PETROLEUM ASSOCIATION of WYOMING

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April 13, 2015

Steven A. Dietrich
Air Quality Administrator
Herschler Building 2-E
122 W. 25th Street
Cheyenne, WY 82002

Re: Comments on Proposed Rule Change to Wyoming Air Quality Standards and Regulations, Chapter 8, Nonattainment Area Regulations

Dear Mr. Dietrich:

The Petroleum Association of Wyoming (PAW) appreciates this opportunity to provide additional comments to the Wyoming Department of Environmental Quality (WDEQ) Air Quality Division (AQD) concerning the proposed revisions to the proposed rule change to Wyoming Air Quality Standards and Regulations, Chapter 8, Nonattainment Area Regulations.

PAW is Wyoming's largest oil and gas trade association. PAW members produce over 90% of the natural gas and 80% of the crude oil in the state and have a vested interest in the policies, rules and regulations administered by the WDEQ.

PAW has been supportive of the UGRB existing source rule effort since its origination as a recommendation from the Ozone Task Force in 2012. PAW continues to support this rulemaking effort, but we continue to request a rule that is clear and technically sound which will facilitate compliance.

PAW thanks WDEQ for addressing many of our concerns from previous comments to earlier drafts of this rule, but a few key issues remain. Explained in more detail later in this document, remaining issues include:

- A compliance date set at 2 years after the promulgation date of this rule.
- Use of correct technical terms to describe pneumatic controllers

- Reduced number of sites requiring fugitive counts to be representative of site applicability for LDAR
- Monitoring, recordkeeping, and reporting of control device downtime and use of blowdown/emergency tanks
- No mandatory trucking of blowdown/emergency tanks within seven days of use

Since the inception of the UGRB Ozone Task Force, the area has now experienced four consecutive years of no exceedances of the current ozone standard. Indeed, the WDEQ can now apply for a Clean Data determination from EPA which will recognize the state as having no ozone emission exceedances over the four year period and that the state has achieved attainment of the ozone standard. The state is also eligible to apply for re-designation of the UGRB nonattainment area to attainment.

Accomplishing attainment of the ozone standard has occurred without this rule. While PAW continues to support this rulemaking to help ensure continued attainment, the urgency to get this rule promulgated as soon as possible is diminished, and time should be allowed if necessary to ensure the rule does not result in a negative environmental impact or inadvertently create compliance issues for industry. PAW requests Environmental Quality Council (EQC) amend the rule with our recommended changes without additional postponement for approval.

Compliance Date

At present, the current draft of the rule sets a hard compliance date of January 1, 2017. By the time this rule is promulgated, it is quite likely less than one and a half years will remain until operators must comply. While it is typical and precedent exists for existing source rules to have a 3 yr compliance phase-in period, PAW supports a 2 yr phase-in period. A phase in period is needed for companies to evaluate the business impact of the rule to existing production sites, plan accordingly, budget funds to support implementation costs, order and purchase equipment, and complete construction of controls or replacement equipment. While preliminary evaluation and planning can occur prior to the final rule being promulgated, operators may be unable to budget funds, purchase new equipment, and schedule construction until there is certainty of a final rule.

For operators with widespread use of pneumatic pumps at hundreds of wells, replacement of these pumps or installation of emission control could be the most troublesome to have completed by January 1, 2017. Demand on vendors to deliver the needed equipment or construction crews could lead to delays.

Pneumatic Controllers: Continuous Bleed or Intermittent Vent

In the current proposal at paragraph (f), pneumatic controllers are limited to continuous bleed controllers emitting less than 6 scf/hr, zero-bleed controllers, or controller bleed that is controlled which is the same as a zero bleed controller. PAW requests the term "zero bleed" be replaced with "intermittent vent". PAW originally asked WDEQ to replace the term "no-bleed" with "intermittent vent" but instead it was changed to "zero-bleed". No-bleed is more of a marketing term than technical term, and vendors do not consistently describe no-bleed in the same way, which is why PAW asked for the technically correct term.

Based on the requirements of the current oil and gas guidance we believed this was a rational request as it was generally thought by PAW members that WDEQ considered "no-bleed" to be synonymous with "intermittent vent". However, in the WDEQ's response to comments from the last version of the proposed rule, PAW is concerned that, there may not be a good fundamental understanding of pneumatic controllers. As written, without any definitions provided in the rule, the response to comments suggests an interpretation of the current proposal to mean that intermittent vent controllers cannot be used, unless the emission rate is less than 6 scf/hr. Intermittent vent controllers are not designed to bleed, nor do they have zero emissions. They also do not have an inherently designed emission rate. Instead emissions are dependent on the frequency of actuation required for the application, but across the widest range of applications are the lowest emitting controllers. The correct terminology that PAW recommends eliminates the need for any demonstration of emissions as well as additional definitions in the rule.

Since pneumatic controllers became a regulated source in EPA's NSPS, Subpart OOOO rule, our industry has realized the need to standardize terminology to avoid confusion of using non-standardized terms in regulation. Non-standard and undefined terminology has existed within both industry operators and vendors supplying this equipment, which further confounds good regulation. Led by the American Petroleum Institute (API), industry has been making a concerted effort to educate EPA, other state agencies, and emission study groups on the design and function of controllers, and to standardize the terminology used to describe these controllers.

A pneumatic controller basically receives a signal to operate an end device; commonly an actuator to open and close a valve, such as a dump valve to drain a separator after it fills to a certain level. The pneumatic controller can be one of two designs: continuous bleed or intermittent vent. A continuous bleed controller vents gas continuously even between actuation cycles for an almost constant emission rate. An intermittent vent controller does not bleed gas continuously, instead it is designed to only vent the volume of gas required to actuate the end device when actuation ends making quantification of a constant emission rate not feasible. Unlike a continuous bleed controller, the total volume of gas vented over a given period of time is dependent on the actuation frequency and volume of gas required for actuation.

Over the widest range of applications, the intermittent vent controller has the lowest emissions and is generally the controller of choice to replace a continuous high bleed controller as it uses less gas while providing the equivalent response time required for actuation of an end device. When a continuous bleed controller operates at a bleed rate of less than 6 scf/hr (i.e. low bleed), it may not provide the required response time for end device actuation, or in other words, a valve may not open or close fast enough for the application. Additional detail about pneumatic controller design and operation is provided in attachment 1 authored by API. A study conducted by the Oklahoma Independent Producer Association (OIPA) that compares measured emissions from continuous bleed and intermittent vent controllers is included in attachment 2 and clearly demonstrates that intermittent vent controllers are the lowest emitters. From the executive summary page 2 in attachment 2: "The OIPA sample contained on average 3.83 intermittent vent controllers per site and 0.12 continuous bleed controllers per site. On average, intermittent vent controllers emitted 0.40 scfh gas..."

Site Fugitive Component Counts

In (g)(ii)(A)(I) fugitive component counts at 100 wells are required to be representative of other sites. The count from 100 wells is unnecessary and representative sites should be based on similarity of equipment configurations not on statistical significance. PAW believes the result of counting fugitive components at 100 sites is a high cost in time and effort that will not yield any better results than counting only a handful of representative, similarly configured sites.

One member operator counted fugitives at five gas well sites in the western UGRB area. Each well site had a wellhead, separator(s), a tank, a dehy, fuel gas system, and sales line. Fugitive counts at these five sites ranged from 426 components to 906 components as shown in the table below. Even overestimating emissions using the AP-42 gas/vapor factor for flanges at 100% VOC instead of reducing by actual VOC content in the gas stream, emissions at each are well below the 4 tpy threshold.

Equipment	Site 1	Site 2	Site 3	Site 4	Site 5
Wellhead	31	38	38	36	33
Unit	20	60	NA	NA	NA
Separator (Water)	56	63	83	32	48
Separator (gas)	139	230	61	85	80
Fuel Gas	258	381	200	240	203
Dehy	NA	63	45	54	NA
Sales Line	12	29	35	5	25
Tank	22	42	28	39	37
Total	538	906	490	491	426
TPY VOC Emissions using AP42 gas/vapor flange factor (0.00086) at 100% VOC	2.02	3.4	1.84	1.84	1.60

Note: Emissions above overestimated using gas/vapor flange factor at 100% VOC due to fugitive count not broken down by component type (i.e. flange, valve, connector) Actual gas VOC content is 5%.

Another operator counted fugitive components from several high volume oil producing PAD sites outside of UGRB that were similarly configured in which the component counts were much higher than the other operator's gas well sites in UGRB but with all liqht oil components which have the highest emission factor. As with a few similarly configured single well sites above demonstrating an exemption from proposed LDAR requirements, only a few similarly configured PAD sites are needed to demonstrate a need to comply with proposed LDAR requirements.

			Major Equipment				
Oil Production (BPD)	Light oil Total Component #	VOC (TPY)	Wellheads	Separators	Tanks	ECDs	VRUs
1047	10,039	25.4	6	6	6	3	4
532	9,922	23.2	7	6	8	3	1
960	10,204	25.5	8	6	5	3	3
1079	9,153	22.1	5	5	5	4	3
904	9,062	22.0	6	5	5	4	2
1296	9,137	23.5	5	5	6	4	4

Note: Separators have the largest number of fugitive components so groupings are based on separator count

Using the data from the field counts in the tables above, it is clear that when component counts are grouped by similar facilities total counts can vary by a few hundred components and result in minor differences in VOC emissions.

Typically, a single facility is designed and then installed at new locations and scaled, based on production need. Therefore facilities with similar major equipment that are of the same generation will vary little between locations. Operators understand their operations and the facilities that are similar. All emission totals and counts are subject to the Division's review and approval to ensure accurate component counts and emission totals. Requiring counts of at least 100 wells could result in inaccurate emission totals by requiring the need to group unlike facilities.

PAW requests the language be modified to the following:

> (g)(ii)(A)(I) PAD and single-well facility or source component counts shall be determined by actual field count, or a representative component count from 5 representative wells located at a PAD or single-well facility.

Monitoring, Recordkeeping, and Reporting

Section 6 (h) Monitoring, Recordkeeping, and Reporting.

(ii) Recordkeeping.

(B) Owner(s) or operator(s) shall maintain the following records for each combustion device:

(I) Manufacturer-designed VOC destruction efficiency.

(II) Records of the parameter monitoring during active site operation under Subparagraph (h)(i)(A) including;

(1.) A description of the reason(s) for the absence of the monitored parameter;

(2.) The steps taken to return the combustion device back to the 98% manufacturer-designed VOC destruction efficiency; and

PAW requests the elimination of the requirement for recording a reason for absence of a pilot flame and steps taken to return the combustion device back to service. Most pilots are remotely monitored by telemetry systems that automatically record downtime, but the systems do not record the cause of downtime or steps taken to return to service. This additional requirement to log a reason and the steps taken to return to combustion device back to service adds a significant amount of additional paper work with no additional environmental benefit. Instead, a description of the parameter being monitored would seem more appropriate.

Section 6 Monitoring, Recordkeeping, and Reporting (h)(ii)(D)

(D) Records of the date, duration, and reason for emergency and/or blowdown tank usage, shall be maintained pursuant to Subparagraph (c)(i)(C) of these regulations.

The requirements in (h)(ii)(D) are more stringent than requirements for new production locations and add no additional environmental benefit. PAW requests EQC delete this provision.).

Blowdown/venting permits required for all operators in the non-attainment area require that six months of initial record-keeping be collected. Based on the record-keeping reported from these permits, the Division has acknowledged that emissions from blowdown and venting are not a significant source of emissions and thus additional record keeping is overly burdensome.

Additionally, some new facilities that include requirements for blowdown tanks require "Records of tank usage shall be maintained for a period of five (5) years and made available to the Division upon request." Again the proposed rule is more stringent by requiring reason for usage of existing sources but the equivalent requirement is not in permits for new sources.

Emptying Frequency of Emergency and Blowdown Tank Liquids

PAW has commented on the use of open-top and or blowdown tanks extensively during the previous comment periods. The sections in question are below.

Section 6(c) Flashing Emissions at an Existing Facility or Source as of January 1, 2014

(C) Emergency, open-top and/or blowdown tanks shall not be used as active storage tanks but may be used for temporary storage.

(II) If emergency, open-top and/or blowdown tanks are utilized, they must be emptied within seven (7) calendar days."

Section 6(c) Flashing Emissions at an Existing Facility or Source as of January 1, 2014
(D) Records of the date, duration, and reason for emergency and/or blowdown tank usage, shall be maintained pursuant to Subparagraph (c)(i)(C) of these regulations.

PAW believes once flashing has occurred, emissions from these tanks are insignificant.

Furthermore, given the number of possible discharges to these tanks including some with volumes less than a barrel, it would be impossible to show compliance with this requirement, without having trucks constantly traveling to each and every pad to drain inches or less of fluids from these tanks every 7 days or potentially more frequently if a tank is used more than once per seven days. The increase in emissions from truck traffic does not justify the environmental benefit from emptying these tanks as frequently as 7 days. Therefore, PAW suggests the division impose a more realistic volume based limit for emptying the tanks. To minimize truck traffic and set an enforceable limit, PAW suggests a volume limit for emptying the tanks of 100 barrels as this is the approximate volume of a vacuum truck which would make most efficient use of these trucks which would reduce truck traffic emissions.

The Response to Comments document from the previous comment period states that flashing is the emissions source at issue and the reason the Division will not remove the requirement to empty open-top tanks every 7 days from the proposed regulation. Perhaps the most important point to be made is that flashing emissions occur instantly when the liquids enter the tank. Emptying the tanks every seven days will not prevent these emissions.

The increase in truck traffic needed to empty these tanks is significant and outweighs any emission reductions associated with the 7-day emptying frequency. As the language is currently written in the proposed rule, applicable tanks with minor amounts of fluid discharged to them would be required to be emptied within seven days.

The increase in NOx and VOC emissions from 1 truck, operating 365 days per year (estimated at a 10 hour shift with continuous idle to empty the tanks) would be 8,718 lbs of NOx and 905 lbs of VOC (see attachment 3). Compared to the negligible amounts of VOC that would be reduced, nearly 4.5 tons of NOx per truck is released with no offset reductions from tank unloading.

Because the amount of fluid in the tanks is variable and unpredictable, it is difficult to say how many trucks would be needed to empty all of the tanks in the non-attainment area on an ongoing basis. The reduction in truck traffic specified in the Bureau of Land

Management (BLM) 2008 Record of Decision for the Pinedale anticline protection area was included based on evaluations in the Environmental Impact Statement. This reduction in truck traffic was not only to lower emissions, but also to reduce fugitive dust, noise and wildlife concerns. This rule runs contrary to the findings of this EIS.

Fluid volumes associated with individual blowdown or emergency events can be variable and frequently less than 1 barrel. It will not always be practicable to have a truck come out within seven days to unload less than a barrel from a tank. Low volume discharges to the tank may not be able to be unloaded if the fluid level in the tank is below the capability of the vacuum truck to draw out of the tank.

PAW understands that the Division does not want tanks to be used for storage; however, we believe that this can be corrected with a minor language change to the proposed rule.

Section 6(c) Flashing Emissions at an Existing Facility or Source as of January 1, 2014

> *"(C) Emergency, open-top and/or blowdown tanks shall not be used as active storage tanks but may be used for temporary storage.*
>
> > *(II) If emergency, open-top and/or blowdown tanks are utilized; they must be emptied within seven (7) calendar days after the liquid volume reaches 100 bbls. ."*

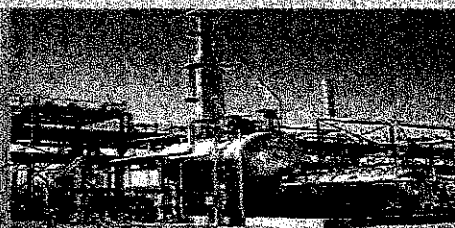
Thank you for your consideration of PAW's comments concerning the proposed revisions to the proposed rule change to Wyoming Air Quality Standards and Regulations, Chapter 8, Nonattainment Area Regulations.

Thank you,

John Robitaille
Vice President

ATTACHMENT 1

Pneumatic Controllers



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Common Misconceptions

- Intermittent controllers emit at a higher rate than low bleed (Subpart W)
- Low bleed controllers are the best overall choice
- Emissions also occur at the valve actuator
- Controller terminology is standardized and commonly understood
- That snap-acting, on/off, no-bleed, & intermittent are synonymous terms
- That throttling, continuous bleed, and proportional are synonymous terms

Goals

- Seek common understanding of pneumatic controllers
  - Types of pneumatic controllers
  - How they operate
  - Expected emission profiles.
- Seek common understanding of key principles
  - The choice of controller types for a particular application is dictated by the process needs/demands while ensuring safe and reliable operation
  - For most applications, intermittent controllers are the lower emission option than continuous bleed controllers
  - If the process can tolerate the inherent delay in response associated with a low-bleed continuous controller, a low-bleed continuous controller may, in limited situations, be a lower emission option

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Process Control Systems

- A process control system/loop must have:
  - A way to sense the state of a process variable (Float, pressure transducer, etc.)
  - A way to change the state of the sensed process variable (Pneumatic Supply Gas, Controller, Actuator, and Valve)
- Process variables most commonly controlled in upstream Oil & Gas are:
  - Fluid level (often found on separators, tanks, treaters, etc.)
  - Pressure (includes pressure regulating, back pressure regulating, and over-pressure limiting)
  - Temperature (includes tank heaters, indirect process heaters, direct process heaters, and fan control)
  - Differential pressure (often used as a surrogate for flow, generally used for constant flow processes)
  - Position (includes devices that sense plunger arrival in a well and signal end-devices to allow after flow and/or to shut off the flow to allow the plunger to drop)
- Safety – Unique Category (includes control of emergency shut-down valves that shut when manually tripped or an unsafe condition is sensed)

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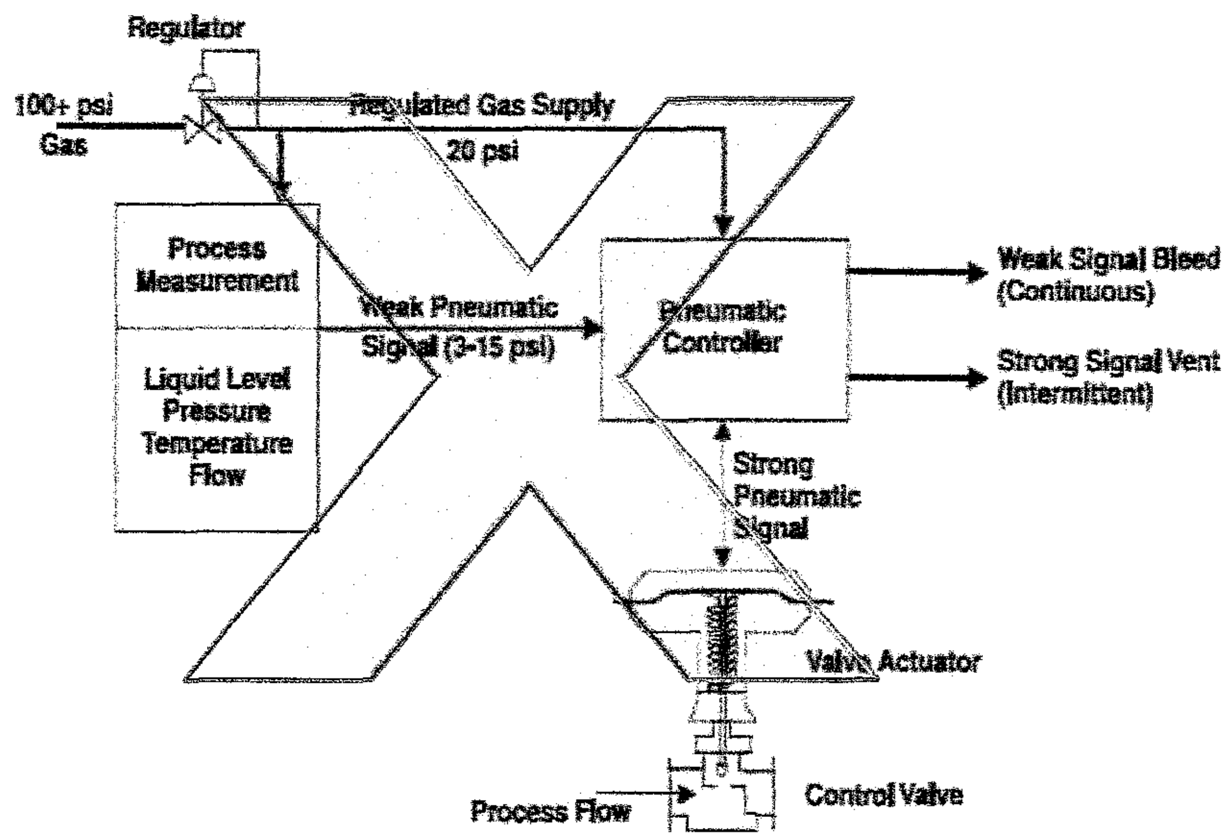
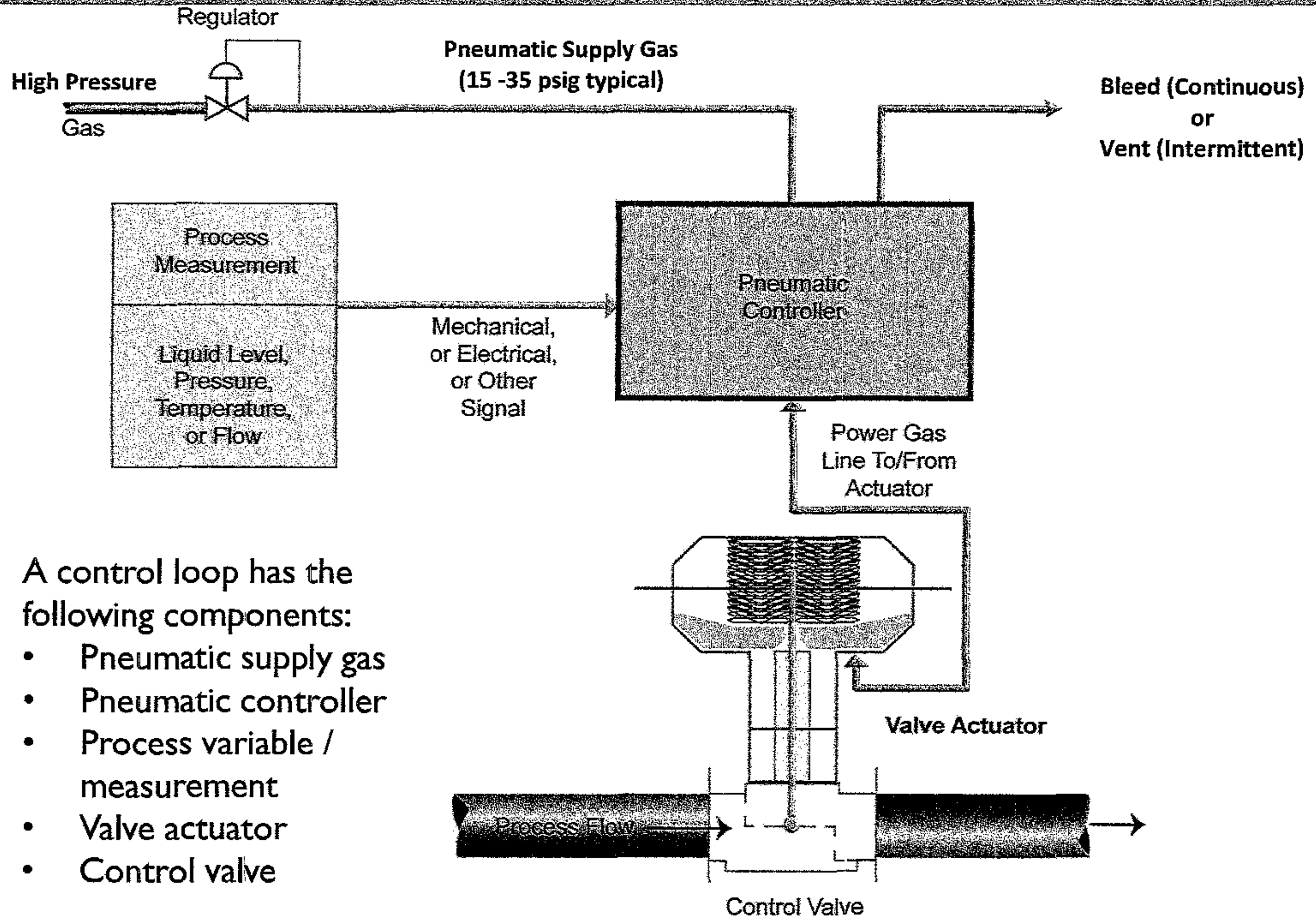
Simple Control Loop Example - Wrong

Pneumatic device schematic - Source: U.S. EPA Lessons Learned



Simple Control Loop Example - Right



A control loop has the following components:

- Pneumatic supply gas
- Pneumatic controller
- Process variable / measurement
- Valve actuator
- Control valve

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Simple Process Control Loop Concepts

- The sensor, control valve and actuator do not bleed or vent gas
- All emissions occur at the controller
- The amount of gas needed for a full actuation cycle depends on the pressure and volume of the control loop
  - The full actuation volume is the volume of the valve actuator + the tubing from the controller to the actuator – corrected to standard conditions for the actuation pressure.
- For a continuous bleed controller the speed of actuation is limited by the rate that gas can pass through the restrictive orifice. (Limits utility of low bleed devices)

Example: 3-Phase Separator Control Schematic

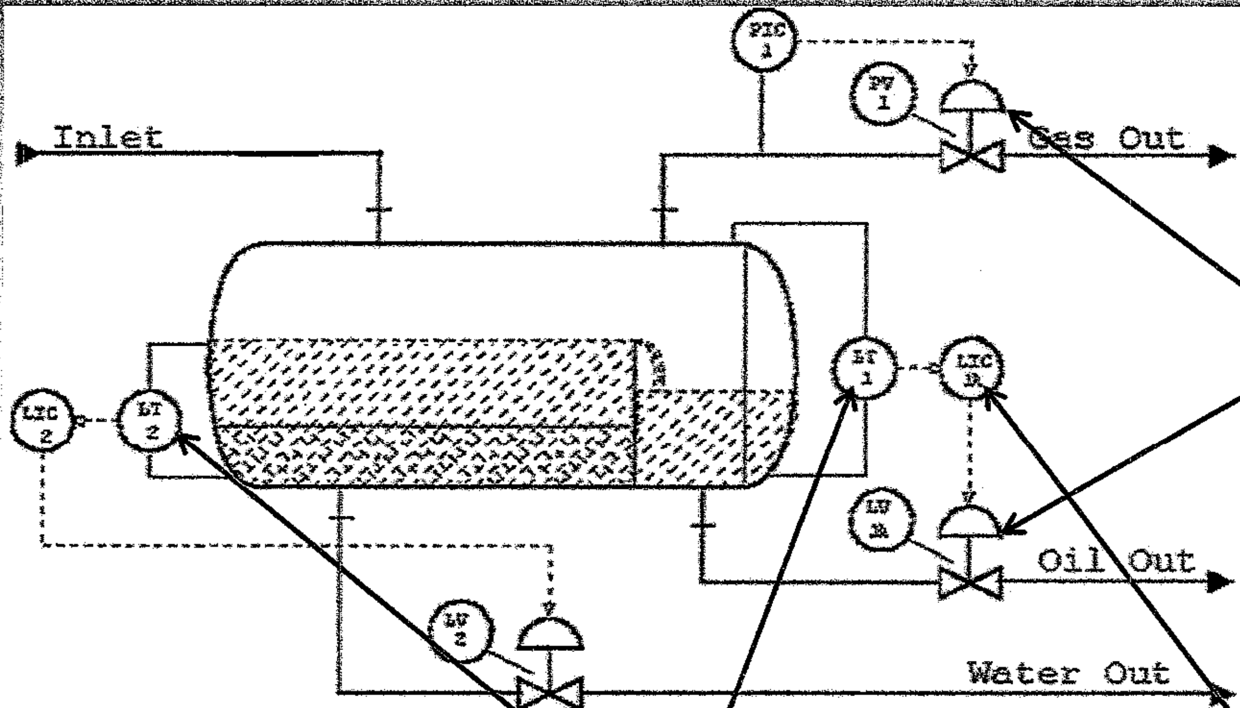

Fig. 6-9. A Three-Phase Separator / Slug Catcher

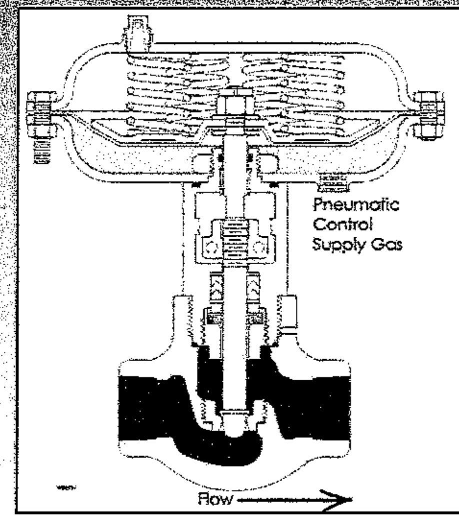

Figure 1 End Device[1]

Pneumatic Controllers

- Pneumatic controllers convert an input signal to a pneumatic pressure output using gas pressure
  - Input signals: Mechanical (e.g. float arm (level)), (bordon tube (pressure)), (bi-metal rod (temperature), etc)); Electrical (e.g. pressure transducer)
- Two types of pneumatic controllers:
  - Intermittent vent (physical barrier between supply gas and output)
  - Continuous bleed (no physical barrier)
- Two types of service
  - On/Off
  - Throttling
- Protection/Shut-in Devices – unique category

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Controller Description

- Large number of controller manufacturers and models
- Large number of field configurations
- All typically control a valve via a valve actuator
- From an emissions standpoint, process controllers can be classified into 4 buckets

		Type of Service	
		On/Off	**Throttling**
Type of Controller	Intermittent	Vents on de-actuation with emissions near zero between de-actuation cycles	Vents some gas pressure when valve needs to move towards closed
	Continuous	Bleeds continuously, rate slows while process is "on", but average rate is ~constant	Bleeds continuously, rate varies with actuation, but average rate is ~constant

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On/Off Controller Action – Snap acting vs. Proportional

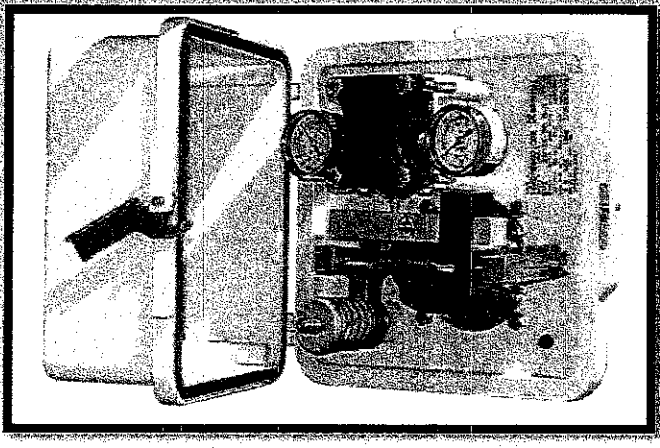
- On/Off Controllers can be configured to operate in a "snap-acting" or proportional mode. These modes are often confused with the on/off and throttling services but are *not interchangeable* with them.
  - Snap-acting is not the same as On/off service
  - Proportional acting is not the same as Throttling service
- On/Off Snap acting (like an on/off light switch)
  - Snap acting controllers wait until a set point is reached and then send a full supply pressure signal to the valve actuator which fully opens the valve.
  - When the low set point is reached, a snap acting controller will fully vent the actuation volume and return the valve to fully closed.
- On/Off Proportional (like a light switch with a dimmer)
  - A proportional controller will send a partial pressure signal to a valve actuator as the control variable reaches the actuation set point. If the control variable continues to increase, the controller will increase the pressure signal to the valve actuator until the variable ceases increasing.
  - When a control variable approaches the de-actuation set point a proportional controller will vent a portion of the pressure signal from the actuator. As the control variable continues to decrease the controller will decrease the vent rate until the actuator loop is fully depressured.
  - This is different than a throttling action and can be thought of as a soft open/close action
- Snap acting vs Proportional action does not normally have a large impact on emissions.
  - For an intermittent-vent controller, a proportional action may vent somewhat less gas on de-actuation than a snap-acting controller in the same service.
  - For a continuous bleed controller emissions would be essentially the same between proportional and snap-acting settings

Intermittent Controllers – How they operate

- On/Off service
  - Operate against a set point (s) (e.g. liquid level Hi/Lo)
  - Send a pressure signal (gas) when a set point (e.g. liquid level) is reached (e.g. pressure-to-open dump valve) to fully open valve
  - Vent pressure (gas) to fully return valve to prior position (e.g. normally closed with spring-for-return dump valve)
- Throttling service (like cruise control in your car)
  - Operate against a desired set point (e.g. pressure)
  - Send a pressure signal (gas) to increase output signal (pressure to open – partially open valve)
  - Vent pressure (gas) to decrease output signal (partially close valve)
  - Hold a valve in an intermediate position

Intermittent Controllers – Design & Operation

- Typically a pilot (small 3-way valve) operated design



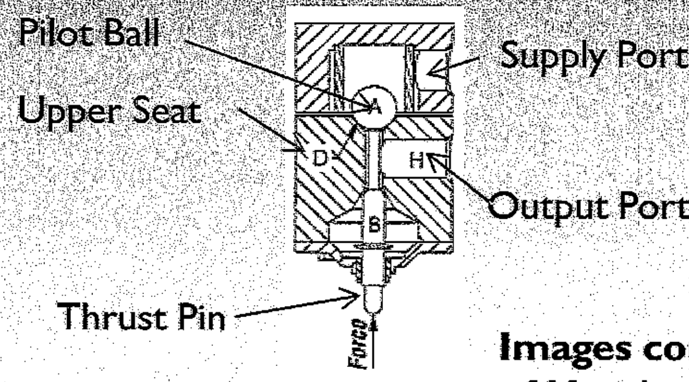


Figure 4 — Snap Pilot

Images courtesy of Norriseal

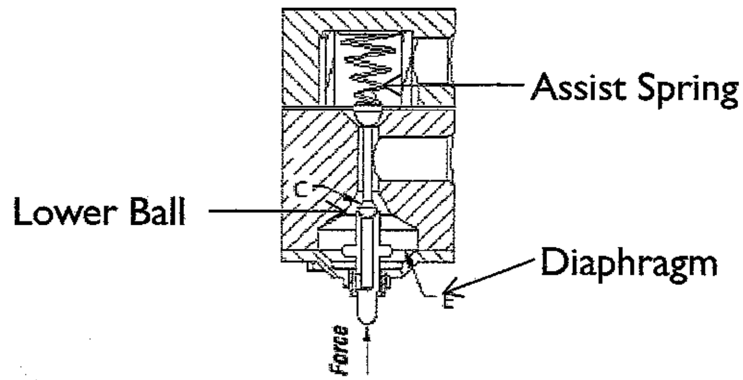


Figure 5 — Throttle Pilot

- To actuate, the thrust pin displaces the upper ball allowing supply gas to flow to the output port and valve actuator
- To de-actuate, the thrust pin moves down, the upper ball reseats and the exhaust port is opened de-pressuring the actuator and tubing
- In throttling service the diaphragm senses force/feedback with the output signal proportional to the mechanical force on the thrust pin. The upper ball controls supply gas and has spring assist to help seating and the lower ball vents gas. The pilot seeks to maintain equilibrium by increasing or decreasing pressure. Supply air does not flow when balanced.

Exhaust Port Not Shown

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Intermittent Controllers – Emissions #1

- Two components to emissions in normal operation
  - Vent on de-actuation – Almost all emissions from an intermittent controller are from venting the internal volume from the valve actuator to return the valve to its prior position and return the control loop to an idle (non-emitting) mode.
  - Seepage/Leakage past pilot ball/seat – Normally minor
- De-actuation vent volume depends on:
  - Size/volume of valve actuator & length of valve actuator travel – Actuation Volume
  - Service
    - On/Off - Pressure of output gas (function of supply pressure and controller);
    - Throttling – Differential pressure from adjustments to maintain set-point
  - Length and diameter of tubing from controller to actuator

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Intermittent Controllers – Emissions #2

- Emissions from intermittent controllers are "event based"
  - An event is an occurrence of cycling the control valve actuator
  - Nearly zero emissions between events
- Gas volume emitted per unit of time depends on frequency of cycles and de-actuation volume per cycle
- Total vented gas is a function of the number of times that the valve operates, not the length of time the controller is in operation
- Normal continuous seepage/leakage depends on:
  - Material of balls and seats; Elastomer seats claim zero leakage
  - Pressure of supply gas
  - Gas gravity; Natural gas volume is ~1.3 X air volume
  - Designed for near-zero emissions when not de-actuating a control loop

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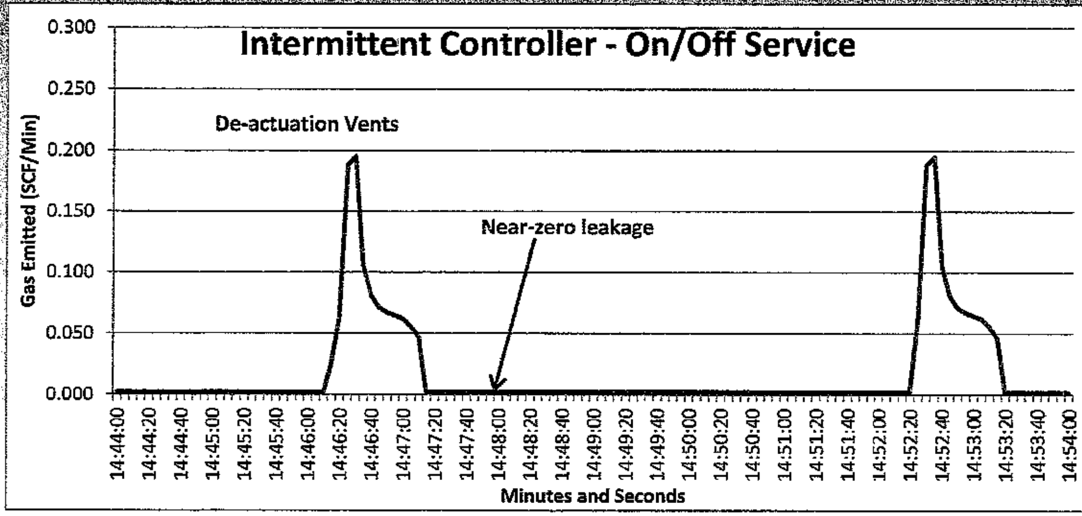
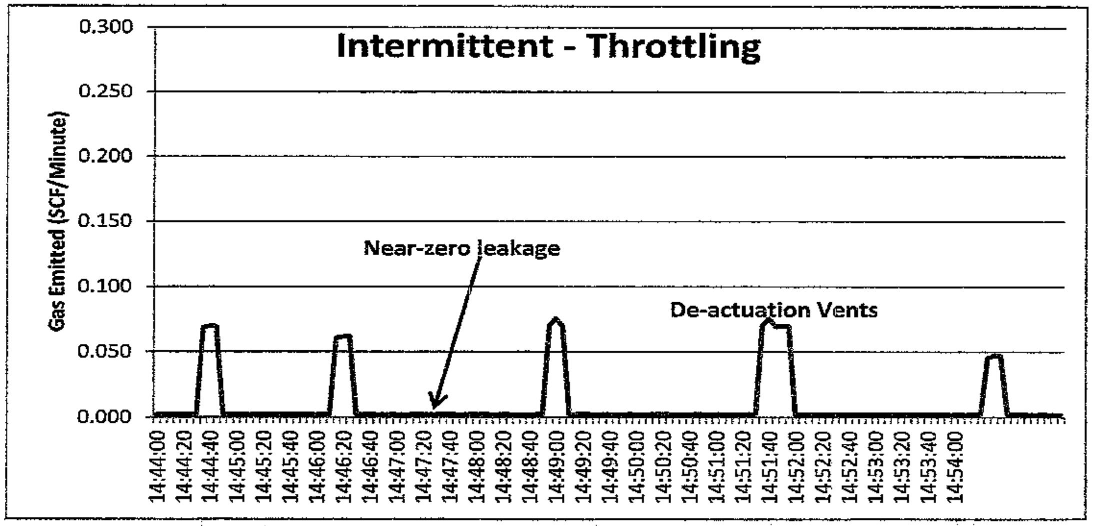
Emission Profile





On/Off Snap Acting

Seep/Leak Rate examples

Kimray: (Air)
Snap: 0.407 scf/day
Throttle: 0.610 scf/day

Norriseal: (Gas)
Snap: 0.2 scf/hr
Throttle: 0.007 scf/hr
Envirosave: 0.0 scf/hr

Throttling

More frequent de-actuations with less volume each

Note: data is not actual; constructed for illustration purposes only

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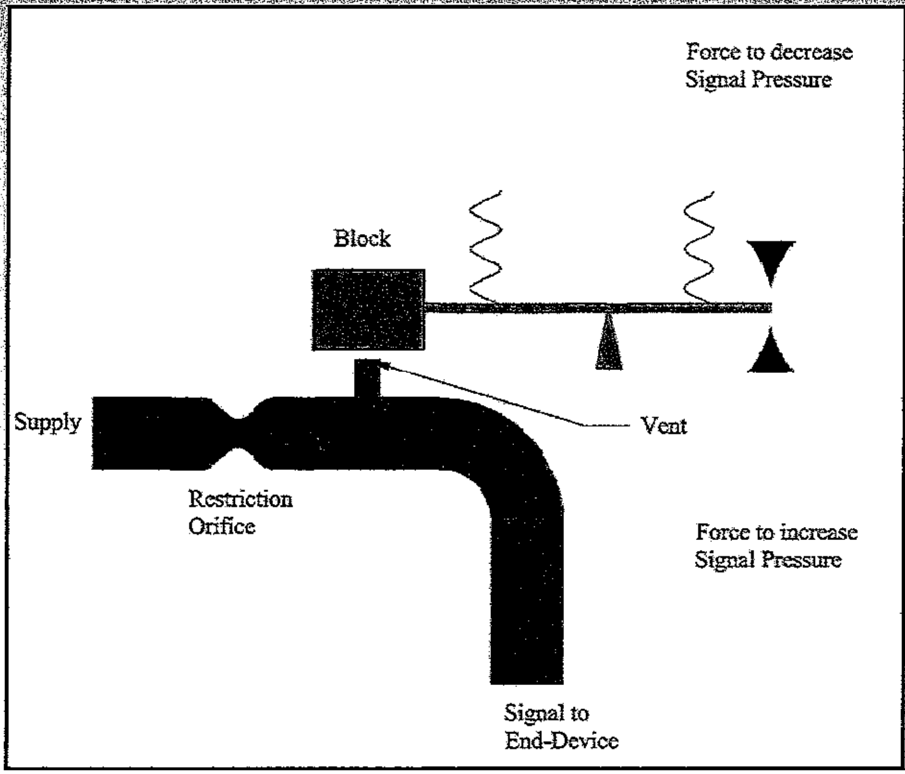
Cycle Frequency Challenges

- Events do not tend to occur on a predictable schedule
  - A pressure regulator is actuated when downstream demand changes (not predictable)
  - A level controller is actuated when liquids accumulate (a function of the process inlet stream which is not completely predictable for a short time frame)
- Two identical controllers and end-devices can have significantly different emissions depending on the particular process configuration, process variable controlled and demands that **change the number of cycles**
- There is no reliable way to convert an event-based emission into a time-based emission rate unless the frequency of events (actuations) is known or determined.
- Currently, there is insufficient high-quality measurement data, coupled with the relevant process data, to support an average emission factor reflective of the population of intermittent controller types, services, and conditions.

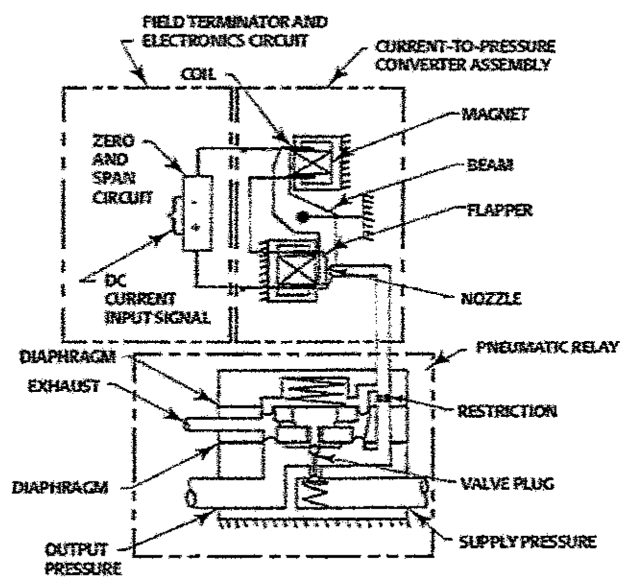
Continuous Bleed Controllers Design & Operation

Typically a nozzle & flapper arrangement



- As the block/flapper is pushed closer to the nozzle the output signal to the actuator increases
- As the block/flapper moves away from the nozzle the output signal decreases
- Maximum emissions are controlled by the restriction orifice

Figure 11. Fisher i2P-100 Transducer Schematic



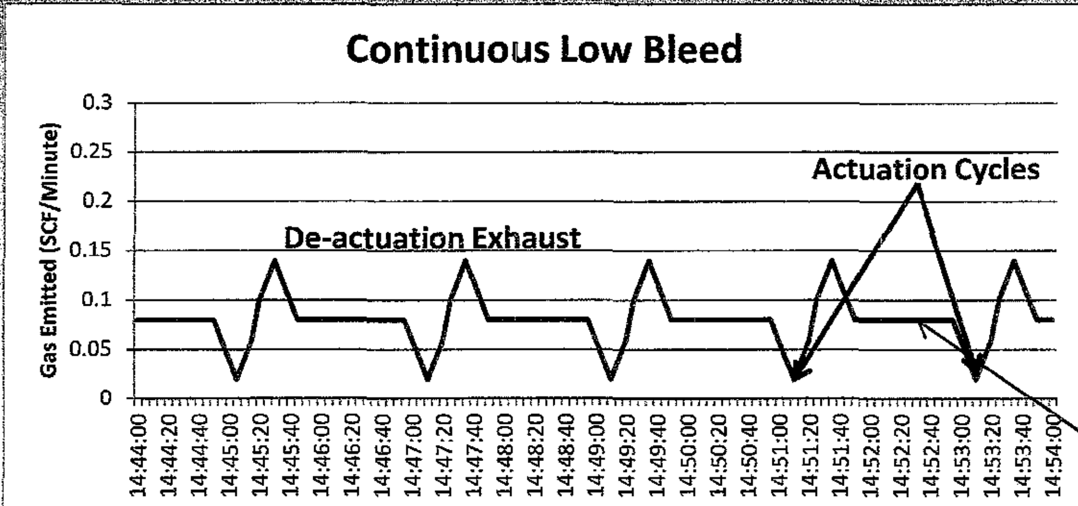
Continuous Bleed Controllers – How they operate

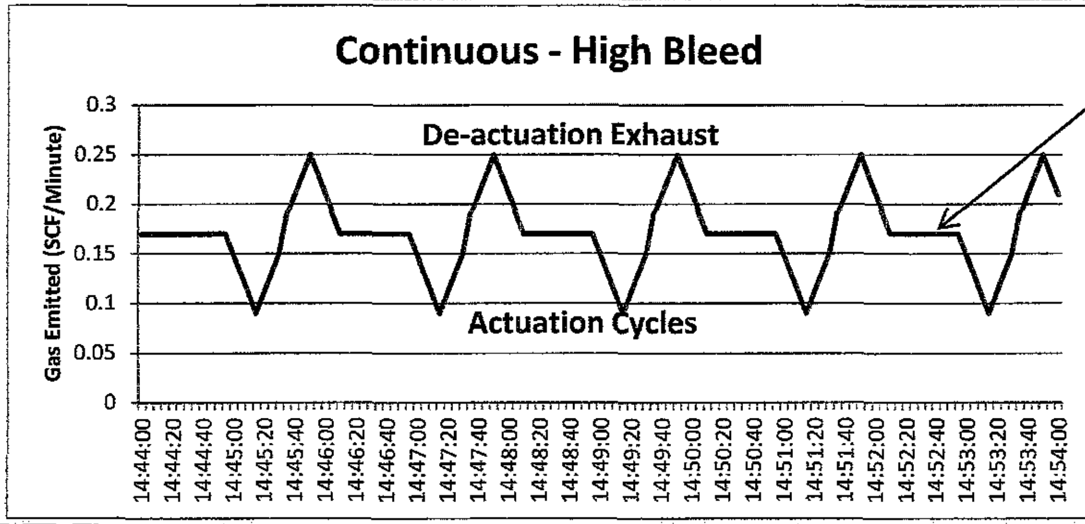
- On/Off service
  - Operate against a single set point (e.g. pressure)
  - Fully close the nozzle (with flapper) and send a 100% output pressure signal (gas) when a set point (e.g. pressure) is reached
  - Continuously bleed gas at a rate determined by critical orifice/restriction size; gas pressure; gas gravity and degree of nozzle closure by block/flapper - except when nozzle is fully closed
- Throttling service
  - Operate against a desired set point (e.g. pressure)
  - Partially close nozzle and send a pressure signal (gas) to increase output signal (partially open valve)
  - Partially open nozzle to decrease output signal (partially close valve)
  - Continuously bleed gas at a rate determined by critical orifice/restriction size; gas pressure; gas gravity and degree of nozzle restriction
- Continuous "low bleed" <6scf/hr; "high bleed" >6scf/hr (regulatory)
  - Low bleed rates are achieved by using small diameter orifices (0.012 – 0.009 inches). These small diameters increase the risk of debris plugging and significantly limit the speed of control action/response which limits the situations they can be used.

Continuous Bleed Controllers - Emissions

- Emissions in normal operation
  - Bleeds to atmosphere continuously except for 100% output (flapper fully closes nozzle)
  - Rate of bleed decreases during actuation and increases on de-actuation
    - De-actuation exhausts the actuation volume plus returns controller to normal bleed rate
- Bleed rate depends on
  - Restrictive orifice size
  - Pressure of supply gas
  - Gravity of supply gas
  - Lower bleed during actuation depends on degree that flapper closes nozzle vs. maximum rate through restrictive orifice
  - Exhaust during de-actuation balances lower rate during actuation

Continuous Bleed Controllers Emission Profile





Zero output emission rate (steady-state) determined by restrictive orifice size, gas pressure, and gas properties

The average emission rate over time will be ~equal to the amount of gas through the restrictive orifice

Note: data is not actual; constructed for illustration purposes only

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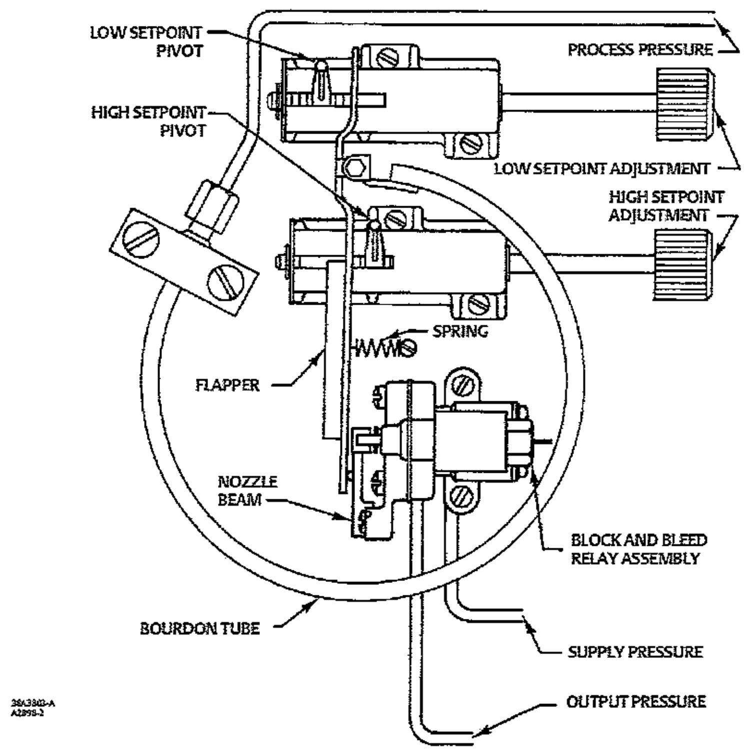
Protection/Shut-in Devices/Controllers

- Not a source of material emissions
- Used to protect against abnormal conditions
  - e.g. Overpressure/under-pressure (Hi/Lo pilots); Hi/Hi liquid level in tanks/vessels;
  - Typically do not emit unless abnormal condition occurs
- Example: Hi/Lo pressure pilot
  - Normally operates at 100% output holding a "fail closed" valve open
  - If overpressure or under-pressure occurs then output bleeds to atmosphere and valve closes
- Not controlling a "process variable"
- Seldom open and emit

Figure 1. Principle of Operation Schematic



Steady-State Air Consumption(3)

Output Signal at 0 psig: ≤0.134 normal m^3/hr (≤5 scfh)
Output Signal at Full Supply Pressure: ≤0.00134 normal m3/hr (≤0.05 scfh)

Image and information courtesy of FISHER

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Intermittent or Continuous – Choice?

- Although intermittent vent controllers are the lowest emitting selection in most applications, due to not bleeding gas between actuation cycles, in certain cases a low bleed continuous type controller may be a lower emission selection.
  - This is only the case where "over-shooting" the high parameter set point can be safely and operationally tolerated.
- Each application must be analysed to determine whether a low-bleed continuous controller is a better emission choice and whether the application can tolerate the "overshoot" inherent in the slow response time of a low bleed continuous controller.
- All of the different types and services of controllers have scenarios where they are the lowest emission options and operators need the flexibility to deploy the appropriate technology while taking into account the overriding drivers of operational and process safety, stability, and reliability.

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Intermittent or Continuous – Temp. Control Example

- Comparing a typical temperature control loop using an intermittent controller to a low-bleed continuous controller the intermittent is the lower emission choice
- Temperature control loops sense temperature and control fuel flow to a heater to turn it on or off. Very common and basically every field heater (dehydrator, tank heater, heater-treater, production unit, etc.) has a temperature control loop. Also used to control air coolers and other processes
- Since the fuel valve is small and in low pressure service, the actuator used to move the valve is equally small volume. For instance an actuator for a fuel control valve is about 1.1 cubic inch volume which will yield emissions ~100 times smaller per cycle than the 110 cubic inch level controller example used in background slide.

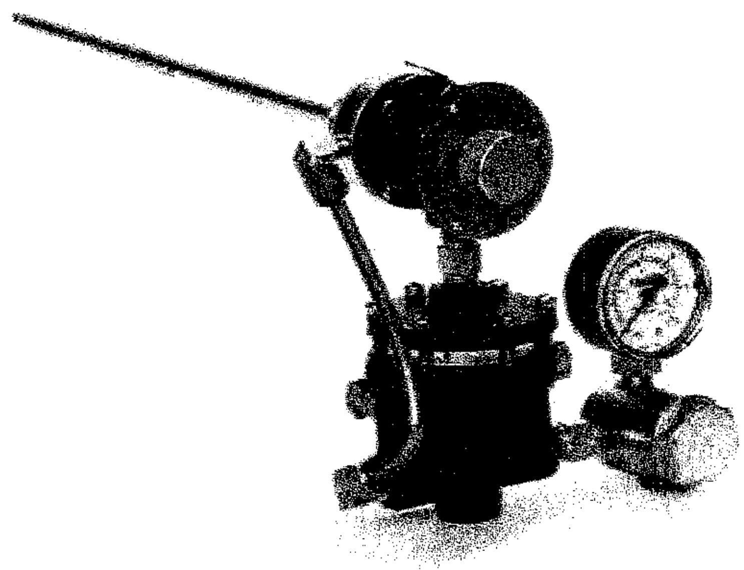

Image Courtesy of Kimray

- It would require ~378 cycles/hr (or about one cycle every 9.5 seconds) to reach hourly emissions of 6 scf/hr (regulatory low-bleed continuous). This is not going to occur.
- In this application, an intermittent type controller is the obvious low emission choice and fits the process control demand very well.

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Emission Factors and Population Counts

- Subpart W (GHGRP) emission data for pneumatic controllers
  - **The current emission factor (EF) for intermittent controllers is almost certainly an order of magnitude too high.**
  - Given how intermittent controllers and continuous controllers operate this is almost certainly not valid across the spectrum of controllers and services.
  - For 2011 and 2012 the "counts" of pneumatic controllers in each category were estimated rather than counted. The 2013 emission data requires an actual count.
- National inventory emission data for pneumatic controllers
  - The National Inventory uses a single estimate of the number of pneumatic devices and a single emission factor to calculate a potential methane emission for pneumatic controllers (called devices).
  - Reductions in emissions attributable to Natural Gas Star voluntary taken and reported actions and regulatory required reductions (if required) are subtracted from these potential emission estimates.
  - It is not clear what the genesis is for the pneumatic controller population estimate or emission factor.

Known Studies/Projects

- UT Phase 1 Study sampled 305 controllers.
- UT Phase 2 study, with improved methodologies, is underway and due to be published later this year
- GRI/EPA 1996 study
- Canadian Association of Petroleum Producers published pneumatic device emission factors (CAPP, 2002 and CAPP, 2003)
- Recent British Columbia study (Prasino) published
- Pioneer Natural Resources is planning to publish the results of a measurement study in the near future.

Important to remember the following:

- All studies need to be QA/QC'd to judge whether the type of controller and service was correctly identified
- All studies need to be QA/QC'd to judge whether the appropriate methodologies, sampling populations, and sampling times were used to adequately measure emissions from controllers
- All studies need to be QA/QC'd to judge whether the data collected was appropriately analyzed and attributed

Conclusions

- Operators need the flexibility to deploy the appropriate technology while taking into account the overriding drivers of operational and process safety, stability, and reliability.
- Different types and services of controllers have scenarios where they are the lowest emission options
- Intermittent controllers will be the low emission choice in most applications
- In a small number of cases, **where the process can tolerate control delay**, low-bleed continuous controllers may be the low emission choice.
- The current views regarding the emission rate from intermittent controllers are almost certainly not correct.
- Although measurement studies are being done and published, care needs to be taken to QA/QC the results before simply accepting them. Sufficient good quality study and measurement data is not yet available to characterize the population of controllers and applications.
- Due to the methodologies and emission factors the GHGRP and National Inventory data for pneumatic controllers needs to be carefully understood before using it for either population counts of different types of controllers or emissions estimates.

Background

Intermittent Controllers – Emissions Example

On/Off Level Controller/Device Example		
	2" Level Range	6" Level Range
Supply Pressure PSIG	25	25
Atmospheric Pressure PSI	14.7	14.7
Gallons per dump	1.3	3.9
Production/day (bbls)	10	10
Length of tubing (ft)	10	10
Dia. Of tubing (inches)	3/8	3/8
X-section of tubing (sq ft)	0.0008	0.0008
Volume of tubing (scf)	0.022	0.022
Volume of actuator (cubic inches)	110	110
Actuator de-actuation volume (scf)	0.17	0.17
Total volume per cycle (scf)	**0.19**	**0.19**
# of Cycles per hour	**13.5**	**4.5**
Total volume per hour (scf)	**2.6**	**0.9**

Intermittent Controller Calc

Kimray Actuator Vent Worksheet

- Typical example only. In practice the parameters and actuations per unit of time will vary.
- The seepage/leakage of gas (minor) while in the idle mode is additional to the volume shown
- In 2012 the average US gas well produced 1.3 bbls/day of oil/condensate (Source: DI)
- In 2012 the average US oil well produced 9.4 bbls/day of oil (Source: DI)
- In 2012 the average US well produced 5.6 bbls/day of oil (Source: Basic Petroleum Databook)
- At 25 psig and 5.6 bbls/day the gas emitted for an average intermittent oil dump controller would be between 1.4 SCF/hr and 0.4 SCF/hr; The GHGRP factor is 13.5 SCF/hr

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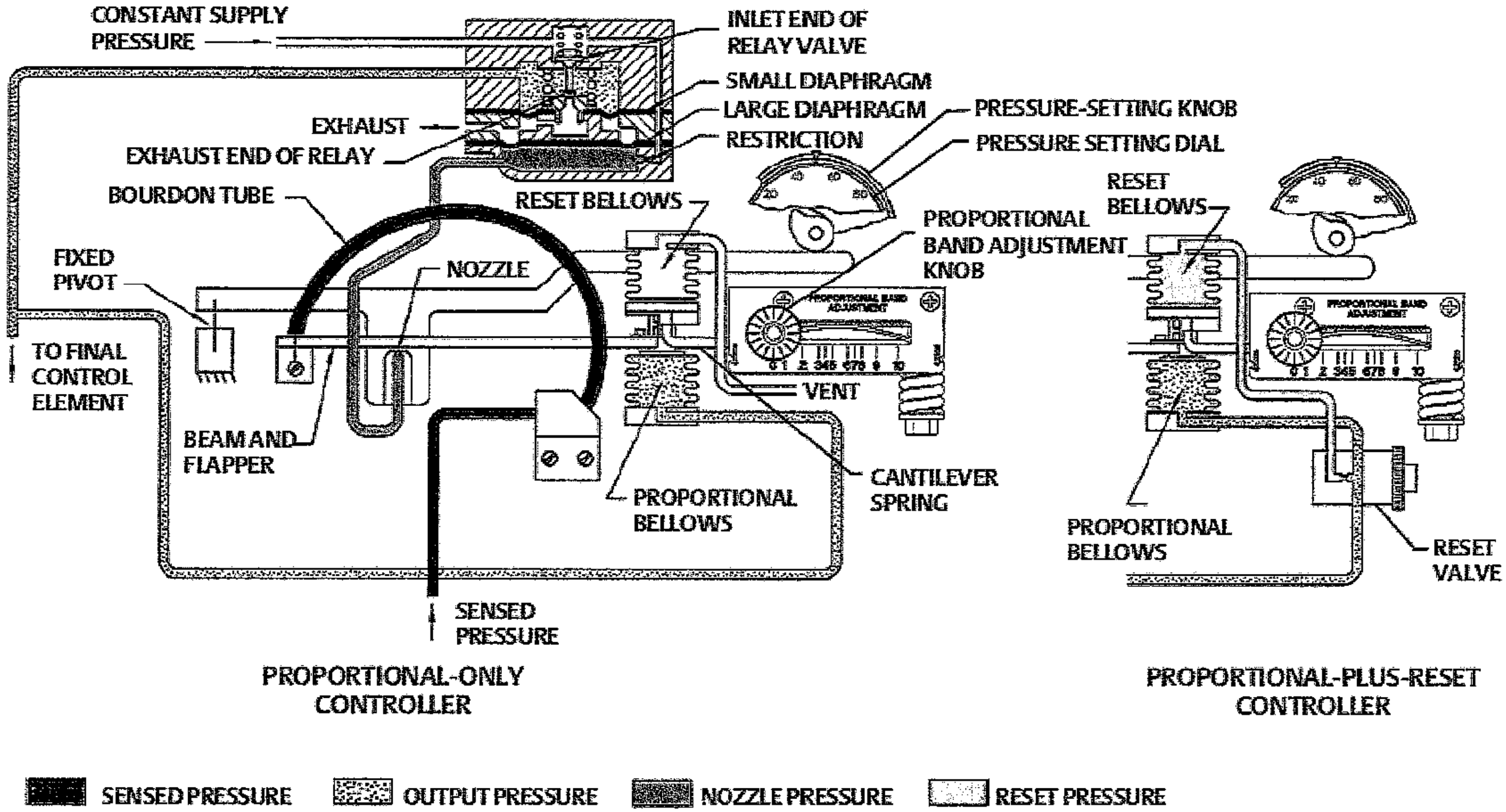
Intermittent Controllers – Emission Variability

- **What can go wrong to increase emissions**
  - Debris/deposits on vent pilot plug: Material on the vent pilot can allow the controller to exhaust gas during the activation cycle.
  - Debris/deposits on the supply pilot plug. Material on the supply pilot can cause the introduction of gas while the vent is open.
  - Broken spring (when equipped) The spring holds the supply pilot-plug on its seat and without this spring the controller has similar emissions as a continuous bleed controller. This particular malfunction generally calls attention to itself quickly because the end-device being actuated doesn't operate.
  - Broken diaphragm (where installed). Many intermittent vent controllers have diaphragms for various reasons. A detailed analysis of a particular device would be required to determine the results of the failure on the emitted gas.
- **Other** - leaking tubing/tubing-fittings, etc (equipment leaks not controller emissions)

Continuous Bleed Controller - Schematic

Figure 1. Schematic of Reverse-Acting Proportional-Only and Proportional-Plus-Reset Controllers



Schematic Courtesy of FISHER

Continuous Bleed Controllers Emission Variability

- **What operational factors impact emissions rate**
  - Supply Gas Pressure and Gravity
- **What can go wrong to change emissions**
  - The orifice can partially plug which lowers bleed rate
  - A continuous controller that will still operate an end device has its emissions capped by the restriction orifice
  - A leak within the controller upstream of the restriction orifice can increase total emissions.
- **Other (e.g. leaking tubing/tubing-fittings, o-rings)**

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ATTACHMENT 2

Pneumatic Controller Emissions from a Sample of 172 Production Facilities

Prepared by Oklahoma Independent Petroleum Association

November 2014

Contents

Executive Summary

A study conducted by the Oklahoma Independent Petroleum Association (OIPA) provided examples of natural gas pneumatic controller emissions at production facilities across Oklahoma. The results addressed recognized knowledge gaps and were useful to assess the representativeness of previous reports. Improved quantification methods were applied to a new, up-to-date controller sample. The study examined controller emissions for a variety of facility characteristics such as age, production type (oil or natural gas), and state air permit applicability. By collecting data types not typically recorded, this study helped identify inconsistencies in pneumatic controller terminologies in past research.

Data Collection

The study included 172 oil and gas production sites selected from the Oklahoma assets of eight OIPA companies. A random selection of sites was used that had approximately equal numbers of newer sites versus older sites and oil sites versus gas sites. The sites contained 205 producing wells and 680 pneumatic controllers. With engineering calculations in mind to quantify emissions, data collected for each controller included:

- Controller make and model
- Controller supply pressure
- Volume contained within tubing between controller and actuator
- Actuator make and model
- Actuator physical dimensions
- Actuation count over a 15-minute observation period
- Located at oil site or gas site, based on Oklahoma Corporation Commission (OCC) filings
- Located at new site (first production in 2000 or later) or old site (1999 or earlier)
- Located at permitted site or permit-exempt site
- Supply gas composition

The data collected in the field was augmented with manufacturer specifications such as continuous bleed rates and gas volumes contained within the actuator.

Assumptions and Calculations

This study used assumptions for missing data and complex emissions scenarios, which resulted in conservatively high emissions. The assumption most influential on calculated emissions was default actuation frequency. It was impractical for the study team to monitor actuations for intervals exceeding 15 minutes, considering the time requirement for travel and observation. As a result, this study assumed that a controller with zero observed actuations over a 15-minute interval undergoes actuation once every 15-minutes. The data and assumptions were combined using the equation in Exhibit 1.

Exhibit 1: Pneumatic Controller Emissions Engineering Calculation

$$r_{tot} = \Sigma_{controllers} \frac{c}{z}\left[r_{bleed} + r_{seep} + lft\left(V_{controller} + V_{tubing} + V_{actuator}\right)\right]$$

Where:

r_{tot}	is the total emissions rate in standard cubic feet per hour (scfh) of natural gas, volatile organic compounds (VOC), or methane.
$\Sigma_{controllers}$	represents a sum over controllers in the sample with a desired trait, such as all controllers at oil sites.
c	is the site-specific volume fraction of natural gas, VOC, or methane. For natural gas, c is equal to 1.
z	is the site-specific gas compressibility.
r_{bleed}	is the manufacturer's specified bleed rate for a continuous bleed controller in scfh natural gas. This is 0 for intermittent vent controllers.
r_{seep}	is the seepage rate to reduce hysteresis in scfh natural gas. This is 0 for continuous bleed controllers.
l	is the relay multiplier which is 1 for controllers with no relay and 3 for controllers with a relay.
f	is the observed actuation frequency during data collection in actuations per hour. f is equal to 4 if no actuations were observed during data collection.
t	is the unitless actuator stem travel fraction for throttling controllers which is equal to 1 for a complete opening of the valve during actuation. This is always equal to 1 for on/off controllers.
$V_{controller}$	is the volume in the controller at supply pressure, in scf natural gas. This is not readily available, so a conservative allotment of 2 inches of tubing length is used to acknowledge this parameter.
V_{tubing}	is the volume in the tubing between the controller and actuator at supply pressure, in scf natural gas. This is determined from tubing length and diameter measurements for each controller.
$V_{actuator}$	is the volume in the actuator at supply pressure, in scf natural gas. This value is equal to manufacturer specifications of the gas space under the actuator diaphragm. Actuators with no available manufacturer specification conservatively defaulted to the dimensions of the entire actuator body.

Controller emissions were determined as the sum of the controller, tubing, and actuator emissions as a result of actuation plus any continuous bleed and seepage emissions. Any unintended leaks from the tubing, controller, and actuator were not included, as they are leak repair issues rather than pneumatic controller vent or bleed characteristics. Combining leaks and pneumatic controller emissions into a single value would introduce ambiguity since leaks would represent an unknown value of total controller emissions anywhere between 0 to 100% of the result. Combined leak and controller emissions data increases the difficulty of emissions mitigation since reduction options for leaks are different from pneumatic controllers. Replacement, refurbishment, or retrofit of a pneumatic controller does not address the root cause of equipment leaks in the same manner as leak detection and repair. Because of the difficulty in distinguishing metered gas as a leak or as a continuous bleed, future research to explore leaks specific to pneumatic controllers would be to record one set of measurements to represent a controller's base case emissions and then measure again as a case after leak detection and repair.

Results

The OIPA sample contained on average 3.83 intermittent vent controllers per site and 0.12 continuous bleed controllers per site. On average, intermittent vent controllers emitted 0.40 scfh gas and continuous bleed controllers emitted 21.54 scfh gas. Results are presented in two sections, summary of observations and summary of emissions calculations.

Summary of Observations

Exhibit 2 is a summary of the collected data.

Exhibit 2: Key Observational Results

SITES	
172 sites (205 wells) visited for data collection	
162 sites (190 wells) had natural gas pneumatic controllers	
10 sites (15 wells) did not have natural gas pneumatic controllers	
CONTROLLERS	
680 natural gas pneumatic controllers	659 intermittent vent controllers
77 controller models	21 continuous bleed controllers
AVERAGE CONTROLLER COUNTS	
4.0 pneumatic controllers per site	3.6 pneumatic controllers per well
5.0 pneumatic controllers per new gas site	5.3 pneumatic controllers per new oil site
3.1 pneumatic controllers per old gas site	2.7pneumatic controllers per old oil site
ACTUATION FREQUENCIES	
538 controllers (79%) had no actuations detected during the observation period and were assigned the default rate	
126 controllers (19%) had actuation rates less frequent than the once per 15 minute default rate	
16 controllers (2%) had actuation rates more frequent than or equal to the default rate	

Key remarks were that a) the majority of controllers were intermittent vent, b) most intermittent vent controllers emitted infrequently, and c) inconsistent and non-explicit controller definitions in past research introduced significant controller count uncertainty in other work.

a) 97% of controllers were intermittent vent and 3% were continuous bleed which is a significantly different result than representations in past work. All continuous bleed controllers were level controllers and constituted about 12% of the level controllers in the sample.
b) 142 out of 680 controllers, or 21%, had an actuation rate supported by direct observation or other company records such as plunger runs. 538 controllers, or 79%, were observed for 15 minutes, did not actuate, and were assigned the conservatively high actuation rate of once every 15 minutes.
c) Of the 77 controller models identified, 17 models were in the Kimray SGT/FGT series of backpressure controllers. They accounted for 269, or 40%, of observed controllers. These backpressure controllers are often used for overpressure protection, rarely actuated when encountered in the field, and generally used the default assumed actuation rate of four per hour. Controller counts can therefore vary significantly depending on if these controller types are included or excluded. It is unclear if the counts and rates presented by other reports include or exclude these types of backpressure controllers. Some studies did not state explicit definitions, while others had non-explicit definitions that created conflicting interpretations.

Controllers were placed into one of four bins based on age (new or old) and production (oil or gas). A key observation was that the average controller count per site is higher by 2.2 for new sites than for old sites, which was due to the increased number of process units at some newer sites.

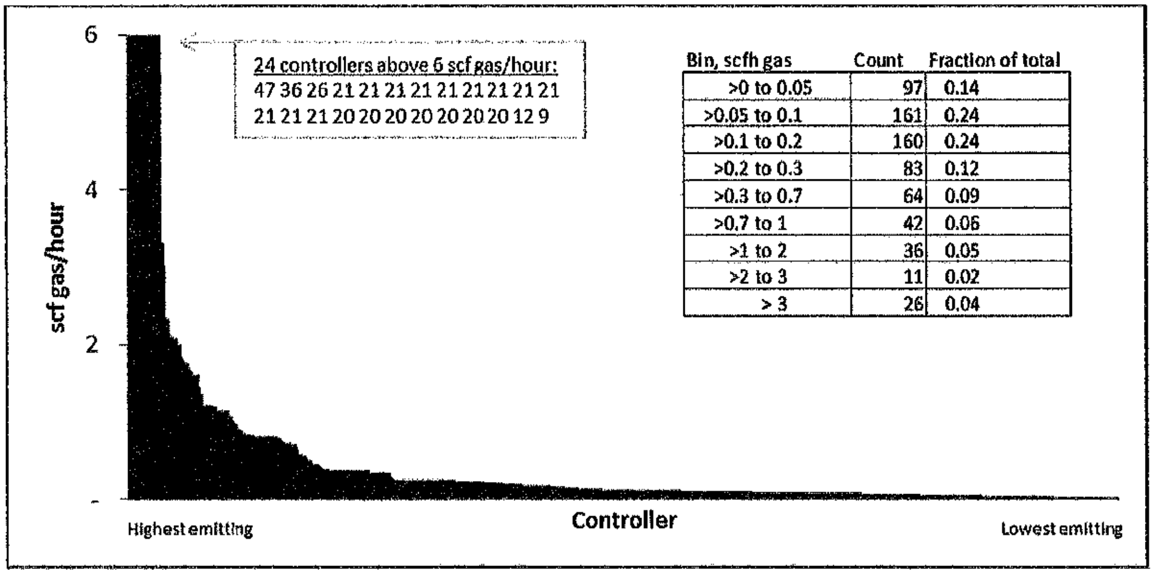
Summary of Calculations

Emissions from all controllers were 717 scfh gas before considering annual operating factors. Exhibit 3 displays the calculated emissions results as a histogram. Each bar along the x-axis is a controller whose magnitude is represented by the y-axis. The y-axis was truncated at 6 scfh gas, the maximum rate for a "continuous bleed natural gas-driven pneumatic controller" as defined in 40 CFR 60 subpart OOOO[1]. The y-axis was truncated so that the results can be compared against this regulatory value for new

[1] EPA. Subpart OOO-Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution. www.ecfr.gov/cgi-bin/text-idx?SID=7a126adb4fe9f7e9056273a955236a5a&node=40:7.0.1.1.1.103&rgn=div6#se40.7.60_15430

sources and to allow the majority of controllers to be perceivable. The magnitude of each bar that exceeds the scale is shown in the first inset. A numerical histogram of all bars is shown in the second inset.

Exhibit 3: Pneumatic Controller Emissions Histogram, 717 scfh gas in total



The calculated results conformed to a pattern commonly found in oil and natural gas emissions sources: a small number of sources were responsible for the majority of emissions. This occurred because two heterogeneous categories were being combined. One way to describe the heterogeneity in this source category is to note that the largest emitter, 47 scfh gas, was a factor of 1,838 larger than smallest emitter, 0.03 scfh gas. The 24 controllers above the 6 scfh gas emissions rate represented 520 scfh gas or 73% of emissions. The remaining 656 controllers represented 197 scfh gas or 27% of emissions.

Exhibit 4 displays average rates for all controllers in the sample and for the two different controller types, continuous bleed and intermittent vent. The table shows rates for production gas, methane, and VOC. Hourly rates exclude annual operating factors. Annual rates incorporate annual operating factors.

Exhibit 4: Average controller emissions

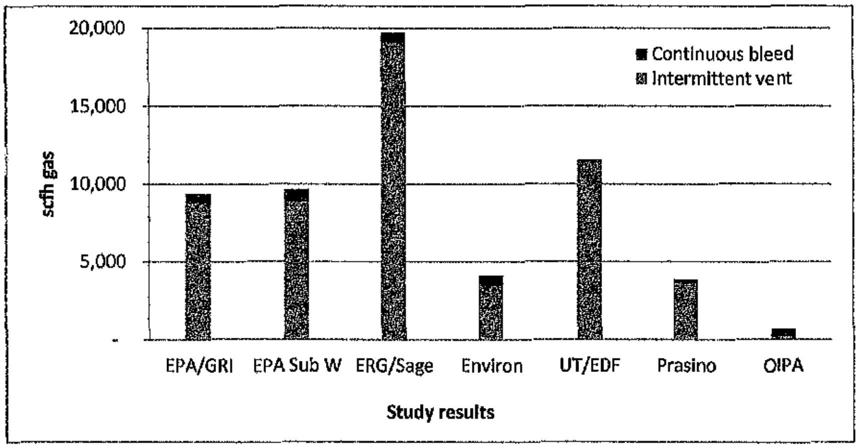
	scf/hour	Mscf/year	lb/hour	ton/year
All controllers				
Gas	1.05	8.78		
Methane	0.85	7.08	0.030	0.125
VOC	0.085	0.70	0.012	0.049
Intermittent Vent				
Gas	0.40	3.24		
Methane	0.33	2.64	0.012	0.047
VOC	0.031	0.25	0.004	0.018
Continuous Bleed				
Gas	21.54	182.65		
Methane	17.23	146.15	0.609	2.585
VOC	1.79	15.05	0.247	1.038

The intermittent vent controllers' average hourly rate was a factor of 54 times lower than that of the continuous bleeds'. The difference was attributable to the continuous bleed stream rather than any features of the actuators or facilities. The average hourly rate results for methane and VOC followed the expected pattern based on gas composition, and VOC emissions were a small fraction of the total rates.

Comparison with Other Studies

Exhibit 5 shows the emissions from all 680 controllers in the OIPA sample when using different quantification methods. For each study, the most applicable emissions factor was chosen to represent the 659 intermittent vent controllers in the OIPA sample, and the most applicable emissions factor was chosen to represent the 21 continuous bleed controllers in the OIPA sample.

Exhibit 5: Emissions from OIPA controllers estimated using different study results



The exhibit illustrates that the existing body of work overestimates emissions from the OIPA controller sample. The degree of overestimation ranged from a factor of 5.4 in the Prasino study to a factor of 27.5 in the ERG/Sage study. The choice of intermittent vent controller quantification method is important since intermittent vent controllers are 97% of the OIPA sample. The OIPA results show that the majority of emissions occur from a small count of continuous vent controllers, but use of methods from other studies would incorrectly indicate that the majority of emissions occur from the large count of intermittent vent controllers. Therefore, the intermittent vent emission factors used in other work were a poor representation of emissions from controllers in the OIPA sample.

Conclusions

This study improved upon the body of work to characterize production site pneumatic controller emissions by:

- Providing an up-to-date pneumatic controller data set.
- Collecting data at a variety of site types.
- Estimating emissions by applying engineering calculations to data types not typically collected, such as actuation frequency and actuator volumes.
- Providing practical examples of emissions quantification challenges, such as the significant effect of controller definition and the assumptions necessary to describe complex operating scenarios.
- Using the average counts per site and emissions per controller to assess the representativeness of inventories and other quantification work.

The controller counts per site and the emissions per controller can be used as points of reference to assess the representativeness of inventories and other work. By using the results as a point of reference, OIPA found that prior work:

- underestimated the intermittent vent controller counts at the visited sites.
- overestimated the intermittent vent controller emissions at the visited sites.
- overestimated the continuous bleed controller counts at the visited sites.
- overestimated the continuous bleed controller emissions at the visited sites, though previous methods give results of the same magnitude.

The largest disagreement between the results and previous work is the characterization of intermittent vent controller emissions. The disagreement stemmed from knowledge gaps, different controller definitions, and use of historical data not representative of the visited sites. This study's up-to-date data, significant sample size, incorporation of a variety of site characteristics, all-encompassing controller definition, and conservatively high quantification assumptions provided evidence that intermittent vent controller emissions were not a significant emissions source compared to other emissions at production sites.

This study reported on controller makes, models, and functions. This information can help identify controller definition inconsistencies, which may have contributed to discrepancies between studies. Without explicit and consistent controller definitions, an emissions estimate receives subjective interpretations of what well pad equipment constitutes a pneumatic controller.

ATTACHMENT 3

Construction Equipment

			EQUIPMENT ACTIVITY	Emission Factors		Emissions	
Equipment Type	**Quantity of Equipment**	**Annual Operating Time (Days)**	**Daily Operating Period (hrs/day)**	**NOx (lb/hr)**	**VOC (lb/hr)**	**NOx (lb)**	**VOC (lb)**
Water Truck	1	365	10	2.3885	0.2480	8718.0	905.2
				TOTAL		8718	905

NOTES:

Emission Factors are CARB SCAQMD 2010 off-road emission factors for diesel equipment