Non-Invasive Digitization of Industrial Plants

Applications and ROI
Version 5 – July 2025

CYPRESS ENVIROSYSTEMS™

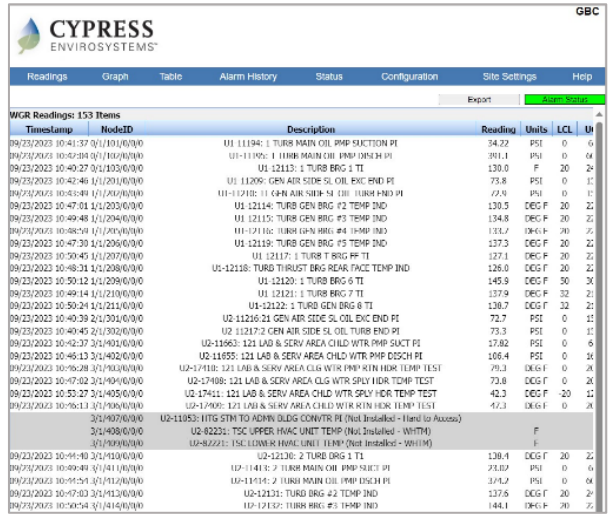
Problem: Most Plant Data is NOT Digitized

Solution: Non-Invasive Sensors – 5 Minute Install

Connection via
RESTful API or OPC

Historian

HMI



Wireless, battery operated, does not touch plant process:
~10% the cost of traditional instrumentation, 5 minute install

Where are they installed?

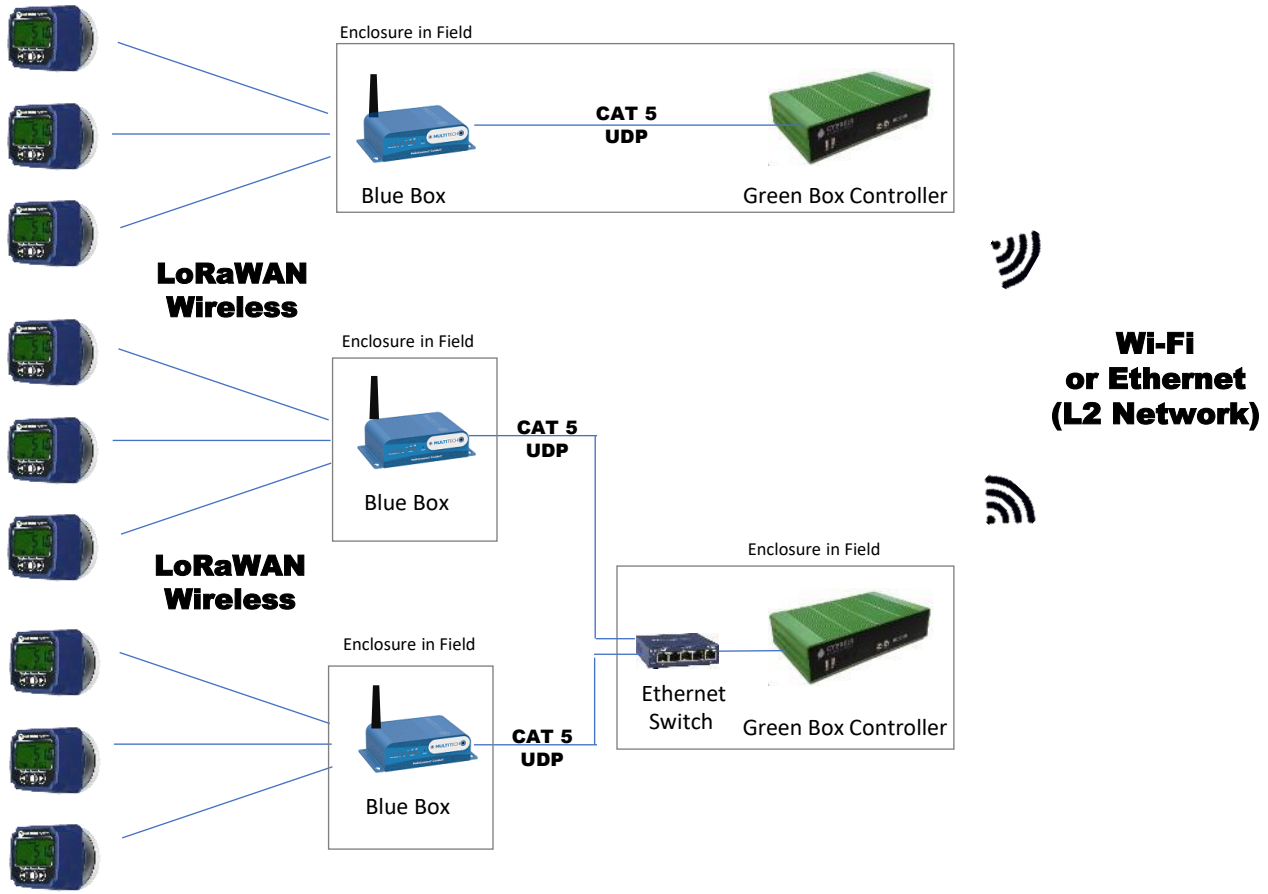
CYPRESS ENVIROSYSTEMS™

Variety of Mounting Methods per Operational Need

- Use of flip doors with gas struts provide hands-free maximum visibility of original gauge

CYPRESS ENVIROSYSTEMS™

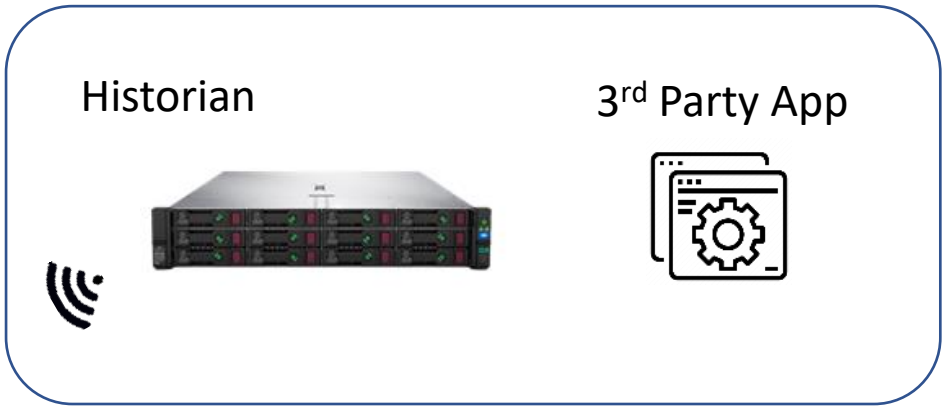
Typical Deployment Architecture – Option 1



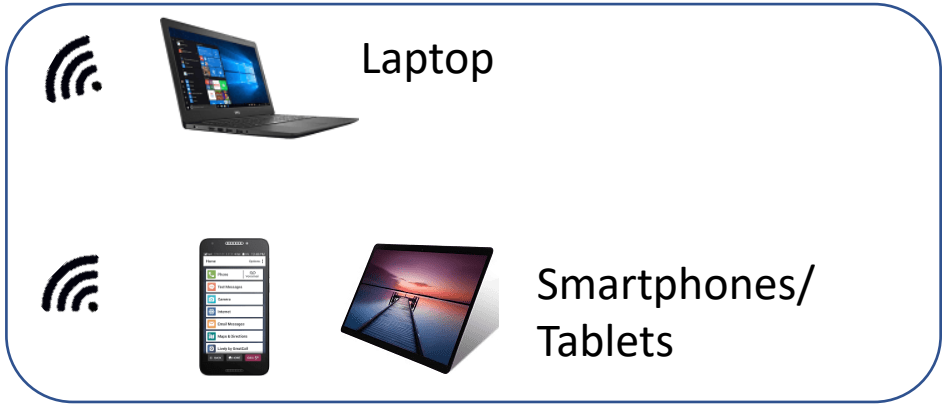
Wireless Gauge Reader

Wi-Fi or Ethernet (L2 Network)

Connection via RESTful API, OPC UA, or OPC DA

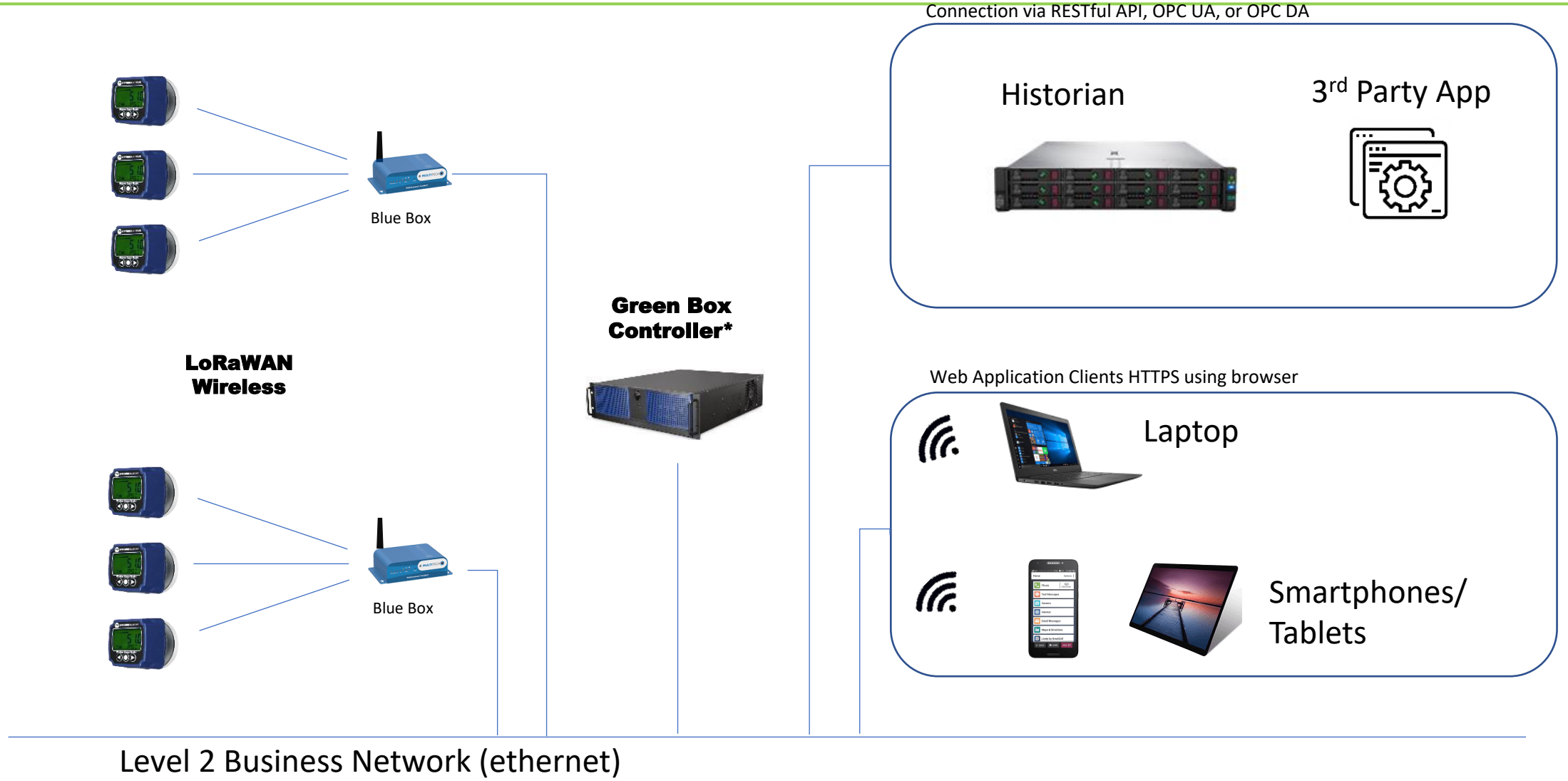


Web Application Clients HTTPS using browser



CYPRESS ENVIROSYSTEMS

Typical Deployment Architecture – Option 2



Data Visibility on Tablets or Plant Historian

CYPRESS ENVIROSYSTEMS™

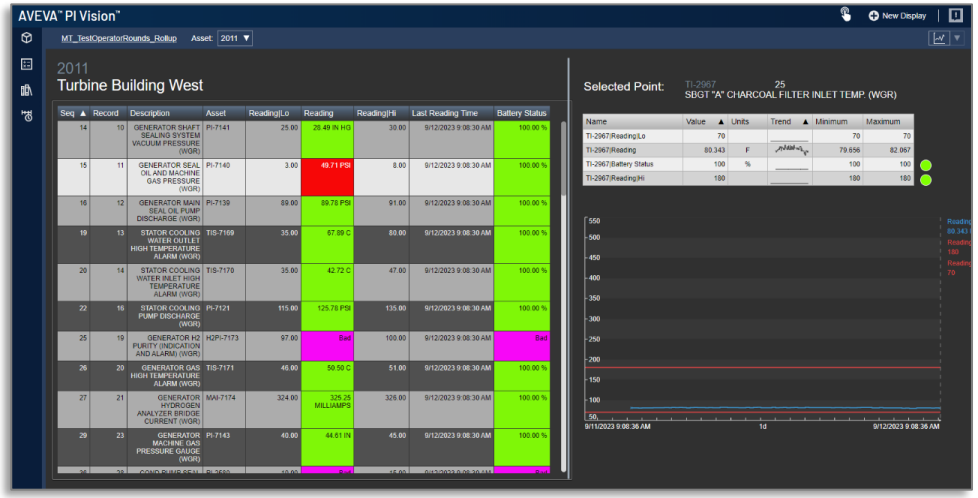
GBC

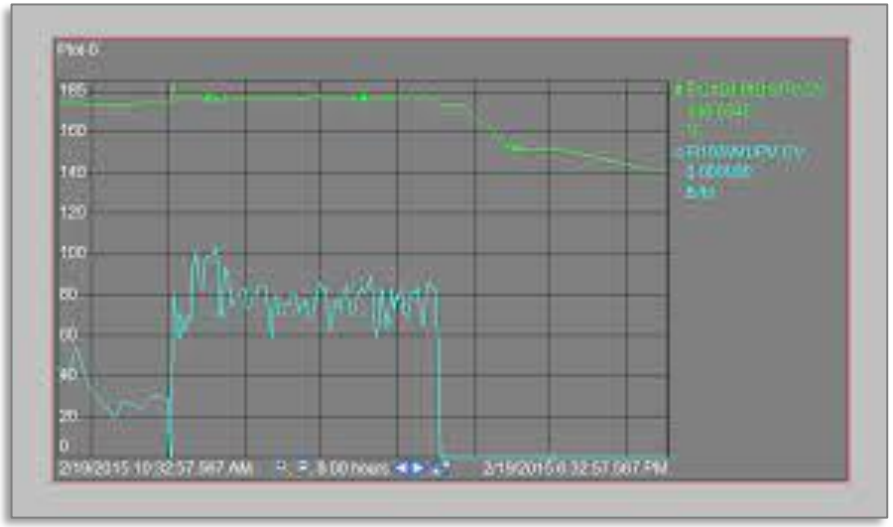
Readings | Graph | Table | Alarm History | Status | Configuration | Site Settings | Help

Export | Alarm Status

WGR Readings: 153 Items

Timestamp	NodeID	Description	Reading	Units	LCL	UC
09/23/2023 10:41:37	0/1/101/0/0/0	U1-11194: 1 TURB MAIN OIL PMP SUCTION PI	34.22	PSI	0	6
09/23/2023 10:42:04	0/1/102/0/0/0	U1-11195: 1 TURB MAIN OIL PMP DISCH PI	391.1	PSI	0	6(
09/23/2023 10:40:27	0/1/103/0/0/0	U1-12113: 1 TURB BRG 1 TI	130.0	F	20	2(
09/23/2023 10:42:46	1/1/201/0/0/0	U1-11209: GEN AIR SIDE SL OIL EXC END PI	73.8	PSI	0	1(
09/23/2023 10:43:49	1/1/202/0/0/0	U1-11210: 11 GEN AIR SIDE SL OIL TURB END PI	72.9	PSI	0	1(
09/23/2023 10:47:01	1/1/203/0/0/0	U1-12114: TURB GEN BRG #2 TEMP IND	130.5	DEG F	20	2(
09/23/2023 10:49:48	1/1/204/0/0/0	U1-12115: TURB GEN BRG #3 TEMP IND	134.8	DEG F	20	2(
09/23/2023 10:48:59	1/1/205/0/0/0	U1-12116: TURB GEN BRG #4 TEMP IND	133.7	DEG F	20	2(
09/23/2023 10:47:30	1/1/206/0/0/0	U1-12119: TURB GEN BRG #5 TEMP IND	137.3	DEG F	20	2(
09/23/2023 10:50:45	1/1/207/0/0/0	U1-12117: 1 TURB T-BRG FF TI	127.1	DEG F	20	2(
09/23/2023 10:48:31	1/1/208/0/0/0	U1-12118: TURB THRUST BRG REAR FACE TEMP IND	126.0	DEG F	20	2(
09/23/2023 10:50:12	1/1/209/0/0/0	U1-12120: 1 TURB BRG 6 TI	145.9	DEG F	50	3(
09/23/2023 10:49:14	1/1/210/0/0/0	U1-12121: 1 TURB BRG 7 TI	137.9	DEG F	32	21
09/23/2023 10:50:24	1/1/211/0/0/0	U1-12122: 1 TURB GEN BRG 8 TI	138.7	DEG F	32	21
09/23/2023 10:40:39	2/1/301/0/0/0	U2-11216:21 GEN AIR SIDE SL OIL EXC END PI	72.7	PSI	0	1(
09/23/2023 10:40:45	2/1/302/0/0/0	U2-11217:2 GEN AIR SIDE SL OIL TURB END PI	73.3	PSI	0	1(
09/23/2023 10:42:37	3/1/401/0/0/0	U2-11663: 121 LAB & SERV AREA CHLD WTR PMP SUCT PI	17.82	PSI	0	6
09/23/2023 10:46:13	3/1/402/0/0/0	U2-11655: 121 LAB & SERV AREA CHLD WTR PMP DISCH PI	106.4	PSI	0	1(
09/23/2023 10:46:28	3/1/403/0/0/0	U2-17410: 121 LAB & SERV AREA CLG WTR PMP RTN HDR TEMP TEST	79.3	DEG F	0	2(
09/23/2023 10:47:02	3/1/404/0/0/0	U2-17408: 121 LAB & SERV AREA CLG WTR SPLY HDR TEMP TEST	73.8	DEG F	0	2(
09/23/2023 10:53:27	3/1/405/0/0/0	U2-17411: 121 LAB & SERV AREA CHLD WTR SPLY HDR TEMP TEST	42.3	DEG F	-20	1:
09/23/2023 10:46:13	3/1/406/0/0/0	U2-17409: 121 LAB & SERV AREA CHLD WTR RTN HDR TEMP TEST	47.3	DEG F	0	2(
	3/1/407/0/0/0	U2-11053: HTG STM TO ADMN BLDG CONVTR PI (Not Installed - Hard to Access)				
	3/1/408/0/0/0	U2-82231: TSC UPPER HVAC UNIT TEMP (Not Installed - WHTM)		F		
	3/1/409/0/0/0	U2-82221: TSC LOWER HVAC UNIT TEMP (Not Installed - WHTM)		F		
09/23/2023 10:44:40	3/1/410/0/0/0	U2-12130: 2 TURB BRG 1 T1	138.4	DEG F	20	2(
09/23/2023 10:49:49	3/1/411/0/0/0	U2-11413: 2 TURB MAIN OIL PMP SUCT PI	23.02	PSI	0	6
09/23/2023 10:44:54	3/1/412/0/0/0	U2-11414: 2 TURB MAIN OIL PMP DSCH PI	374.2	PSI	0	6(
09/23/2023 10:47:03	3/1/413/0/0/0	U2-12131: TURB BRG #2 TEMP IND	137.6	DEG F	20	2(
09/23/2023 10:50:54	3/1/414/0/0/0	U2-12132: TURB BRG #3 TEMP IND	144.1	DEG F	20	2(





CYPRESS ENVIROSYSTEMS™

Cypress Family of Non-Invasive Digitization Solutions

Non-Invasive Sensors

Wireless Gauge Reader

Cycle Isolation Valve Monitor

Wireless Temperature and Humidity Monitor

Steam Trap Monitor

Webcam Digitization
(machine vision)

Vibration Sensors

Wireless Transducer Reader
(thermocouples, 4-20mA, 0-5V, dry contacts, RS-232 etc.)

Magnetic Mount Thermocouple

Void Detection

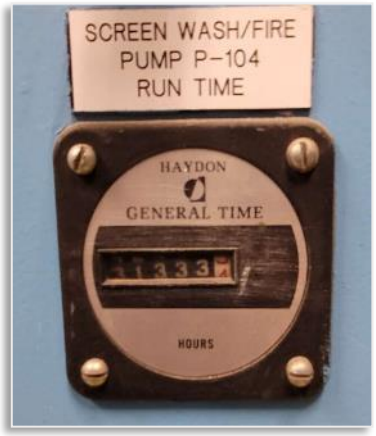
Drone Integration
(machine vision)

Wireless, Battery Operated, Non-Invasive, Install in Minutes
10% Cost of Traditional Approaches

CYPRESS ENVIROSYSTEMS™

Wireless Digit Reader

- Reads numeric indicators
- Exactly same form factor as Wireless Gauge Reader
- Should not require additional engineering review/approval
- Has different firmware than WGR
- Wireless transmission duty cycle is higher - battery life about 30% of WGR. Use slower sample rate to compensate



Wireless Pipe Temperature Monitor

- Clamp on Type K thermocouples to pipe wall
- Thermocouples may also be inserted between pipe insulation and pipe wall
- Small form factor, slim profile – can fit in tight spaces
- Low weight – less than 1 lb – reduces civil and seismic concerns.
- 500 deg F maximum temperature at thermocouple
- Electronics module max temperature of 158 F. Thermocouple wires may be up to 100 ft long.
- Battery life of 3+ years at 15 minute sample rate
- Optional IP67 enclosure available

CYPRESS ENVIROSYSTEMS™

Wireless Steam Trap/Pipe Wall Temp Monitor

Leaking Traps Waste Energy

Typical Steam Trap

- Traps are a necessary part of the steam distribution system, usually hundreds of units per site
- 15-20% average failure rate; leaks steam
- Failed traps lose $5,000 per year (1/8” orifice)
- Manual inspection typically done annually – labor intensive, do not catch problems in timely manner
- Solution: Wireless steam trap monitor detects faults and alarms on error, avoiding expensive leak loss
- Non-invasive installation: no breaking seals, wireless, integrates with BMS
- Battery life of 3+ years at typical sample rates
- IP65/NEMA 4 rated for outdoor use
- One year payback on investment

CYPRESS ENVIROSYSTEMS™

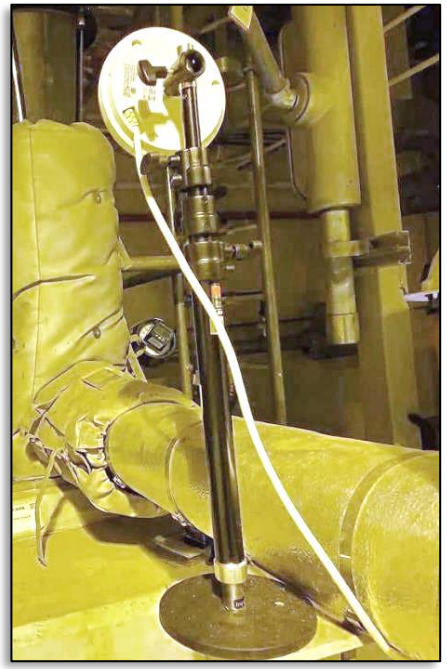
Wireless Transducer Reader

- Software configurable I/O and signal conditioning
- Enables wireless remote monitoring of virtually any analog transducer or instrument with the following outputs: 4-20mA, 0-5V, or 0-10V, RS-232, RS-485, thermocouple, thermistor, dry contacts
- 2 channels per device
- Configurable sample rates from three seconds to four hours
- Compatible with most existing flow meters, current meters, particle counters, thermocouples, weigh scales, etc.
- Battery life of 3+ years at 15 minute sample rate, also accepts 110VAC line power
- IP 67 protection
- Enables data logging to enable trend analysis, notification, or statistical process control

Wireless Humidity, Temperature, Wet Bulb Monitor

- -20 ºC to +70 ºC (-4 ºF to 158 ºF) Temperature Range
- 0 – 100% Relative Humidity Range
- Displays Temperature, Relative Humidity, and Wet Bulb Temperature (optional)
- Used for worker heat stress management, materials life tracking etc.
- Magnetic Mounting for steel walls or columns
- Adhesive Mounting for other surfaces
- Battery life of 3+ years at 15 minute sample rate
- IP56/NEMA 4 rated for outdoor use

IP Camera Monitoring Automation



- Capture images from 3rd party IP Cameras
- Use GBC machine vision engine to automatically convert to digital value and store for history, trending, alarming
- No need for human operator to always check camera feed
- Leverage existing approved data architecture

CYPRESS ENVIROSYSTEMS™

Wireless Liquid Level Monitor – mobile application

INSTALLED

CYPRESS ENVIROSYSTEMS

Vibration Monitoring

HONEYWELL
VERSATILIS TRANSMITTER

Multi-Variant Sensing

Honeywell Versatilis™ Transmitter is a multi-variant sensing platform based on the latest LoRaWAN® protocol communication technology. Its inherently low-power compact design coupled with quick & easy installation, and commission helps manufacturers to deploy them at scale with the lowest CAPEX and negligible OPEX. These sensors are designed to monitor and predict the health of rotating equipment like motors, pumps, blowers, fans, compressors, and gearboxes. In addition, they can be deployed to remotely monitor the position of manual valves, the health of steam traps, and the surface temperature of static process equipment. They can also be deployed to monitor environmental conditions in life science facilities.

Figure 1– Honeywell Versatilis Transmitter

MEASUREMENT PARAMETERS:

Surface Temperature	Ambient Humidity	Ambient Pressure
Vibration	Audio Acoustics	Ambient Temperature

SENSORS AND COMMUNICATIONS:

The Honeywell Versatilis platform contains a suite of sensors encompassing versatile sensing parameters such as pressure, temperature, humidity, triaxial accelerometer, and audio acoustics MEMS to provide insightful measurements. Sensors on the platform are selected to cover a broad frequency spectrum enabling adequate sensing coverage of process and physical phenomena. Sensor fusion analysis on the acquired measurements can be performed. Any specific parameter is customizable in either software or hardware according to the requirement of a specific application. Each measured parameter contributes a unique dimension thereby augmenting the system into a multi-dimension sensing platform. Sensor data can be transferred over the LoRaWAN® network which is protected through secure key authentication. The Honeywell Versatilis Transmitter can be configured to notify the application through Event Triggers and FFT (Fast Fourier Transform) Triggers.

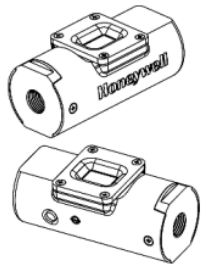


Figure 2– Assembly

Honeywell

Honeywell Versatilis™ Transmitter Technical Specification Honeywell Proprietary

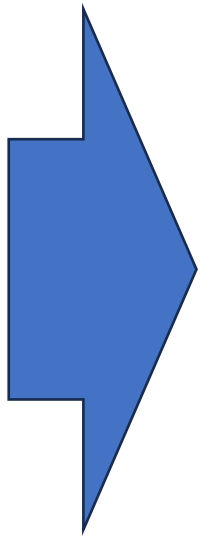
CYPRESS ENVIROSYSTEMS™

Return on Investment
Use Cases

Plant-wide Engagement – Broad benefits

DEPARTMENT:

- Operations
- Maintenance
- Engineering
- Environmental Compliance
- Worker Safety
- Monitoring & Diagnostics Center



BENEFITS:

- Improve operator efficiency
- Equipment fault detection/reduce unplanned downtime
- Reduce maintenance cost – enable condition-based maintenance
- Improve worker safety – confined space, heights
- Troubleshooting via crash cart, emergent needs

Crash Cart for Emergent Issues

Southern Hatch

Need:

- Plant needs data quickly to troubleshoot, diagnose and correct emergent issues.

Concept:

- Use Crash Cart with non-invasive sensors to collect data
- Pre-approved, ready to install in 30 minutes.

Benefit:

- Avoid lengthy engineering reviews and approvals to add sensors
- Minimize operator man-hours
- Reduce plant downtime

Steam Trap Monitoring Energy Savings

WSTM Payback Calculator[2] (years)

WSTM Installed Cost[3]:

$850 per unit

Your Steam Cost:

$20 per 1,000 lbs.

Inspection Frequency[4]:

1 times/year

Inspection Costs[5]:

$5 per trap

Facility Uptime:

365 days/year

Failure Rate[6]:

15% per year

Steam Trap Orifice Diameter[1]

Steam Pressure PSI (gauge)	1/32"	1/16"	3/32"	1/8"	5/32"	3/16"	7/32"	1/4"	9/32"	5/16"	11/32"	3/8"	13/32"	7/16"	15/32"	1/2"
5	76.4	28.9	14.2	8.3	5.4	3.8	2.8	2.2	1.7	1.4	1.2	1.0	0.9	0.8	0.7	0.6
10	67.1	23.8	11.5	6.7	4.4	3.1	2.3	1.8	1.4	1.1	1.0	0.8	0.7	0.6	0.5	0.5
15	59.7	20.3	9.7	5.6	3.7	2.6	1.9	1.5	1.2	1.0	0.8	0.7	0.6	0.5	0.5	0.4
25	49.0	15.7	7.4	4.2	2.8	1.9	1.4	1.1	0.9	0.7	0.6	0.5	0.5	0.4	0.4	0.3
50	33.9	10.0	4.6	2.6	1.7	1.2	0.9	0.7	0.6	0.5	0.4	0.3	0.3	0.3	0.2	0.2
75	25.9	7.3	3.4	1.9	1.3	0.9	0.7	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2
100	20.9	5.8	2.7	1.5	1.0	0.7	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1
125	17.6	4.8	2.2	1.3	0.8	0.6	0.4	0.4	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1
150	15.2	4.1	1.9	1.1	0.7	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1
175	13.3	3.6	1.6	0.9	0.6	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
200	11.9	3.2	1.5	0.8	0.6	0.4	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
225	10.7	2.9	1.3	0.8	0.5	0.4	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
250	9.8	2.6	1.2	0.7	0.5	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
275	9.0	2.4	1.1	0.6	0.4	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
300	8.3	2.2	1.0	0.6	0.4	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Payback Period

0 - 2 Years | 2 - 8 Years | 8+ Years

1. Orifice diameter should not be confused with pipe diameter. Consult the steam trap manufacturer if orifice size is not known.
2. Calculations are theoretical estimates and actual results will vary. Payback calculation includes avoided lost steam and inspection labor. Benefits from avoided damage resulting from blocked traps are not included in model. The formula used for steam loss in this model is: L=24.24*Pa*D2. Where L=pounds/hour, Pa=Pgauge + Patm , D=orifice diameter.
http://www.energy.rochester.edu/efficiency/steam.pdf
3. Actual WSTM installed cost will vary based on volume and integrator.
4. Refers to the manual inspections of steam traps that are currently being done at the facility. The frequency determines the potential avoided failure time when using the WSTM.
5. The frequency and cost of inspection determine the labor savings enabled by the WSTM.
6. The failure rate per year should be based on historical data from the facility. 15-20% failure rates per year are typical. In unmaintained facilities, the failure rate can be much higher:
http://www1.eere.energy.gov/femp/pdfs/om_combustion.pdf

CYPRESS ENVIROSYSTEMS

Webcam Digitization

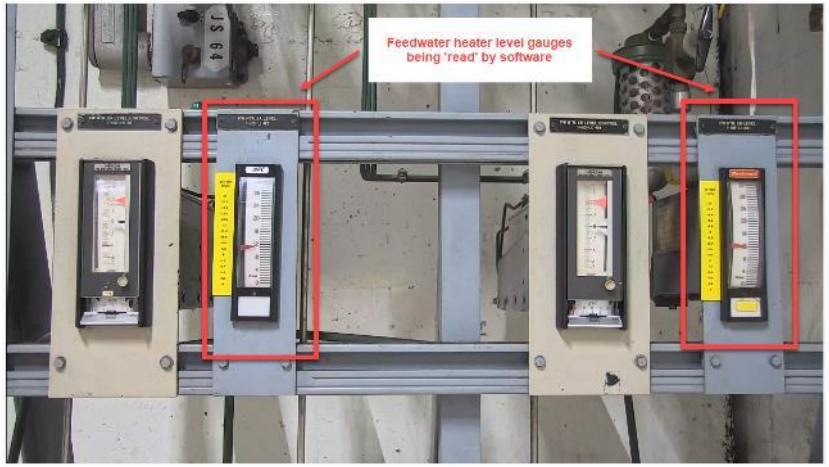
Duke Brunswick

Need:

- Automate data collection from feedwater heater including heater level.
- Prior issue resulted in heater taken offline for repairs.
- Must rely on vertical gauge local indicator.

Solution:

- Install Panasonic IP camera, use GBC machine vision capability to digitize image.
- Data can be stored in PI Historian.
- Operator can look at digitized trend data on PI Vision instead of just watching webcam video.



Data collected and displayed via PI Historian

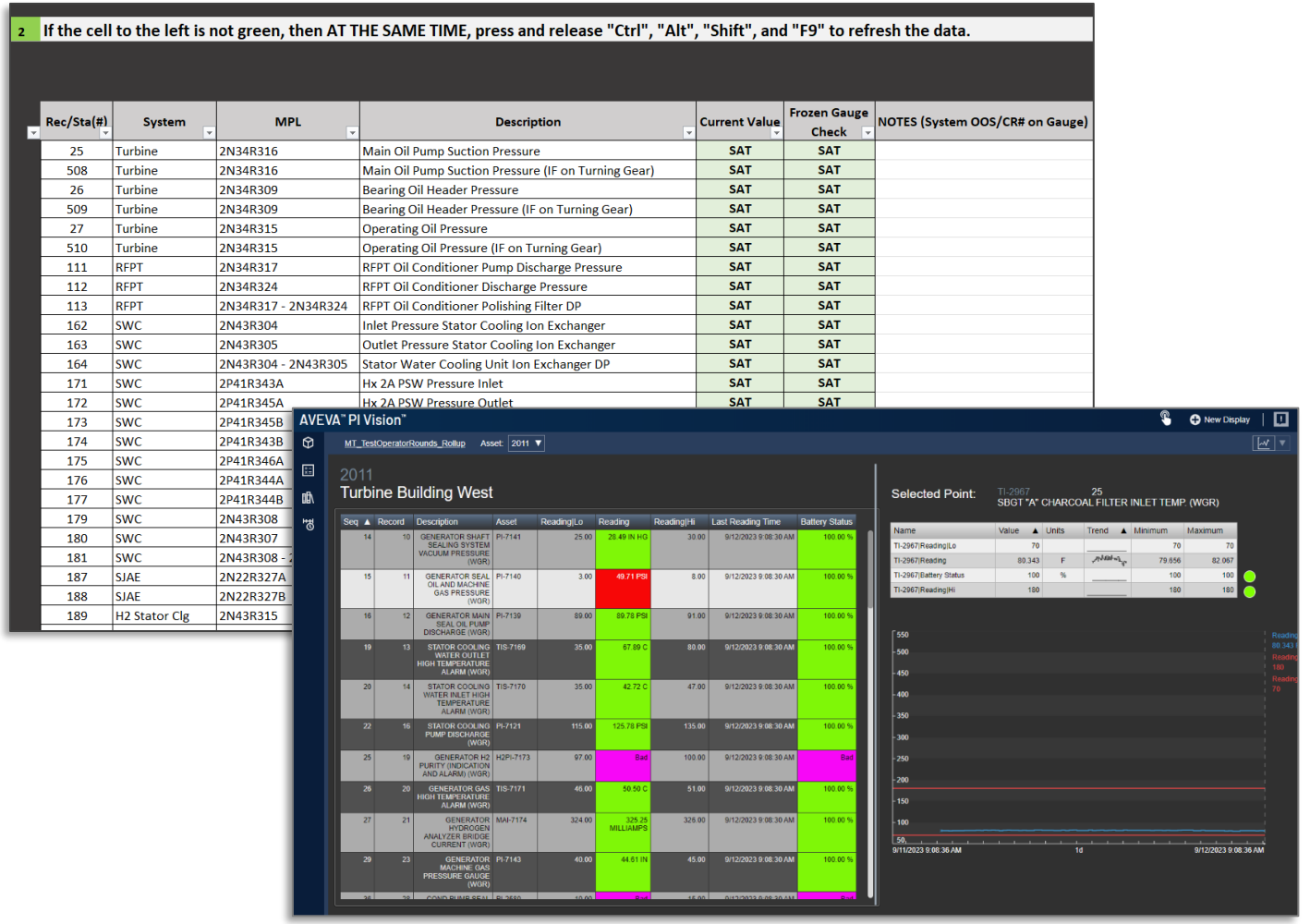
Operator Rounds Dashboard

Concept:

- Collect rounds data throughout day using WGRs
- Operators can review trends and identify abnormalities at start of shift
- Plan and prioritize work more efficiently

Benefit:

- Reduce operator time by 2 hours per shift
- Faster response to excursions / emergent issues



2 If the cell to the left is not green, then AT THE SAME TIME, press and release "Ctrl", "Alt", "Shift", and "F9" to refresh the data.

Rec/Sta(#)	System	MPL	Description	Current Value	Frozen Gauge Check	NOTES (System OOS/CR# on Gauge)
25	Turbine	2N34R316	Main Oil Pump Suction Pressure	SAT	SAT	
508	Turbine	2N34R316	Main Oil Pump Suction Pressure (IF on Turning Gear)	SAT	SAT	
26	Turbine	2N34R309	Bearing Oil Header Pressure	SAT	SAT	
509	Turbine	2N34R309	Bearing Oil Header Pressure (IF on Turning Gear)	SAT	SAT	
27	Turbine	2N34R315	Operating Oil Pressure	SAT	SAT	
510	Turbine	2N34R315	Operating Oil Pressure (IF on Turning Gear)	SAT	SAT	
111	RFPT	2N34R317	RFPT Oil Conditioner Pump Discharge Pressure	SAT	SAT	
112	RFPT	2N34R324	RFPT Oil Conditioner Discharge Pressure	SAT	SAT	
113	RFPT	2N34R317 - 2N34R324	RFPT Oil Conditioner Polishing Filter DP	SAT	SAT	
162	SWC	2N43R304	Inlet Pressure Stator Cooling Ion Exchanger	SAT	SAT	
163	SWC	2N43R305	Outlet Pressure Stator Cooling Ion Exchanger	SAT	SAT	
164	SWC	2N43R304 - 2N43R305	Stator Water Cooling Unit Ion Exchanger DP	SAT	SAT	
171	SWC	2P41R343A	Hx 2A PSW Pressure Inlet	SAT	SAT	
172	SWC	2P41R345A	Hx 2A PSW Pressure Outlet	SAT	SAT	
173	SWC	2P41R345B				
174	SWC	2P41R343B				
175	SWC	2P41R346A				
176	SWC	2P41R344A				
177	SWC	2P41R344B				
179	SWC	2N43R308				
180	SWC	2N43R307				
181	SWC	2N43R308 -				
187	SJAE	2N22R327A				
188	SJAE	2N22R327B				
189	H2 Stator Clg	2N43R315				

AVEVA™ PI Vision™

MT_TestOperatorRounds_Rollup Asset: 2011

2011
Turbine Building West

Selected Point: TI-2967 25
SBGT "A" CHARCOAL FILTER INLET TEMP (WGR)

Gas Cylinder Monitoring

CATERPILLAR®

Long Distances

Basement

Concrete and Metal walls

- Peoria, IL ~200 Cylinders
- Initial installation in 2011
- Large site, basement areas
- Demanding, data driven end-customer

Secure IT Environment

CYPRESS ENVIROSYSTEMS™

Condition Based Maintenance – Filter Delta Pressure

Environmental Compliance – Hour Meter Monitoring

- As part of a Groundwater Protection Plan, Cypress installed wireless gauge readers on sump pump hour meters to track electrical manhole sump pump run-time.
- No current method to monitor sump levels automatically.
- Catch two types of faults:
  - Pumps not running when they should (sump level too high)
  - Pumps running too much (must be a leak)
- Automate environmental compliance reporting

Bag House – Condition Based Maintenance

Typical Baghouse

Baghouses Require Frequent Maintenance and Inspection

- Existing analog systems make maintaining baghouses challenging
- Regulatory audits can be cumbersome due to lack of historical data
- Failures can persist for weeks or months without notice, increasing potential fines and safety risks
- Manual inspection of analog systems is labor intensive
- Production line efficiency can be impacted
- Energy is wasted

CYPRESS ENVIROSYSTEMS

Compress Air Systems Energy Savings

Customer Challenge:

Compressed air systems are one of the largest energy users in a manufacturing facility which often run at settings beyond what is needed.

Monitoring of the compressed air system is intrusive and expensive

Installing additional compressed air capacity to accommodate system needs due to excessive leakage and compressor duty cycling.

WGR Solution:

Typically manual gauges are already installed throughout CDA systems or coolant loop systems.

WGR's can monitor and alarm pressure/flow to ensure process integrity and reduce energy use.

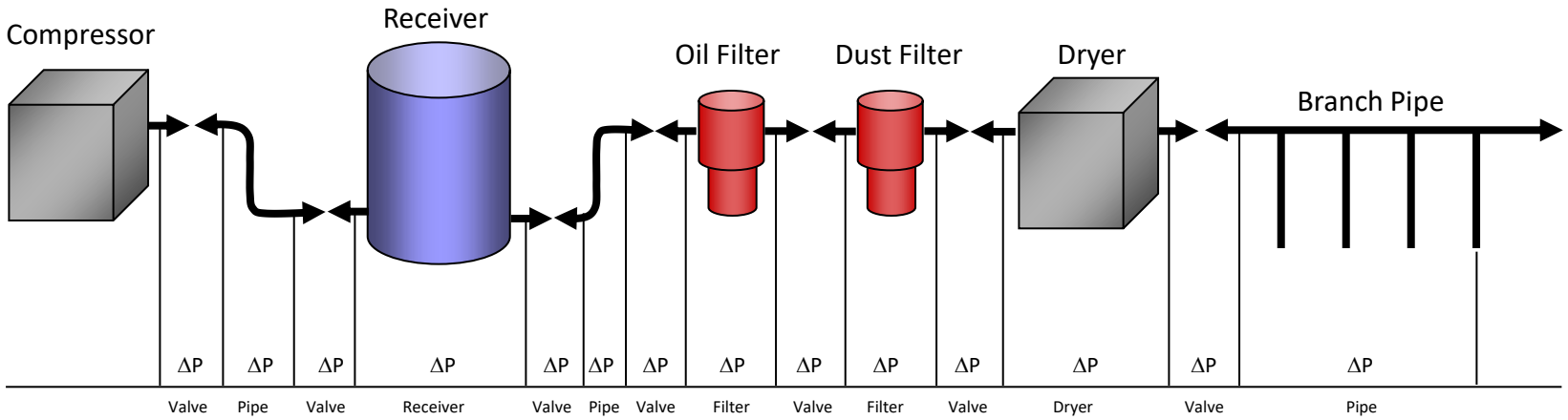
App note available:
"Compressed Dry Air System Energy Savings"

CYPRESS ENVIROSYSTEMS

Compressed Air System Energy Savings

Design Case

Compressor Working Pressure		End User Pressure
105 psi	15 psi loss	90 psi



Typical Case

Compressor Working Pressure		End User Pressure
125 psi	Unknown Loss	Must keep at least 90 psi

Clogged Filters, Leaks, Peak Usage

CYPRESS ENVIROSYSTEMS

Cypress network:
Open System to Integrate with 3rd LoRaWAN sensors

Integration of 3rd Party LoRaWAN devices

MultiTech Reveal™ Wireless Proximity Sensors

MultiTech Reveal™ LoRaWAN Wireless Proximity Sensors detect contact between two wires, proximity detection with a magnet, range with an ultrasonic signal, while the Reveal UltraSonic Level Sensors provide high accuracy proximity detection and ranging in air.

MultiTech Reveal™ Wireless Push Button Sensors

The MultiTech Reveal™ LoRaWAN Wireless Push Button Sensor transmits on a button press event. They can be used as a panic button wearable device, personal emergency response system (PERS), remote control or other remote push button applications. When the button is pressed, an alert is sent to the wireless network.

MultiTech Reveal™ Wireless Movement Sensors

MultiTech Reveal™ LoRaWAN Wireless Movement Sensors use an ultra sensitive internal accelerometer to detect movement of a critical asset. When movement is detected that exceeds a certain threshold, an alert is sent over the wireless network. Reveal Tilt Sensors detect transitions between horizontal and vertical orientation, as well as reporting the angle of the tilt.

MultiTech Reveal™ Wireless Leak Detection Sensors

MultiTech Reveal™ LoRaWAN Wireless Leak Detection Sensors use a water probe to detect the presence of water or other liquids. When the presence of water or another liquid is detected, an alert is sent over the wireless network to prevent a potentially catastrophic event.

- Integrate devices with Cypress Gateway and GBC
- Same wireless network infrastructure
- Same cyber security approval
- Same OSI PI connectivity

CYPRESS ENVIROSYSTEMS™

Integration of 3rd Party Sensors

3rd party LoRaWAN sensor

Enclosure in Field

Blue Box

CAT 5
UDP

Green Box

Plant Wi-Fi or Ethernet (L2 Network)

Connection via RESTful API, OPC UA, or OPC DA

OSI PI Historian

3rd Party App

Web Application Clients HTTPS using browser

Laptop

Smartphones/ Tablets

CYPRESS ENVIROSYSTEMS™