AIM® brings intelligence to wireless technology by applying smart thinking devices to monitor critical plant applications in real time.

Three Challenges - One Intelligent System Solution

Three constant challenges that plant managers and maintenance personnel face in the operation of any system include:

1. **Identifying a failure:** ability to immediately pinpoint what has failed, when it failed and where it failed.
2. **Evaluating the scope:** comprehending the magnitude of the failure related to process and utility systems.
3. **Measuring the impact:** accurately calculate the costs including process disruptions, wasted energy and plant shut downs, safety hazards and fines levied.

AIM® enables your team to tackle all three challenges with one system solution that combines a mix of methods including acoustic and temperature monitoring with integrated smart wireless solutions that deliver:

- Immediate failure notification of devices such as steam traps
- Immediate notification of release to flare for emissions mitigation
- Pinpoint accuracy of failure location for fast resource deployment
- Detection of “sizzling” relief valves for proactive maintenance scheduling
- Preemptive warning of hazardous vapor release to improve worker safety

*last updated 11/15

Scenario 1: Condensate Back Up Caused by Steam Trap Malfunctions

- **Problem:** The customer was experiencing problems with multiple steam traps that caused condensate to back up into their steam turbine. This issue caused severe downtime and decreased performance, directly affecting their bottom line.
- **Solution:** The customer installed a ST5700 on the defected steam traps to monitor their condition. If issues were to arise, the customer was made aware of a problem before condensate backed up into their steam turbine thus solving the issue before it occurred.
- **Result:** The instant notification from Armstrong's ST5700 helped the customer decrease downtime and increase production directly stabilizing or increasing their performance. The customer realized significant value in being instantly alerted by the ST5700 so the team could react immediately.

Scenario 2: Significant Energy Loss on Steam Lines

- **Problem:** The customer was realizing significant energy loss due to failed steam traps on high pressure steam lines.
- **Solution:** The customer installed ST5700 devices on their steam trap population on high pressure lines to provide consistent monitoring to alert their team when a steam trap failed.
- **Result:** Armstrong's wireless monitoring system proved to lower energy loss substantially thus increased performance and profits for the customer.

Scenario 3: Critical Steam Traps in Inaccessible Locations

- **Problem:** The customer's hard-to-access steam traps were 105 feet off the ground, in the middle of a pipe rack with no scaffolding support. When checking the traps, employees had to install scaffolding and a lift, causing the road to be blocked. As the traps were being checked, traffic is stopped thus causing a decrease in efficiency.
- **Solution:** The customer installed a ST5700 on critical steam traps throughout the plant that were difficult to access. Armstrong's ST5700 allowed the customer to continuously monitor the traps' condition to ensure proper operation. If any trap failed, the system would immediately detect its condition and notify the company.
- **Result:** The customer recognized a decrease in downtime since their steam trap system could be monitored remotely. Since Armstrong's wireless steam trap monitoring system was implemented, the customer was able to reallocate manpower to other projects in the field.

*last updated 11/15

Scenario 1: Excessive Flare

- **Problem:** The customer experienced burn off of valuable feed stocks and gasses due to interruptions in normal unit operations.
- **Solution:** Armstrong's AD5000 was installed downstream from the safety relief valve. The AD5000 device detected any leak through the valve and alarmed the control system so that action could be taken.
- **Result:** By continuously monitoring the safety relief valve, the customer was able to immediately pinpoint the exact location of the discharge. The immediate notification empowered the customer to eliminate the small leak mitigating the possibility of a full discharge.

Scenario 2: Leaking Isolation Shut Off Valves

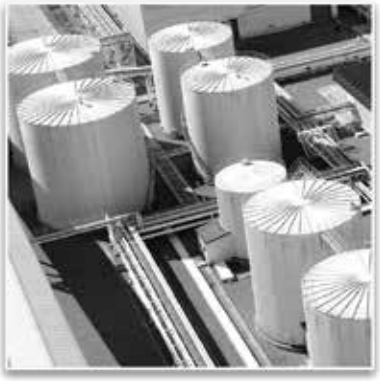
- **Problem:** The customer experienced problems identifying the location of a leaking isolation shut off valve. When leaking shut off valves bypass materials for critical process, production efficiency decreases significantly.
- **Solution:** An AD5000 was installed to acoustically monitor and identify when and where leaks occurred along the line. If a potential leak was identified, the customer would be immediately notified to avoid even more leakage.
- **Result:** Because of Armstrong's proactive acoustic monitoring solution, the customer reduced material loss due to immediate location identification.

Scenario 3: Gas Pressure Regulator Failure

- **Problem:** The customer was experiencing issues identifying why their steam system's gas pressure regulator was failing. The potential danger of a failed gas regulator concerned the customer significantly.
- **Solution:** An AD5000, which operated using a WirelessHART gateway, was installed on the gas pressure regulator. The device was integrated into a control system using a Modbus connection to increase the accountability of real-time alerts.
- **Result:** The customer enjoyed reduced process loss due to immediate identification and location of the root cause. More importantly, the customer was able to lessen the threat of safety issues.

*last updated 11/15

Scenario 1: Temperature Fluctuations in Storage Tanks



- **Problem:** Temperature fluctuations in the customer's bulk storage tanks caused high viscosity which created potential pumping issues.
- **Solution:** A TD5100 was installed on the storage tanks to continuously monitor the temperature and location of the tank. By monitoring the storage tanks, the customer observed temperature fluctuations so that action could be taken before pumping problems occurred.
- **Result:** The customer enjoyed immediate storage tank temperature warnings as well as tank location to prevent potential pumping problems such as transfer/tank loading issues caused by high viscous material.

Scenario 2: Sulfur/Asphalt Transfer

- **Problem:** Potential solidification in the customer's sulfur/asphalt transfer lines was caused by consistent temperature fluctuations.
- **Solution:** The customer installed a TD5100 to gather low temperature readings to help prevent process loss by continually monitoring sulfur/asphalt line condition.
- **Result:** The customer received immediate low temperature indications and locations on sulfur/asphalt lines to prevent possible material solidification. Process interruption was avoided thus boosting efficiency and sustaining the customer's bottom line.

Scenario 3: Pump Trap Failure

- **Problem:** Pump trap failure caused condensate backup, flooding coils and process equipment, causing harm to the customer's steam system and equipment.
- **Solution:** The customer installed a TD5100 to wirelessly monitor the skin temperature of any pipe, vessel or piece of equipment. Using non-intrusive technology combined with WirelessHART, the TD5100 was placed on the inlet of the pump trap to communicate back to the control system.
- **Result:** Early detection of reduced inlet condensate temperature to pump trap allowed the customer to prevent potential failure.

*last updated 11/15

The HART Communication Protocol has served as the world's leading process communication technology for smart instruments since 1989. Today, more than 30 million HART devices are installed and in service worldwide.

Industry suppliers are manufacturing and shipping HART products in record numbers—75% of the smart devices installed are HART-enabled.

More HART products are installed in more plants around the world than any other. No other communication protocol comes close. Wireless technology allows users to access the vast amount of unused information stranded in these installed HART smart devices— 85% of the installed HART devices. It also provides a cost-effective, simple and reliable way to deploy new points of measurement and control without the wiring costs.

Simple
- Reduced installation and wiring costs
- Always on security
- Adjusts as new instruments are added and to changes in plant infrastructure

Reliable
- "Hops" across channels
- Co-existence with other wireless networks
- Optimizes bandwidth and radio time
- Mesh network and multiple access points

Secure
- Protects valuable information with multi-layered security
- Robust multi-tiered always on security
- Protects wireless network with channel hopping
- Reports message integrity failures and authentication failures

Item	Description
Based on Industrial Standards	HART - IEC 61158 Wireless HART - IEC/PAS 62591Ed.1 EDDL - IEC 61804-3 Radio & MAC - IEEE 802.15.4(TM)-2006 IEC/PA
Radio Standard	IEEE 802.15.4-2006 @ 250kbps
Frequency Band	2.4GHz
Frequency Management	Channel hopping on a per packet basis
Distance	Up to 250 m (820 ft) line-of-sight between devices
Power	Battery
Topologies	Wireless HART Mesh

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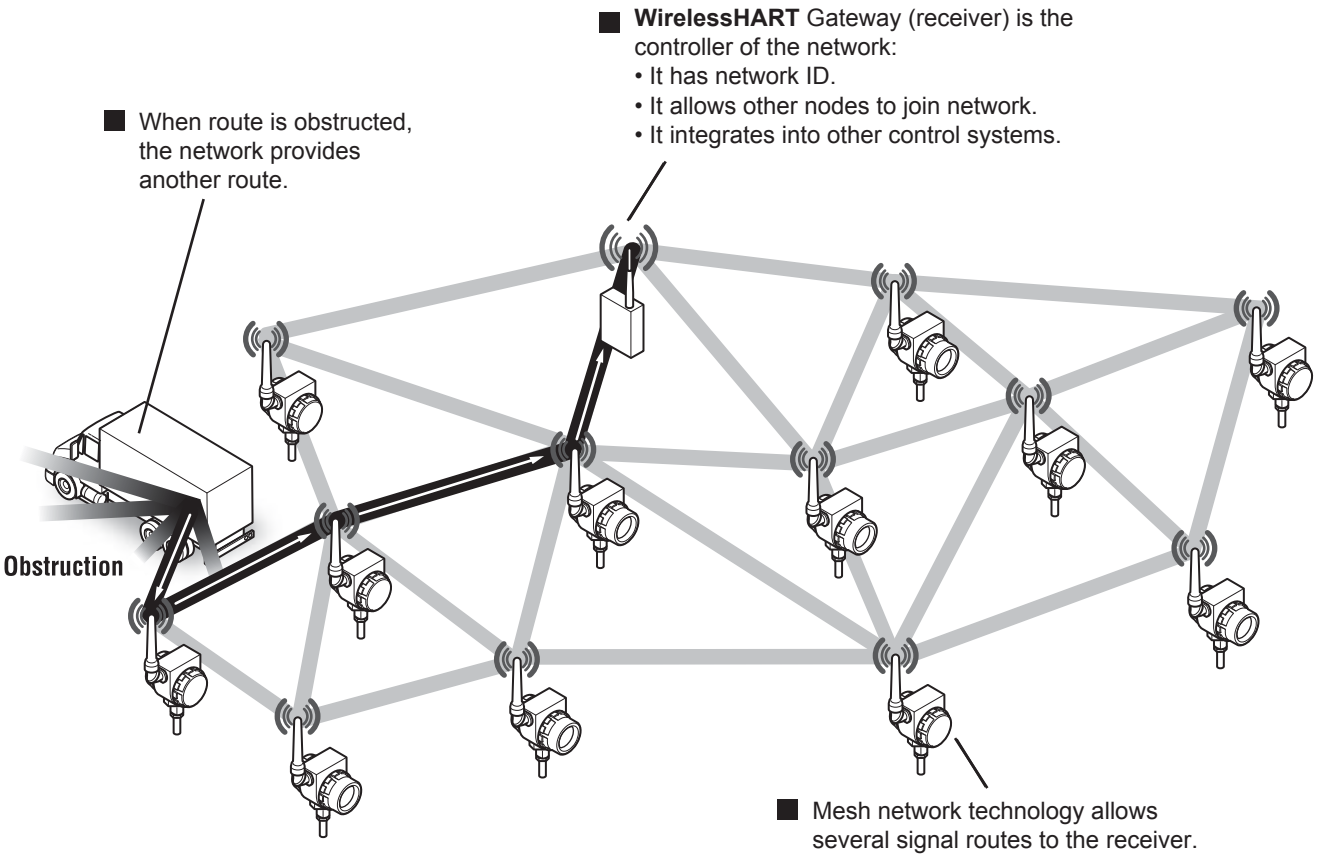

Self Organizing.

- Devices automatically establish routes for efficient and reliable communication.
- Expansion is simple… additional devices seamlessly integrate into existing networks.
- Mesh topology allows for easy network reconfiguration.

Self Healing.

- If obstructions are introduced within an existing network, the system will automatically adjust communication paths for continuous and reliable data flow.

Industry Standard IEEE 802.15.4.

- 2.4 GHz 16 band.
- Continuously hops across 16 channels to reduce potential interference.

No Blind Spots.

- Utilizing industry standard WirelessHART, an open mesh networking design, AIM® communicates through and around stacks, silos, cranes and other obstructions.

Harsh Environments? No Worries.

- AIM® is designed to withstand extreme ambient temperature conditions (-40°F - 194°F) (-40°C - 90°C).

No Plant Disruptions.

- Installing AIM® won't disrupt plant processes. There's no shutdown required to perform an installation and AIM® is non-intrusive to valves, pipes and system equipment.

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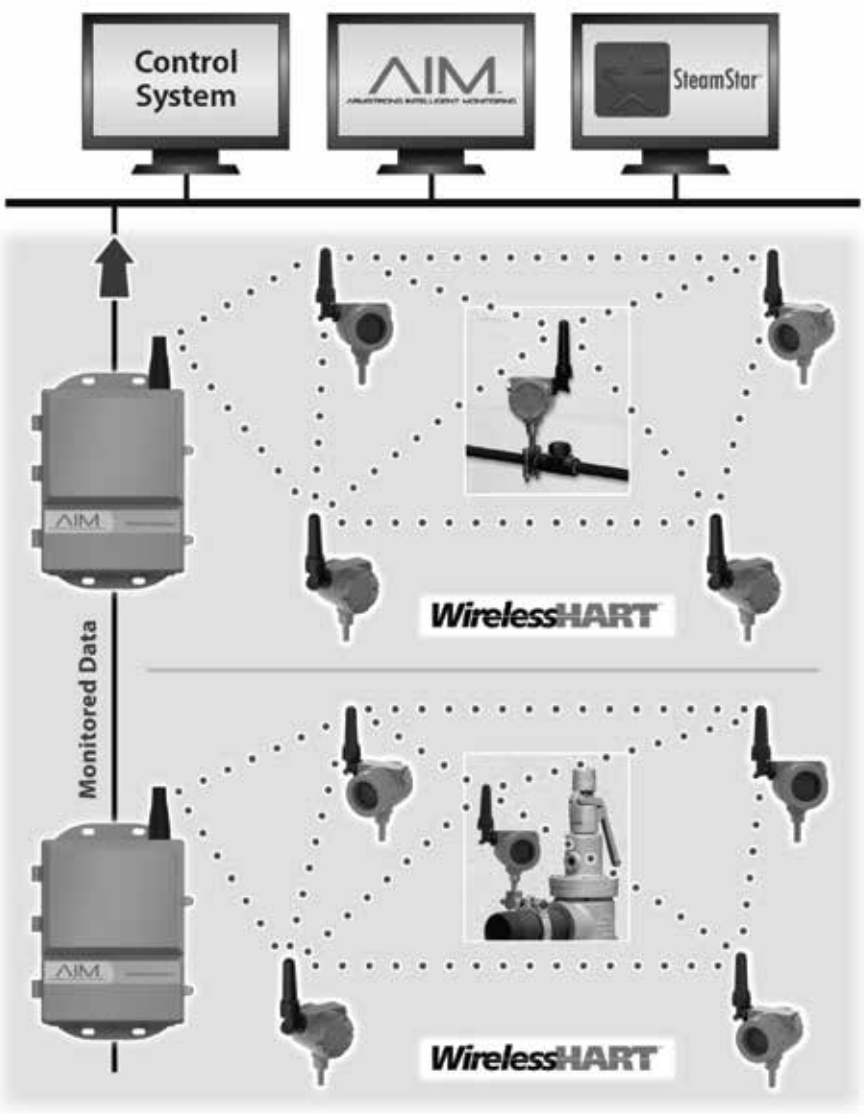
AIM® helps you work smarter by anticipating your needs and taking the guess work out of system troubleshooting enabling you to address problems before they spiral out of control.

Wireless Architecture



Smart Thinking is in the Box

AIM® works through a centrally located wireless gateway that enables real time, 24/7 monitoring. The AIM® Wireless Gateway easily connects and organizes WirelessHART devices to your host system while providing industryleading security, scalability, and data reliability. The Gateway interface is easily viewed in a web browser.

Wireless Gateway Specifications

- Burst rate: User Selectable 4, 8, 16, 32 second or 1 to 60 minutes
- Network Size: Up to 100 devices
- Output: Ethernet, Modbus (485 or TCP), OPC, HART IP
- Approvals: FM, CSA, ATEX, IECEx

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AIM® and SteamStar® bring steam savings through instant notification of steam trap failure.

AIM® is Armstrong's intelligent systemsolution that reduces labor and energy costs by constantly monitoring steam system operations. SteamStar® is Armstrong's web-based application that creates company-wide awareness for a whole new level of steam savings. When working together, AIM® will feed the moment-to-moment steam equipment data into SteamStar®. SteamStar® will instantly report this information through Web-based software that allows easy access forcompany personnel to make timely, money-saving decisions.

- Improve steam system efficiency
- Achieve best practice energy management goals
- Integration into 24/7 wireless monitoring
- Company wide awareness and measurement of steam trap performance
- Assist in ROI decision making
- Trend History

SteamStar®

- Detailed Reports
  - Executive Summary
  - Steam and Monetary loss
  - Defective Trap Report
  - Manufacturer Summary
  - Trap Evaluation by application
- Prioritize work orders
- Emission reports for CO_2, SOx and NOx

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Executive Summary Report:

Highlights total site energy losses and current steam trap failures. This report is critical in establishing a base line for future achievement of company energy goals.

TRAP TYPE SUMMARY

Generic Type		Population Count	% of Total	Failure Count	In Service Failure
BI	Bi-Metal	282	15.4%	9	4.9%
DC	Disc	267	14.6%	9	5.2%
FL	Float	3	0.2%	0	0.0%
IB	Inverted Bucket	1,269	69.3%	50	5.0%
Other		9	0.5%	0	0.0%
Totals:		1,830	100%	68	5.0%

TOTAL ANNUALIZED SUMMARIES

Steam Loss(ib)	8,283,095
Monetary Loss(USB)	1,075,561
Fuel used to generate lost steam (MMBTU/yr)	11,650
CO2 Emissions (ib)	1,363,949

Benchmark Report:

A premium report that establishes a comparison to sister sites. The user has a choice of which sites to benchmark and which factors to compare. Steam loss and monetary loss can be compared by site, by type of application, by trap type, and more.

Location	Installed	In Service	Defective	Defect%	Total Annual Steam Loss lb/yr	Total Annual Monetary Loss
SSG Company	2,164	1,656	134	8.1	33,625,760	1,646,279 USD
Oil Refinery	1,907	1,421	88	6.2	14,097,225	1,158,970 USD
Unit 1	660	499	37	7.4	10,308,259	432,006 USD
Unit2	1,247	922	51	5.5	3,788,965	726,964 USD

Work Order Report:

The work order report is a premium report that is designed for optimum facility payback on labor and material while keeping energy losses to a minimum. This report is available at the site or unit level and will prioritize a work order for steam trap repairs based on greatest cost.

Unit 2

Tag Number	Condition	Annual Cost (USD)	Location	Manufacturer - Model	Recommendations	Comments
101	Blow Thru	32117	66/E3/NORTH PIPE RACK	Spirax Sarco - FT75 - 3/4”		
128	Blow Thru	10526	SULPHUR PIT SOUTH	TLV - A50 - 2”		
115	Blow Thru	4514	SULPHUR PIT WEST 67/G1	Spirax Sarco - FT30 - 1 -1/2”		
118	Blow Thru	585	N/LAND PARAMA STORAGE EAST	Armstrong - 881A - 3/4”		
130	Plugged	----------	N/LAND -WEST OF FIRE STATION	TVL - A46 - 2”		
107	Flooded	----------	B130M Pump Trap	Armstrong - PT - 312 - 3”		

Trend Report:

The premium trend analysis report will assist a manager with the comparison of multiple years of data. The data available for comparison is steam loss, monetary loss, fuel consumed, and emissions created. Like the other premium reports, the trend analysis report can be compared by site and or region. This report also tracks emissions; CO_2, SOx, NOx, and highlights the progress made toward steam system efficiency and dollars saved.

Steam Loss						
Location	2008	2009	2010	2011	2012	2013
SSG Company	59,111,353 lb/yr	41,191,839 lb/yr	19,960,408 lb/yr	29,584,815 lb/yr	28,218,355 lb/yr	20,371,452 lb/yr
Oil Refinery	2,376,903 lb/yr	3,929,212 lb/yr	3,387,815 lb/yr	2,237,262 lb/yr	5,686,630 lb/yr	17,598,330 lb/yr
Unti 1	2,051,577 lb/yr	2,234,521 lb/yr	1,881,202 lb/yr	1,597,794 lb/yr	4,354,034 lb/yr	12,581,687 lb/yr
Unit 2	325,325 lb/br	1,694,691 lb/yr	1,506,613 lb/yr	639,468 lb/yr	1,332,596 lb/yr	5,016,643 lb/yr

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