
BEFORE THE AIR QUALITY CONTROL COMMISSION, STATE OF COLORADO

In the Matter of Proposed Revisions to Ambient Air Quality Standards Regulation, Regulation Numbers 3, 7, and 11 for the Denver Metropolitan & North Front Range Ozone Action Plan

REBUTTAL WITNESS TESTIMONY OF LISA A. McDONALD, Ph.D., WITNESS FOR ANADARKO PETROLEUM CORPORATION, NOBLE ENERGY, INC., and WILLIAMS PRODUCTION RMT COMPANY

I, Lisa A. McDonald, depose and state as follows:

I am a Mineral Economist with over 15 years experience conducting economic analysis studies for government and private sector clients in domestic and international markets. These studies were focused on various natural resource related issues such as fluid and non-fluid mineral production. I have conducted numerous studies using economic impact analysis, benefit-cost analysis, financial modeling, and market and non-market valuation studies. I live at 15005 East Grand Avenue, Aurora, Colorado. My education and professional background are summarized in the curriculum vitae attached to my witness testimony submitted in the Final Prehearing Statement for this proceeding.

I have been asked to provide rebuttal testimony in the captioned proceeding concerning my analysis of the costs related to the Air Pollution Control Division's 95% system-wide control of condensate tank batteries with uncontrolled actual emissions greater than two tons per year. Specifically, the analysis evaluates the incremental costs of adding additional controls to tanks with smaller levels of total annual emissions. This includes all tanks with emissions less than 5 tpy. Costs are summarized on an annual, per ton basis of VOCs reduced.

Assumptions

A cost analysis was completed to evaluate the incremental cost of adding more controls to tanks of progressively smaller size. The analysis relied on a series of assumptions which include the following:

- 1) The cost analysis evaluates the additional cost of installing and operating flares on condensate tanks that emit less than 5 tons per year of VOCs.
- 2) The cost estimates provided in this analysis do not include the additional costs of auto-igniters on tanks emitting 5 tpy or less.

- 3) The number of tanks and/or batteries that would be impacted by the increased requirements was estimated with data from the two largest operators that currently comply with Reg. 7.¹
- 4) Detailed capital and operational and maintenance costs were obtained from Anadarko and Noble and represent current vendor quotes and actual field experience.
- 5) Inflation rates were not considered as part of this analysis.
- 6) A discount rate of 10% was used for the analysis and represents an approximate industry weighted cost of capital.
- 7) Life of control devices was assumed for this analysis to be 15 years based on the EPAs *Pollution Control Cost Manual*.²

Analysis and Discussion

Table 1 summarizes the number of tanks by level of annual emissions used in this cost analysis. The number of tanks within each threshold for Anadarko and Noble were estimated from their 2007 and 2008 Reg. 7 spreadsheet, respectively, as summarized in Column 2. The number of tanks for the rest of the industry was estimated by applying an escalation factor of 35% to the number of tanks reported by Anadarko and Noble given that these two companies account for approximately 65% of gas and oil production within the DJ Basin (Column 3). The total number of tanks for the industry was estimated by summing those calculated for Anadarko and Noble with those for the rest of the industry as shown in Column 4.

¹ The number of tanks that would need controls throughout the DJ Basin were derived by applying an escalation factor of 35% to the number of tanks reported by Anadarko and Noble given that these two companies account for approximately 65% of gas and oil production within the DJ Basin.

² The fifteen year life of the control devices (*e.g.*, flares) is debatable for operations in the DJ Basin. This is due to the fact that these devices have not been fully field tested, and there is no evidence to support that devices or parts of devices can sustain a 15 year life. A change in the life of the devices will alter the costs and the results of this analysis.

Table 1
Estimated Number of Tanks or Batteries
For Each Emission Threshold

Tank Emission Levels	Number of Tanks (Anadarko & Noble)	Number of Tanks (Rest of Industry)	Total Number of Tanks
(1)	(2)	(3) = (2) * 0.35	(4) = (2) + (3)
> 5	2,805	982	3,787
4 to 5	248	87	335
3 to 4	222	78	300
2 to 3	217	76	293
1 to 2	199	70	269
< 1	221	77	298
Total	3,912	1,369	5,281

Costs for flares were obtained from Noble and Anadarko, and include both capital and O&M costs as summarized in Table 2. Costs for operators of fewer wells may be higher, since they will not purchase these items in as large a quantity.

Table 2
Average Cost of Control Devices

Device	Capital and Installation Costs	Annual O&M Costs	Pilot Fuel
Flares	\$17,400	\$1,200	\$2,000

The benefits (reduction in VOCs) of increased controls for each threshold was estimated and summarized in Table 3. Column 2 shows the incremental reduction in VOC emissions for each tank threshold for Anadarko and Noble and was estimated with data from the Reg. 7 spreadsheets. The reduction in VOCs was estimated by applying a 0.95 reduction standard to the total uncontrolled emission level for each tank and then summed for all tanks in that category. The incremental emissions for the rest of the industry were extrapolated by applying a 0.35 factor to the emissions for both Anadarko and Noble as summarized in Column 3. Column 4 shows the summation of the emission reductions for the entire industry.

Table 3
Estimated Reduction in VOCs (ton/year) for each Tank Threshold

Tank Emission Levels	Incremental Reduction in Emissions of VOCs (Tons) @ 95% Reduction—Anadarko & Noble	Incremental Reduction in Emissions of VOCs (Tons) @ 95% Reduction—Rest of Industry	Incremental Reduction in Emissions of VOCs (Tons) @ 95% Reduction
(1)	(2)	(3) + (2) *0.35	(4) = (2) + (3)
> 5	60,611	21,214	81,824
4 to 5	1,084	379	1,463
3 to 4	767	268	1,035
2 to 3	543	190	733
1 to 2	284	99	384
< 1	100	35	135
Total	63,388	22,186	85,574

The incremental cost for applying increased controls to different tank thresholds was estimated using the data discussed in Tables 1, 2, and 3. The results are summarized in Table 4. The incremental costs per ton of VOCs increases significantly as the tanks' thresholds decline in size. For instance, the cost per ton of VOC reduced per year ranges from \$1,497 for tanks that emit between 4 and 5 tpy to just over \$14,400 per ton per year for tanks emitting less than one ton per year.

Table 4
Incremental Cost for VOCs Emission Reductions (\$/year)
For each Tank Threshold

Tank Emission Levels	Incremental Reduction in Emissions of VOCs (Tons) @ 95% Reduction	Cost Per Ton of VOCs (\$/ton)
> 5	78,310	
4 to 5	1,569	\$1,497
3 to 4	1,071	\$1,894
2 to 3	765	\$2,612
1 to 2	391	\$4,578
< 1	146	\$14,426

Conclusion

The cost analysis demonstrates the increasing costs of implementing controls on condensate tanks with small levels of annual uncontrolled VOC emissions. These incremental costs include the costs to install and operate flares on tanks emitting less than 5 tpy on an annual basis. With the diminishing benefits (VOC emission reductions) achieved by controlling smaller and smaller tanks, the incremental costs on a per ton basis will increase as demonstrated here. The costs range from \$1,497 per ton of VOC emissions destroyed per year for tanks with between 4 and 5 tpy of uncontrolled emissions to over \$14,400 per ton for tanks emitting less than 1 tpy.

s/ Lisa A. McDonald

Lisa A. McDonald