Response to Comments on Revisions to Oil and Gas Production Facilities Chapter 6, Section 2 Permitting Guidance

On October 28, 2015, in the Cottonwood Room of the Laramie County Library, 2200 Pioneer Avenue, Cheyenne, Wyoming, the Wyoming Department of Environmental Quality (DEQ), Division of Air Quality (Division) presented revisions to the *Oil and Gas Production Facilities Chapter 6, Section 2 Permitting Guidance* (Guidance) to the Air Quality Advisory Board (Board). The presentation occurred on the last day of the public comment period that began on September 25, 2015, and during which time the Division requested comment on proposed revisions to the 2013 version of the Guidance. After the presentation, the public was invited by the Board to provide oral and/or written comments on the proposed revisions. The public comment period closed at the end of the meeting. Comments submitted to the Division prior to close of the public comment period, including oral comments submitted during the Board meeting, were reviewed by the Division. Similar comments were grouped together into one summary comment. The summary comments and associated response from the Division are provided in the following pages.

BOARD COMMENTS

1. **Incorrect word usage** – Board member Hansen noted that the word "through" was incorrectly used in the second sentence on page 25 of the October 2015 proposed Guidance.

   Response – The second sentence on page 26 of the May 2016 version of the Guidance has been revised by replacing the word "through" with "though".

2. **Missing word** – Board member Hansen commented that the first sentence on page 35 of the October 2015 proposed Guidance was missing at least one word, which made it difficult to understand.

   Response – The Division's intent is to clearly describe the steps involved in processing an oil and gas application. After reviewing the paragraph in further detail, the Division revised the paragraph to include a description of the receipt process for both paper applications and electronic applications. The revised language, which appears on page 36 of the May 2016 Guidance, is listed below.

   "Upon receipt of a paper application, the Division must input the required application information into an electronic system (IMPACT) for processing. Once the paper application is processed, the Division sends the applicant a receipt letter. For electronic applications received via IMPACT, the Division simply issues a receipt letter after the application is received and a reviewer is assigned."

3. **Word usage** – Board member Hansen requested clarification of the term "produce" when used in the first sentence on page 37 of the October 2015 proposed Guidance.

   Response – The term "produce" is commonly used in the oil and gas industry to refer to the operation of a well in order to produce liquids or gases from the well bore. "Operate" and "produce" can be used interchangeably in the context of the first sentence on page 37 of the October 2015 proposed Guidance. The Division did not change the first sentence on page 38 of the May 2016 Guidance.

INDUSTRY COMMENTS

1. **Truck loading**

   A. **Cost to control** – The industry group is concerned the cost to control truck loading emissions is too high. The UQ (Ultra and QEP) group estimated costs would be $27,000/ton when emissions are controlled at 4 TPY VOC.

   Response – Through the application of BACT for sources without presumptive BACT determinations, the Division received BACT analyses to control truck loading emissions of 8 TPY VOC or greater at a facility in the JPAD area and a facility in the current SWA. The BACT analyses are for the installation of a truck loadout vapor collection system without a dedicated combustor. The BACT analysis from the JPAD area shows the cost to control emissions to be $3,116/ton VOC. The BACT analysis from the SWA area shows the cost to control emissions to be $1,056/ton VOC. The Division used the costs from the BACT analyses to calculate a cost to control truck loading emissions at the 6 TPY VOC threshold. The cost to control is $1,408/ton. The applicants demonstrated that controlling VOC emissions is technically feasible and the Division considers the costs to be economically reasonable.

   After discussing truck loadout operations with industry, it was brought to the Division's attention that some operators may choose to use dedicated combustors to control vapors from truck loading operations. Although the Division has not issued permits that include dedicated combustors for truck loading, the Division conducted a BACT review for the SWA using cost-to-control values from the 2013 Guidance revision for 16-, 20-, and 24-inch combustors, costs provided by industry to install and operate a vapor collection system, and maintenance costs from EPA, which include maintenance labor, maintenance materials and make-up gas. The control costs for the SWA are summarized in the first table of Appendix A. Cost-to-control values for a presumptive threshold of 8 TPY ranged from $3,852/ton VOC to $4,010/ton VOC.

Cost-to-control values for a presumptive threshold of 6 TPY ranged from $5,136/ton VOC to $5,346/ton VOC. Controlling truck loading VOC emissions has been demonstrated by companies to be technically feasible and the Division considers the costs to control 6 TPY of VOC emissions from truck loading to be economically reasonable.

The Division conducted a BACT review for the UGRB using the EPA Air Pollution Control Cost Spreadsheets from the 2013 Guidance revision for 16-, 20-, and 24-inch combustors and costs provided by industry to install and operate a vapor collection system. Cost-to-control values for a presumptive threshold of 6 TPY ranged from $19,729/ton VOC to $21,031/ton VOC. Cost-to-control values for a presumptive threshold of 4 TPY ranged from $29,593/ton VOC to $31,547/ton VOC. The costs associated with a presumptive threshold of 6 TPY are below an average cost effectiveness of $22,938, which was determined to be reasonable in the 2013 Guidance revision for all sizes of combustors in the UGRB. Controlling VOC emissions from truck loading operations is technically feasible and the Division considers the costs to control 6 TPY of VOC emissions from truck loading to be economically reasonable.

Based upon the results of the Division's BACT analyses for controlling VOC emissions from truck loading operations at facilities in the SWA and UGRB, the Division is establishing P-BACT requirements for truck loading operations in the SWA, UGRB, and JPAD/NPL. Truck loading operations containing greater than or equal to 6 TPY VOC and HAP emissions shall be controlled. The truck loading requirements listed in the 2016 Guidance for the UGRB and JPAD/NPL reflect the Division's BACT determination.

B. **Custody Transfer** – Condensate/oil is trucked by third party companies to refineries for processing. With the control of truck loading emissions, the emission source is transferred from the tank (under the control of the operator) to the tank truck (under the control of the trucking company). To our knowledge, AQD has not reached out to the trucking companies to discuss the proposed changes in operations to control tank truck loading. The trucking companies may need to require training for all drivers.

Response – Companies using third parties for truck loading operations is not unique to oil and gas production facilities. For example, third parties are utilized at refineries during truck loadout where the refinery is responsible for controlling emissions generated during truck loadout. Another example is where railcars are loaded in the trona patch and emissions are

controlled by the trona facility. These are diverse examples where freight on board (ownership changes hands as soon as the material is loaded) examples exist, and where emissions are being controlled where they are generated.

Operators that currently control truck loading emissions handle the logistics of how truck loading occurs at their facilities. Logistical issues with truck loading should be handled through operator's contracts with the truck loading companies.

C. **Safety** – The industry group is concerned about the potential for explosions and collapsing tank trucks if control systems are not operated and designed properly.

Response – The Division has included the option in the Guidance for companies to demonstrate that safety issues would preclude the application of controls. The demonstration would have to be approved by the Division prior to the date that controls would be installed under the Guidance.

D. **Increase in number of affected facilities at 6 TPY** – At 6 TPY VOC, far more sites would be required to control truck loading emissions than at 8 TPY VOC. AQD had not provided an analysis of existing facilities to determine the potential number of sites requiring controls for truck loading. With the pressure to reduce the disturbance of land and minimize the foot print of our locations from BLM and the Fish and Wildlife Service, more operators are doing PAD sites with more and more wells tied in increasing the production rates per site resulting in more sites triggering controls at a 6 TPY threshold. Industry believes a solution may be that if a facility is expected to be over 8 TPY VOC then a BACT analysis is required. If the analysis is cost effective and shows that a reduction in emissions is meaningful, then the requirement will be applied.

Response – In 2014, four counties in the current SWA were some of the highest producers in the state. For example, Campbell County was the #1 oil producer, Converse County was the #2 oil producer, Park County was the #3 oil producer and Johnson County was the #3 natural gas producer. These statistics support the need for development and implementation of more stringent control requirements in these areas.

The cost to control truck loading emissions have been shown to be economically reasonable in these areas as described in Response 1A. The Division has maintained a proactive approach to decreasing emissions before significant deterioration in air quality occurs.

2. **Pneumatic Controllers** – Industry requests that intermittent vent controllers be removed from the definition of low-bleed controllers. Intermittent vent controllers have the lowest emissions and are generally the controller of choice to replace continuous high-bleed controllers. Industry requests the following sentence be added to the definition of low-bleed pneumatic controller: *It is assumed intermittent vent controllers meet the definition of a low-bleed controller.*

   Response – While intermittent vent controllers generally have emissions less than low-bleed controllers over the life of a well, they produce more emissions upfront. The Guidance includes a method for calculating emissions from intermittent vent controllers that was taken from multiple applications submitted by industry. Multiple companies are estimating emissions from intermittent vent controllers to ensure compliance with the 6 scf/hr limit. The Division has also reviewed applications that include intermittent vent controllers that have an emission rate greater than the 6 scf/hr limit and are required to send the motive gas to a closed-loop system. In the UGRB non-attainment area where the Division's *Interim Policy on Demonstration of Compliance with WAQSR* [Wyoming Air Quality Standards and Regulations] *Chapter 6, Section 2(c)(ii) for Sources in Sublette County* applies, it is important to estimate these emissions as they affect the attainment of the 2008 ozone standard.

   After considering current processes used to estimate emissions from intermittent vent controllers and the importance of accounting for emissions from such controllers located in the UGRB, the Division will continue to require a demonstration in each application that the intermittent vent controllers meet the 6 scf/hr limit for low-bleed pneumatic controllers. The Division will not revise the Guidance to include an assumption that intermittent vent controllers meet the definition of a low-bleed controller. The Division will continue to evaluate BACT for intermittent vent controllers and revise P-BACT accordingly.

3. **Control Removal** - Industry requests the Division streamline the control equipment removal process. As stated previously, we do not agree that the conditions allowed to remove control equipment be different than the conditions which require controls. Control removal should be

allowed when flash emissions fall below 6 TPY VOC, the same level at which controls are required. Control removal should be allowed at any time when the sustained emissions fall below this level, not after one year at the earliest. By requiring controls to remain in place for low emissions the operator may have to purchase fuel to keep combustion controls operable. Other areas of the Guidance allow control removal when the emissions fall below the level at which controls are required and the Guidance should be consistent.

Industry suggests this change will simplify the permitting process as 40 CFR Part 60 (OOOO) is specific to emissions from individual tanks where the Guidance applies to emissions for a facility.

Response – The control thresholds and removal thresholds in the Guidance have been designed to avoid duplicative State and Federal requirements. When the State's requirements are more stringent, companies may be exempt from the Federal requirements. The 4 TPY VOC control removal threshold for flashing emissions is put in place to align with NSPS OOOO's removal threshold for storage vessels and ensure the State's requirements are as stringent as the Federal requirements.

Prior versions of the Guidance have not allowed control removal for sources of flashing emissions prior to the control being in place for one year. NSPS OOOO for storage vessels requires the controls to be in place for at least one year and the Guidance is consistent with this requirement. In accordance with prior versions of the Guidance, dehydration unit controls and produced water tank controls also have to be in place one year before removal. The Division's experience with dehydration units is that VOC emissions do not vary with production rates as much as flashing emissions. The Division has not received any requests to remove controls from dehydration units that have been operating less than a year.

4. **Produced Water Tank Control** – Industry requests TPY be referenced in the Guidance rather than on a percentage basis. Industry suggests using equal to or greater than 6 TPY for controls to be put on and less than 6 TPY for controls to be removed. This will eliminate confusion as to when controls are required to be in place. As written, it appears emissions over 4 TPY would require controls.

Response – The language regarding control of produced water tanks remains unchanged from the previous Guidance. The language for the concentrated development area was applied to the new Statewide area. The Division has not required operators to calculate water tank emissions as there

is currently no accurate way to calculate emissions from water tanks. The control requirement applies when oil/condensate tank flashing emissions require controls. The removal threshold is based on when oil/condensate tank controls can be removed.

5. **Definition of Modified Facility** – Industry has many concerns over the proposed definition of modified facility as it will drastically change the way permitting is required. The current definition states that "An existing facility becomes modified once production streams or production equipment associated with another well or wells is added or tied into it". The Division needs to make the definition of a modification in the Guidance consistent with the US Clean Air Act and WAQSR definitions. Unless the hydraulic fracturing of a well or addition of another well increases the emissions above what is authorized for the facility to emit, then it cannot be a modification.

   Response – The definition for "modified facility" has not changed since the 2007 version of the Guidance. The 2016 Guidance includes the same definition and provides examples of modifications that can occur even when new wells or production from existing wells are not added to or tied into the facility.

   The definition of "modification" listed in Chapter 1 of the WAQSR applies to all facilities, including oil and gas production facilities. Oil and gas production facilities are permitted using actual production rates as the basis for determining emissions, which is very different from the way non-oil and gas facilities are permitted using the maximum design or operational capacity of the equipment. Physical changes or changes in the method of operation of the well that result in an increase in production above previous production rates will cause a corresponding increase in emissions and result in a modification of the facility. The Division understands that some operations that are temporary in nature or are normal maintenance, like the swabbing of a well, can result in a temporary increase in production. The temporary increase is often not sustainable and production returns to historical levels. The Division recognizes the inherent variability in oil and gas production rates and evaluates increases in actual production on a case-by-case basis to determine if a modification occurred.

PUBLIC COMMENTS

1. **Control Thresholds** – The public urges the Division to evaluate closely the control thresholds for tanks and dehydration units at single well facilities and tank batteries outside the UGRB. Specifically, the Division should consider a 4 TPY threshold for tanks and dehydration units outside

the UGRB. This would harmonize requirements throughout the state and ensure the residents in the eastern and southwestern counties benefit from the same protective air pollution controls.

Response – The control threshold in the UGRB was set based on the UGRB being an ozone non-attainment area. The Division considered a higher cost-to-control reasonable in the ozone non-attainment area. Costs to control tank emissions outside the UGRB were evaluated previously and costs have not decreased. The control threshold is much more stringent than the threshold in OOOO since in OOOO operators are allowed to emit up to 6 TPY VOC per tank and in the Guidance the control threshold is 6 TPY VOC for all tank emissions.

2. **Leak Detection and Repair** – Multiple public interest groups and citizens are concerned that a fugitive emissions monitoring (FEM) program is not a Presumptive BACT requirement in the new Statewide area. These groups would like to see a FEM program that requires quarterly fugitive leak inspections.

Response – As discussed in the Technical Support Document accompanying the proposed Guidance revisions, the Division is not proposing a P-BACT determination for fugitive emissions from oil and gas production facilities located in the statewide area at this time. During the Division's recent review of information regarding fugitive emissions and potential ways to reduce or control fugitive emissions, EPA proposed revisions to 40 CFR Part 60, Subpart OOOO – Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution (NSPS OOOOa). The revisions were published in the Federal Register on September 18, 2015. 80 FR 56593-56698. After reviewing EPA's proposed requirements for controlling fugitive emissions, the Division determined that the proposed FEM requirements were not consistent with Wyoming's current requirements and should the proposed requirements be finalized, considerable effort will be required to revise existing requirements to avoid duplication and potential conflict between state and federal programs. The Division provided comment to EPA on the proposed FEM requirements. See http://www.regulations.gov, Docket ID Number EPA–HQ–OAR–2010–0505, Document Number EPA-HQ-OAR-2010-0505-6993.

The Division will continue to consider establishing a P-BACT determination for fugitive emissions in the statewide area. After finalizing the May 2016 Guidance, the Division will gather additional input on FEM programs from stakeholders, including input related to EPA's proposed NSPS OOOOa, and evaluate P-BACT for fugitive VOC emissions in the SWA. Until a P-BACT

determination is made for fugitive emissions, the Division will continue to evaluate fugitive emissions on a case-by-case basis through the implementation of BACT, which is required by the oil and gas guidance for sources without P-BACT.

3. **Wording of the Public Notice** – During the question and answer portion of the Division's presentation before the Board, a comment was made that the public notice for the comment period on the Guidance was confusing as to what is an acceptable electronic means to submit comment. The notice mentioned a system for providing comments electronically, but then in the same notice the Division states that comments submitted via email would not be accepted.

   Response – As discussed before the Board in response to the comment, the Division's intent was to provide notice of a web-based online system by which any member of the public could submit comment to the Division electronically. Mention of the Division's current and past practice of not accepting comments emailed to the Division was included in the notice as a matter of standard practice and as notice that the Division's practice of not accepting emailed comments was still in effect. The web-based online system offers an alternative to email that is robust, manageable, and includes measures to ensure comments are submitted by citizens and not by computers portraying themselves as citizens. For additional information on DEQ's web-based online public comment system, please see http://deq.wyoming.gov/admin/public-involvement/resources/public-comments-online-2/. The Division will clarify the difference between the web-based online public comment system and email in future public notices when the online system is used to gather comments.

CHANGES MADE TO THE GUIDANCE AFTER THE PUBLIC COMMENT PERIOD

1. **Title Page** –The Division revised the title page of the 2016 Guidance to clarify the application of the Guidance. The following language was added to the title page:

   "Under § 35-11-801(e) of the Wyoming Environmental Quality Act, construction or modification of an oil and gas exploration or production well may occur prior to permitting, as long as the facility (1) is not a major source; (2) is permitted within 90 days of the first date of production (FDOP); and (3) applies Best Available Control Technology (BACT). However, any owner or operator may instead apply for a construction or modification permit under Chapter 6, Section 2 of the Wyoming Air Quality Standards and Regulations prior to construction or modification of a facility.

This interpretive guidance discusses the Division's current understanding of BACT for the purpose of assisting owners and operators who choose to construct or modify oil and gas production facilities prior to initiating the permitting process. This interpretive policy is not binding on the agency, the regulated community, or any person; it is for informational purposes and does not create any rights, responsibilities, or liabilities for the Division, members of the regulated community, or any other person.

Owners and operators should be advised that this Guidance represents the agency's current understanding of BACT as of May 12, 2016."

2. **Effective Date** – After reviewing the comments received during the public comment period, the Division revised the effective date of the Guidance to afford operators additional time to implement the new Guidance. The title page of the 2016 Guidance has been changed to include the following:

   "The Presumptive BACT permitting requirements under this Guidance apply to facilities with associated wells that have a first date of production (FDOP) on/after July 1, 2016 and to facilities with a modification occurring on/after July 1, 2016."

3. **Green Completion/Blowdown Permit Applications** – The Division revised the due date for submitting permit applications to address well completion and venting/blowdown activities at existing production sites located in the Statewide area. Operators are afforded an additional 6 months, until January 1, 2017, in which to assemble and submit their applications for well completion permits and for blowdown/venting permits. The presumptive BACT determinations for well completions and blowdown/venting have been revised with the following language:

   Well Completion

   "For existing operators, Green Completion permit applications shall be filed with the Division by January 1, 2017. For new operators, a Green Completion permit application shall be filed with the first application for a production site."

Blowdown/Venting

"For existing operators, well blowdown and venting permit applications shall be filed with the Division by January 1, 2017. For new operators, a well blowdown and venting permit application shall be filed with the first application for a production site."

4. **Introduction** – The Division revised the Introduction on page 1 of the 2016 Guidance to further clarify the purpose of the Guidance. The prior language was removed and the following language added:

   "The Oil and Gas Production Facilities Chapter 6 Section 2 Permitting Guidance (C6 S2 Guidance) document is an interpretive policy intended to publicize the Division's current understanding of BACT for certain types of emission sources at certain types of oil and gas production facilities. This interpretive policy is not binding on the agency, the regulated community, or any person; it is for informational purposes and does not create any rights, responsibilities, or liabilities for the Division, members of the regulated community, or any person. Any owners or operators seeking site-specific BACT analyses may choose to follow the standard Chapter 6, Section 2 permitting process prior to the construction or modification of a facility."

5. **Applicability** – Effective July 1, 2015, Wyoming Wyo. Stat. Ann. § 35-11-801(e) allows certain types of oil and gas equipment to be installed prior to receiving a permit provided the Guidance is followed for the application of BACT. The Applicability section on page 1 of the 2016 Guidance was updated to include language that identifies the statutory changes:

   "Under the Wyoming Environmental Quality Act, certain oil and gas production facilities may be constructed or modified prior to obtaining a permit or waiver, as long as they are minor sources, obtain a permit within 90 days of FDOP, and utilize BACT." Wyo. Stat. Ann. § 35-11-801(e).

6. **Applicability** – The Applicability section on page 1 of the 2016 Guidance was updated to include additional actions the Division can take when an operator fails to comply with the applicable permitting requirements. The following language replaces the prior language:

   "Failure to comply with the Wyoming Environmental Quality Act and Wyoming Air Quality Regulations may result in an enforcement action undertaken by the State in the form of a "Notice of Violation", a complaint filed in District Court, or any other enforcement action allowed by law. The Wyoming Environmental Quality Act authorizes the assessment of penalties of up to $10,000.00 per violation per day and/or injunctive relief."

7. **Pumping Unit Engines** – The word "policy" was removed from the title of the Pump Unit Engine section on page 38 of the 2016 Guidance for clarity because the Guidance effectively replaces the *March 9, 2012 Pumping Unit Engine Emissions Policy*. The term "policy" was replaced with "guidance" in the second and third paragraphs to avoid confusion.

8. **Acronyms** – The acronym LDAR (leak detection and repair) was replaced with the acronym FEM (fugitive emissions monitoring) because the Division removed reference to LDAR in the 2016 Guidance document. LDAR is typically used in reference to leak detection and repair programs implemented at larger sources such as gas plants and refineries. These programs measure concentrations of leaks and use a defined reference concentration to determine when further action, such as repair, is needed. The Division requires FEM protocols for well sites located the UGRB or JPAD/NPL areas with greater than or equal to 4 TPY of VOC emissions from fugitive sources. FEM protocols are not required to include concentration measurements and the use of reference concentrations. Companies may propose to use concentration measurements and thresholds in their FEM protocols.

9. **Fugitives** – In order to differentiate between leak detection and repair programs implemented at sources like gas plants and refineries and the fugitive emissions monitoring and repair programs required at certain oil and gas production facilities in the UGRB and JPAD/NPL, the Division replaced the acronym LDAR (leak detection and repair) with the acronym FEM (fugitive emissions monitoring) on pages 17 and 22 of the 2016 Guidance. There is no change to the substantive P-BACT requirements for VOC emission from fugitive sources at facilities located in the UGRB and PAD/NPL areas with this change in terminology.

Dated this 12th day of May, 2016

Nancy E. Vehr
Administrator
Wyoming Air Quality Division

Appendix A

Cost Analysis for Controlling VOC Emissions from Truck Loading

Truck Loading Control Costs w/ TLVB and Dedicated Combustor - SWA		
Combustor Size	Emissions (TPY)	Cost to Control ($/ton)
16-inch	8	3,852
	6	5,136
20-inch	8	3,911
	6	5,215
24-inch	8	4,010
	6	5,346

Truck Loading Control Costs w/ TLVB and Dedicated Combustor - UGRB		
Combustor Size	Emissions (TPY)	Cost to Control ($/ton)
16-inch	6	19,729
	4	29,593
20-inch	6	20,062
	4	30,093
24-inch	6	21,031
	4	31,547

Company Name: 16-inch combustor
Facility Name: Truck Loading BACT @ 8 TPY Control Threshold

Wyoming Air Quality Standards and Regulations - Chapter 6, Section 2(c)(v)

Best Available Control Technology Control Cost Analysis Worksheet

(Based on Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Fourth Edition, EPA 450/3-90-006, January 1990, Section 2.3.2)

Reference No.	Site Rating (units)	Manufacturer	Model	Control Method	Controlled or Targeted Emission	Typical BACT (units)	Targeted Emission without Control (TPY)	Targeted Emission with Control (TPY)
1				TLVB/16-inch combustor	VOC		8	2.4

Reference No.	Interest Rate (i)	Control System Life (n)	Capital Recovery Factor (CRF)	Capital Investment (P)	Annual Maintenance Cost	Capital Recovery Cost (CRC)	Realized Economic Benefit
1	0.05	20	0.080	$83,944	$14,834	$6,736	$0
0						$0	
0						$0	

"n" is the control system economic life, typically thought to be 10-20 years.
"i" is the considered the annual pretax marginal rate of return on private investment (i.e., what it may cost you to borrow the money).
"P" is the capital investment required to install the controls (i.e., equipment purchase cost, installation/retrofit cost, engineering, etc.).
Annual Maintenance Cost is the yearly costs to maintain the control effectiveness (i.e., cleaning, testing, etc).

CRC = CRF * P

CRC = Capital Recovery Cost (Annualized cost of control over the life of the control)
CRF = Capital recovery Factor
P = Capital Investment

CRF = i(1+i)n/(1+i)n-1

i = Annual Interest Rate
n = Economic life of the control

Total Annual Cost (TAC) = Annual Maintenance Cost + Capital Recovery Cost - Realized Economic Benefit

Cost to Control = TAC / (Targeted Emission Volume Without Control - Targeted Emission Volumn with Control)

Reference Number	TAC ($)	Cost to Control ($/Ton)
1	$21,570	$3,852
0	$0	#DIV/0!
0	$0	#DIV/0!

Does the control have "Economic Reasonableness" and "Technical Practicability"? Yes

Company Name: 16-inch combustor
Facility Name: Truck Loading BACT @ 6 TPY Control Threshold

Wyoming Air Quality Standards and Regulations - Chapter 6, Section 2(c)(v)

Best Available Control Technology Control Cost Analysis Worksheet

(Based on Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Fourth Edition, EPA 450/3-90-006, January 1990, Section 2.3.2)

Reference No.	Site Rating (units)	Manufacturer	Model	Control Method	Controlled or Targeted Emission	Typical BACT (units)	Targeted Emission without Control (TPY)	Targeted Emission with Control (TPY)
1				TLVB/16-inch combustor	VOC		6	1.8

Reference No.	Interest Rate (i)	Control System Life (n)	Capital Recovery Factor (CRF)	Capital Investment (P)	Annual Maintenance Cost	Capital Recovery Cost (CRC)	Realized Economic Benefit
1	0.05	20	0.080	$83,944	$14,834	$6,736	$0
0						$0	
0						$0	

"n" is the control system economic life, typically thought to be 10-20 years.
"i" is the considered the annual pretax marginal rate of return on private investment (i.e., what it may cost you to borrow the money).
"P" is the capital investment required to install the controls (i.e., equipment purchase cost, installation/retrofit cost, engineering, etc.).
Annual Maintenance Cost is the yearly costs to maintain the control effectiveness (i.e., cleaning, testing, etc).

CRC = CRF * P

CRC = Capital Recovery Cost (Annualized cost of control over the life of the control)
CRF = Capital recovery Factor
P = Capital Investment

CRF = i(1+i)n/(1+i)n-1

i = Annual Interest Rate
n = Economic life of the control

Total Annual Cost (TAC) = Annual Maintenance Cost + Capital Recovery Cost - Realized Economic Benefit

Cost to Control = TAC / (Targeted Emission Volume Without Control - Targeted Emission Volumn with Control)

Reference Number	TAC ($)	Cost to Control ($/Ton)
1	$21,570	$5,136
0	$0	#DIV/0!
0	$0	#DIV/0!

Does the control have "Economic Reasonableness" and "Technical Practicability"? Yes

Company Name: 20-inch combustor
Facility Name: Truck Loading BACT @ 8 TPY Control Threshold

Wyoming Air Quality Standards and Regulations - Chapter 6, Section 2(c)(v)

Best Available Control Technology Control Cost Analysis Worksheet

(Based on Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Fourth Edition, EPA 450/3-90-006, January 1990, Section 2.3.2)

Reference No.	Site Rating (units)	Manufacturer	Model	Control Method	Controlled or Targeted Emission	Typical BACT (units)	Targeted Emission without Control (TPY)	Targeted Emission with Control (TPY)
1				TLVB/20-inch combustor	VOC		8	2.4

Reference No.	Interest Rate (i)	Control System Life (n)	Capital Recovery Factor (CRF)	Capital Investment (P)	Annual Maintenance Cost	Capital Recovery Cost (CRC)	Realized Economic Benefit
1	0.05	20	0.080	$88,092	$14,834	$7,069	$0
0						$0	
0						$0	

"n" is the control system economic life, typically thought to be 10-20 years.
"i" is the considered the annual pretax marginal rate of return on private investment (i.e., what it may cost you to borrow the money).
"P" is the capital investment required to install the controls (i.e., equipment purchase cost, installation/retrofit cost, engineering, etc.).
Annual Maintenance Cost is the yearly costs to maintain the control effectiveness (i.e., cleaning, testing, etc).

CRC = CRF * P

CRC = Capital Recovery Cost (Annualized cost of control over the life of the control)
CRF = Capital recovery Factor
P = Capital Investment

CRF = i(1+i)n/(1+i)n-1

i = Annual Interest Rate
n = Economic life of the control

Total Annual Cost (TAC) = Annual Maintenance Cost + Capital Recovery Cost - Realized Economic Benefit

Cost to Control = TAC / (Targeted Emission Volume Without Control - Targeted Emission Volumn with Control)

Reference Number	TAC ($)	Cost to Control ($/Ton)
1	$21,903	$3,911
0	$0	#DIV/0!
0	$0	#DIV/0!

Does the control have "Economic Reasonableness" and "Technical Practicability"? Yes

Company Name: 20-inch combustor
Facility Name: Truck Loading BACT @ 6 TPY Control Threshold

Wyoming Air Quality Standards and Regulations - Chapter 6, Section 2(c)(v)

Best Available Control Technology Control Cost Analysis Worksheet

(Based on Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Fourth Edition, EPA 450/3-90-006, January 1990, Section 2.3.2)

Reference No.	Site Rating (units)	Manufacturer	Model	Control Method	Controlled or Targeted Emission	Typical BACT (units)	Targeted Emission without Control (TPY)	Targeted Emission with Control (TPY)
1				TLVB/20-inch combustor	VOC		6	1.8

Reference No.	Interest Rate (i)	Control System Life (n)	Capital Recovery Factor (CRF)	Capital Investment (P)	Annual Maintenance Cost	Capital Recovery Cost (CRC)	Realized Economic Benefit
1	0.05	20	0.080	$88,092	$14,834	$7,069	$0
0						$0	
0						$0	

"n" is the control system economic life, typically thought to be 10-20 years.
"i" is the considered the annual pretax marginal rate of return on private investment (i.e., what it may cost you to borrow the money).
"P" is the capital investment required to install the controls (i.e., equipment purchase cost, installation/retrofit cost, engineering, etc.).
Annual Maintenance Cost is the yearly costs to maintain the control effectiveness (i.e., cleaning, testing, etc).

CRC = CRF * P

CRC = Capital Recovery Cost (Annualized cost of control over the life of the control)
CRF = Capital recovery Factor
P = Capital Investment

CRF = i(1+i)n/(1+i)n-1

i = Annual Interest Rate
n = Economic life of the control

Total Annual Cost (TAC) = Annual Maintenance Cost + Capital Recovery Cost - Realized Economic Benefit

Cost to Control = TAC / (Targeted Emission Volume Without Control - Targeted Emission Volumn with Control)

Reference Number	TAC ($)	Cost to Control ($/Ton)
1	$21,903	$5,215
0	$0	#DIV/0!
0	$0	#DIV/0!

Does the control have "Economic Reasonableness" and "Technical Practicability"? Yes

Company Name: 24-inch combustor
Facility Name: Truck Loading BACT @ 8 TPY Control Threshold

Wyoming Air Quality Standards and Regulations - Chapter 6, Section 2(c)(v)

Best Available Control Technology Control Cost Analysis Worksheet

(Based on Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Fourth Edition, EPA 450/3-90-006, January 1990, Section 2.3.2)

Reference No.	Site Rating (units)	Manufacturer	Model	Control Method	Controlled or Targeted Emission	Typical BACT (units)	Targeted Emission without Control (TPY)	Targeted Emission with Control (TPY)
1				TLVB/24-inch combustor	VOC		8	2.4

Reference No.	Interest Rate (i)	Control System Life (n)	Capital Recovery Factor (CRF)	Capital Investment (P)	Annual Maintenance Cost	Capital Recovery Cost (CRC)	Realized Economic Benefit
1	0.05	20	0.080	$94,975	$14,834	$7,621	$0
0						$0	
0						$0	

"n" is the control system economic life, typically thought to be 10-20 years.
"i" is the considered the annual pretax marginal rate of return on private investment (i.e., what it may cost you to borrow the money).
"P" is the capital investment required to install the controls (i.e., equipment purchase cost, installation/retrofit cost, engineering, etc.).
Annual Maintenance Cost is the yearly costs to maintain the control effectiveness (i.e., cleaning, testing, etc).

CRC = CRF * P

CRC = Capital Recovery Cost (Annualized cost of control over the life of the control)
CRF = Capital recovery Factor
P = Capital Investment

CRF = i(1+i)n/(1+i)n-1

i = Annual Interest Rate
n = Economic life of the control

Total Annual Cost (TAC) = Annual Maintenance Cost + Capital Recovery Cost - Realized Economic Benefit

Cost to Control = TAC / (Targeted Emission Volume Without Control - Targeted Emission Volumn with Control)

Reference Number	TAC ($)	Cost to Control ($/Ton)
1	$22,455	$4,010
0	$0	#DIV/0!
0	$0	#DIV/0!

Does the control have "Economic Reasonableness" and "Technical Practicability"? Yes

Company Name: 24-inch combustor
Facility Name: Truck Loading BACT @ 6 TPY Control Threshold

Wyoming Air Quality Standards and Regulations - Chapter 6, Section 2(c)(v)

Best Available Control Technology Control Cost Analysis Worksheet

(Based on Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Fourth Edition, EPA 450/3-90-006, January 1990, Section 2.3.2)

Reference No.	Site Rating (units)	Manufacturer	Model	Control Method	Controlled or Targeted Emission	Typical BACT (units)	Targeted Emission without Control (TPY)	Targeted Emission with Control (TPY)
1				TLVB/24-inch combustor	VOC		6	1.8

Reference No.	Interest Rate (i)	Control System Life (n)	Capital Recovery Factor (CRF)	Capital Investment (P)	Annual Maintenance Cost	Capital Recovery Cost (CRC)	Realized Economic Benefit
1	0.05	20	0.080	$94,975	$14,834	$7,621	$0
0						$0	
0						$0	

"n" is the control system economic life, typically thought to be 10-20 years.
"i" is the considered the annual pretax marginal rate of return on private investment (i.e., what it may cost you to borrow the money).
"P" is the capital investment required to install the controls (i.e., equipment purchase cost, installation/retrofit cost, engineering, etc.).
Annual Maintenance Cost is the yearly costs to maintain the control effectiveness (i.e., cleaning, testing, etc).

CRC = CRF * P

CRC = Capital Recovery Cost (Annualized cost of control over the life of the control)
CRF = Capital recovery Factor
P = Capital Investment

CRF = i(1+i)n/(1+i)n-1

i = Annual Interest Rate
n = Economic life of the control

Total Annual Cost (TAC) = Annual Maintenance Cost + Capital Recovery Cost - Realized Economic Benefit

Cost to Control = TAC / (Targeted Emission Volume Without Control - Targeted Emission Volumn with Control)

Reference Number	TAC ($)	Cost to Control ($/Ton)
1	$22,455	$5,346
0	$0	#DIV/0!
0	$0	#DIV/0!

Does the control have "Economic Reasonableness" and "Technical Practicability"? Yes

Air Pollution Control Costs Spreadsheet

Cost to Control Based on Cost Information Provided By Ultra 16" Combustor 6 tpy Control Applicability Threshold
Basis: minimum flow rate 66 scf/hr (waste gas: 22 scf/hr make-up gas: 44 scf/hr)

CAPITAL INVESTMENT

A. Direct Costs, DC			
1. Purchased Equipment Costs, PEC			
a. Equipment Cost, EC	$	65,000	
b. Auxiliary Equipment, A	$	6,400	flame arrestor & detonation arrestor
c. Instrumentation	$	-	Included in EC
d. Sales Tax	$	4,284	6% of EC+A
e. Freight	$	3,570	5% of EC+A
Total PEC	**$**	**79,254**	Sum of A.1.a through A.1.e
2. Direct installation Costs, DC			
a. Foundations and Supports		$9,510	12% of PEC
b. Handling and Erection		$31,702	40% of PEC
c. Electrical		$0	1% of PEC
d. Piping		$1,585	2% of PEC
e. Insulation		$0	1% of PEC
f. Painting		$0	1% of PEC
g. Site Prep/Building Constr.		$3,963	5% of PEC
Total DC		**$126,014**	Sum of A.2.a through A.2.g
B. Indirect Installation Costs, IIC			
1. Engineering & Supervision		$7,925	10% of PEC
2. Construction & Field Expenses		$7,925	10% of PEC
3. Contractor Fees		$0	0% of PEC
4. Start-Up & Training		$793	1% of PEC
Total IIC		**$16,643**	Sum of B.1 through B.4
Total DC & IIC		**$142,657**	Sum of A & B
C. Contingency Costs, CC		$14,266	10% of Total DC & IIC
Total Capital Investment, TCI		**$156,923**	Sum of Total DC & IIC + CC

Capital Recovery Factor

$CRF = i(1+i)^n/(1+i)^n-1$ → **0.1315**

i = Annual Interest Rate =	0.1
n = Economic Life of Control =	15
1+i	1.1000
(1+i)"	4.1772
i(1+1)"	0.4177
$(1+i)^n - 1$	3.1772

ANNUAL COSTS

A. Direct Costs, DC		
1. Operating		
a. Operator Labor	$18,900	630 man-hours per year @ $30/hr
b. Supervisor Labor	$2,835	15% of Operator Labor
2. Maintenance		
a. Maintenance Labor	$5,460	(0.5 hr/shft)*(shft/8-hr)*(2912 hr/yr)@ $30/hr
b. Materials	$5,460	100% of Maintenance Labor
3. Utilities		
a. Natural Gas Pilot	$1,971	Assume 50 scf/hr pilot @ $4.50/MCF
b. Electricity	$0	Assume 1 hp blower, $0.08/kW-hr (90% eff.)
c. Make-up Gas	$1,734	44 scf/hr make-up gas @ $4.50/MCF
Total DC	**$36,360**	
B. Indirect Costs, IC		
1. Overhead	$19,593	60% of Operating and Maintenance
2. Administrative Charges	$3,138	2% of TCI
3. Property Taxes	$1,569	1% of TCI
4. Insurance	$1,569	1% of TCI
5. Capital Recovery	$20,631	TCI × CRF
Total IC	**$46,501**	Sum of B.1 through B.5
Total Annual Cost	**$82,861**	Sum of Annual total DC and Total IC

Cost of Pollution Control

Uncontrolled Baseline VOC Emission Rate	6	ton/yr
Controlled VOC Emission Rate	1.8	ton/yr
Emission Reduction	4.2	ton/yr

Cost Effectiveness ($/ton)
Total Annual Cost / Emission Reduction

$19,729

Air Pollution Control Costs Spreadsheet

Cost to Control Based on Cost Information Provided By Ultra 16" Combustor 4 tpy Control Applicability Threshold
Basis: minimum flow rate 66 scf/hr (waste gas: 22 scf/hr make-up gas: 44 scf/hr)

CAPITAL INVESTMENT

A. Direct Costs, DC			
1. Purchased Equipment Costs, PEC			
a. Equipment Cost, EC	$	65,000	
b. Auxiliary Equipment, A	$	6,400	flame arrestor & detonation arrestor
c. Instrumentation	$	-	Included in EC
d. Sales Tax	$	4,284	6% of EC+A
e. Freight	$	3,570	5% of EC+A
Total PEC	**$**	**79,254**	Sum of A.1.a through A.1.e
2. Direct installation Costs, DC			
a. Foundations and Supports		$9,510	12% of PEC
b. Handling and Erection		$31,702	40% of PEC
c. Electrical		$0	1% of PEC
d. Piping		$1,585	2% of PEC
e. Insulation		$0	1% of PEC
f. Painting		$0	1% of PEC
g. Site Prep/Building Constr.		$3,963	5% of PEC
Total DC		**$126,014**	Sum of A.2.a through A.2.g
B. Indirect Installation Costs, IIC			
1. Engineering & Supervision		$7,925	10% of PEC
2. Construction & Field Expenses		$7,925	10% of PEC
3. Contractor Fees		$0	0% of PEC
4. Start-Up & Training		$793	1% of PEC
Total IIC		**$16,643**	Sum of B.1 through B.4
Total DC & IIC		**$142,657**	Sum of A & B
C. Contingency Costs, CC		$14,266	10% of Total DC & IIC
Total Capital Investment, TCI		**$156,923**	Sum of Total DC & IIC + CC

Capital Recovery Factor

$CRF = i(1+i)^n/(1+i)^n-1$	→	**0.1315**
i = Annual Interest Rate =	0.1	
n = Economic Life of Control =	15	
1+i	1.1000	
$(1+i)^n$	4.1772	
$i(1+i)^n$	0.4177	
$(1+i)^n - 1$	3.1772	

ANNUAL COSTS

A. Direct Costs, DC		
1. Operating		
a. Operator Labor	$18,900	630 man-hours per year @ $30/hr
b. Supervisor Labor	$2,835	15% of Operator Labor
2. Maintenance		
a. Maintenance Labor	$5,460	(0.5 hr/shft)*(shft/8-hr)*(2912 hr/yr)@ $30/hr
b. Materials	$5,460	100% of Maintenance Labor
3. Utilities		
a. Natural Gas Pilot	$1,971	Assume 50 scf/hr pilot @ $4.50/MCF
b. Electricity	$0	Assume 1 hp blower, $0.08/kW-hr (90% eff.)
c. Make-up Gas	$1,734	44 scf/hr make-up gas @ $4.50/MCF
Total DC	**$36,360**	
B. Indirect Costs, IC		
1. Overhead	$19,593	60% of Operating and Maintenance
2. Administrative Charges	$3,138	2% of TCI
3. Property Taxes	$1,569	1% of TCI
4. Insurance	$1,569	1% of TCI
5. Capital Recovery	$20,631	TCI × CRF
Total IC	**$46,501**	Sum of B.1 through B.5
Total Annual Cost	**$82,861**	Sum of Annual total DC and Total IC

Cost of Pollution Control

Uncontrolled Baseline VOC Emission Rate	4	ton/yr
Controlled VOC Emission Rate	1.2	ton/yr
Emission Reduction	2.8	ton/yr

Cost Effectiveness ($/ton)
Total Annual Cost / Emission Reduction

$29,593

Air Pollution Control Costs Spreadsheet

New 20" MESSCO VOCinerator™ Enclosed Flare (Combustor) 6 tpy Control Applicability Threshold
Basis: minimum flow rate 79 scf/hr (waste gas: 22 scf/hr make-up gas: 57 scf/hr)

CAPITAL INVESTMENT

A. Direct Costs, DC			
1. Purchased Equipment Costs, PEC			
a. Equipment Cost, EC	$	67,350	
b. Auxiliary Equipment, A	$	6,400	flame arrestor & detonation arrestor
c. Instrumentation	$	-	Included in EC
d. Sales Tax	$	4,425	6% of EC+A
e. Freight	$	3,688	5% of EC+A
Total PEC	**$**	**81,863**	Sum of A.1.a through A.1.e
2. Direct installation Costs, DC			
a. Foundations and Supports		$9,824	12% of PEC
b. Handling and Erection		$32,745	40% of PEC
c. Electrical		$0	1% of PEC
d. Piping		$1,637	2% of PEC
e. Insulation		$0	1% of PEC
f. Painting		$0	1% of PEC
g. Site Prep/Building Constr.		$4,093	5% of PEC
Total DC		**$130,161**	Sum of A.2.a through A.2.g
B. Indirect Installation Costs, IIC			
1. Engineering & Supervision		$8,186	10% of PEC
2. Construction & Field Expenses		$8,186	10% of PEC
3. Contractor Fees		$0	0% of PEC
4. Start-Up & Training		$819	1% of PEC
Total IIC		**$17,191**	Sum of B.1 through B.4
Total DC & IIC		**$147,353**	Sum of A & B
C. Contingency Costs, CC		$14,735	10% of Total DC & IIC
Total Capital Investment, TCI		**$162,088**	Sum of Total DC & IIC + CC

Capital Recovery Factor

$CRF = i(1+i)^n/(1+i)^n-1$		→	**0.1315**
i = Annual Interest Rate =	0.1		
n = Economic Life of Control =	15		
1+i	1.1000		
$(1+i)^n$	4.1772		
$i(1+1)^n$	0.4177		
$(1+i)^n - 1$	3.1772		

ANNUAL COSTS

A. Direct Costs, DC		
1. Operating		
a. Operator Labor	$18,900	630 man-hours per year @ $30/hr
b. Supervisor Labor	$2,835	15% of Operator Labor
2. Maintenance		
a. Maintenance Labor	$5,460	(0.5 hr/shft)*(shft/8-hr)*(2912 hr/yr)@ $30/hr
b. Materials	$5,460	100% of Maintenance Labor
3. Utilities		
a. Natural Gas Pilot	$1,971	Assume 50 scf/hr pilot @ $4.50/MCF
b. Electricity	$0	Assume 1 hp blower, $0.08/kW-hr (90% eff.)
c. Make-up Gas	$2,247	57 scf/hr make-up gas @ $4.50/MCF
Total DC	**$36,873**	
B. Indirect Costs, IC		
1. Overhead	$19,593	60% of Operating and Maintenance
2. Administrative Charges	$3,242	2% of TCI
3. Property Taxes	$1,621	1% of TCI
4. Insurance	$1,621	1% of TCI
5. Capital Recovery	$21,310	TCI × CRF
Total IC	**$47,387**	Sum of B.1 through B.5
Total Annual Cost	**$84,260**	Sum of Annual total DC and Total IC

Cost of Pollution Control

Uncontrolled Baseline VOC Emission Rate	6	ton/yr
Controlled VOC Emission Rate	1.8	ton/yr
Emission Reduction	4.2	ton/yr

Cost Effectiveness ($/ton)
Total Annual Cost / Emission Reduction

$20,062

Air Pollution Control Costs Spreadsheet

New 20" MESSCO VOCinerator™ Enclosed Flare (Combustor) 4 tpy Control Applicability Threshold
Basis: minimum flow rate 79 scf/hr (waste gas: 22 scf/hr make-up gas: 57 scf/hr)

CAPITAL INVESTMENT

A. Direct Costs, DC			
1. Purchased Equipment Costs, PEC			
a. Equipment Cost, EC	$	67,350	
b. Auxiliary Equipment, A	$	6,400	flame arrestor & detonation arrestor
c. Instrumentation	$	-	Included in EC
d. Sales Tax	$	4,425	6% of EC+A
e. Freight	$	3,688	5% of EC+A
Total PEC	**$**	**81,863**	Sum of A.1.a through A.1.e
2. Direct installation Costs, DC			
a. Foundations and Supports		$9,824	12% of PEC
b. Handling and Erection		$32,745	40% of PEC
c. Electrical		$0	1% of PEC
d. Piping		$1,637	2% of PEC
e. Insulation		$0	1% of PEC
f. Painting		$0	1% of PEC
g. Site Prep/Building Constr.		$4,093	5% of PEC
Total DC		**$130,161**	Sum of A.2.a through A.2.g
B. Indirect Installation Costs, IIC			
1. Engineering & Supervision		$8,186	10% of PEC
2. Construction & Field Expenses		$8,186	10% of PEC
3. Contractor Fees		$0	0% of PEC
4. Start-Up & Training		$819	1% of PEC
Total IIC		**$17,191**	Sum of B.1 through B.4
Total DC & IIC		**$147,353**	Sum of A & B
C. Contingency Costs, CC		$14,735	10% of Total DC & IIC
Total Capital Investment, TCI		**$162,088**	Sum of Total DC & IIC + CC

Capital Recovery Factor

$CRF = i(1+i)^n/(1+i)^n-1$ → **0.1315**

i = Annual Interest Rate =	0.1
n = Economic Life of Control =	15
1+i	1.1000
$(1+i)^n$	4.1772
$i(1+i)^n$	0.4177
$(1+i)^n - 1$	3.1772

ANNUAL COSTS

A. Direct Costs, DC		
1. Operating		
a. Operator Labor	$18,900	630 man-hours per year @ $30/hr
b. Supervisor Labor	$2,835	15% of Operator Labor
2. Maintenance		
a. Maintenance Labor	$5,460	(0.5 hr/shft)*(shft/8-hr)*(2912 hr/yr)@ $30/hr
b. Materials	$5,460	100% of Maintenance Labor
3. Utilities		
a. Natural Gas Pilot	$1,971	Assume 50 scf/hr pilot @ $4.50/MCF
b. Electricity	$0	Assume 1 hp blower, $0.08/kW-hr (90% eff.)
c. Make-up Gas	$2,247	57 scf/hr make-up gas @ $4.50/MCF
Total DC	**$36,873**	
B. Indirect Costs, IC		
1. Overhead	$19,593	60% of Operating and Maintenance
2. Administrative Charges	$3,242	2% of TCI
3. Property Taxes	$1,621	1% of TCI
4. Insurance	$1,621	1% of TCI
5. Capital Recovery	$21,310	TCI × CRF
Total IC	**$47,387**	Sum of B.1 through B.5
Total Annual Cost	**$84,260**	Sum of Annual total DC and Total IC

Cost of Pollution Control

Uncontrolled Baseline VOC Emission Rate	4	ton/yr
Controlled VOC Emission Rate	1.2	ton/yr
Emission Reduction	2.8	ton/yr

Cost Effectiveness ($/ton)
Total Annual Cost / Emission Reduction

$30,093

Air Pollution Control Costs Spreadsheet

Cost to Control Based on Cost Information Provided By Ultra 24" Combustor 6 tpy Control Applicability Threshold
Basis: minimum flow rate 90 scf/hr (waste gas: 22 scf/hr make-up gas: 68 scf/hr)

CAPITAL INVESTMENT

A. Direct Costs, DC			
1. Purchased Equipment Costs, PEC			
a. Equipment Cost, EC	$	77,000	
b. Auxiliary Equipment, A	$	6,400	flame arrestor & detonation arrestor
c. Instrumentation	$	-	Included in EC
d. Sales Tax	$	5,004	6% of EC+A
e. Freight	$	4,170	5% of EC+A
Total PEC	**$**	**92,574**	Sum of A.1.a through A.1.e
2. Direct installation Costs, DC			
a. Foundations and Supports		$11,109	12% of PEC
b. Handling and Erection		$37,030	40% of PEC
c. Electrical		$0	1% of PEC
d. Piping		$1,851	2% of PEC
e. Insulation		$0	1% of PEC
f. Painting		$0	1% of PEC
g. Site Prep/Building Constr.		$4,629	5% of PEC
Total DC		**$147,193**	Sum of A.2.a through A.2.g
B. Indirect Installation Costs, IIC			
1. Engineering & Supervision		$9,257	10% of PEC
2. Construction & Field Expenses		$9,257	10% of PEC
3. Contractor Fees		$0	0% of PEC
4. Start-Up & Training		$926	1% of PEC
Total IIC		**$19,441**	Sum of B.1 through B.4
Total DC & IIC		**$166,633**	Sum of A & B
C. Contingency Costs, CC		$16,663	10% of Total DC & IIC
Total Capital Investment, TCI		**$183,297**	Sum of Total DC & IIC + CC

Capital Recovery Factor

$CRF = i(1+i)^n/(1+i)^n-1$	→	**0.1315**
i = Annual Interest Rate =	0.1	
n = Economic Life of Control =	15	
1+i	1.1000	
$(1+i)^n$	4.1772	
$i(1+i)^n$	0.4177	
$(1+i)^n - 1$	3.1772	

ANNUAL COSTS

A. Direct Costs, DC		
1. Operating		
a. Operator Labor	$18,900	630 man-hours per year @ $30/hr
b. Supervisor Labor	$2,835	15% of Operator Labor
2. Maintenance		
a. Maintenance Labor	$5,460	(0.5 hr/shft)*(shft/8-hr)*(2912 hr/yr)@ $30/hr
b. Materials	$5,460	100% of Maintenance Labor
3. Utilities		
a. Natural Gas Pilot	$1,971	Assume 50 scf/hr pilot @ $4.50/MCF
b. Electricity	$0	Assume 1 hp blower, $0.08/kW-hr (90% eff.)
c. Make-up Gas	$2,681	68 scf/hr make-up gas @ $4.50/MCF
Total DC	**$37,307**	
B. Indirect Costs, IC		
1. Overhead	$19,593	60% of Operating and Maintenance
2. Administrative Charges	$3,666	2% of TCI
3. Property Taxes	$1,833	1% of TCI
4. Insurance	$1,833	1% of TCI
5. Capital Recovery	$24,099	TCI × CRF
Total IC	**$51,024**	Sum of B.1 through B.5
Total Annual Cost	**$88,331**	Sum of Annual total DC and Total IC

Cost of Pollution Control

Uncontrolled Baseline VOC Emission Rate	6	ton/yr
Controlled VOC Emission Rate	1.8	ton/yr
Emission Reduction	4.2	ton/yr

Cost Effectiveness ($/ton)
Total Annual Cost / Emission Reduction

$21,031

Air Pollution Control Costs Spreadsheet

Cost to Control Based on Cost Information Provided By Ultra 24" Combustor 4 tpy Control Applicability Threshold
Basis: minimum flow rate 90 scf/hr (waste gas: 22 scf/hr make-up gas: 68 scf/hr)

CAPITAL INVESTMENT

A. Direct Costs, DC			
1. Purchased Equipment Costs, PEC			
a. Equipment Cost, EC	$	77,000	
b. Auxiliary Equipment, A	$	6,400	flame arrestor & detonation arrestor
c. Instrumentation	$	-	Included in EC
d. Sales Tax	$	5,004	6% of EC+A
e. Freight	$	4,170	5% of EC+A
Total PEC	**$**	**92,574**	Sum of A.1.a through A.1.e
2. Direct installation Costs, DC			
a. Foundations and Supports		$11,109	12% of PEC
b. Handling and Erection		$37,030	40% of PEC
c. Electrical		$0	1% of PEC
d. Piping		$1,851	2% of PEC
e. Insulation		$0	1% of PEC
f. Painting		$0	1% of PEC
g. Site Prep/Building Constr.		$4,629	5% of PEC
Total DC		**$147,193**	Sum of A.2.a through A.2.g
B. Indirect Installation Costs, IIC			
1. Engineering & Supervision		$9,257	10% of PEC
2. Construction & Field Expenses		$9,257	10% of PEC
3. Contractor Fees		$0	0% of PEC
4. Start-Up & Training		$926	1% of PEC
Total IIC		**$19,441**	Sum of B.1 through B.4
Total DC & IIC		**$166,633**	Sum of A & B
C. Contingency Costs, CC		$16,663	10% of Total DC & IIC
Total Capital Investment, TCI		**$183,297**	Sum of Total DC & IIC + CC

Capital Recovery Factor

CRF = $i(1+i)^n/(1+i)^n-1$	→	**0.1315**
i = Annual Interest Rate =	0.1	
n = Economic Life of Control =	15	
1+i	1.1000	
(1+i)"	4.1772	
i(1+1)"	0.4177	
$(1+i)^n - 1$	3.1772	

ANNUAL COSTS

A. Direct Costs, DC		
1. Operating		
a. Operator Labor	$18,900	630 man-hours per year @ $30/hr
b. Supervisor Labor	$2,835	15% of Operator Labor
2. Maintenance		
a. Maintenance Labor	$5,460	(0.5 hr/shft)*(shft/8-hr)*(2912 hr/yr)@ $30/hr
b. Materials	$5,460	100% of Maintenance Labor
3. Utilities		
a. Natural Gas Pilot	$1,971	Assume 50 scf/hr pilot @ $4.50/MCF
b. Electricity	$0	Assume 1 hp blower, $0.08/kW-hr (90% eff.)
c. Make-up Gas	$2,681	68 scf/hr make-up gas @ $4.50/MCF
Total DC	**$37,307**	
B. Indirect Costs, IC		
1. Overhead	$19,593	60% of Operating and Maintenance
2. Administrative Charges	$3,666	2% of TCI
3. Property Taxes	$1,833	1% of TCI
4. Insurance	$1,833	1% of TCI
5. Capital Recovery	$24,099	TCI × CRF
Total IC	**$51,024**	Sum of B.1 through B.5
Total Annual Cost	**$88,331**	Sum of Annual total DC and Total IC

Cost of Pollution Control

Uncontrolled Baseline VOC Emission Rate	4	ton/yr
Controlled VOC Emission Rate	1.2	ton/yr
Emission Reduction	2.8	ton/yr

Cost Effectiveness ($/ton)
Total Annual Cost / Emission Reduction

$31,547