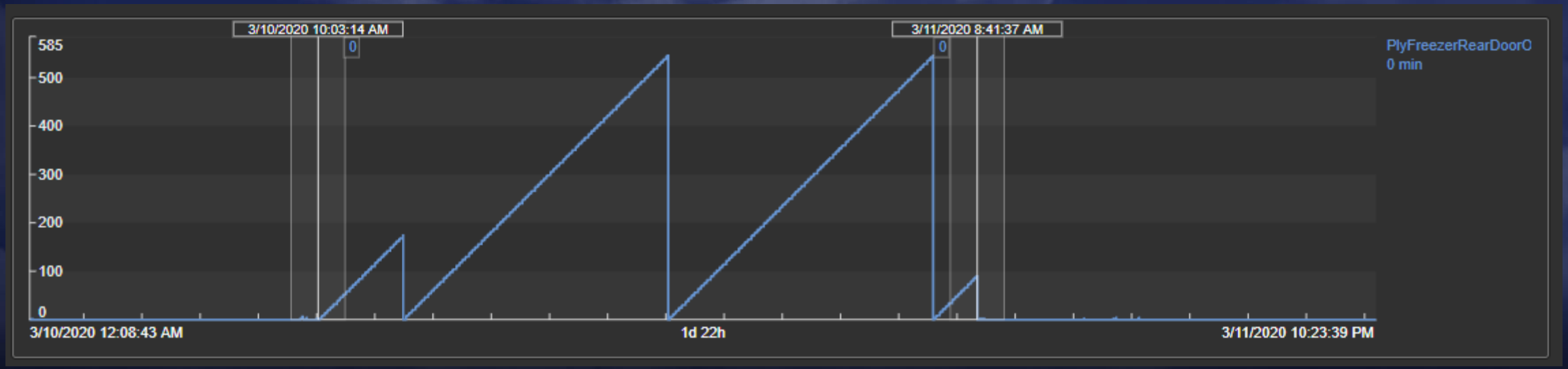
Bonus Bonus





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In Work…..

- TRANE/BACNet
- Freezers
- Paint booths
- Ovens

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Looking Forward….

- **Thermal Chambers**
  - Temperature tracking, analytics
- **Flight Operations**
  - Meteorological monitoring
  - Facility monitoring
- **Machine Shop**
  - All CNC machines
  - All Aeronautical facilities at all geographic locations
  - Assets with opportunities for “sensorization”

CUSTOMER STORY

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CHALLENGES

- Opportunities to improve final aircraft assembly
- Unaware of pressure conditions during assembly
- Number of tool executions before calibration needed

SOLUTION

- PI Asset Framework
  - Setup hierarchy
  - Pressure analysis
  - Notifications
- PI Manual Logger – interact with PI System values
- PI Vision – visualize current and past conditions

BENEFITS

- Historical visibility into past crimps
- Collaboration with quality calibration
- Alerting on various pressure conditions

Engineers and technicians now have digital information in front of them real time indicating requirements and actual assembly results – Russ Manson

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AMSTERDAM
October 26-29, 2020

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