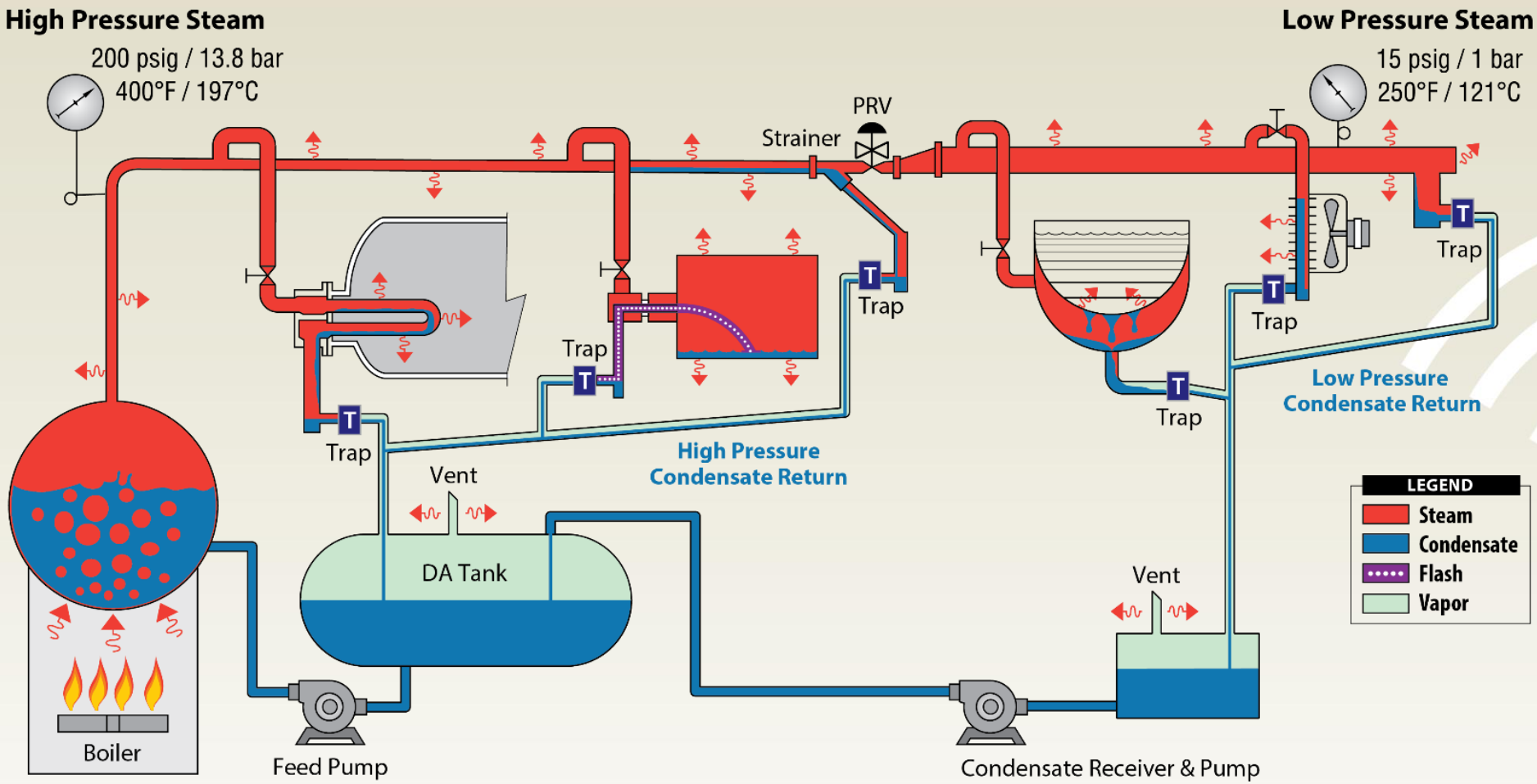
Typical Steam and Condensate loop



Steam Traps

Primary function

A Steam Trap must remove condensate out of the system as quickly as it collects.

Steam Traps

Secondary function

Minimize steam losses

Have long life and dependable service

Resist corrosion

Vent Non-Condensable Gases (NCG)

Operate against backpressure

Be free from dirt problems


Armstrong
WHERE ARE YOU?
TRAP MANAGEMENT
THERMAL ASSESMENT
THERMAL STUDIES
DECARBONIZATION ALTERNATIVES STUDY
DETAILED DECARBONIZATION STUDIES
DELIVERING THE DECARBONIZED SOLUTIONS
DECARBONIZATION COMPLETE
FINANCING, INSURING, O&M OF THE DECARBONIZED SOLUTION
ROADMAP TO DECARBONIZATION

Steam Trap Failure Rate

	Service Life (in Years)	Annual Failure Rate	Light Industry
Low Pressure (< 75 psig) – Tracing or Drip			**50%**
Thermodynamic (Disc)	7	14%	20%
Inverted Bucket	15	7%	15%
Bimetallic	10	10%	30%
Wafer or Bellow	8	13%	25%
Float & Thermostatic	8	13%	10%
Medium Pressure (75 – 200 psig) – Process			**45%**
Thermodynamic (Disc)	5	20%	40%
Inverted Bucket	10	10%	10%
Bimetallic	8	13%	0%
Wafer or Bellow	5	20%	0%
Float & Thermostatic	5	20%	50%
High Pressure (200 – 400 psig) – Drip			**5%**
Thermodynamic (Disc)	3	33%	60%
Inverted Bucket	7	14%	20%
Bimetallic	6	17%	10%
Wafer or Bellow	3	33%	0%
Float & Thermostatic	6	17%	10%
Annual Failure Rate		**14.6%**	

Steam Trap Failure Rate

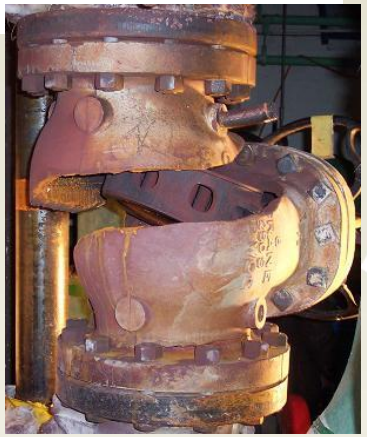
If a steam trap **fails open** (leaking or blow-thru):

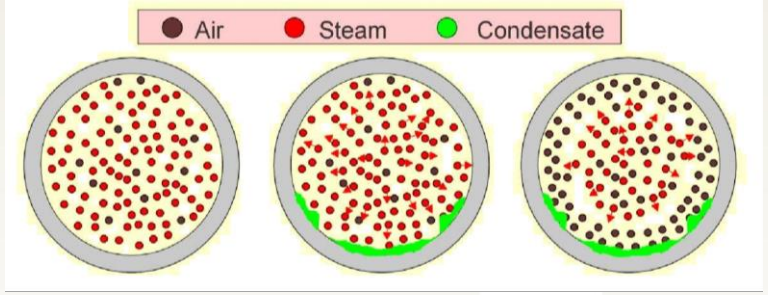
- Increased back pressure in condensate return line
  - Reduced flow for surrounding steam traps
  - Stalling surrounding heat exchanger
- Steam losses (monetary losses)
- Safety issue
- Environmental issue

Steam Trap Failure

If a steam trap **fails closed** (cold):

- Wet steam
  - Water hammering
  - Damaged turbine LP saturated steam stage
  - Piping corrosion
  - Erosion on valves, reducers
- Flooded heat exchanger
  - Decrease in production
  - Reduced heat transfer
  - Batch process losses
  - Thermal stress
- Non-Condensable Gases in the system
  - Air is an insulator: heat exchanger less efficient
  - Oxygen in the pipe = corrosion: $H_2O + CO_2 \rightarrow H_2CO_3$ (Carbonic Acid)
  - System binding: flow of steam and condensate can be blocked
  - Temperature drops because steam pressure drops





Steam Losses [lbs/day]

	psig							
Orifice	15	30	60	100	150	250	400	600
#60	31	46	77	118	169	272	427	632
3/64"	42	63	106	162	233	374	586	869
1/16"	75	112	188	288	414	665	1,042	1,544
5/64"	117	175	293	450	646	1,039	1,628	2,413
3/32"	168	253	422	648	931	1,496	2,344	3,474
#38	197	296	495	760	1,091	1,754	2,747	4,072
7/64"	228	344	575	882	1,267	2,036	3,190	4,729
1/8"	298	449	751	1,153	1,655	2,660	4,167	6,177
9/64"	378	568	950	1,459	2,095	3,366	5,274	7,817
5/32"	466	702	1,173	1,801	2,586	4,156	6,511	9,651
11/64"	564	849	1,419	2,179	3,129	5,029	7,878	11,678
3/16"	671	1,011	1,689	2,593	3,724	5,984	9,376	13,897
7/32"	914	1,376	2,299	3,530	5,068	8,145	12,761	18,916
1/4"	1,194	1,797	3,002	4,610	6,620	10,639	16,668	24,706
9/32"	1,511	2,274	3,800	5,835	8,378	13,465	21,095	31,269
5/16"	1,865	2,807	4,691	7,203	10,343	16,623	26,043	38,603

$10/1,000lbs

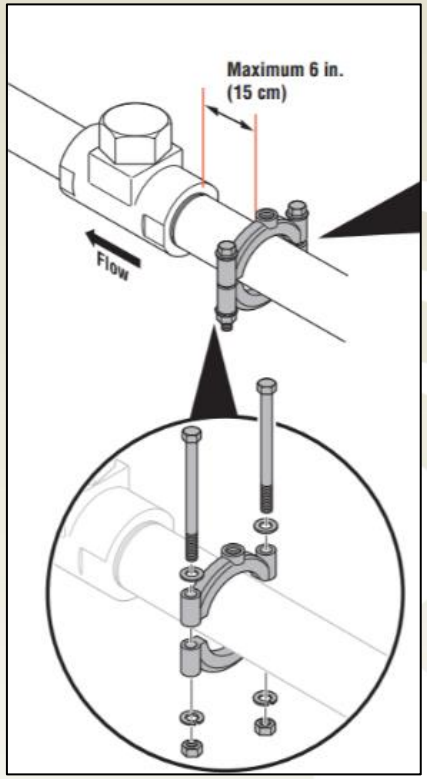
⇩

$ 6,000/year

Blow-Thru steam trap, Outlet Pressure < (Inlet Pressure/2) - Source: AM0017 http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

Armstrong Intelligent Monitoring (AIM®)

- ST6700 model
- Launched in 2016
- NAMUR NE107 compliant
- 5-year battery life
- Non-intrusive installation
- Class I, Division 1, Zone 0



Channel	Description
#9	Steam Trap Condition: 1=OK, 2=COLD, 3=BLOW-THRU
#10	Current Temperature (°C or °F)
#11	Temperature (°C or °F)
100+ NAMUR NE107 diagnostics available	

Fugitive Emissions

Fugitive emissions are unintended or irregular releases of gases or vapors from pressurized system, either due to faulty equipment, leakage, or other unforeseen mishaps.

Leak detection is an essential component of risk management as it allows the operator to respond to the leaks to prevent further escalation of incidents.

Pressure/Safety Relief Valve

Pressure/Safety Relief Valves are necessary to the protection of many processes but most of these are known to be continuous sources for leakage.

Regardless of whether these gases, hazardous area pollutants or more benign fluids such as steam, are released to an enclosed recovery system or to the environment, it is important **to identify the source, time, and magnitude of the release**.

Four Benefits of Valve Monitoring

Safety
It reduces exposure of employees to potentially harmful emissions and fluids as well as exposure of property to potentially highly corrosive fluids.

Environmentally
It reduces global warming and greenhouse gases getting to the atmosphere.

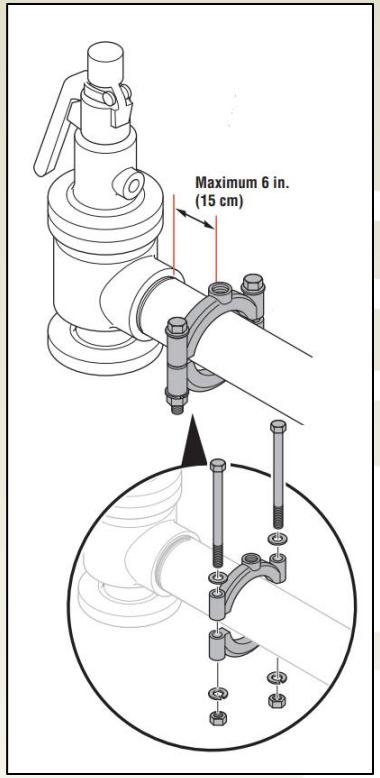
Economically
It makes sure the process is efficient by limiting downtime and reducing losses of pressurized gases.

Legally
It helps avoid fines from local and states regulated by complying with legislation.

Armstrong Intelligent Monitoring (AIM®)

- AD6000 model
- Launched in 2021
- NAMUR NE107 compliant
- 5-year battery life
- Non-intrusive installation
- Class I, Division 1, Zone 0

Channel	Description
#9	Acoustic Level Counts
#10	Stem Temperature (°C or °F)
#11	Occurrence Counter
#12	Occurrence Duration
100+ NAMUR NE107 diagnostics available	

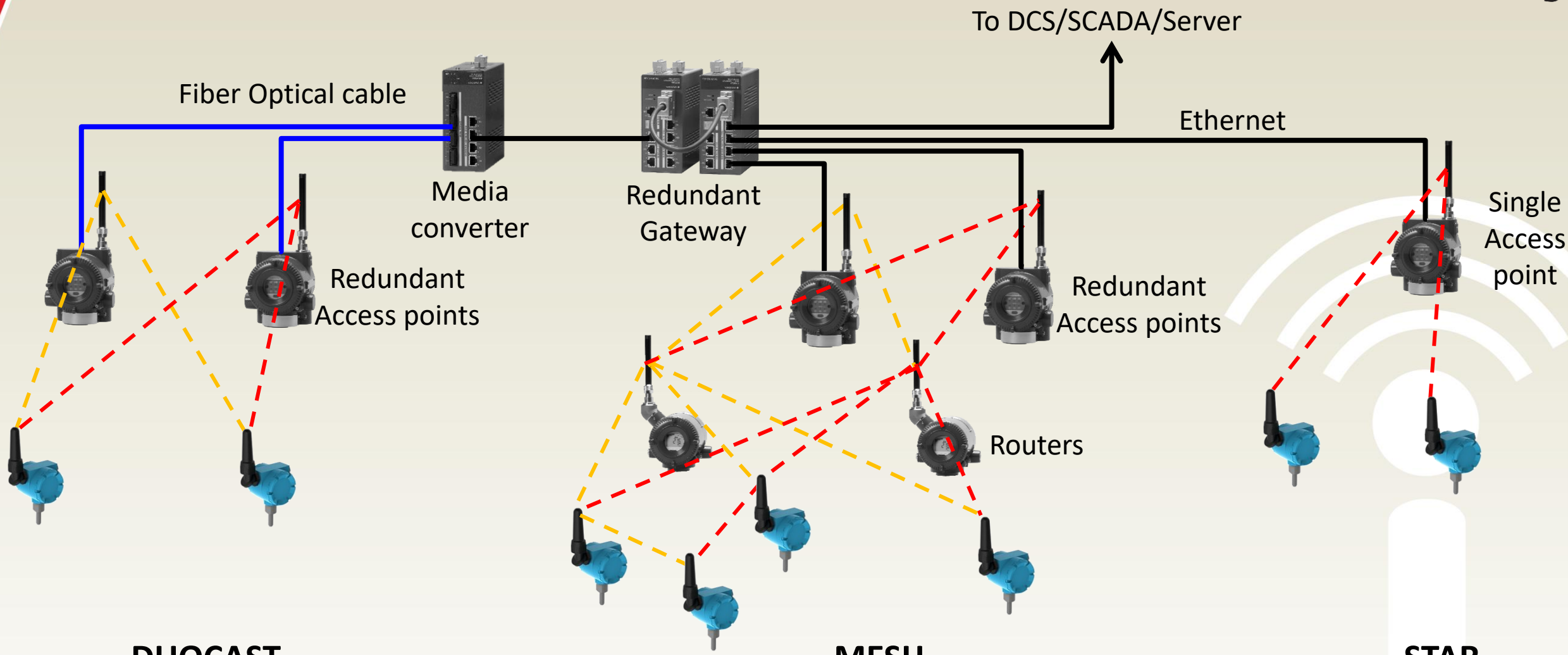


Applications

- Safety Relief Valve
- By-pass valves
- Blowdown valves
- Isolation valves
- …

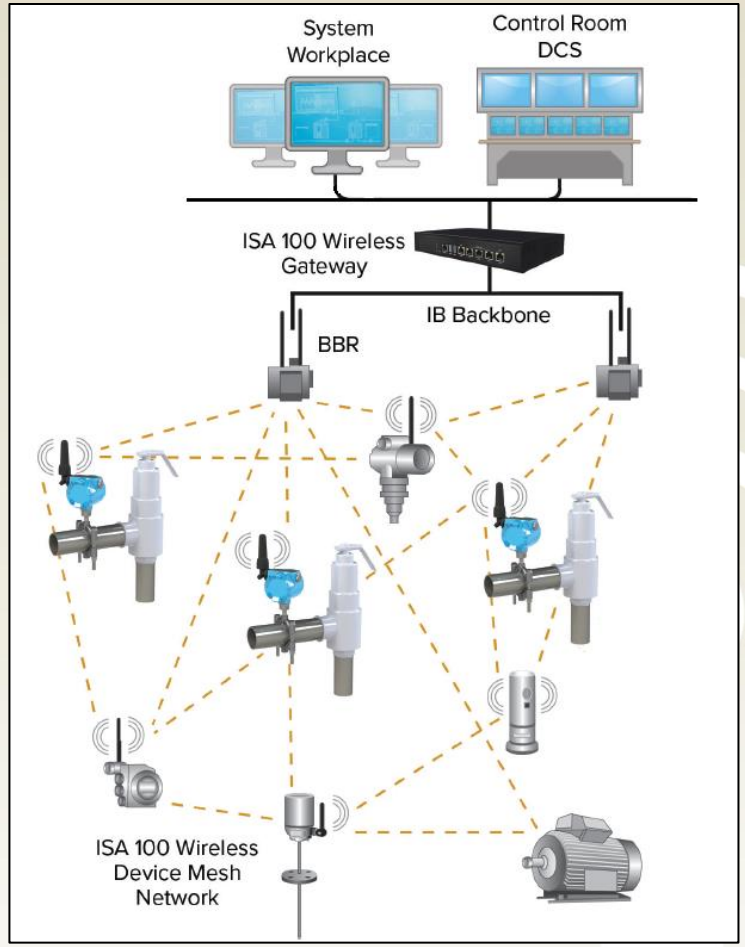
- Saturated or Superheated Steam
- Liquid Crude
- Natural Gas
- LNG
- Methane
- Nitrogen
- CO_2
- …

Wireless Infrastructure



ISA100 Network

- 24/7 monitoring vs. point of time
- Quickly identify a failure (what, when, and where)
- Avoid unplanned downtime
- Cut labor cost
- Free up maintenance resources
- Increase efficiency
- Reduce energy consumption
- Short payback due to high cost of leaks
- Additional devices will strengthen any existing network



Questions?

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