Denver Metropolitan Area and North Front Range
8-Hour Ozone
State Implementation Plan

Technical Support Document
For
Proposed Pneumatic Controller Regulation

DRAFT
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Colorado Department of Public Health and Environment
Air Pollution Control Division
4300 Cherry Creek Drive South
Denver, Colorado 80246

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1. Proposed Regulation

Regulation being proposed to the Air Quality Control Commission in Fall 2008 would require that high-bleed natural gas actuated pneumatic controllers in ozone non-attainment areas (NAAs) be replaced or retrofit (converted) to low-bleed controllers, unless they are exempt. The proposed regulation would also allow for other means to reduce emissions, such as using a solar device or a device that is actuated, or powered, using compressed air. Inspections, enhanced maintenance, and recordkeeping would be required for remaining exempt high-bleed controllers. Implementation of this proposed regulation would lead to a reduction in emissions of volatile organic compounds (VOCs), which are precursors to ozone.

Most background information and data used to develop the proposed regulation were obtained from either the Environmental Protection Agency (EPA) Gas STAR program or Independent Petroleum Association of Mountain States (IPAMS). Both sources use the term pneumatic "device", while the Colorado Air Pollution Control Division (Division) has chosen to be more specific by using the term pneumatic "controller" in the proposed regulation. A pneumatic device generally consists of a controller and a valve. The term "device" is used throughout this document to be consistent with data provided by EPA Gas STAR program and IPAMS.

2. What is a pneumatic device?

Many types of process control devices can be used to operate valves that regulate pressure, flow, temperature, and liquid levels. These devices can be operated pneumatically, electrically, or mechanically. A pneumatic device is an instrument that is actuated using gas. Most of the devices used by the natural gas industry are pneumatically operated. Although instrument air is commonly used to power pneumatic devices at gas processing facilities, since electricity is readily available to power air compressors at the facilities, the majority of natural gas industry pneumatic devices are powered by natural gas since electricity is not readily available at remote locations.[1]

As part of normal operation, most pneumatic devices emit, or "bleed", gas to the atmosphere, either continuously or intermittently. Pneumatic devices generally consist of a controller and a valve. Bleed rates are associated with the controller. Gas is vented to atmosphere during actuation when valves open and/or close. However, vent rates are not significant and are the same whether a high-bleed or low-bleed controller is used. The proposed regulation would address bleed rates from controllers that are actuated by natural gas. It will not address valve vent rates or controllers actuated by compressed air.

By definition, high-bleed pneumatic devices emit in excess of 6 standard cubic feet gas per hour (scfh) to atmosphere. The highest bleed rate listed in a table published by the EPA is 42 cubic feet per hour (cfh).[1] The average bleed rate for high-bleed pneumatic devices in the Denver-Julesburg (DJ) Basin is 17cfh.[2] Bleed rates of 6, 17, and 42 cfh natural gas represent emission sources of 0.3, 0.8, and 2.1 tons per year (tpy) VOC, respectively, assuming a VOC molar fraction of 7.47 percent, which is representative of the DJ Basin.[2]

3. Why was this proposed regulation developed?

A 2003 EPA study reported that emissions from pneumatic devices are collectively one of the largest sources of methane emissions in the natural gas industry. Natural gas is primarily composed of methane, but also contains VOCs and hazardous air pollutants (HAPs). Annual nationwide methane emissions are estimated to be approximately 31 billion cubic feet (Bcf) from the production sector, 16 Bcf from the processing sector, and 14 Bcf from the transmission sector.[1]

VOC emissions from pneumatic devices within the 9-county Denver Metro Area/North Front Range (DMA/MFR) NAA were estimated to be 24.8 tons per day (tpd) for the 2006 baseline and have been projected to be 31.1 tpd for the 2010 baseline. These emissions represent 13 and 15 percent of the total VOC emissions from oil and gas sources in the DMA/MFR NAA in 2006 and 2010, respectively.[3] This source category, pneumatic devices, has the second highest VOC emissions within the oil and gas industry. Therefore, emission reductions related to this source category have the potential to be significant. It is estimated that if this proposed regulated is implemented, 2010 VOC emissions will be reduced by approximately 23 tpd.

4. Why is this proposed regulation reasonable?

4.1. Timeframe

Many companies have already converted high-bleed devices to low-bleed devices voluntarily, as evidenced from responses to a Section 111 information request letter that the Division mailed to industry in June 2008. At a minimum, industry has committed to converting approximately 95 percent of high-bleed devices to low-bleed devices by November 2008. Therefore, if the proposed regulation is adopted in February 2009, it is anticipated that vendors would have enough supply on hand to satisfy orders for low-bleed devices and retrofit kits. There has been enough supply during the recent and ongoing conversions.

Under the proposed regulation, companies would be prohibited from installing a high-bleed device after February 1, 2009, unless the Division grants an exemption. The Division would approve use of a high-bleed device if a company can demonstrate that it is not technically feasible (e.g., safety or process concerns) to use a low-bleed device in a specific application. High-bleed pneumatic devices that are in place as of the anticipated regulation implementation date must be converted to low-bleed devices within three months (by May 1, 2009), unless the Division grants an exemption.

4.2. Associated Costs

Because implementation of this proposed regulation would increase the amount of natural gas that industry can sell, companies have the potential to save money. Calculations related to proposed regulation are available in Attachment 1 of this document. Costs (savings) associated with this proposed regulation include:

- Cost per ton of reduced VOC associated with converting existing pneumatic devices and performing enhanced maintenance on remaining high-bleed devices would represent an estimated savings of $747
- Weighted average annualized cost associated with converting existing pneumatic devices and performing enhanced maintenance on remaining high-bleed devices would represent an estimated savings of $1,505
- Weighted average annualized cost associated with installing low-bleed pneumatic devices for new applications and performing enhanced maintenance on remaining high-bleed devices would represent an estimated savings of $1,630
- Payback time period of implementing this proposed regulation is estimated to be 3 to 24 months

4.3. Conversion Effectiveness

The service life and process control ability of low-bleed pneumatic devices is comparable to that of high-bleed devices in most applications. Low-bleed devices are no more likely to fail than high-bleed devices.[4] If a device does fail, the process would no longer be controlled. For example, if a level controller fails, the dump valve would remain open. This would lead to a shortened residence time, which would not allow adequate separation between condensate and water. The mixed liquids would flow directly to a tank. This failure would be noticed during a regular site visit. It is anticipated that a device that fails would be repaired as soon as possible.

4.4. Emission Threshold

Typically, the threshold to require a permit for VOC sources in a Colorado NAA is 2 tpy. An average high-bleed pneumatic device emission rate in the DMA/MFR NAA is approximately 0.8 tpy of VOC. An average low-bleed pneumatic device emission rate in the DMA/MFR NAA is approximately 0.1 tpy of VOC.[2] The proposed regulation is targeting high-bleed devices, which have VOC emissions ranging from 0.3 to 2.1 tpy in the DJ Basin. While the low end of the emission range is a lower threshold than required for other emission sources, industry is already converting most high-bleed devices. Therefore, this proposed regulation represents a reasonably simple means of ensuring further VOC reductions. If the proposed regulation only applied to high-bleed devices emitting above typical thresholds, emission testing for high-bleed devices may be required to determine how many tons per year VOC were being emitted from each device. That could require additional resources both for industry and the Division.

4.5. Applying Regulation to only High-Bleed Devices

IPAMS estimated that in 2006 there were 41,494 pneumatic devices in the DMA/MFR NAA. Of those, 5,524 were high-bleed (13% of total), 34,847 were low-bleed (84% of total), and 1,122 were actuated with compressed air and therefore do not emit any natural gas or VOCs (3% of total).

If 5 percent of high-bleed devices receive an exemption from the Division, an estimated 276 devices would be allowed to remain in place based on 2006 data.[2] The percentage of exempt high-bleed devices, 5 percent, is based on the projection that 95 percent of devices would be converted from high-bleed to low-bleed devices. The regulation would require that enhanced maintenance be performed on all high-bleed devices. Enhanced maintenance potentially reduces emissions. It includes cleaning, tuning, and repairing leaking gaskets, tubing fittings, and seals; tuning to operate over a broader range of proportional band; and eliminating unnecessary valve positioners. Routine inspection and recordkeeping would also be required for remaining high-bleed devices.

Emissions associated with low-bleed devices are a fraction of the emission threshold level, 2 tpy, and of high-bleed device emissions. Therefore, it is reasonable to avoid the burdens of inspection, enhanced maintenance, and record keeping for low-bleed devices.

5. Data and Calculations

Most data used in calculations performed to support proposed regulations regarding pneumatic devices are from an IPAMS report.[3] Data used to determine the number of devices that would be converted or require enhanced maintenance and emission reductions as a result of the proposed rule include:

- Estimated number of devices in 2006 located within the DJ Basin, by device bleed rate
- 2006 VOC device emissions and fraction of wells in each DJ Basin county
- Average VOC fraction and molecular weight in DJ Basin natural gas

Most data used in cost analysis calculations were obtained from vendors. Costs include purchase, installation, operation, maintenance, and the benefit earned from sale of natural gas that had previously been emitted to the atmosphere. Costs were obtained to replace or retrofit two of the most common types of devices, liquid level controllers and pressure controllers. Costs of these four scenarios were averaged into one scenario.

All data and calculations used to support proposed regulations regarding pneumatic devices are available in Attachment 1, Pneumatic Device Proposed Regulation Data and Calculations.

5.1. Emission Reduction

To calculate the reduction of VOC emissions that would occur in the NAA if the proposed regulation is implemented, the following steps were followed. The calculations are available in Attachment 1.

1. Obtain emissions for baseline cases: 24.8 tpd (baseline 2006), 31.1 tpd (baseline 2010)
2. Obtain total bleed rate emissions from high bleed devices in the NAA by adding bleed rate emissions of each high bleed device in the NAA: 150,885 cfh (calculation for each type of high-bleed device based on number and bleed rate of each type of device; see Attachment 1 spreadsheet, sheet “device calc”, column S)
3. Obtain total bleed rate emissions from low-bleed devices in the NAA by adding bleed rate emissions of each low-bleed device in the NAA: 30,823 cfh (calculation for each type of low-bleed device based on number and bleed rate of each type of device; see Attachment 1 spreadsheet, sheet “device calc”, column T):
4. Obtain 2006 baseline emissions (emissions in terms of bleed rate) by adding the total bleed rate emissions of high bleed devices in the NAA to the total bleed rate

emissions of low-bleed devices in the NAA: 150,885 cfh + 30,823 cfh = 181,708 cfh

5. Obtain the 2006 total bleed rate emissions of low-bleed devices in the NAA (baseline): see step 3 (same parameter; 30,823 cfh)
6. Obtain the 2006 total bleed rate emissions of low-bleed devices in the NAA (converted from high-bleed if proposed regulation had been implemented) by adding bleed rate emissions of each converted low-bleed device in the NAA: 10,148 cfh (calculation for each type of converted low-bleed device based on number and bleed rate of each type of device; see Attachment 1 spreadsheet, sheet “device calc”, column U)
7. Obtain the 2006 total bleed rate emissions of high-bleed devices in the NAA (remaining 5%, taking into account enhanced maintenance) by adding bleed rate emissions of each remaining high bleed device in the NAA taking into account bleed rate reductions from enhanced maintenance: 4,782 cfh (calculation for each type of high-bleed device based on number and bleed rate of each type of device taking into account bleed rate reductions from enhanced maintenance ; see Attachment 1 spreadsheet, sheet “device calc”, column W)
8. Obtain 2006 projected emissions (emissions in terms of bleed rate) by adding the total bleed rate emissions of low-bleed devices in the NAA (baseline) to the total bleed rate emissions of low-bleed devices in the NAA (converted from high-bleed if proposed regulation had been implemented) and total bleed rate emissions of high-bleed devices in the NAA (remaining 5%, taking into account enhanced maintenance): 30,823 cfh + 10,148 cfh + 4,782 cfh = 45,754 cfh
9. Obtain reduction percent obtained from implementing proposed regulation based on 2006 baseline emissions and 2006 projected emissions (as if proposed regulation had been in place) (emissions in terms of bleed rate): (181,708 cfh – 45,754 cfh) / 181,708 cfh = 0.75 or 75%
10. Obtain 2010 projected emissions based on 2010 baseline emissions and reduction percent obtained from implementing proposed regulation: 31.1 * (1-0.75) = 7.8 tpd
11. Obtain VOC emission reduction that would occur in NAA if proposed regulation is implemented by subtracting 2010 projected emissions from 2010 baseline emissions: 31.1 tpd – 7.8 tpd = 23.3 tpd

6. References

1. US EPA, *Lessons Learned: Options for Reducing Methane Emissions from Pneumatic Devices in the Natural Gas Industry*

2. ENVIRON, Buys and Associates, and IPAMS, *Development of Baseline 2006 Emissions from Oil and Gas Activity in the Denver-Julesburg Basin*, February 7, 2008

3. ENVIRON, Buys and Associates, and IPAMS, *Development of Baseline 2006 Emissions from Oil and Gas Activity in the Denver-Julesburg Basin*, March, 2008

4. Conversations between the Division and industry/vendors; additionally, document available at http://www.fossil.energy.gov/programs/oilgas/publications/environ_benefits/14fsprod.pdf

Attachment 1 - Pneumatic Device Proposed Regulation Data and Calculations

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March 2008 Raw IPAMS Data

Parameter	Value	Units
Basinwide VOC Fraction (molar)	7.47%	
Well Count - surveyed producers	8247	wells
Well Count - basinwide	16894	wells
Basinwide VOC molecular weight	54.696	g/mol
Surveyed Producer Total Gas Emissions	989,848	MCF

County	2006 Pneumatic VOC Emissions (tpy)	Well Count Fraction
ADAMS	614	5.3%
ARAPAHOE	70	0.6%
BOULDER	172	1.5%
BROOMFLD	43	0.4%
DENVER	23	0.2%
ELBERT	41	0.4%
FREMONT	25	0.2%
KIT CARS	8	0.1%
LARIMER	92	0.8%
LINCOLN	8	0.1%
LOGAN	77	0.7%
MORGAN	45	0.4%
PHILLIPS	13	0.1%
SEDGWICK	2	0.0%
WASHNGTN	312	2.7%
WELD	8,164	70.7%
YUMA	1,834	15.9%
Grand Total	11,545	100.0%

Device Type	Total Devices	Survey Supplied Bleed Rate (cfh)	Estimated Bleed rate (cfh)	Utilized Bleed rate (cfh)	Notes
no/low-bleed liquid level controller	1654		0.867833	0.867833	use average of all no/low bleed liquid level controllers
no/low-bleed pressure controller	0		2.62	2.62	
high bleed liquid level controller	118		22	22	Fisher device
high bleed pressure controller	70		16.82143	16.82143	use average of all high bleed pressure controllers
Instrument Air Pneumatics	30		0	0	air utilized
Gas Pneumatics	32		16.94048	16.94048	average of all high bleed devices
Instrument Air Pneumatics	26		0	0	air utilized
Instrument Air Pneumatics	473		0	0	air utilized
Gas Pneumatics	2		16.94048	16.94048	average of all high bleed devices
Instrument Air Pneumatics	25		0	0	air utilized
Instrument Air Pneumatics	45		0	0	air utilized
Instrument Air Pneumatics	30		0	0	air utilized
Gas Pneumatics	7		16.94048	16.94048	average of all high bleed devices
Instrument Air Pneumatics	25		0	0	air utilized
Gas Pneumatics	32		16.94048	16.94048	average of all high bleed devices
Instrument Air Pneumatics	35		0	0	air utilized
Instrument Air Pneumatics	9		0	0	air utilized
CEMCO Cantilever Liquid Level Con	1875	30.41697		30.41697	
Fisher Wizard HiLo Controller	370	12.84272		12.84272	
Fisher 4660 HiLo Controller on Singl	2005	0.777323		0.777323	
Fisher 4660 HiLo Controller on Dual	125	0.811119		0.811119	
Well Plunger Lift Controller	4200	0.054075		0.054075	
Temperature Controllers	4250	0.371763		0.371763	
Wellmark/CEMCO Oil Dump Control	2375	0.054075		0.054075	
Wellmark/CEMCO Water Dump Con	2375	0.033121		0.033121	
liquid level controller	381	35		35	
liquid level controller	548	25		25	
liquid level controller	4686	3		3	
Total Counted Devices for DJ Basin	25,803				
Total Devices for DJ Basin	52,858				

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Calculations for Oil and Gas Ozone Reduction Strategy "Pneumatic Devices"

Table 1: Determine 2006 VOC Emissions

County	Estimate of Devices in NAA*	2006 Pneumatic VOC Emissions (tpy)
ADAMS	2,810	614
ARAPAHOE	322	70
BOULDER	788	172
BROOMFLD	197	43
DENVER	106	23
DOUGLAS	0	0
JEFFERSON	0	0
LARIMER	309	67
WELD	36,961	8,073
Total	41,494	9,063

* Calculated by multiplying total number of devices in DJ Basin by well count fraction for each county. Multiplied that result by production rates for Larimer and Weld county to obtain device count for portions of counties in non-attainment area

Table 2: Data from Dale Wells

Parameter	Value	Units
VOC Emissions 2006 - NAA	24.83	tpd
VOC Emissions 2010 - NAA	31.11	tpd
% bbl production Larimer - 2006	73.14	%
% bbl production Weld - 2006	98.88	%
Gas Production in DJ Basin - 2006	241,263,240	MCF
Gas Production outside DJ Basin - 2006	1,369,821,425	MCF

Table 3: Calculating Emission Reductions and Costs

Parameter	Value	Units
Bleed Rates		
High-bleed device, definition of pneumatic device	6	scfh
Average high-bleed	16.82	cfh
Average low- and no-bleed	0.868	cfh
Maximum low- and no-bleed[2]	3.000	cfh
Average of avg. and max. low- and no-bleed	1.934	cfh
Average of retrofitted/replaced (HB to LB/NB)	1.934	cfh
Reduction if perform enhanced maintenance[1]	10	scfh
Percentage of emissions in NAA by bleed rate[3]		
high-bleed	13.3	%
low-/no-bleed	84.0	%
compressed air	2.7	%
Percentage of devices in NAA by controller type[3]		
liquid level controller	35.9	%

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Calculations for Oil and Gas Ozone Reduction Strategy "Pneumatic Devices"		
Parameter	Value	Units
pressure controller	10.0	%
other/unknown - natural gas	51.4	%
other/unknown - compressed air	2.7	%
liquid level controller percentage if only consider liquid/pressure controllers	78.3	%
pressure controller percentage if only consider liquid/pressure controllers	21.7	%
HB Devices Converted to LB - NAA		
Percent of HB devices that can be converted to LB/NB in NAA[6]	95	%
Number of high bleed devices in NAA - 2006	5,524	--
Number of NAA HB devices that can be converted to LB/NB @ 95 % - 2006	5,248	--
NAA Emissions and Reductions - 2006[4]		
Baseline emissions	181,708	cfh
Emissions if convert 95 % HB->LB/NB w/o enh maint	48,516	cfh
Reductions if convert 95 % HB->LB/NB w/o enh maint	73%	%
Emissions if convert 95 % HB->LB/NB w/ enh maint on remaining HB	45,754	cfh
Reductions if convert 95 % HB->LB/NB w/ enh maint on remaining HB	75%	%
NAA Emissions and Reductions - 2010[4]		
Emissions if convert 95 % HB->LB/NB w/o enh maint	8.3	tpd
Reductions if convert 95 % HB->LB/NB w/o enh maint	22.8	tpd
Emissions if convert 95 % HB->LB/NB w/ enh maint on remaining HB	7.8	tpd
Reductions if convert 95 % HB->LB/NB w/ enh maint on remaining HB	23.3	tpd
Reductions from enh maint on remaining HB @ 5 %	0.5	tpd
Cost Analysis[5] - NAA, Device Costs		
Annualized Cost to Retrofit HB to LB Liquid Level Controller	(1223)	$ per device
Annualized Cost to Replace HB to LB Liquid Level Controller	(1225)	$ per device
Annualized Cost to Retrofit HB to LB Pressure Controller	(1214)	$ per device
Annualized Cost to Replace HB to LB Pressure Controller	(946)	$ per device
Annualized Cost to perform enhanced maintenance	(312)	$ per device
Weighted Average Annualized Cost to Retrofit HB to LB	(1221)	$ per device
Weighted Average Annualized Cost to Replace HB to LB	(1164)	$ per device
Weighted Average Annualized Cost to Retrofit or Replace HB to LB	(1193)	$ per device
Weighted Average Annualized Cost to Retrofit or Replace HB to LB and perform enh maint on remaining HB	(1505)	$ per device
Cost Analysis NAA, Program Costs and Benefits		
Cost to retrofit 95 % NAA HB->LB/NB	(6,408,658)	$ in NAA
Cost to replace 95 % NAA HB->LB/NB	(6,110,376)	$ in NAA
Cost to retrofit or replace 95 % NAA HB->LB/NB	(6,259,517)	$ in NAA
Cost to perform enhanced maint. on 5 % NAA HB devices	(86,144)	$ in NAA
Cost to retrofit or replace 95 % NAA HB->LB/NB and to perform enhanced maint. on 5 % NAA HB devices	(6,345,661)	$ in NAA
Cost per ton reduced if retrofit 95 % NAA HB->LB/NB	(770)	$/ton in NAA
Cost per ton reduced if replace 95 % NAA HB->LB/NB	(734)	$/ton in NAA
Cost per ton reduced if retrofit or replace 95 % NAA HB->LB/NB	(752)	$/ton in NAA
Cost per ton reduced to perform enhanced maint. on 5 % NAA HB devices	(499)	$/ton in NAA
Cost per ton reduced to retrofit or replace 95 % NAA HB->LB/NB and to perform enhanced maint. on 5 % NAA HB devices	(747)	$/ton in NAA

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Calculations for Oil and Gas Ozone Reduction Strategy "Pneumatic Devices"

Notes:
1 EPA Gas STAR Lessons Learned "Options for Reducing Methane Emissions from Pneumatic Devices in the Natural Gas Industry", page 6, states "Cleaning and tuning, in addition to repairing leaking gaskets, tubing fittings, and seals, can save 5 to 10 scfh per device. Tuning to operate over a broader range of proportional band often reduces bleed rates by as much as 10 scfh. Eliminating unnecessary valve positioners can save up to 18 scfh per device." Using 75% of each type of maintenance leads to a savings of 28.5 scfh per device. However, bleed rates for HB in this study range from 13 to 30 scfh; therefore, will use a savings of 10 scfh as it is unrealistic that emissions would be reduced to zero or even become negative

2 Maximum bleed rate for low- and no-bleed pneumatic devices was obtained from industry by Jerry Dilley (RAQC)

3 Percentage of devices in the NAA by bleed rate is calculated based on 2006 data. 2010 calculations assume that the percentage will be the same as 2006; better data was not available.

4 Percentage of emission reductions via options in this strategy were based on 2006 data. 2010 calculations assume that the percentage will the be the same as 2010

5 Annualized cost data for retrofit/replacement from July 2008 LeSair report to CDPHE. Annualized cost data for performing enhanced maintenance based on EPA Gas STAR Lessons Learned "Options for Reducing Methane Emissions from Pneumatic Devices in the Natural Gas Industry"

6 Initially, used value of 80% of high bleeds being converted to low/no bleeds per EPA Gas STAR Lessons Learned "Options for Reducing Methane Emissions from Pneumatic Devices in the Natural Gas Industry". Industry in CO NAA indicates that close to 100% of the high bleeds will be converted to low/no bleeds. Therefore, raised the percentage to 95%.

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Economic Impact Analysis Summary

Parameter	NAA	Units
Number of high bleed devices in NAA - 2006	**5,524**	**--**
Percent of HB devices that can be converted to LB/NB in NAA (%)	**95**	**%**
Number of HB devices in NAA to be converted	5,248	--
Reductions if convert 95 % HB->LB/NB w/ enh maint on remaining HB (tpd)	**23.3**	**tpd**
Weighted Average Annualized Cost to Retrofit HB to LB	(1,221)	$ per device
Weighted Average Annualized Cost to Replace HB to LB	(1,164)	$ per device
Weighted Average Annualized Cost to Retrofit or Replace HB to LB	(1,193)	$ per device
Annualized Cost to perform enhanced maintenance	(312)	$ per device
Weighted Average Annualized Cost to Retrofit or Replace HB to LB and perform enh maint on remaining HB	**(1,505)**	**$ per device**
Cost to retrofit 95 % NAA HB->LB/NB	(6,408,658)	$ per NAA
Cost to replace 95 % NAA HB->LB/NB	(6,110,376)	$ per NAA
Cost to retrofit or replace 95 % NAA HB->LB/NB	(6,259,517)	$ per NAA
Cost to perform enhanced maint. on 5 % NAA HB devices	(86,144)	$ per NAA
Cost to retrofit or replace 95 % NAA HB->LB/NB and to perform enhanced maint. on 5 % NAA HB devices	**(6,345,661)**	**$ per NAA**
Cost per ton reduced if retrofit 95 % NAA HB->LB/NB	(770)	$/ton in NAA
Cost per ton reduced if replace 95 % NAA HB->LB/NB	(734)	$/ton in NAA
Cost per ton reduced if retrofit or replace 95 % NAA HB->LB/NB	(752)	$/ton in NAA
Cost per ton reduced to perform enhanced maint. on 5 % NAA HB devices	(499)	$/ton in NAA
Cost per ton reduced to retrofit or replace 95 % NAA HB->LB/NB and to perform enhanced maint. on 5 % NAA HB devices	**(747)**	**$/ton in NAA**

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Determining How Bleed Rate Relates to Emissions

Parameter	Eq.	Value	Units
Surveyed Producer Total Gas Emissions	A	989848	MCF
Annual Hours of Operation	B	8760	hrs
Well Count - surveyed producers	C	8247	wells
Well Count - basinwide	D	16894	wells
Basinwide VOC Fraction (molar)	E	7.47%	
Basinwide VOC molecular weight	F	54.7	g/mol
R	G	0.08206	L atm / K-mol
standard temp	H	273.15	K
standard press	I	1	atm
MCF to 1000 liter conversion	J	28.317	1000L/MCF

Basin-wide Emissions

Basin-wide VOC volume emissions	K	151,567	MCF/year
Basin-wide VOC volume emissions	L	4,291,903	1000L/year
Basin-wide VOC mass emissions	M	10,473,301	kg/year
Basin-wide VOC mass emissions	N	11,545	tons/year

	IPAMS Calc	High Bleed (by definition)	High Bleed (highest IPAM)	High Bleed (avg., IPAM)	High Bleed (EPA Gas STAR)	Bleed Rate that gives 1 tpy	Avg Low/No Bleed	
		6	35	16.8	42.0	20.1	1.93	cfh total gas
IPAMS calc (use as example, modified)		52.56	306.6	147.4	367.9	176.1	16.94	MCF natural gas/year
K = A x D / C x E	151,567	3.9	22.9	11.0	27.5	13.2	1.3	MCF VOC/year
L = K x J	4,291,903	111	649	312	779	373	36	1000L VOC/year
M = I x L x 1000 / (G x H) x F / 1000	10,473,301	271	1,584	761	1,900	909	88	kg VOC/year
N = M / 907.185	11,545	0.30	1.75	0.84	2.09	1.00	0.10	tpy VOC

MCF = thousand cubic feet

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Proposed Regulation Payback

Parameter	with enhanced maintenance							
	liquid level controller retrofit		liquid level controller replace		pressure controller retrofit		pressure controller replace	
	typical	high	typical	high	typical	high	typical	high
Value of Gas Saved ($/yr)	1898	5947	1898	5947	1898	5947	1898	5947
Cost of Implementation ($)	637	1590	619	1681	733	1741	3769	4314
Payback (months)	4	3	4	3	5	4	24	9

Average Value of Gas Saved ($/yr) = 3923
Average Cost of Implementation ($) = 1885
Average Payback (months) = 7

Note:
Cost of Natural Gas ($/Mcf)[1]: 10.82

1 source: Energy Information Administration, Official Energy Statistics from the US Government, June 2008

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Bleed Rate and Emission Data by Device Type

Device Type	Total Devices (counted) (raw data)	Total Devices in DJ Basin	Total Devices in NAA	IPAMS Bleed Rate (cfh)	Is this Device High or Low/No Bleed? (or comp air?)	# of High Bleed Device in NAA	# of Low/No Bleed Device in NAA	# of Device Using Comp Air in NAA	Rate of High Bleed Device (cfh)
no/low-bleed liquid level controller	1654	3388	2660	0.87	low/no		2,660		
no/low-bleed pressure controller	0	0	0	2.62	low/no		0		
high bleed liquid level controller	118	242	190	22	high	190			22
high bleed pressure controller	70	143	113	16.82	high	113			17
Instrument Air Pneumatics	30	61	48	0	comp air			48	
Gas Pneumatics	32	66	51	16.94	high	51			17
Instrument Air Pneumatics	26	53	42	0	comp air			42	
Instrument Air Pneumatics	473	969	761	0	comp air			761	
Gas Pneumatics	2	4	3	16.94	high	3			17
Instrument Air Pneumatics	25	51	40	0	comp air			40	
Instrument Air Pneumatics	45	92	72	0	comp air			72	
Instrument Air Pneumatics	30	61	48	0	comp air			48	
Gas Pneumatics	7	14	11	16.94	high	11			17
Instrument Air Pneumatics	25	51	40	0	comp air			40	
Gas Pneumatics	32	66	51	16.94	high	51			17
Instrument Air Pneumatics	35	72	56	0	comp air			56	
Instrument Air Pneumatics	9	18	14	0	comp air			14	
CEMCO Cantilever Liquid Level Control	1875	3841	3015	30.42	high	3,015			30
Fisher Wizard HiLo Controller	370	758	595	12.84	high	595			13
Fisher 4660 HiLo Controller on Single Coils	2005	4107	3224	0.78	low/no		3,224		
Fisher 4660 HiLo Controller on Dual Coils	125	256	201	0.81	low/no		201		
Well Plunger Lift Controller	4200	8604	6754	0.05	low/no		6,754		
Temperature Controllers	4250	8706	6834	0.37	low/no		6,834		
Wellmark/CEMCO Oil Dump Controllers	2375	4865	3819	0.05	low/no		3,819		
Wellmark/CEMCO Water Dump Controllers	2375	4865	3819	0.03	low/no		3,819		
liquid level controller	381	780	613	35	high	613			35
liquid level controller	548	1123	881	25	high	881			25
liquid level controller	4686	9599	7536	3	low/no		7,536		
Total		52,858	41,494			5,524	34,847	1,122	

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Bleed Rate and Emission Data by Device Type

Device Type	Rate of High Bleed Device w/enhanc maint (cfh)	Rate of Low/No Bleed Device (cfh)	2006 Emissions from HB in NAA (cfh)	2006 Emissions for existing LB/NB in NAA (cfh)	2006 Emissions of HB converted to LB/NB in NAA (cfh)	2006 Emissions HB not converted to LB/NB in NAA (w/ enh maint) (cfh)	Number of liquid level controllers in NAA	Number of pressure controllers in NAA	Number of unknown/ other type controllers in NAA (NG, not incl air)
no/low-bleed liquid level controller		0.867833		2,308			2660		
no/low-bleed pressure controller		2.62		0				0	
high bleed liquid level controller	12		4,175		349	113.852895	190		
high bleed pressure controller	7		1,894		207	38.3931904		113	
Instrument Air Pneumatics									
Gas Pneumatics	7		872		95	17.8574759			51
Instrument Air Pneumatics									
Instrument Air Pneumatics									
Gas Pneumatics	7		54		6	1.11609225			3
Instrument Air Pneumatics									
Instrument Air Pneumatics									
Instrument Air Pneumatics									
Gas Pneumatics	7		191		21	3.90632286			11
Instrument Air Pneumatics									
Gas Pneumatics	7		872		95	17.8574759			51
Instrument Air Pneumatics									
Instrument Air Pneumatics									
CEMCO Cantilever Liquid Level Control	20		91,712		5,540	3078.03372	3015		
Fisher Wizard HiLo Controller	3		7,641		1,093	84.5700695		595	
Fisher 4660 HiLo Controller on Single Coils		0.777323		2,506				3224	
Fisher 4660 HiLo Controller on Dual Coils		0.811119		163				201	
Well Plunger Lift Controller		0.054075		365					6754
Temperature Controllers		0.371763		2,541					6834
Wellmark/CEMCO Oil Dump Controllers		0.054075		207					3819
Wellmark/CEMCO Water Dump Controllers		0.033121		126					3819
liquid level controller	25		21,444		1,126	765.853692	613		
liquid level controller	15		22,031		1,619	660.925706	881		
liquid level controller		3		22,607			7536		
Total			150,885	30,823	10,148	4,782	14,894	4,133	21,344

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Data Used in Economic Calculations

IPAMS Data

Bleed Rates Natural Gas (cfh)		
High Bleed (highest)	High Bleed (average)	Low/No Bleed (average)
35	16.8	1.93

VOC Emissions (tpy)		
High Bleed (highest)	High Bleed (average)	Low/No Bleed (average)
1.75	0.84	0.10

Misc. Data
Cost of Natural Gas ($/Mcf)[1]: 10.82

Note:
[1] source: Energy Information Administration, Official Energy Statistics from the US Government, June 2008

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Total Annual Cost for Performing Enhanced Maintenance

Low	High	Avg	
0	350	175	Annual Maintenance Cost ($) (reference: 1)
45	260	152.5	Volume of Gas Saved (MCF/yr) (reference: 1)

System Life (yr)	Interest Rate (%)	Capital Recovery Factor	Capital Investment	Purchase Cost	Annualized Installation Cost[1]	Annual Operational Costs	Annual Maintenance Costs	Capital Recovery Cost	Realized Economic Benefit[2]
n	**i**	**CRF**	**P**	P_p	P_i	P_o	P_m	**CRC**	**REB**
15	**5%**	**0.10**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$175.00**	**$0.00**	**$486.90**

Total Annual Cost ($)
($311.90)

$$CRF = \frac{i \times (1+i)^n}{(1+i)^n - 1}$$ The Capital Recovery Factor allows for calculation of end-of-year payment to repay investment.

$P = P_p$ The capital investment includes the purchase of the control device

CRC = CRF x P The Capital Recovery cost is the payment required to repay the capital investment at end of term.

$TAC = P_i + P_o + P_m + CRC - REB$ The Total Annual Cost is the sum of the installation cost, annual operational and maintenance costs, the Capital Recovery Costs less the Realized Economic Benefit.

$$Cost\ of\ Control = \frac{TAC}{Emission\ Reduction}$$ The Cost of Control is the Total Annual Cost divided by the Emission Reduction achieved through the installation of the control device.

Notes:

[1] Annualized Installation Cost would be calculated by dividing installation costs by system life years; however, installation costs do not apply since this analysis is only looking at enhanced maintenance

[2] When calculating REB, used low end of gas savings to be conservative

References

1. EPA Gas STAR Lessons Learned "Options for Reducing Methane Emissions from Pneumatic Devices in the Natural Gas Industry"

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Summary of Costs Associated with Four Types of Pneumatic Device Conversions

		Total Annual Cost ($)
Emission Source:	Liquid Level Controller	
Control Device:	Retro-Fit High to Low Bleed	
Emission Reduction:	89%	($1,223.25)

		Total Annual Cost ($)
Emission Source:	Liquid Level Controller	
Control Device:	Replace High with Low Bleed	
Emission Reduction:	89%	($1,224.98)

		Total Annual Cost ($)
Emission Source:	Pressure Controller	
Control Device:	Retro-Fit High to Low Bleed	
Emission Reduction:	89%	($1,214.05)

		Total Annual Cost ($)
Emission Source:	Pressure Controller	
Control Device:	Replace High with Low Bleed	
Emission Reduction:	89%	($946.13)

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Liquid Level Controller Cost Anaalysis to Retrofit from High-Bleed to Low Bleed

Emission Source: Liquid Level Controller
Control Device: Retro-Fit High to Low Bleed
Manufacturer: Wellmark
Model No: Mizer-Cemco 1110-111
Model No: Mizer-Invalco 4010-111
Model No: Mizer-Fisher 2500
Emission Reduction: 89%

Control Device Description: The Liquid Level Controller is used to detect and/or maintain the liquid level within a vessel.

Control Benefits: The Liquid Level Controller is a reliable, low maintenance device designed to maintain a liquid level. The low maintenance requirements make the controller ideal for applications in remote areas.

Control Limitations: Liquid Level Controllers by design, are an emission source and have potential environmental risks.

Targeted Pollutant	Emission Factor (scf/hr)	Emission Basis (hrs)	Annual Emissions High Bleed (TPY)	Annual Emissions Low Bleed (TPY)	Annual Emissions Reduction (TPY)
VOC	1.93	8760	0.839	0.096	0.743

System Life (yr)	Interest Rate (%)	Capital Recovery Factor	Capital Investment	Purchase Cost	Annualized Installation Cost[1]	Annual Operational Costs	Annual Maintenance Costs	Capital Recovery Cost	Realized Economic Benefit
n	i	CRF	P	P_p	P_i	P_o	P_m	CRC	REB
15	5%	0.10	$307.40	$307.40	$12.22	$0.00	$146.00	$29.62	$1,411.09

Total Annual Cost ($)
($1,223.25)

$$CRF = \frac{i \times (1+i)^n}{(1+i)^n - 1}$$ Capital Recovery Factor allows for calculation of end-of-year payment to repay investment

$P = P_p$ Capital investment includes base instrument cost, instrumentation cost, and sales tax

$CRC = CRF \times P$ Capital Recovery cost is payment required to repay capital investment at end of term

$TAC = P_i + P_o + P_m + CRC - REB$ The Total Annual Cost is the sum of the installation cost, annual operational and maintenance costs, the Capital Recovery Costs less the Realized Economic Benefit.

$$Cost\ of\ Control = \frac{TAC}{Emission\ Reduction}$$ The Cost of Control is the Total Annual Cost divided by the Emission Reduction achieved through the installation of the control device.

Notes:
1 Annualized Installation Cost includes freight costs and is calculated by dividing installation costs by system life years
2 Based on Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Sixth Edition, EPA/452/B-02-001, January 2002, Section 1, Chapter 2

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Liquid Level Controller Cost Breakdown to Retrofit from High-Bleed to Low Bleed

Emission Source: **Liquid Level Controllers**
Control Device: **Retro-Fit High to Low Bleed**
Manufacturer: **Wellmark**
Model No: **Mizer-Cemco 1110-111**
Model No: **Mizer-Invalco 4010-111**
Model No: **Mizer-Fisher 2500**

		Typical	High
Purchase Cost:			
	Base Equipment Cost:[a]	265.00	475.00
	Instrumentation Cost:[b]	26.50	47.50
	Sales Tax:[b,3]	15.90	28.50
	Total:	**307.40**	**551.00**
Installation Cost:			
	Freight Cost:[b]	13.25	23.75
	Site Preparation Cost:[c]	20.00	50.00
	Auxiliary Cost:[d]	0.00	0.00
	Installation Cost:[e]	150.00	250.00
	Total	**183.25**	**323.75**
Annual Operating Cost:			
	Taxes, Insurance, and Admin:[i]	0.00	0.00
	Overhead:[i]	0.00	0.00
	Total:	**0.00**	**0.00**
Annual Maintenance Cost:			
	Maintenance Labor Cost:[f]	73.00	182.50
	Maintenance Material Cost:[b]	73.00	182.50
	Total:	**146.00**	**365.00**
Realized Economic Benefit:			
	High Bleed Gas Consumption Cost:[g]	1594.39	3317.41
	Low Bleed Gas Consumption Cost:[h]	183.30	183.30
	Total:	**1411.09**	**3134.11**

Notes

a- Cost provided by Manufacturers and Distributors
b- Cost is estimated using the Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Sixth Edition EPA/452/B-02-001, January 2002, Section 1, Chapter 2
c- Cost provided by Industry and based on an hourly rate of $20 - $50 multiplied by 1 hour for length of task; task will include shutting in the well and isolating the vessel so that the work can be performed safely
d- Cost omitted from report ; however there are auxiliary cost associated with installation (i.e. piping and painting)
e- Cost provided by Distributors and based on an hourly rate of $75 - $125 multiplied by 2 hours for length of task; this information is available in the documentation binder provided
f- Cost provided by Industry and based on an hourly rate of $20 - $50 multiplied by 3.65 hours annually for length of task
g- Cost calculated by multiplying high bleed consumption rate with current Natural Gas rate
h- Cost calculated by multiplying low bleed consumption rate with current Natural Gas rate
i- Cost omitted from report because there is no difference in annual operation between a high or low bleed

Assumptions

Maintenance Cost: Assumed that 3 minutes per day would be allocated to each high bleed controller for maintanence which totals 18.25 hrs annually; low bleed controllers require slightly more maintenance than high bleed; as such the assumption made for the difference in required maintenance is 20%; 18.25 hrs*20% = 3.65 hrs

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Liquid Level Controller Cost Analaysis to Replace High-Bleed with Low Bleed

Emission Source: Liquid Level Controller
Control Device: Replace High with Low Bleed
Manufacturer & Model: Kimray; 2 IN Gen II LLC RH
Manufacturer & Model: Norriseal; 1001, A, XL, EVS, S
Manufacturer & Model: Norriseal; 1001, A, XL, EVS, T
Manufacturer & Model: Wellmark; ST4UP
Manufacturer & Model: Wellmark; 2001NB Series
Emission Reduction: 89%

Control Device Description: The Liquid Level Controller is used to detect and/or maintain the liquid level within a vessel.

Control Benefits: The Liquid Level Controller is a reliable, low maintenance device designed to maintain a liquid level. The low maintenance requirements make the controller ideal for applications in remote areas.

Control Limitations: Liquid Level Controllers by design, are an emission source and have potential environmental risks.

Targeted Pollutant	Emission Factor (scf/hr)	Emission Basis (hrs)	Annual Emissions High Bleed (TPY)	Annual Emissions Low Bleed (TPY)	Annual Emissions Reduction (TPY)
VOC	1.93	8760	0.839	0.096	0.743

System Life (yr)	Interest Rate (%)	Capital Recovery Factor	Capital Investment	Purchase Cost	Annualized Installation Cost[1]	Annual Operational Costs	Annual Maintenance Costs	Capital Recovery Cost	Realized Economic Benefit
n	i	CRF	P	P_p	P_i	P_o	P_m	CRC	REB
15	5%	0.10	$290.00	$290.00	$12.17	$0.00	$146.00	$27.94	$1,411.09

Total Annual Cost ($)
($1,224.98)

Calculations:

$$CRF = \frac{i \times (1+i)^n}{(1+i)^n - 1}$$ Capital Recovery Factor allows for calculation of end-of-year payment to repay investment

$P = P_p$ Capital investment includes base instrument cost, instrumentation cost, and sales tax

$CRC = CRF \times P$ Capital Recovery cost is payment required to repay capital investment at end of term

$TAC = P_i + P_o + P_m + CRC - REB$ The Total Annual Cost is the sum of the installation cost, annual operational and maintenance costs, the Capital Recovery Costs less the Realized Economic Benefit.

$$Cost\ of\ Control = \frac{TAC}{Emission\ Reduction}$$ The Cost of Control is the Total Annual Cost divided by the Emission Reduction achieved through the installation of the control device.

Notes:
1 Annualized Installation Cost includes freight costs and is calculated by dividing installation costs by system life years
2 Based on Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Sixth Edition, EPA/452/B-02-001, January 2002, Section 1, Chapter 2

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Liquid Level Controller Cost Breakdown to Replace High-Bleed with Low Bleed

Emission Source:	**Liquid Level Controller**	**Manufacturer & Model:**	**Kimray; 2 IN Gen II LLC RH**
Control Device:	**Replace High with Low Bleed**	**Manufacturer & Model:**	**Norriseal; 1001, A, XL, EVS, S**
		Manufacturer & Model:	**Norriseal; 1001, A, XL, EVS, T**
		Manufacturer & Model:	**Wellmark; ST4UP**
		Manufacturer & Model:	**Wellmark; 2001NB Series**

		Typical	High
Purchase Cost:			
	Base Equipment Cost:[a]	250.00	550.00
	Instrumentation Cost:[b]	25.00	55.00
	Sales Tax:[b,3]	15.00	33.00
	Total:	**290.00**	**638.00**
Installation Cost:			
	Freight Cost:[b]	12.50	27.50
	Site Preparation Cost:[c]	20.00	50.00
	Auxiliary Cost:[d]	0.00	0.00
	Installation Cost:[e]	150.00	250.00
	Total	**182.50**	**327.50**
Annual Operating Cost:			
	Taxes, Insurance, and Admin:[i]	0.00	0.00
	Overhead:[i]	0.00	0.00
	Total:	**0.00**	**0.00**
Annual Maintenance Cost:			
	Maintenance Labor Cost:[f]	73.00	182.50
	Maintenance Material Cost:[b]	73.00	182.50
	Total:	**146.00**	**365.00**
Realized Economic Benefit:			
	High Bleed Gas Consumption Cost:[g]	1594.39	3317.41
	Low Bleed Gas Consumption Cost:[h]	183.30	183.30
	Total:	**1411.09**	**3134.11**

Notes

a- Cost provided by Manufacturers and Distributors
b- Cost is estimated using the Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Sixth Edition EPA/452/B-02-001, January 2002, Section 1, Chapter 2
c- Cost provided by Industry and based on an hourly rate of $20 - $50 multiplied by 1 hour for length of task; task will include shutting in the well and isolating the vessel so that the work can be performed safely
d- Cost omitted from report ; however there are auxiliary cost associated with installation (i.e. piping and painting)
e- Cost provided by Distributors and based on an hourly rate of $75 - $125 multiplied by 2 hours for length of task; this information is available in the documentation binder provided
f- Cost provided by Industry and based on an hourly rate of $20 - $50 multiplied by 3.65 hours annually for length of task
g- Cost calculated by multiplying high bleed consumption rate with current Natural Gas rate
h- Cost calculated by multiplying low bleed consumption rate with current Natural Gas rate
i- Cost omitted from report because there is no difference in annual operation between a high or low bleed

Assumptions

Maintenance Cost: Assumed that 3 minutes per day would be allocated to each high bleed controller for maintanence which totals 18.25 hrs annually; low bleed controllers require slightly more maintenance than high bleed; as such the assumption made for the difference in required maintenance is 20%; 18.25 hrs*20% = 3.65 hrs

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Pressure Controller Cost Analaysis to Retrofit from High-Bleed to Low Bleed

Emission Source: **Pressure Controller**
Control Device: **Retro-Fit High to Low Bleed**
Manufacturer: **Wellmark**
Model No: **Mizer-Fisher Wizard**
Model No: **Mizer-Fisher 4150/4160**
Emission Reduction: **89%**

Device Description: Pressure controllers are used to regulate and/or maintain a certain level of pressure.

Control Benefits: The Pressure Controller is a reliable, low maintenance device designed to regulate pressure. The low maintenance requirements make the controller ideal for applications in remote areas.

Control Limitations: Pressure Controllers by design, are an emission source and have potential environmental risks.

Targeted Pollutant	Emission Factor (scf/hr)	Emission Basis (hrs)	Annual Emissions High Bleed (TPY)	Low Bleed (TPY)	Reduction (TPY)
VOC	**1.93**	**8760**	**0.839**	**0.096**	**0.743**

System Life (yr)	Interest Rate (%)	Capital Recovery Factor	Capital Investment	Purchase Cost	Annualized Installation Cost[1]	Annual Operational Costs	Annual Maintenance Costs	Capital Recovery Cost	Realized Economic Benefit
n	**i**	**CRF**	**P**	**P_p**	**P_i**	**P_o**	**P_m**	**CRC**	**REB**
15	**5%**	**0.10**	**$400.20**	**$400.20**	**$12.48**	**$0.00**	**$146.00**	**$38.56**	**$1,411.09**

Total Annual Cost ($)
(1,214.05)

Calculations:

$$CRF = \frac{i \times (1+i)^n}{(1+i)^n - 1}$$

Capital Recovery Factor allows for calculation of end-of-year payment to repay investment

$P = P_p$ Capital investment includes base instrument cost, instrumentation cost, and sales tax

$CRC = CRF \times P$ Capital Recovery cost is payment required to repay capital investment at end of term

$TAC = P_i + P_o + P_m + CRC - REB$ The Total Annual Cost is the sum of the installation cost, annual operational and maintenance costs, the Capital Recovery Costs less the Realized Economic Benefit.

$$Cost\ of\ Control = \frac{TAC}{Emission\ Reduction}$$

The Cost of Control is the Total Annual Cost divided by the Emission Reduction achieved through the installation of the control device.

Notes:
1 Annualized Installation Cost includes freight costs and is calculated by dividing installation costs by system life years
2 Based on Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Sixth Edition, EPA/452/B-02-001, January 2002, Section 1, Chapter 2

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Pressure Controller Cost Breakdown to Retrofit from High-Bleed to Low Bleed

Emission Source: **Pressure Controller** **Manufacturer:** **Wellmark**
Control Device: **Retro-Fit High to Low Bleed** **Model No:** **Mizer-Fisher Wizard**
Model No: **Mizer-Fisher 4150/4160**

		Typical	High
Purchase Cost:			
	Base Equipment Cost:[a]	345.00	600.00
	Instrumentation Cost:[b]	34.50	60.00
	Sales Tax:[b,3]	20.70	36.00
	Total:	**400.20**	**696.00**
Installation Cost:			
	Freight Cost:[b]	17.25	30.00
	Site Preparation Cost:[c]	20.00	50.00
	Auxiliary Cost:[d]	0.00	0.00
	Installation Cost:[e]	150.00	250.00
	Total	**187.25**	**330.00**
Annual Operating Cost:			
	Taxes, Insurance, and Admin:[i]	0.00	0.00
	Overhead:[i]	0.00	0.00
	Total:	**0.00**	**0.00**
Annual Maintenance Cost:			
	Maintenance Labor Cost:[f]	73.00	182.50
	Maintenance Material Cost:[b]	73.00	182.50
	Total:	**146.00**	**365.00**
Realized Economic Benefit:			
	High Bleed Gas Consumption Cost:[g]	1594.39	3317.41
	Low Bleed Gas Consumption Cost:[h]	183.30	183.30
	Total:	**1411.09**	**3134.11**

Notes

a- Cost provided by Manufacturers and Distributors
b- Cost is estimated using the Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Sixth Edition EPA/452/B-02-001, January 2002, Section 1, Chapter 2
c- Cost provided by Industry and based on an hourly rate of $20 - $50 multiplied by 1 hour for length of task; task will include shutting in the well and isolating the vessel so that the work can be performed safely
d- Cost omitted from report ; however there are auxiliary cost associated with installation (i.e. piping and painting)
e- Cost provided by Distributors and based on an hourly rate of $75 - $125 multiplied by 2 hours for length of task; this information is available in the documentation binder provided
f- Cost provided by Industry and based on an hourly rate of $20 - $50 multiplied by 3.65 hours annually for length of task
g- Cost calculated by multiplying high bleed consumption rate with current Natural Gas rate
h- Cost calculated by multiplying low bleed consumption rate with current Natural Gas rate
i- Cost omitted from report because there is no difference in annual operation between a high or low bleed

Assumptions

Maintenance Cost: Assumed that 3 minutes per day would be allocated to each high bleed controller for maintanence which totals 18.25 hrs annually; low bleed controllers require slightly more maintenance than high bleed; as such the assumption made for the difference in required maintenance is 20%; 18.25 hrs*20% = 3.65 hrs

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Pressure Controller Cost Analaysis to Replace High-Bleed with Low Bleed

Emission Source: **Pressure Controller**
Control Device: **Replace High with Low Bleed**
Manufacturer & Model: **Fisher; C1 Series**
Emission Reduction: **89%**

Device Description: Pressure controllers are used to regulate and/or maintain a certain level of pressure.

Control Benefits: The Pressure Controller is a reliable, low maintenance device designed to regulate pressure. The low maintenance requirements make the controller ideal for applications in remote areas.

Control Limitations: Pressure Controllers by design, are an emission source and have potential environmental risks.

Targeted Pollutant	Emission Factor (scf/hr)	Emission Basis (hrs)	Annual Emissions		
			High Bleed (TPY)	Low Bleed (TPY)	Reduction (TPY)
VOC	**1.93**	**8760**	**0.839**	**0.096**	**0.743**

System Life (yr)	Interest Rate (%)	Capital Recovery Factor	Capital Investment	Purchase Cost	Annualized Installation Cost[1]	Annual Operational Costs	Annual Maintenance Costs	Capital Recovery Cost	Realized Economic Benefit
n	**i**	**CRF**	**P**	P_p	P_i	P_o	P_m	**CRC**	**REB**
15	**5%**	**0.10**	**$2,610.00**	**$2,610.00**	**$67.50**	**$0.00**	**$146.00**	**$251.45**	**$1,411.09**

Total Annual Cost ($)
(946.13)

Calculations:

$$CRF = \frac{i \times (1+i)^n}{(1+i)^n - 1}$$ Capital Recovery Factor allows for calculation of end-of-year payment to repay investment

$P = P_p$ Capital investment includes base instrument cost, instrumentation cost, and sales tax

$CRC = CRF \times P$ Capital Recovery cost is payment required to repay capital investment at end of term

$TAC = P_i + P_o + P_m + CRC - REB$ The Total Annual Cost is the sum of the installation cost, annual operational and maintenance costs, the Capital Recovery Costs less the Realized Economic Benefit.

$$Cost\ of\ Control = \frac{TAC}{Emission\ Reduction}$$ The Cost of Control is the Total Annual Cost divided by the Emission Reduction achieved through the installation of the control device.

Notes:
1 Annualized Installation Cost includes freight costs and is calculated by dividing installation costs by system life years
2 Based on Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Sixth Edition, EPA/452/B-02-001, January 2002, Section 1, Chapter 2

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Pressure Controller Cost Breakdown to Replace High-Bleed with Low Bleed

Emission Source: Pressure Controller — **Manufacturer:** Fisher
Control Device: Replace High with Low Bleed — **Model No:** C1 Series

		Typical	High
Purchase Cost:			
	Base Equipment Cost:[a]	2250.00	2250.00
	Instrumentation Cost:[b]	225.00	225.00
	Sales Tax:[b,3]	135.00	81.00
	Total:	**2610.00**	**2556.00**
Installation Cost:			
	Freight Cost:[b]	112.50	112.50
	Site Preparation Cost:[c]	20.00	50.00
	Auxiliary Cost:[d]	0.00	0.00
	Installation Cost:[e]	880.00	880.00
	Total	**1012.50**	**1042.50**
Annual Operating Cost:			
	Taxes, Insurance, and Admin:[i]	0.00	0.00
	Overhead:[i]	0.00	0.00
	Total:	**0.00**	**0.00**
Annual Maintenance Cost:			
	Maintenance Labor Cost:[f]	73.00	182.50
	Maintenance Material Cost:[b]	73.00	182.50
	Total:	**146.00**	**365.00**
Realized Economic Benefit:			
	High Bleed Gas Consumption Cost:[g]	1594.39	3317.41
	Low Bleed Gas Consumption Cost:[h]	183.30	183.30
	Total:	**1411.09**	**3134.11**

Notes

a- Cost provided by Manufacturers and Distributors
b- Cost is estimated using the Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Sixth Edition EPA/452/B-02-001, January 2002, Section 1, Chapter 2
c- Cost provided by Industry and based on an hourly rate of $20 - $50 multiplied by 1 hour for length of task; task will include shutting in the well and isolating the vessel so that the work can be perfomed safely
d- Cost omitted from report ; however there are auxiliary cost associated with installation (i.e. piping and painting)
e- Cost provided by Distributor and based on an hourly rate of $110 (minimum of 4 hrs) multiplied by 2 hours for length of task then multiplied again by 2 because of a 2 technician requirement; this information is available in the documentation binder
f- Cost provided by Industry and based on an hourly rate of $20 - $50 multiplied by 3.65 hours annually for length of task
g- Cost calculated by multiplying high bleed consumption rate with current Natural Gas rate
h- Cost calculated by multiplying low bleed consumption rate with current Natural Gas rate
i- Cost omitted from report because there is no difference in annual operation between a high or low bleed

Assumptions

Maintenance Cost: Assumed that 3 minutes per day would be allocated to each high bleed controller for maintanence which totals 18.25 hrs annually; low bleed controllers require slightly more maintenance than high bleed; as such the assumption made for the difference in required maintenance is 20%; 18.25 hrs*20% = 3.65 hrs

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Low Bleed Liquid Level Pneumatic Devices Costs Analyses

Retro-Fit and Replacement Liquid Level Pneumatic Devices Operated by Instrument Gas

Manufacturer	Model	Bleed Type	Type	Capital Cost[1]	Installation Cost[a]		Maintenance Cost[b]		Life of Control[1,c]	Expected Life of Control	Bleed Rate[1]
					Low[2]	High[2]	Low[1]	High[1]			
Wellmark[1]	Cemco 1110-111	Retro-fit	Liquid Level	$265.00	$150.00	$250.00	$73.00	$182.50	15+	15	0.28
Wellmark[1]	Invalco 4010-111	Retro-fit	Liquid Level	$295.00	$150.00	$250.00	$73.00	$182.50	15+	15	0.28
Wellmark[1]	Fisher 2500	Retro-fit	Liquid Level	$475.00	$150.00	$250.00	$73.00	$182.50	15+	15	0.28
Wellmark[1]	ST4UP	Low Bleed	Liquid Level	$275.00	$150.00	$250.00	$73.00	$182.50	15+	15	0.28
Wellmark[1]	2001NB Series	Low Bleed	Liquid Level	$550.00	$150.00	$250.00	$73.00	$182.50	15+	15	0.28
Norriseal[1]	1001, A, XL, EVS, S	Low Bleed	Liquid Level	$250.00	$150.00	$250.00	$73.00	$182.50	15+	15	0.2
Norriseal[1]	1001, A, XL, EVS, T	Low Bleed	Liquid Level	$250.00	$150.00	$250.00	$73.00	$182.50	15+	15	0.007
Kimray[1]	2 IN GEN II LLC RH	Low Bleed	Liquid Level	$375.00	$150.00	$250.00	$73.00	$182.50	15+	15	0.02

Notes:

a- Cost provided by Distributors and based on an hourly rate of $75 - $125 multiplied by 2 hours for length of task
b- Cost provided by Industry and based on an hourly rate of $20 - $50 multiplied by 3.65 hours annually for length of task
c- Life of control value reports 15+ because the majority of manufacturers claim devices will last indefintiley if properly maintained; this information is available in the interview notes section of the documentation binder provided

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Low Bleed Pressure Pneumatic Devices Costs Analyses

Retro-Fit and Replacement Pressure Pneumatic Devices Operated by Instrument Gas

Manufacturer	Model	Bleed Type	Type	Capital Cost[1]	Installation Cost[a,c]		Maintenance Cost[b]		Life of Control[1,d]	Expected Life of Control	Bleed Rate[1]
					Low[2]	High[2]	Low[1]	High[1]			
Wellmark[1]	Fisher Wizard	Retro-fit	Pressure	$345.00	$150.00	$250.00	$73.00	$182.50	15+	15	0.28
Wellmark[1]	Fisher 4150/4160	Retro-fit	Pressure	$600.00	$150.00	$250.00	$73.00	$182.50	15+	15	0.28
Fisher[1]	C1 Series	Low Bleed	Pressure	$2,250.00	$880.00	$880.00	$73.00	$182.50	15+	15	4.5

Notes:

a- Cost provided by Distributors and based on an hourly rate of $75 - $125 multiplied by 2 hours for length of task
b- Cost provided by Industry and based on an hourly rate of $20 - $50 multiplied by 3.65 hours annually for length of task
c- Cost provided by Distributor and based on an hourly rate of $110 (minimum of 4 hrs) multiplied by 2 hours for length of task then multiplied again by 2 because of a 2 technician requirement
d- Life of control value reports 15+ because the majority of manufacturers claim devices will last indefintiley if properly maintained; this information