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June 19, 2015

Jenna Whitlock
Acting State Director
440 West 200 South, Suite 500
Salt Lake City, Utah 84101-1345

Re: Greater Monument Butte Final EIS

Dear Ms. Whitlock:

We are writing on behalf of Newfield Exploration Company (Newfield) regarding the Environmental Impact Statement for the Monument Butte Oil and Gas Development Project. Newfield has been working with the Bureau of Land Management (BLM) on this project since 2009, and we appreciate the hard work and patience the BLM team has brought to this effort. The BLM has invested significant time and resources into preparing an Environmental Impact Statement (EIS) for this project, as has Newfield. The environmental impacts of a range of alternatives have been identified and evaluated, and a comprehensive list of mitigation measures and Applicant Committed Environmental Protection Measures (ACEPM) has been developed. Based on that record and years of work, Newfield strongly believes that the National Environmental Policy Act (NEPA) process should be brought to a conclusion.

Newfield was surprised and disappointed to see that recently the Environmental Protection Agency (EPA) forwarded to BLM additional comments and mitigation recommendations, over and above the comments and mitigation recommendations EPA appropriately provided at the DEIS stage. At that time, both BLM and EPA understood the ozone issue and the draft EIS fully disclosed and evaluated a range of air quality issues, including potential ozone NAAQS violations. EPA could have, and should have completed its investigation of mitigation measures at that time.

EPA's new comments provide no substantial new information. Their new comments are untimely and threaten to further delay the process while intruding into BLM's responsibilities

and authorities as the lead agency and the federal land manager. Moreover, EPA did not provide with its new mitigation recommendations an analysis of the cost effectiveness and technical feasibility of these additional mitigation measures. EPA appears not to understand the project that is the subject of this EIS, and has unlawfully conflated its NEPA review responsibilities with its regulatory authorities.

INTRODUCTION

Newfield has a stellar record for the responsible development of oil and gas in the Uinta Basin and elsewhere. In keeping with that commitment, Newfield has worked collaboratively with the BLM and other state and federal agencies on a wide range of environmental issues. For example, Newfield is one of several companies that provided financial support and technical expertise to the series of winter ozone studies that are incrementally providing valuable insight into the phenomenon of winter ozone formation. Newfield voluntarily purchased an infrared camera to facilitate the implementation of a leak detection and repair program in the basin. Newfield also is pressing forward with its voluntary commitment to replace existing pumpjack engines with clean-burning JJJJ-compliant units. Finally, Newfield has committed to a lengthy and comprehensive set of ACEPMs that will significantly reduce emissions of ozone precursors into the atmosphere and provide significant collateral air quality benefits.

Newfield recognizes that upon completion of this EIS and issuance of a record of decision, and before Newfield initiates site specific activities, Newfield will have to secure permits from the appropriate air quality regulatory agency or agencies. Perhaps more important, Newfield also recognizes that if EPA designates the Uinta Basin as nonattainment for ozone at some point in the future, the state, tribe, and EPA will be required to develop comprehensive plans to bring the area into attainment and that such plans likely will impose additional control or process requirements on all oil and gas operators in the basin including Newfield. However, Newfield vigorously disputes EPA's apparent view that it is somehow empowered to use its NEPA review responsibilities as a short-cut to imposing the kind of basin-wide measures that cannot lawfully be achieved save through development of state and federal implementation plans that are accompanied by thorough scientific and technical analysis, none of which is apparent in its most recent submission.

EPA'S COMMENTS ON THE FEIS

EPA's last minute comments concern Newfield, for several reasons. Some of EPA's newly proposed mitigation measures mirror ACEPMs to which Newfield has already agreed. Some others are simply inapposite; for example, Newfield has no evaporation ponds and proposes none. And others are not technically or economically reasonable. In the section below, we address each of EPA's new proposals in some detail. However, Newfield is still evaluating some of the proposals and intends to provide additional technical and economic analysis soon to

further explain why some of EPA's new proposals are unreasonable. The section below lists the various comments from EPA, and follows each with an explanation of why the proposal is inapposite, is already covered by an ACEPM, or is unreasonable.

A. Tier IV Engines. EPA proposed Tier 4 engines for drill rigs and hydraulic fracturing pump engines at the outset of the project and asserted that significant reductions may be achieved for not only NO_x, but $PM_{2.5}$ and volatile hydrocarbons as well.

In the draft EIS, Newfield committed to the use of Tier 2 drill rig engines initially with the phase-in of Tier 4 engines by the year 2018. This phase in period is necessary to allow sufficient time for this new technology to be developed and manufactured, and to then penetrate the industry. In crafting the diesel engine emission standards, EPA itself recognized that engine manufacturers would need sufficient time to develop and implement the technologies necessary to meet the mandated Tier 4 emission standards. Only recently have manufacturers of new engines suitable for drill rig applications been required to meet Tier 4 emission standards and in fact, the largest class of engines, those greater than 750 hp, were not required to meet Tier 4 standards until this year, 2015. Newfield is not aware of any drill rigs in the Uinta basin that can meet Tier 4 standards for all engines. Similarly, we are not aware of any Tier 4 compliant hydraulic fracturing fleets currently operating within the basin. While one hydraulic fracturing contractor, Halliburton, does have a limited number of Tier 4 fracturing fleets outside of the Uinta Basin, the supply is so limited that Newfield cannot be assured that they would be available for mobilization to the basin to serve our operations. Furthermore, Halliburton has indicated that current equipment in the basin cannot be retrofitted to Tier 4 Standards. To meet operating specifications Halliburton contends that Tier 4 compliant pressure pumping equipment must be manufactured from the ground up. The lack of available compliant equipment makes this measure technically infeasible and therefore unreasonable.

B. Closed loop drilling.

Closed loop drilling offers no additional air quality benefits when compared to the use of reserve pits; both systems are essentially open to the atmosphere. The use of closed loop systems would impose non-trivial incremental operating costs while providing no corresponding air quality benefits. It is therefore unreasonable.

C. Elimination of any existing evaporation ponds and requiring other means of storage and disposal than evaporation for new development.

This proposed mitigation measure indicates EPA's lack of understanding of the proposed project as described in the EIS. Newfield does not operate any existing evaporation ponds

within the GMBU. Furthermore, one distinct aspect of the project is that the Unit is operated as a waterflood. As such, produced water is managed as a valuable resource and is thoughtfully managed, treated, and ultimately recycled via injection into the producing formation. As discussed in the EIS (Section 2.2.9), Class II SWD wells may also be utilized to dispose of produced water. Therefore, we request that BLM reject this mitigation measure as it is not applicable to the project.

D. Retrofit all existing pneumatic controllers to meet the standards established for pneumatic controller affected facilities that are constructed, modified or reconstructed on or after October 15, 2013, as specified in 40 CFR 60, Subpart OOOO Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution (as is required by Utah DAQ R307-502-4).

Newfield has carefully considered and advanced all reasonable ACEPMs applicable to our project including a commitment to replace or retrofit existing high bleed pneumatic devices (see section 2.2.12.1.3 of the EIS). The inclusion of this mitigation measure in EPA's most recent comments indicates the agency's overall failure to understand and evaluate Newfield's ACEPMs.

E. Consideration of non-gas driven (no bleed) pneumatics and potential opportunities for power supply for such devices through renewable resources for both existing and new development.

Newfield embraces new technologies that improve operational efficiency while reducing environmental impacts. For example, Newfield already, and on its own initiative, is utilizing electronic controllers in place of certain pneumatic devices at injection wells. Newfield will evaluate and consider the use of no bleed pneumatics for new facilities where appropriate; this is something Newfield would do in any event as new technologies evolve and are proven.

F. Control of existing tank emissions for tanks with a VOC potential to emit greater than six tons per year.

Newfield has previously discussed with EPA and BLM the reasons why the control of existing stock tanks is not feasible at this time. Newfield currently operates approximately 850 existing tank batteries within the project area. While the use of enclosed flares to combust tank vapors is often recognized as the most cost effective measure to control tank emissions, the retrofitting of existing tank batteries remains an expensive proposition that averages at least $54,000 per battery for Newfield's operations. The implementation of this measure could potentially be very significant, costing many millions of dollars; this could challenge the economic viability of many wells resulting in their premature abandonment and the loss of production.

Furthermore, the premature imposition of this measure in advance of control programs implemented through the CAA could severely handicap Newfield's ability to obtain voluntary emission credits under any future ozone non-attainment designation and thus severely handicap Newfield's ability to fulfill its obligations as operator to manage the GMBU to be the benefit of all unit owners. Put another way, the fact that Newfield is disclosing via the NEPA potential air quality impacts that most likely will never occur due to self-enforcing provisions of the CAA, should not result in the undue burden of costly mitigation measures that have not been thoroughly evaluated for effectiveness, nor imposed upon similar operations across the basin.

Furthermore, the application of combustion devices to control stock tank emissions will trade one ozone precursor pollutant, namely VOC, for another pollutant, NO_x. To the best of our knowledge, EPA has not undertaken an analysis that determines whether the use of combustors to control stock tank emissions will in fact benefit air quality in the basin, or if the emission of NO_x from the combustors would offset any potential benefit from reduced VOC emissions. This is precisely the kind of analysis that would be performed as an element in development of state and federal implementation plans to bring the basin into attainment, should the basin be designated as nonattainment. It is clearly unreasonable to mandate such a costly and onerous mitigation measure with no analysis to support the effectiveness of the measure.

G. Control of VOC emissions from all new tanks regardless of potential to emit.

In its recent analysis of tank emission control strategies for the NSPS OOOO rule, EPA determined that the control of storage tanks with emissions of less than 6 tons/year was not economically feasible. EPA directly addressed this issue upon Reconsideration of Certain Provisions of New Source Performance Standards:

> As shown in the memo entitled *Cost and Secondary Environmental Impacts Associated with Controlling Storage Vessels under the Oil and Natural Gas Sector New Source Performance Standards,* available in the docket, our analysis indicates that the cost of controls for each storage vessel affected facility at a VOC emission rate of 4 tpy is approximately $5,100 per ton. This cost increases to approximately $6,900 per ton at an emission rate of 3 tpy, and to approximately $10,000 per ton at 2 tpy. For comparison, we note that, in a previous NSPS rulemaking [72 FR 64864 (November 16, 2007)], we had concluded that a VOC control option was not cost effective at a cost of $5,700/ton, which calls into question the cost effectiveness of continuing control of storage vessel affected facilities at an emission rate below 4 tpy.

78 Fed. Reg. 58416, 58,429 (Sept. 23, 2013). We have attached as Appendix A to this letter a copy of the technical report cited by and relied upon by EPA in its reconsideration decision.

Aside from the question of cost-effectiveness, in its new comments EPA did not evaluate the air quality benefits that could be achieved by controlling stock tanks to levels below 6 tons/year. Since EPA has provided no analysis or explanation to suggest that the conclusion it reached in 2013 no longer obtains, and given the cost-ineffectiveness of the proposal being propounded here by EPA, we urge BLM to find that the proposal is unreasonable.

H. Require further utilization (than was considered in the current analysis) of oil gathering systems (GOSPs) to reduce decentralized equipment emissions.

Again EPA has failed to appreciate Newfield's carefully developed project development plan and air quality mitigation measures. Section 2.2.12.1.5 of the EIS states that Newfield would employ central gathering systems and construct GOSPs where feasible. Clearly it would be unreasonable to require the construction of GOSPs when they were not technically, environmentally and economically feasible.

I. Require three-way oil/water/gas separators to be controlled via combustor or otherwise reroute vapors to sales lines.

Newfield currently gathers and processes produced gas in the Unit for use as on-lease fuel or for sales as product when feasible. With respect to air quality impacts, this practice is beneficial when compared to EPA's apparent preference for routing the produced gas to a combustor.

J. Require that wells utilize plunger lift systems (or otherwise automated systems) to minimize potential for fugitive emissions from well pressure fluctuation and liquid accumulation within the well.

Plunger lift systems are technically infeasible for black wax oil wells. There are many liquids lifting technologies, each with its own appropriate applications and related strengths and weaknesses. No single liquids lifting technology is appropriate under all conditions. Newfield, as the operator of the wells and the subject matter experts on the producing reservoirs, should be allowed to determine which technologies are appropriate for its operation. EPA via the NEPA process should not and cannot dictate what equipment and technologies Newfield must apply to our downhole operations.

K. Directed Inspection & Maintenance program – scope and frequency could be negotiated.

Newfield thoughtfully considered this measure as it applies to its operations and proposed an appropriate inspection and maintenance program for stock tank thief hatches as an ACEPM (see section 2.2.12.1.6 of the EIS). Inspection and maintenance programs for production operations that are overly broad in scope and highly regimented in recordkeeping and reporting requirements quickly become very labor intensive and costly; at the same time, the cost effectiveness of such large scale programs has not been clearly demonstrated. Newfield has proposed an inspection and maintenance program appropriate for the project, and the arbitrary expansion of that program without further justification and a supporting impact analysis is unreasonable.

L. Require bottom filling of tanker trucks to reduce fugitive emissions.

Newfield previously adopted this practice within the basin in accordance with the Utah Division of Air Quality retro-fit rules. If EPA desires additional information, they could contact the Utah Department of Environmental Quality.

M. Reduce the pace or density of proposed development.

Wintertime ozone formation is a basin-wide issue that is completely independent from the density of development (well spacing) within the GMBU project. We are not aware of any credible evidence that increasing the distance between wells within a project area will have any positive influence on ozone formation in the basin, and EPA provided no analysis to accompany its recommendations. Reducing the pace of development would require the analysis of a completely new alternative, and is highly unreasonable at such a late stage in the NEPA process. Moreover, EPA presented no analysis whatsoever to identify the air quality benefits that might accrue to consideration of a new alternative. This option would be tantamount to starting over in preparation of an EIS and is patently unreasonable.

Viewed from a larger perspective, EPA's role at this stage of the process is troubling. Some of the measures EPA is proposing go well beyond the permitting requirements that apply to the oil and gas sector, all of which were subject to careful analysis before being finalized. For example, so far as we have been able to determine EPA has never even considered requiring controls on existing tanks regardless of potential to emit despite their authority over a large percentage of the basin designated as Indian Country. We are equally concerned by EPA's attempt to reach back in time through an analysis of a proposed project to force controls on existing sources. Perhaps most important, EPA provided no analysis or quantitative evaluation of the mitigation measures

they are proposing. Neither we nor BLM has any way of knowing whether the measures EPA is proposing would measurably affect winter time ozone formation, or by how much.

It appears that EPA is trying to find a short-cut past the regulatory processes that are in place to address air quality concerns. As we noted, there exists at both the state and federal level a complex set of permit limits and requirements that will apply at the time Newfield proposes site specific activities. In addition, if the Uinta Basin is designated as a nonattainment area for ozone, the state, tribe, and EPA will initiate a planning process that is designed to comprehensively address air quality. They will be required to develop an accurate inventory of emissions and emissions sources, something that does not exist today. They will also evaluate existing major stationary sources as well as sources for which a control technique guideline exists to determine reasonably available control measures that should be implemented. The very significant benefit of that approach is that the agencies, in collaboration with stakeholders, will carefully and thoroughly evaluate the control technologies and process changes that are available, and will select the set of measures that will most cost-effectively reduce both emissions and ambient levels of ozone. Moreover, the agencies and stakeholders presumably will have at their disposal photochemical models that show how emissions reductions of VOCs or NO_x will affect ambient ozone levels and that will permit the agencies to consider the trade-offs between reductions of one precursor emission or the other. The EPA is unable to do any of these things at this date.

That is the process the Clean Air Act prescribes for addressing the broad but still poorly understood air quality issues in the Uinta Basin. It many ways, it is a self-correcting process that operates within a set of well understood parameters. EPA would be acting wholly within its regulatory authority at that point, and stakeholders would have a clear understanding of the nonattainment planning process. But EPA is not empowered to short-circuit that process because of its "concern" that an area may be designated as nonattainment in the future (a process wholly within EPA's control).

The *Memorandum of Understanding Among U.S. Department of Agriculture, U.S. Department of the Interior, and Environmental Protection Agency Regarding Air Quality Analysis and Mitigation for Federal Oil and Gas Decisions Through the National Environmental Policy Act Process* (MOU) is entirely consistent with the approach Newfield is proposing, wherein BLM considers all available mitigation measures and selects those that are reasonable, while leaving to EPA decisions on permitting and development of implementation plans for areas designated as nonattainment.

The MOU speaks largely of process – the process for determining if a project may result in a substantial increase in emissions, and if so the modeling protocols that should be followed and the collaborative process that should obtain between the lead agency and other federal agencies. The MOU also adverts in multiple places to the analysis needed to be done in evaluating air quality impacts of proposed projects, and in so doing emphasizes the science-based approach that

should prevail. Within that process realm, the MOU also emphasizes the importance of timely comments from collaborating agencies, something that did not occur in this instance.

The MOU also addresses the process for developing mitigation recommendations to address air quality impacts. The MOU's stated approach is consistent with NEPA and the case law that has grown up around that statute. It is essential to note that the MOU specifically states that it is the lead agency that has the responsibility for evaluating "reasonable mitigation and control measures." As it must, the MOU also acknowledges that nothing in the MOU is intended to limit, expand, or affect in way the legal authorities or responsibilities of the respective agencies.

To reiterate, the MOU recognizes that it is the lead agency's responsibility to identify potential mitigation measures but then to determine which of the potential mitigation measures are reasonable. The CEQ guidelines reinforce the importance of discussing possible mitigation measures, 40 C.F.R. § 1508.25(b), but one of the Supreme Court's leading NEPA cases, reiterated that NEPA itself cannot be used to achieve particular results; it merely prescribes a process. *Robertson v. Methow Valley Citizens Council*, 109 S.Ct. 1835, 1847, 490 U.S. 332, 352-353 (1989). So long as the agency fully discloses the impacts of its proposed action, along with a discussion of possible mitigation measures, the agency "is not constrained by NEPA from deciding that other values outweigh the environmental costs." *Id.* at 1846. The Court in that case held that while the lead agency must identify and evaluate mitigation, the agency is not compelled to formulate and adopt a complete mitigation plan in a NEPA document.

While Newfield has demonstrated its commitment to develop oil and gas resources in an environmentally responsible way, and while Newfield respects EPA's interest in air quality, EPA's belated comments go well beyond what EPA permits would require with no accompanying justification, go well beyond what either NEPA, the case law, or the MOU demand, and even threaten to intrude into BLM's province. We believe that BLM has more than met and exceeded NEPA's requirements in evaluating this project and that it is past time to bring closure to this NEPA process.

CONCLUSION

BLM must evaluate mitigation options, including those suggested by EPA, and then evaluate those options to identify which, if any, are reasonable. BLM met and exceeded that obligation. BLM now has the discretion to determine which mitigation measures related to oil and gas development and founded on BLM's statutory authority under the Federal Land Policy and Management Act and the Mineral Leasing Act should be included in a ROD. EPA, in turn, should restrict itself to collaborating with BLM in developing an EIS and ensuring that appropriate permit conditions are imposed when Newfield proposed surface disturbing activities. If and when the basin is designated as nonattainment, EPA, the state and the tribe will play a lead role, in their capacities as air quality regulators, in developing a comprehensive plan for

remedying nonattainment. That is how the CAA and the MOU divide responsibilities, and it is unnecessary for BLM to adjust those roles, especially at this extremely late date.

Very truly yours,

BEATTY & WOZNIAK, P.C.

Bret Sumner
Jim Martin
Attorneys on behalf of Newfield

CC: Mr. Leonard Herr
Ms. Stephanie Howard

APPENDIX A

MEMORANDUM

DATE: August 1, 2013

SUBJECT: Cost and Secondary Environmental Impacts Associated with Controlling Storage Vessels under the Oil and Natural Gas Sector New Source Performance Standards

FROM: Heather Brown, EC/R Incorporated

TO: Bruce Moore, EPA/OAQPS/SPPD/FIG

The purpose of this memorandum is to document the estimated cost and secondary environmental impacts related to reducing volatile organic compound (VOC) emissions from new storage vessels using a combustion device to comply with the new source performance standards (NSPS) for the oil and natural gas sector (40 CFR part 60, subpart OOOO).

On April 12, 2013, the Environmental Protection Agency (EPA) proposed amendments to the Oil and Natural Gas Sector NSPS (subpart OOOO) to address reconsideration of certain provisions of subpart OOOO. As a part of the proposed action, EPA established an alternative mass-based emission limitation of 4 tons per year (tpy) of VOC uncontrolled storage vessels. To respond to comments on its rationale for choosing the 4-tpy mass-based emission limit, the EPA further evaluated the cost of controls and secondary environmental impacts associated with operating a combustion control device at emission rates other than 4 tpy.

COST IMPACTS ASSOCIATED WITH COMBUSTION DEVICE OPERATION

Cost effectiveness was calculated for several regulatory options to determine the appropriate mass-based alternative emission limit. Regulatory Options A through E represent uncontrolled VOC emissions ranging from 1 tpy to 6 tpy, respectively. The annual cost of $19,580 per year associated with operating a combustion device was previously estimated for the final, April 2012, NSPS.[1] Emission reductions were calculated based on a 95 percent control device efficiency. The options are presented in Table 1. As shown in Table 1, the cost effectiveness ranges from a maximum of $20,611/ton for uncontrolled VOC emissions of 1 tpy down to $3,435/ton for uncontrolled VOC emissions of 6 tpy.

SECONDARY ENVIRONMENTAL IMPACTS ASSOCIATED WITH COMBUSTION DEVICE OPERATION

Secondary environmental impacts were estimated for nitrogen oxides (NO_X), carbon monoxide, and carbon dioxide (CO_2) emissions associated with the combustion of the VOC emissions from oil and condensate storage vessels. In addition, the emissions associated with the pilot light operation were estimated, as well as methane emission reductions associated with control of oil

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Table 1. Cost Impacts Associated Regulatory Options Operating a Combustion Device to Reduce VOC Emissions

Regulatory Option	Uncontrolled VOC Emissions (tpy)	VOC Emission Reduction (tpy)[a]	Total Annual Cost of Control ($/yr)[b]	Cost Effectiveness ($/ton)
A	1	0.95	19,580	20,611
B	2	1.9	19,580	10,305
C	3	2.85	19,580	6,870
D	4	3.8	19,580	5,153
E	5	4.75	19,580	4,122
F	6	5.7	19,580	3,435

[a]Calculated as 95 percent of uncontrolled VOC Emissions.
[b] Total annual cost for one combustion device. Calculated in previous memorandum (see Reference 1).

and condensate storage vessels. These impacts were calculated on a per-combustion device basis for each of the regulatory options presented in Table 1.

Table 2 presents inputs used to calculate these secondary impacts. As shown in Table 2, the information necessary to calculate the NO_X, CO, CO_2, and methane emissions includes:

- Condensate and oil emission factors (tpy/bbl/day)
- Heating value of the oil and condensate vapor stream (British thermal units/standard cubic feet, Btu/scf);
- Methane heating value (Btu/scf)
- Gas-to-Oil Ratio (GOR) of the oil and condensate (scf per barrel, scf/bbl);
- NO_X Emission factor (pounds per million Btu, lb/MMBtu);
- CO Emission factor (lb/MMBtu);
- CO_2 Emission factor (lb/MMBtu);
- Pilot light gas usage (scf/hr)
- Methane to VOC ratio

The secondary emission impacts are shown in Table 3 for each of the defined regulatory options, using the inputs from Table 2. The associated liquid throughput for each oil and condensate storage vessel was calculated using the uncontrolled VOC emissions associated with each regulatory option and the corresponding oil or condensate emission factor. The associated GOR was then used to calculate the vapor stream flow rate. This flow rate was then converted to heat input using the heat value of oil or condensate vapor stream, as appropriate. Emissions of NO_X, CO and CO_2 were then calculated using the emission factors identified in Table 2 and the heating input calculated for the oil or condensate vapor stream.

Pilot light emissions were calculated using the same NO_X, CO, and CO_2 emission factors and a pilot light usage value of 70 scf/hr from Partner Reported Opportunities associated with the

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Natural Gas STAR program. As shown in Table 3, the NO_X and CO emissions associated with combustion of the pilot light are an order of magnitude higher than the NO_X and CO emissions associated with combustion of the VOC stream.

Table 2. Inputs Used to Calculate Secondary Impacts

Variable	Value	Units	Reference
Condensate VOC emission factor	2.09	tpy VOC/(bbl/day)	2
Oil VOC emission factor	0.214	tpy VOC/(bbl/day)	2
Heating value of vapor stream from condensate storage vessel	2,166	Btu/scf	3
Heating value of vapor stream from oil storage vessel	1,806	Btu/scf	3
Heating value of methane	1,011	Btu/scf	
Condensate GOR	173	scf/bbl3	3
Oil GOR	18.9	scf/bbl3	3
NO_X emission factor	0.068	lb NO_X/MMBtu	4
CO emission factor	0.37	lb CO/MMBtu	4
CO_2 emission factor	60	kg CO_2/MMBtu	5
Pilot light natural gas usage	70	scf/hr	6
Methane to VOC ratio	0.207		3

Figures 1 and 2 illustrate the changes in cost effectiveness and secondary impacts for each of the regulatory options for condensate storage vessels and Figures 3 and 4 present these options for oil storage vessels. Figures 1 and 3 present how cost effectiveness, VOC, NO_X and CO change with each regulatory option for condensate and oil storage vessels, respectively. Figures 2 and 4 show the cost effectiveness, VOC and CO_2 emissions associated with condensate and oil storage vessels, respectively. Pilot light emissions are constant and were not included in these figures. There is a significant increase in cost effectiveness values the lower the emissions of the uncontrolled storage vessel.

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Table 3. Secondary Emission Impacts Associated with Combustion of VOC Emissions from Storage Vessels

Regulatory Option	Uncontrolled VOC Emissions (tpy)	Associated Throughput (bbl/day)[a]	Vapor Flowrate from Storage Vessel (scf/day)[b]	Heating Input from Storage Vessel (MMBtu/hr)[c]	Emissions Associated with Combustion of Vapor Stream (tpy)[d]			Emissions Associated with Pilot Light Operation (tpy)[e]			Total Emissions from Combustion of Pilot Light and Vapor Stream (tpy)[f]		
					NO_X	CO	CO_2	NO_X	CO	CO_2	NO_X	CO	CO_2
CONDENSATE STORAGE VESSELS													
A	1	0.478	82.4	0.00744	0.00221	0.0121	4.31	0.0211	0.115	41.0	0.0233	0.127	45.3
B	2	0.956	165	0.01487	0.00443	0.0241	8.62	0.0211	0.115	41.0	0.0255	0.139	49.6
C	3	1.43	247	0.0223	0.00664	0.0362	12.9	0.0211	0.115	41.0	0.0277	0.151	53.9
D	4	1.91	330	0.0297	0.00886	0.0482	17.2	0.0211	0.115	41.0	0.0299	0.163	58.2
E	5	2.39	412	0.0372	0.0111	0.0603	21.5	0.0211	0.115	41.0	0.0322	0.175	62.5
F	6	2.87	495	0.0446	0.0133	0.0723	25.9	0.0211	0.115	41.0	0.0344	0.187	66.9
OIL STORAGE VESSELS													
A	1	4.66	88.0	0.00662	0.00197	0.0107	3.84	0.0211	0.115	41.0	0.0231	0.125	44.8
B	2	9.33	176	0.0133	0.00395	0.0215	7.68	0.0211	0.115	41.0	0.0250	0.136	48.7
C	3	14.0	264	0.0199	0.00592	0.0322	11.5	0.0211	0.115	41.0	0.0270	0.147	52.5
D	4	18.7	352	0.0265	0.00789	0.0429	15.4	0.0211	0.115	41.0	0.0290	0.158	56.4
E	5	23.3	440	0.0331	0.00986	0.0537	19.2	0.0211	0.115	41.0	0.0309	0.168	60.2
F	6	28.0	528	0.0397	0.0118	0.0644	23.0	0.0211	0.115	41.0	0.0329	0.179	64.0

Note: Slight differences are due to rounding.

[a] Associated throughput (bbl/day) calculated using VOC emission factor of 2.09 tpy/bbl condensate/day or 0.214 tpy/bbl oil/day (see Table 2) and uncontrolled VOC emissions (tpy).

[b] Vapor flowrate (scf/day) calculated using gas-to-oil ratio of 172.5 scf/bbl of condensate or 18.9 scf/bbl of oil (see Table 2) and associated throughput (bbl/day).

[c] Heating input from storage vessel (MMBtu/hr) calculated using heating value of vapor stream of 2,166 Btu/scf of condensate vapor or 1,806 Btu/scf of oil vapor (see Table 2) and vapor flowrate from storage storage vessel (scf/day) and 24 hours/day.

[d] Emissions associated with combustion of vapor stream (tpy) calculated using emission factors for NO_X (0.068 lb/MMBtu), CO (0.37 lb/MMBtu), and CO_2 (60 kg/MMBtu) and heating input from the storage vessel.

[e] Emissions associated with pilot light operation calculated using average annual pilot light gas usage estimate from Natural Gas STAR partners of 70 scf/hr and emission factors for NO_X (0.068 lb/MMBtu), CO (0.37 lb/MMBtu), and CO_2 (60 kg/MMBtu).

[f] Emissions associated with combustion of vapor stream plus the emissions associated with the pilot light operation.

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Figure 1. Cost Effectiveness and NO_X, CO, and VOC Emissions Associated with Controlling VOC Emissions from Condensate Storage Vessels

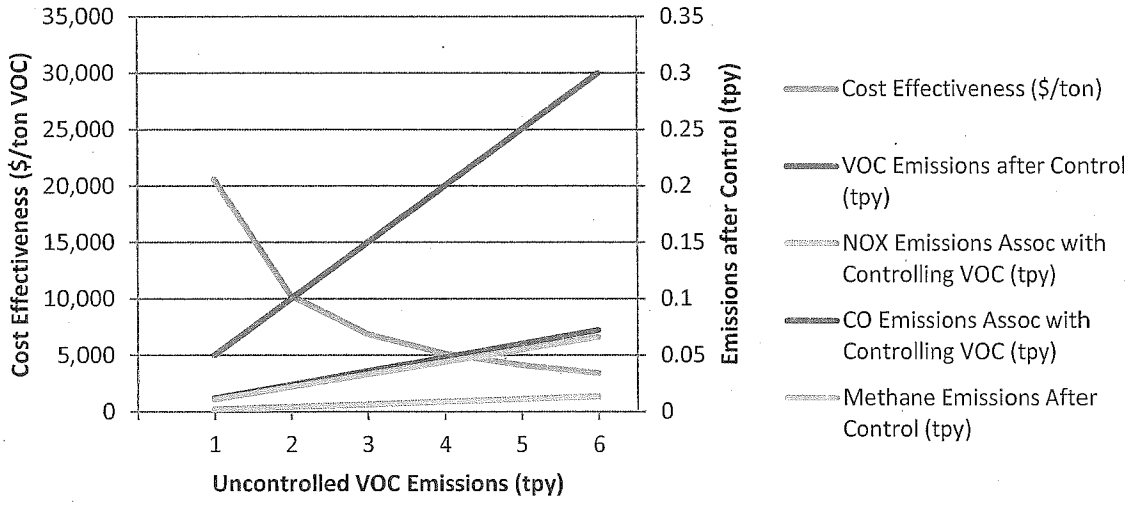
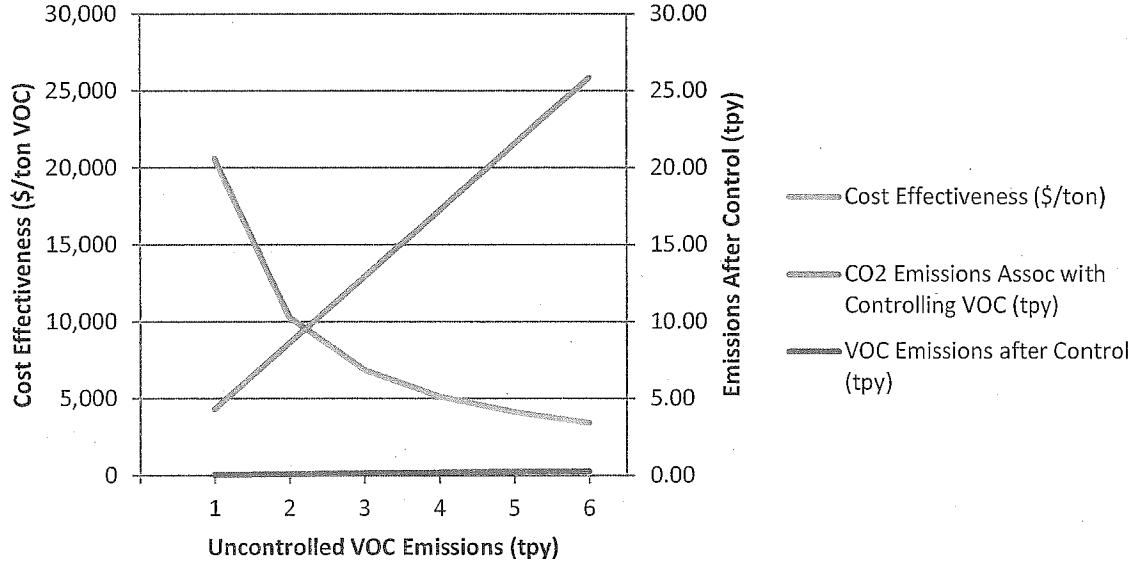


Figure 2. Cost Effectiveness and CO_2 and VOC Emissions Associated with Controlling VOC Emissions from Condensate Storage Vessels



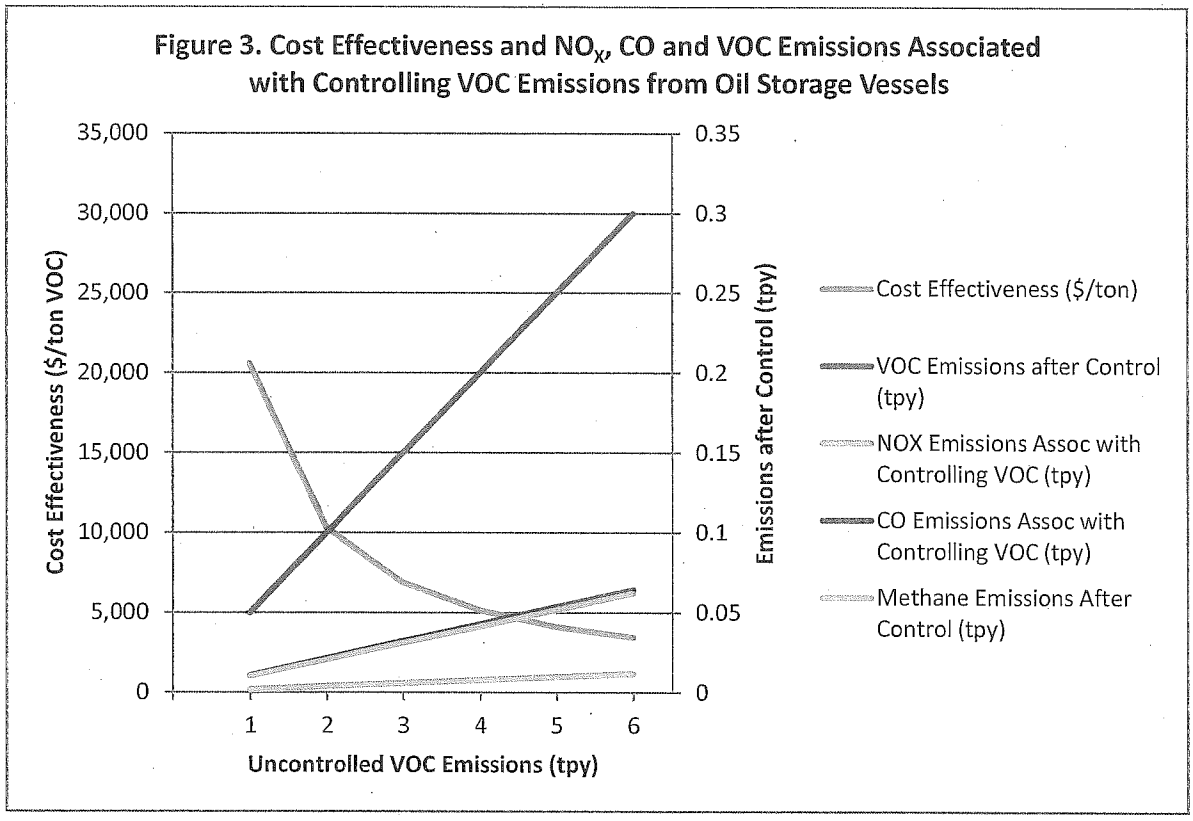


Figure 3. Cost Effectiveness and NO_X, CO and VOC Emissions Associated with Controlling VOC Emissions from Oil Storage Vessels
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Cost Effectiveness ($/ton VOC)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Emissions after Control (tpy)
1
2
3
4
5
6
Uncontrolled VOC Emissions (tpy)
Cost Effectiveness ($/ton)
VOC Emissions after Control (tpy)
NOX Emissions Assoc with Controlling VOC (tpy)
CO Emissions Assoc with Controlling VOC (tpy)
Methane Emissions After Control (tpy)

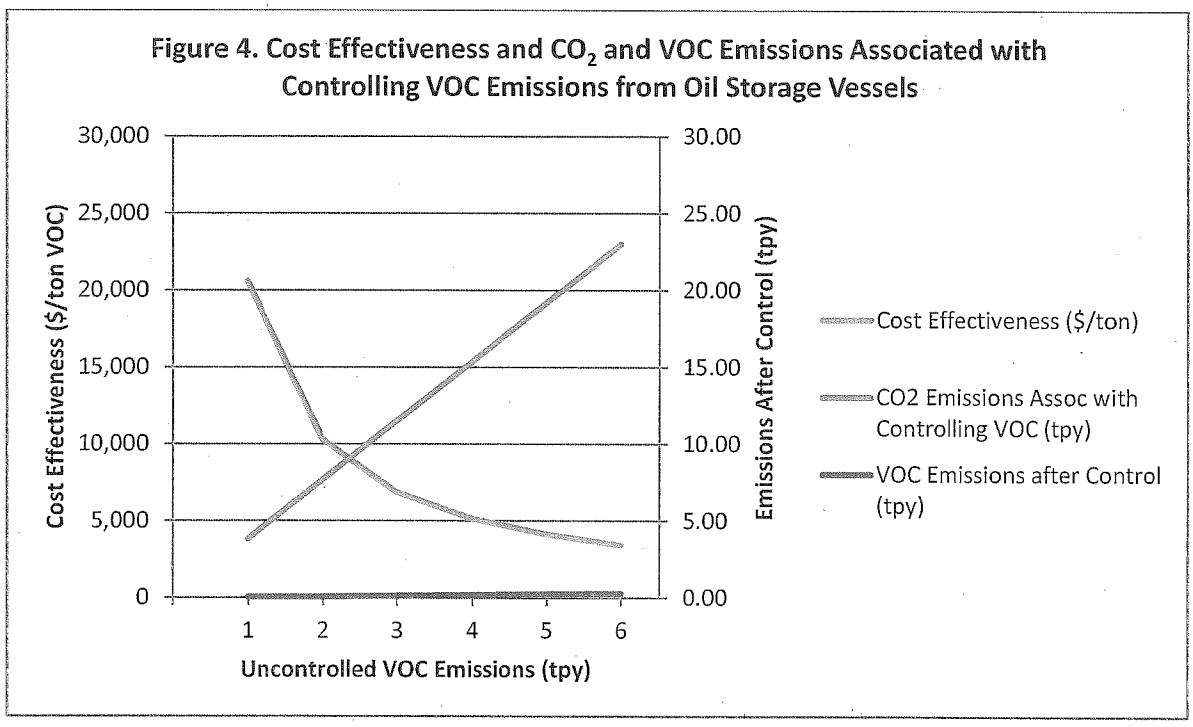


Figure 4. Cost Effectiveness and CO_2 and VOC Emissions Associated with Controlling VOC Emissions from Oil Storage Vessels
30,000
25,000
20,000
15,000
10,000
5,000
0
Cost Effectiveness ($/ton VOC)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Emissions After Control (tpy)
1
2
3
4
5
6
Uncontrolled VOC Emissions (tpy)
Cost Effectiveness ($/ton)
CO2 Emissions Assoc with Controlling VOC (tpy)
VOC Emissions after Control (tpy)

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6. U.S. Environmental Protection Agency. PRO Fact Sheet No. 903. Partner Reported Opporunities for Reducing Methane Emissions: Install Electronic Flare Ignition Devices. 2011. Available on the Internet at: http://www.epa.gov/gasstar/documents/installelectronicflareignitiondevices.pdf

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