Division of Air Pollution Control

January 2016

Engineering Guide #89: Determining When a Best Available Technology Cost-Effectiveness Study is Needed

THIS GUIDE DOES NOT HAVE THE FORCE OF LAW

Introduction

Ohio EPA's air pollution control rules require companies to install state-of-the-art processes and control systems designed to minimize air emissions whenever they install a new source or modify an existing source of air pollution. The state-of-the-art process/control system is called Best Available Technology or BAT.

Applicants preparing a permit application and permit writers reviewing a permit application must determine if BAT is going to be installed on the sources. For many sources, this can be relatively easy by comparing the new or modified source to other similar sources in recently issued permits. However, for some other sources, it can be more difficult to figure out which process/control option should be considered BAT.

One way to help figure out which process/control option should be considered BAT is to do a cost-effectiveness study comparing the cost of the controls to the amount of emission reduced for each process/control option. Annualized costs can do a lot to help determine which control option makes the most sense for BAT. However, cost analysis can involve a lot of work so it is important to only do this work when it is really needed to make the BAT decision. In order to minimize unnecessary work, the Ohio EPA Division of Air Pollution Control has created this guidance to help decide when it is important to prepare a BAT cost-effectiveness study[1].

What is a BAT Cost-Effectiveness Study?

A BAT cost-effectiveness study is a study that analyzes the annual costs associated with an air pollution control process or control option. The study involves evaluating various process or control scenarios, determining the annual costs of each scenario, comparing the costs to the amount of air emissions expected to be reduced and then comparing the different scenarios to determine which one qualifies as BAT. The cost-effectiveness portion of the study involves determining the annualized cost of the control scenario against the annual emissions reduced typically represented as annualized dollars per ton of pollutant reduced ($/ton). For each control scenario, a $/ton value is determined and then the $/ton values are compared to determine which control scenario is most cost effective to implement.

This guide is designed to help decide when a BAT cost-effectiveness study is needed. It is not designed to describe how to put together a BAT cost-effectiveness study. Instead, Engineering Guide #46 (http://epa.ohio.gov/Portals/27/engineer/eguides/guide46.pdf) describes the entire process of developing these studies. However, we have added an appendix to this guide that provides a checklist of items that should be included in a BAT cost-effectiveness study. This checklist can help permittees make sure they are including all of the information needed in a BAT cost-effectiveness study. See Appendix A attached.

[1] In some special cases, either U.S. EPA or Ohio EPA may decide that a cost-effectiveness study is needed in spite of this guidance. Both U.S. EPA and Ohio EPA reserve the right to ask for a cost-effectiveness study for these special cases.

Things to Think About

Discussion with your Permit Writer
It is strongly recommended that applicants for permits have a discussion with their permit writer about the project before they prepare and submit an application and/or BAT cost-effectiveness study. Permit writers can provide you with comments and suggestions that can minimize the work you have to do to prepare the application and can increase your chance of receiving your permit on a timely basis.

Combinations of Air Pollution Sources
If there are multiple air pollution sources within a project, usually the entire combination of new emission units or the entire project must first be considered for the BAT study for each pollutant. If none of the proposed technologies are cost effective for the combination, then a BAT study should be performed for the individual emissions units to see if it is cost effective for the individual units.

Modifications of Air Pollution Sources
For Chapter 31 modifications, the BAT study should be considered for the amount of the emissions increase occurring due to the modification. However, sometimes an analysis needs to be done considering the entire amount of emission from the source so it is best if you discuss this possibility with the appropriate permit review agency before submitting an application.

The requirement of a BAT study must always be determined on a case-by-case basis. It is advisable to consult the appropriate permit review agency prior to submittal of the permit application and any BAT study.

Request for Rule Exemptions
Besides determining BAT for new or modified sources, there are a couple of rules that require BAT cost-effectiveness studies in order to qualify for the exemption. These rule exemptions include OAC Rule 3745-21-07(M) or OAC Rule 3745-21-09(U), as specified in OAC Rule 3745-21-07(M)(5)(e) or OAC Rule 3745-21-09(U)(2)(f), respectively. Contact the appropriate District Office or Local Air Agency office for further information.

Pollution Prevention
It is recommended that permittees research methods of producing their products utilizing pollution prevention techniques. Pollution prevention (P2) is the use of source pollution reduction techniques in order to reduce risk to public health, safety, welfare, and the environment and, as a second preference, the use of environmentally sound recycling to achieve these same goals. Source reduction is the reduction or elimination of waste and emissions at the point of generation. Source reduction measures may include process modification, good operating and management practices, increasing the efficiency of machinery, and recycling within a waste generating or other production process. For example, in a coatings operation, P2 options might include the use of low volatile organic compound (VOC) content paints and solvents, or switching to powder coating.

The Office of Compliance Assistance and Pollution Prevention (OCAPP) provides free and confidential assistance to Ohio business to help them comply with Ohio's environmental requirements, focusing on the needs of small business. The office helps customers identify and implement pollution prevention (P2) measures that can save money, increase business performance and benefit the environment. Services of the office include a toll-free hotline ((800) 329-7518; Open Weekdays 8 a.m. - 5 p.m.), on-site compliance and P2 assessments, workshops/training, plain-English publications library, online training catalogue and assistance in completing permit application forms.

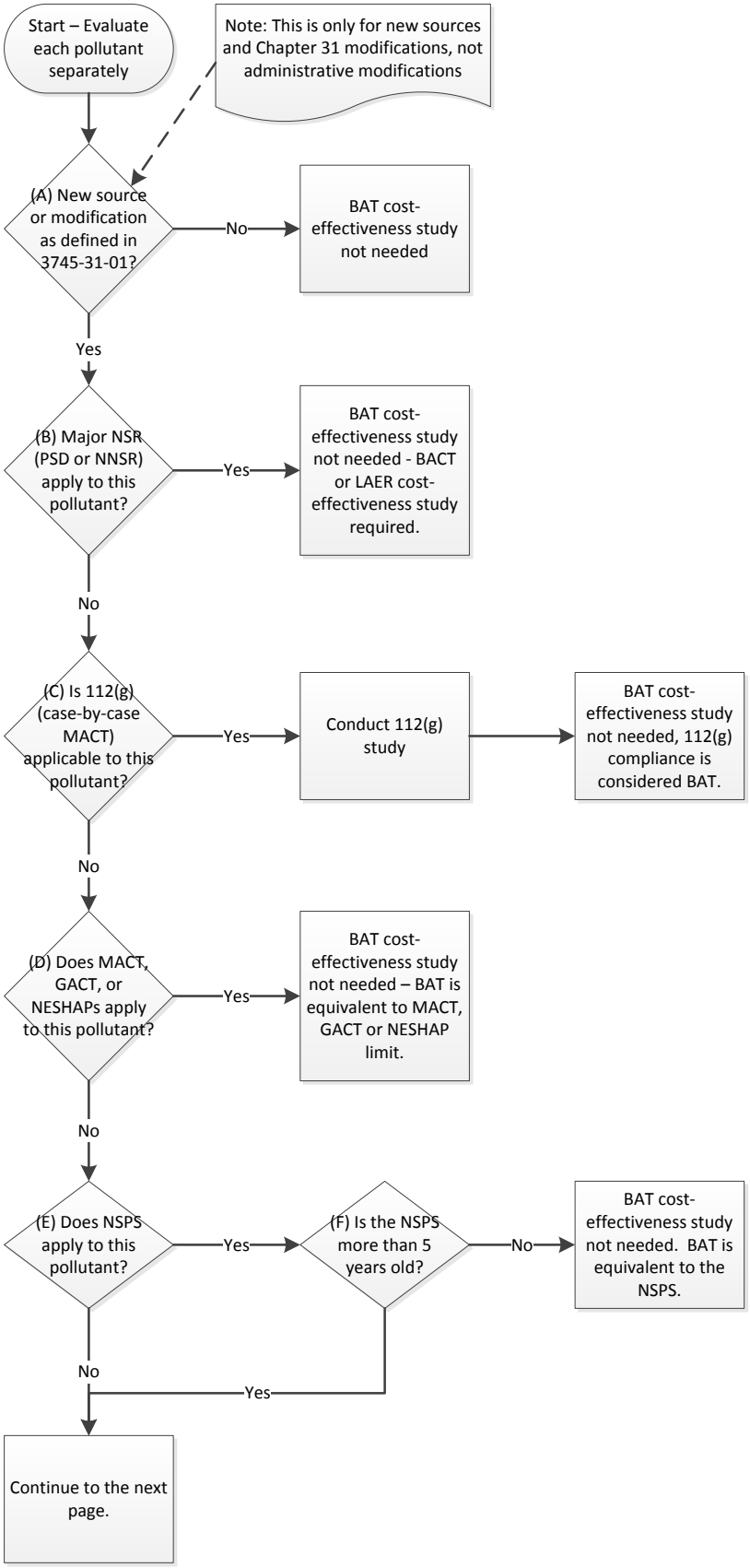
How to Use This Guide

There are a lot of decisions that have to be made in order to decide if a cost-effectiveness study is needed. In order to work through all of these decisions efficiently, this guide is in the form of a flowchart containing yes or no questions along with supporting discussion concerning each of those decisions. You will need to know what air pollution rules apply to the source, what the potential uncontrolled emissions are, and what the expected permit allowed emissions are. You do

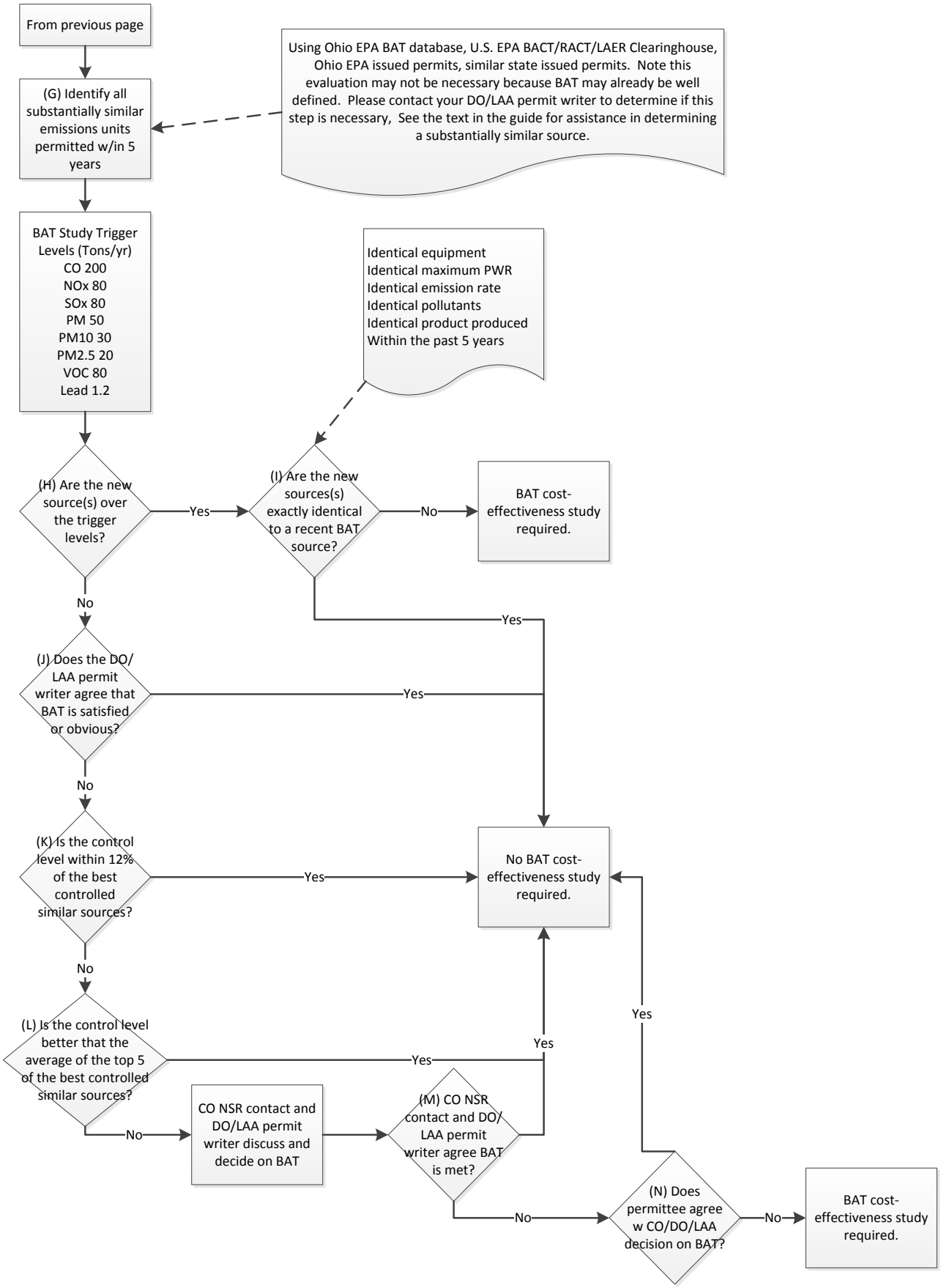
the analysis for each source and for each criteria pollutant that is expected to be emitted from the source. So, remember, you will need to go through the flowchart multiple times in order to cover each pollutant.

The flowchart begins on the next page, followed by the text for each box of the flowchart and then followed by the key definitions used. Just work your way through the flowchart, reading the text for the associated box and reading any definitions of the various acronyms.

BAT Cost-Effectiveness Study Decision Flow Chart Page 1



BAT cost Effectiveness Study Decision Flow Chart Page 2



Flowchart Box Descriptions

A. An evaluation must be performed for each pollutant. Is the project a modification as defined in OAC Rule 3745-31-01 and/or does the project involve the installation of new emissions unit(s)? Permit applicants should discuss their facility's plans with the appropriate District Office or Local Air Agency office to confirm this decision.

Yes - Move to the next *PSD/NNSR* box.
No – A BAT cost-effectiveness study is not required.

B. Does the project trip the Prevention of Significant Deterioration (PSD) or Non-attainment New Source Review (NNSR) rules?

Yes - A State BAT study is not required. If a facility is in a nonattainment area, the Lowest Achievable Emissions Rate (LAER) is applicable to that project. If a facility is in an attainment area, the Prevention of Significant Deterioration (PSD) rules are applicable and a Best Available Control Technology (BACT) review is required. Either one of these require their own cost-effectiveness studies. In either case, LAER or BACT will meet state BAT requirements.

Contact the appropriate District Office or Local Air Agency office to find whether a county is in attainment status for criteria pollutants (i.e., particulate matter, volatile organic compounds, carbon monoxide, nitrogen oxides, sulfur dioxide or lead). A list of Ohio EPA District Office (DO) and Local Air Agencies (LAA) is included with the PTI application.

No - Move to *MACT Determination* box.

C. Are the MACT Determination (OAC Rule 3745-31-28 or also known as the 112(g)) regulations applicable?

Yes - Conduct a MACT Determination control technology study and obtain a "MACT Determination." A BAT cost-effectiveness study is not needed, since compliance with the MACT Determination meets State BAT requirements.

No - Move to *MACT, GACT, NESHAP* box.

D. Are the requirements of Maximum Available Control Technology (MACT) category standards, Generally Available Control Technology (GACT) standards or NESHAP standards applicable?

Yes - BAT is equivalent to the MACT/GACT/NESHAPs standard. No BAT cost-effectiveness study is needed. Note that per other guidance, the GACT rule may not be cited as BAT. Instead, you would use a GACT-like BAT.

No – Move to *NSPS question* box.

E. Does a New Source Performance Standard (NSPS) apply to this pollutant?

Yes – move on to the *5 year old* box.

No – move on to the *Identify Similar Emissions Units* box.

F. Is the applicable NSPS regulation older than five (5) years old?[2]

Yes - move on to the *Identify Similar Emissions Units* box.

No - No BAT cost-effectiveness study required. Compliance with a NSPS standard, which was finalized within the past five (5) years, is BAT. If the NSPS is older than five years, then new technologies might have been developed and may need to be evaluated. If the NSPS was promulgated in the past five years, then DAPC does not see the need for a cost-effectiveness study because BAT is likely to be equivalent to the NSPS.

[2] DAPC selected five years to represent newly evaluated NSPSs.

G. Check previous BAT determinations for substantially similar emissions units. The determination of similar sources is a judgment, which takes into account the following factors:

1. Do the processes have the same design and operation?
2. Do the processes have approximately the same capacity?
3. Do the processes emit the same or similar air pollutants?
4. Can the processes be controlled by the same type of control technology?
5. Is the volume or concentration of the pollutants approximately the same?

Check the BAT database, previously issued PTIs, the RACT/BACT/LAER Clearinghouse and other state permits. The state BAT database can be found at epa.ohio.gov/portals/27/files/BAT.ZIP. The allowable limits may be based on restrictive limits that were accepted to avoid federal requirements and these restrictive limits may not constitute State BAT. You may contact the appropriate District Office or Local Air Agency office for further assistance.

U.S. EPA's RACT/BACT/LAER clearinghouse is available at http://www3.epa.gov/ttncatc1/rblc/htm/welcome.html .

H. Do the potential emissions (prior to controls or pollution prevention alternatives) or the requested permitted limits from the emissions unit or project exceed the trigger levels: 200 TPY CO, 80 TPY NOx, 80 TPY SO2, 50 TPY PE, 30 TPY PM10, 20 TPY PM2.5, 80 TPY VOC, and 1.2 TPY Lead?

Yes - Move to *Identical Source* box.
No - Move to *Does the DO/LAA permit writer agree that BAT is satisfied or obvious*? box.

I. Are the new sources exactly identical to recent BAT sources? The comparison of BAT for similar sources is a judgment, which takes into account the following factors:

1. Do the sources have identical equipment?
2. Do the sources have identical maximum capacity?
3. Do the sources have identical emission rates?
4. Do the sources have identical pollutants?
5. Do the sources make identical products?
6. Have the sources been installed within the past five (5) years?

Yes - No BAT cost-effectiveness study is required.

No - A BAT cost-effectiveness study is required. Please refer to the BAT study checklist for more information about how to conduct and submit a BAT *study. The "Guidance for Estimating Capitol and Annual Costs of Air* Pollution Control Systems" study can be found in Engineering Guide No. 46 on Ohio EPA web page, www.epa.state.oh.us/dapc/engineer/eguides .html.

Do contact the appropriate District Office or Local Air Agency office for guidance in conducting a BAT determination study of substantially similar sources, especially if they are not exactly identical. A permit applicant may wish to employ the services of a consultant to prepare the study of similar sources and propose a BAT determination.

J. Does the DO/LAA permit writer agree that BAT is obviously satisfied? In many cases, the permit writer has seen similar sources and already has a good idea what constitutes BAT. If that is the case, no additional analysis is needed.

Yes – No BAT cost-effectiveness study is required.

No – Move on to the *12%* box.

K. Are the sources within 12% of the best controlled similar sources? Note that permittees and DO/LAA staff should be comparing other sources that meet the BAT definition (similar sized, similar type, located in similar states, etc.) to determine if the proposed source's BAT is within 12% of the similar sources. The selection of these sources is no different than the approach we use today to determine BAT.

Yes - No BAT cost-effectiveness study is required.

No - Move to the *top five (5)* box.

L. Are the new sources better than average of top five (5) of best controlled similar sources?

Yes - No BAT cost-effectiveness study is required.

No – Move on to the *Permit Writer Discuss* box. Ohio EPA will review the similar sources and make a BAT determination.

M. Does the CO/DO/LAA agree that BAT is met?

Yes – No BAT cost-effectiveness study is required.

No – CO/DO/LAA should determine what they believe BAT should be. Then, move on to the *Does permittee agree* box.

N. Does the permittee agree with the CO/DO/LAA BAT determination?

Yes – If the permittee agrees to the CO/DO/LAA determined BAT, then they don't need to do a BAT cost-effectiveness study. So, no BAT cost-effectiveness study is required.

No – If the permittee does not agree with the CO/DO/LAA determined BAT, then they can prove what BAT should be by doing a BAT cost-effectiveness study. Therefore, the must do the cost-effectiveness study.

Definitions

A. **BAT:** "Best Available Technology (BAT) means any combination of work practices, raw material specifications, throughput limitations, emission limitations, source design characteristics, an evaluation of the annualized cost per ton of air pollutant removed, or air pollution control devices that have been previously demonstrated to operate satisfactorily in Ohio or other states with similar air quality on substantially similar air contaminant sources." The use of BAT to control air contaminant emissions is an Ohio requirement for any air contaminant source, installed after January 1, 1974, that requires a PTI.

B. **BACT:** Best Available Control Technology (BACT) is a more stringent standard for major stationary sources or major modifications, as defined in Ohio Administrative Code (OAC) Rule 3745-31-01, subject to Federal New Source Review permitting under the Prevention of Significant Deterioration (PSD) permitting program. BACT is defined in OAC Rule 3745-31-01.

C. **PSD:** Prevention of Significant Deterioration is a permitting process that prevents deterioration of the air quality in areas that are in attainment of the National Ambient Air Quality Standards. The PSD requirements are specified in 40 CFR Part 52.21 and in OAC Rule 3745-31-11 through OAC Rule 3745-31-20.

D. **LAER:** The Lowest Achievable Emission Rate is a requirement that limits emissions of major sources or major modifications in areas that are in nonattainment of the National Ambient Air Quality Standards. The LAER requirements are specified in 40 CFR Part 51, Appendix S and in OAC Rule 3745-31-21 through OAC Rule 3745-31-27.

E. **Major MACT** (Maximum Achievable Control Technology) **Source**: Means any process or production unit that in and of itself has the potential to emit ten tons per year or more of any single hazardous air pollutant or twenty-five tons per year or more of any combination of hazardous air pollutants (as listed in section 112(b) of the Federal Clean Air Act)."

A "MACT Determination" must be developed and approved of by U.S. EPA for Major MACT sources, constructed on or after June 29, 1998, and which do not have an applicable MACT category standard. See OAC Rule3745-31-28 for further information.

F. **NESHAP:** National Emissions Standards for Hazardous Air Pollutants are emissions standards for asbestos, benzene, radionuclides, beryllium, mercury, vinyl chloride, arsenic and coke ovens emissions. A list of the NESHAP categories can be found in 40 CFR Part 61. You may wish to download a copy of Part 61 from the website, http://www.access.gpo.gov/nara/cfr/index.html. Click on the "Browse" feature to search for Title 40, then search for "40 CFR61 Part 61."

G. **NSPS:** New Source Performance Standards are emissions or performance standards for new or older emissions units. A list of NSPS categories can be found in 40 CFR Part 60. You may wish to download a copy of the Table of Contents for Part 60 from the website, http://www3.epa.gov/airtoxics/mactfnlalph.html.

H. **BAT Cost-Effectiveness Study:** A BAT study documents the results/findings of the permit applicant's evaluation of the technical and economic feasibility of various control methods, to minimize and control air contaminant emissions from emissions units in a construction or modification project, as proposed in a PTI application. A BAT cost-effectiveness study may be required for an individual emissions unit or for a combination of emissions units. A BAT cost-effectiveness study, when needed, must be submitted with a PTI application, in order for the application to be deemed complete by the permit reviewing agency.

I. **Modification:** The official definition of “modification” can be found in OAC rule 3745-31-01. Although there are a number of triggers for a modification, in most cases it is tripped when a physical change in, or change in the method of operation of air contaminant source occurs for which the allowed emissions increase. Once the modification definition is tripped, then the rules require BAT to be applied to the new or modified source.

J. **Pollution Prevention:** For the State of Ohio, pollution prevention (P2) is the use of source pollution reduction techniques in order to reduce risk to public health, safety, welfare, and the environment and, as a second preference, the use of environmentally sound recycling to achieve these same goals. Source reduction is the reduction or elimination of waste and emissions at the point of generation. Source reduction measures may include process modification, good operating and management practices, increasing the efficiency of machinery, and recycling within a waste generating or other production process. For example, in a coatings operation, P2 options might include the use of low volatile organic compound (VOC) content paints and solvents, or switching to powder coating.

Follow-up Questions

If you have any questions about this guide, please contact your permit writer at the DO/LAA.

Appendix A – Checklist for BAT Cost-Effectiveness Studies

INTRODUCTION

The purpose of this document is to provide a convenient checklist for preparers and reviewers of BAT studies conducted in conjunction with an Ohio EPA air pollution control installation permit application. This document gives clarification as to the format and content required of the BAT cost-effectiveness study, but does not discuss how to do the study. For detailed reference on how to complete a BAT cost-effectiveness study, refer to Engineering Guide No. 46.

This document covers the basics in a general manner, however, before starting a specific study, confirm with your permit writer at your local Ohio EPA District Office or Local Air Agency office to ensure the proper scenarios are covered. If you are not familiar with BAT studies or engineering economics, you may find a consultant helpful.

The remainder of this document contains a list of items that are typically needed as part of a BAT cost-effectiveness study.

PROCESS INFORMATION:

A. Process Description: A step by step description of the process. Materials used in each step of the process. List of the material information shall include the material's state of matter (solid, liquid, gas), as well as the purpose of the material (catalyst, part of product, etc.). Usage shall be given in a rate form (lb/hr, lb/batch etc...). The description will also include an operational flow diagram.

B. Steady State vs. Batch: Does the emissions unit operate continuously or is it a batch process?

1. For continuous processes, what are the maximum hourly and average input rates (in pounds per hour)?
2. For batch processes, what are the batch times and the down time between batches? What are the maximum and average batch process weights (in pounds per batch)?

EMISSIONS INFORMATION:

A. Pollutants Emitted: A list of any regulated pollutant that could be emitted from the source (criteria pollutants).

B. Concentrations: At what concentration are the pollutants found in the air stream to be controlled (mass/volume)?

C. PTE - Uncontrolled Potential to Emit (PTE): Based upon a 24 hr. per day, 365 days per year at a maximum operational rate. As defined in OAC Rule 3745-31. Include both the short term PTE in lbs./hr., or lbs in batch, and the long term PTE in tons/yr.

D. Allowable Emission Limits (Rule Basis): Limits set forward in a specific rule. If applicable, please list all limits set forth in an applicable rule.

E. Assumptions: Explain in detail any assumptions used, such as control efficiency, inherent physical limitations, emission factors, etc. Include the source of the emission factors used.

EXHAUST DATA:

A. Ventilation System: Describe or diagram the ventilation system.

B. Egress Point Data: Stack or Fugitive.

C. Airflow: The amount of air generated by the emissions unit's air handling systems such as fans, hoods and ducts, the characteristics (velocity, moisture content and temperature) of the air flow should also be known and considered.

D. Make-up Air for Ventilation: Is air added for ventilation for worker safety or cooling?

E. Capture: What percentage of the pollutants emitted from the emissions unit is captured by the air handling systems, as a percentage? How was this percentage determined?

F. Exhaust System: Describe or diagram the exhaust system.

CONTROL TECHNOLOGY OPTIONS/PROCESS MODIFICATIONS (POLLUTION PREVENTION):

A. Technical Feasibility: What control technologies are technically feasible to control the pollutants from the emissions unit given the parameters listed above? Explain feasibility of all options.

B. Design Efficiency: What are the design capture and control efficiencies for the technologies considered?

C. Pollution Prevention (PP): Can any pollution prevention initiatives be considered to reduce, reuse or recycle emissions from the emissions unit? If so, explain what was considered and indicate whether or not it was implemented.

ANALYSIS (COST)

For each feasible control technology, complete the cost analysis section. At least two vender quotes should be included for each feasible control technology. Include what is included with the quotes, i.e., does the system come turnkey, or are some components or accessories required but not included in the quote? To properly perform a cost analysis, please refer to Ohio EPA Engineering Guide No. 46.

For your convenience, the following excerpts from Engineering Guide No. 46 are included below; you may find them helpful in preparing the cost analysis portion of the BAT study. If you would like to view the Engineering Guide in its entirety, go to: http://epa.ohio.gov/Portals/27/engineer/eguides/guide46.pdf .

TABLE 1: EXAMPLE FORMAT FOR COMPUTING AND PRESENTING CAPITAL COSTS

Cost Item	Computation Method				Cost, dollars	
Direct costs						
Purchased equipment:						
• Basic equipment (A)	Purchased cost of control device					
• Auxiliary equipment (B)	Purchased cost of auxiliaries					
Total equipment costs (A+B)	**Total equipment costs (A+B)**					
	Average cost factor x	Adjustment factor x	(A + B)			
Instruments/controls	(0.10)	( )	( )			
Taxes (unless exempt)	(0.05)		( )			
Freight	(0.05)	( )	( )			
Base price (C)	**Subtotal of above plus (A+B)**					**(C)**
Installation costs, direct:	Average cost factor x	Adjustment factor x	(C)			
Foundations/supports	( )		( )			
Erection/handling	( )	( )	( )			
Electrical	( )		( )			
Piping	( )		( )			
Insulation	( )		( )			
Painting	( )		( )			
Site preparation b	Estimate ( ) x adjustment ( )					
Facilities/buildings b	Estimate ( ) x adjustment ( )					
Total installation costs (D)	**Subtotal of above**					**(D)**
TOTAL DIRECT COSTS (E)	**Base price (C) + installation cost (D)**					**(E)**
Installation costs, indirect:	Average cost factor x	Adjustment factor x	(C)			
Engineering/supervision	( )	( )	( )			
Construction/field expenses	( )	( )	( )			
Construction fee	(0.10)	( )	( )			
Start-up	( )		( )			
Performance test	(0.01)		( )			
Model study	( )	( )	( )			
Contingencies	(0.03)	( )				
TOTAL INDIRECT COSTS (F)	Total of above indirect costs					(F)
TOTAL CAPITAL COSTS (G)	Direct costs (E) + indirect costs (F)					(G)

a Absence of parenthesis in the adjustment factor column means no such factor is available.
b Costs for these are unrelated to equipment costs (C) and are developed independently on an individual item

TABLE 2: EXAMPLE FORMAT FOR COMPUTING AND PRESENTING ANNUALIZED COSTS

Cost Item	Computation Method			Cost, dollars	
Direct operating costs					
Operating labor:					
Operator	$/h	x	h/yr	(a)	
Supervision	15% of operator labor cost				
Operating materials:	As required				
Maintenance (general):					
Labor	$/h	x	h/yr	(b)	
Materials	100% of maintenance labor				
Replacement parts:	As required				
Labor	100% of replacement parts cost				
Utilities:					
Electricity	$/kWh	x	kWh/yr		
Fuel oil	$/gal	x	gal/yr		
Gas	$/$10^3$ft^3	x	10^3ft^3/yr		
Water	$/$10^3$gal	x	10^3 gal/ yr		
Steam	$/$10^3$lb	x	10^3lbs/yr		
Other (specify)	As required				
Waste disposal:	$/ton	x	ton/yr		
TOTAL DIRECT OPERATINGCOSTS (A)	Subtotal of above				**(A)**
Indirect operating (fixed) cost:					
Overhead	80% of O/M labor costs (a+b)				
Property tax	1% of capital costs ($)*				
Insurance	1% of capital costs*				
Administration	2% of capital costs*				
Capital recovery	CRF (at %, yrs.) x capital cost*				
TOTAL FIXED COSTS (B)	Subtotal of above				**(B)**
Credits:					
Product recovery	$/ton	x	ton/yr		
Heat recovery	$/106 Btu		106 Btu/yr		
TOTAL CREDITS (minus C)	Subtotal of above				**(C)**
TOTAL ANNUALIZED COSTS (D)	(A+B) minus (C)				**(D)**

* Total capital costs (G) from Table 1.