APPENDIX E

SUGGESTED SHORT LIST AND EVALUATION OF POINT AND AREA SOURCE EMISSION CONTROL MEASURES FOR THE HOUSTON-GALVESTON-BRAZORIA EIGHT-HOUR OZONE NONATTAINMENT AREA (DRAFTED BY ENVIRON FOR LAMAR UNIVERSITY)

Suggested Short List and Evaluation of Point and Area Source Emission Control Measures for the Houston-Galveston-Brazoria 8-Hour Ozone Nonattainment Area

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C O N T E N T S

INTRODUCTION

Background Information

In April 2004, the 8-County Houston-Galveston-Brazoria (HGB) area was designated a *moderate nonattainment area* with respect to the 8-hour ozone standard.[1,2] Moderate nonattainment areas are required to attain the standard no later than June 15, 2010. To demonstrate attainment by this date, appropriate control measures must be in place prior to January 1, 2009.

HGB Area Emission Sources

Ground-level ozone is formed photochemically (reaction caused by sunlight) in the presence of nitrogen oxides (NO_X) and volatile organic compounds (VOC). NO_X and VOC are considered precursors to ozone formation and are regulated to reduce the formation of ground-level ozone. Emissions of ozone are not regulated directly.

Modeling performed by the Texas Commission on Environmental Quality (TCEQ) indicates that large reductions in emissions of NO_X will be necessary to demonstrate attainment with the 8-hour ozone standard. According to the TCEQ, a 60-65 percent reduction in NO_X emissions is required. This includes emissions from all source categories:

Point Sources include industrial and non-industrial stationary equipment or processes considered to be significant sources of air pollution. Examples include electric utility boilers, industrial boilers, combustion turbines, large reciprocating internal combustion engines, and a large variety of industrial processes and unit operations.[3]

Area Sources include industrial and non-industrial stationary equipment or processes that are individually not considered to be significant sources of air pollution but, collectively, may be large sources of air pollution. Examples include gasoline distribution and dispensing, painting, solvent use, small residential and commercial combustion sources (e.g. water heaters), and waste management operations (e.g. landfills and wastewater treatment plants).

On-Road Mobile Sources include internal combustion engines powering the automobiles and trucks (both light-duty and heavy-duty) that are found on HGB area roads and highways.

Non-Road Mobile Sources include a wide variety of internal combustion engines that are not associated with highway vehicles. These include aircraft, locomotives, ships and barges, construction equipment, agricultural equipment, and lawn and garden equipment.

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[1] The HGB consists of the following eight counties: Harris (core county), Galveston, Brazoria, Fort Bend, Waller, Montgomery, Liberty and Chambers.

[2] The 8-hour ozone standard is 0.08 parts per million and compliance is determined using the three-year average of the annual fourth highest value at any specific monitor.

[3] Point sources are those that report emissions under the emission inventory requirements of 30 TAC 101.10. Area sources are those that don't.

In addition to large reductions in NO_X emissions, the modeling indicates that targeted reductions in emissions of volatile organic compounds (VOCs) may be part of an overall ozone attainment strategy. However, the modeling performed by the TCEQ indicates relatively low sensitivity to changes in anthropogenic (human caused) VOC emissions.[4]

2009 Baseline Emissions Inventory

For modeling purposes, the TCEQ has developed a *baseline emissions inventory* for calendar year 2009 that takes into consideration anticipated changes in the sources of air pollution between now and 2009, including implementation of a variety of state and federal air pollution control measures. Table 1 summarizes 2009 emissions for area sources. This data is derived from information prepared and provided by the TCEQ.

Table 1. 2009 Base Case Area Source Emissions

Source Description		NO_X Emissions (tons/day)	VOC Emissions (tons/day)
Industrial Processes	Oil & Gas Production	26	19
	Other (e.g. Bakeries)	0	1
Fuel Combustion	Industrial / Commercial / Institutional (ICI)	16	<1
	Residential	3	<1
Waste Treatment	Landfills	0	4
	Publicly-Owned Wastewater Treatment Plants	0	5
	Leaking Underground Storage Tanks	0	3
	Open Burning	<1	5

[4] It should be noted that there is disagreement among various stakeholder groups as to the magnitude of NO_X emission reductions required to demonstrate attainment with the 8-hour ozone standard, the sensitivity of ozone formation to additional reductions in VOC emissions, and the scientific merit of pursuing additional emission reductions outside of Harris County. A more detailed discussion of these issues and consideration of their merits are beyond the scope of this project which is identification of control measures that could be used to reduce emissions of ground-level ozone precursors.

Table 1. 2009 Base Case Area Source Emissions (continued)

Source Description		NO_X Emissions (tons/day)	VOC Emissions (tons/day)
Solvent Utilization	Degreasing	0	19
	Dry Cleaning	0	5
	Surface Coatings, Adhesives and Sealants	0	74
	Asphalt Applications	0	<1
	Automotive Aftermarket Products	0	5
	Household Products	0	8
	Personal Care Products	0	12
	Other	0	18
Storage & Transport	Gasoline Storage	0	20
	Gasoline Service Stations	0	8
	Marine Vessels	0	57
	Truck Loading	0	<1
Miscellaneous		<1	<1

As shown, the most significant area sources of NO_X emissions are associated with oil and gas production facilities, followed by small industrial, commercial and institutional combustion sources. With respect to VOC, the largest source is evaporation of solvents associated with surface coating, adhesive and sealant use (primarily surface coating) followed by marine vessel loading.

Table 2 summarizes 2009 emissions for point sources. As with the area sources, this data is derived from information prepared and provided by the TCEQ.

Table 2. 2009 Base Case Point Source Emissions

Source Description		NO_X Emissions (tons/day)	VOC Emissions (tons/day)
External Combustion Boilers	Electric Generation Facilities (EGF)	45	2
	Industrial / Commercial / Institutional (ICI)	45	3

Table 2. 2009 Base Case Point Source Emissions (continued)

Source Description		NO_X Emissions (tons/day)	VOC Emissions (tons/day)
Industrial Processes: includes combustion sources (process heaters), process vents, process fugitives and wastewater treatment operations		42	133
Internal Combustion Engines	Electric Generation Facilities (EGF)	<1	<1
	Industrial / Commercial / Institutional (ICI)	24	4
	Other (including engine testing)	<1	<1
Combustion Turbines	Electric Generation Facilities (EGF)	19	<1
	Industrial / Commercial / Institutional (ICI)	38	1
Petroleum & Solvent Evaporation	Storage & Transport	<1	60
	Surface Coating	<1	7
	Other (cleaning, spills, etc.)	<1	2
Waste Disposal		1	2
Other / Unclassified		<1	37

As shown, the most significant point sources of NO_X emissions are associated with combustion of fossil fuels at electric generating facilities (boilers and turbines) and at industrial processing facilities (boilers, turbines, engines and process heaters). With respect to VOC, the largest source is associated with industrial processes followed by storage and transport activities.

Considering both point and area sources, the following are the eight largest sources of NO_X and VOC, presented in order of rank.

NO_X:

1. EGF Boilers ..... 45 tons/day
1. ICI Boilers ..... 45 tons/day
3. Industrial Processes (primarily process heaters) ..... 42 tons/day
4. ICI Combustion Turbines ..... 38 tons/day
5. Oil & Gas Production ..... 26 tons/day
6. ICI Internal Combustion Engines ..... 24 tons/day

7. EGF Combustion Turbines ..... 19 tons/day
8. Small ICI Combustion Sources ..... 16 tons/day

VOC:

1. Industrial Processes ..... 133 tons/day
2. Surface Coating, Adhesives, Sealants and Solvents ..... 81 tons/day
3. Storage and Transport of Petroleum Products and Chemicals ..... 60 tons/day
4. Marine Vessels ..... 57 tons/day
5. Gasoline Storage ..... 20 tons/day
6. Degreasing ..... 19 tons/day
6. Oil & Gas Production ..... 19 tons/day
8. Personal Care Products ..... 12 tons/day

The eight largest NO_X sources account for 98% of total point and area source emissions. The eight largest VOC sources account for 78% of total point and area source emissions.

IDENTIFICATION OF CONTROL STRATEGIES

Process Overview

The TCEQ is responsible for preparing and submitting to EPA for approval a *State Implementation Plan*, or SIP, that details the measures that will be put in place to bring the HGB area into attainment with the 8-hour ozone standard. In preparing the SIP, the TCEQ takes into consideration the best scientific information about how the types, location and timing of air emissions affect ground-level ozone formation and what changes must be made to demonstrate future attainment of the ambient air quality standard. ENVIRON has been retained to assist the TCEQ with the evaluation of potential control strategies and identification of those control strategies that may be both effective and efficient in achieving the necessary emission reductions. This is done through a step-wise process:

1. Identification of potential control strategies for inclusion on the Master Control Strategy List. It is the goal of the TCEQ and ENVIRON to include on the Master List as many measures as possible that might reasonably result in reductions of NO_X and VOC emissions.
2. Seek public input on the Master List to help identify additional measures for consideration.
3. Qualitative evaluation of Master List measures to identify a Short List of control strategies to be evaluated further.
4. Quantitative evaluation of Short List control strategies with respect to emission reduction potential, technical feasibility and cost effectiveness.

Master Control Strategy Lists

DRAFT Master Control Strategy Lists for point sources and area sources have been prepared and submitted to the TCEQ under separate cover. These documents have and will continue to be updated as appropriate to improve clarity and to incorporate comments received from stakeholders and members of the public. Updates will be posted to the Houston Galveston Area Council website (www.h-gac.com) at the request of TCEQ staff.

Evaluation of Master Control Strategies

Step 1. SIP Screening

Each Master List control strategy is qualitatively evaluated to identify those measures with the most potential to effectively and efficiently achieve reductions in emissions of ozone precursors NO_X and VOC. The first step is to screen the control strategy against EPA SIP acceptability criteria:

- ***Quantifiable*** reduction in activity or emission rates;
- ***Surplus*** to other reductions required by and credited to other applicable SIP provisions;

- ***Enforceable*** under both state and federal law; and
- ***Permanent*** within the timeframe specified by the program.

For each Master List control strategy, ENVIRON has provided a *yes* or *no* opinion on each of these four criteria. [It should be noted that, as a technical consulting firm, ENVIRON's opinion does not constitute a legal opinion on whether or not one, any or all of these measures are SIP approvable.] Measures that, in the opinion of ENVIRON, do not meet all four criteria are dropped from further consideration. At their discretion, the TCEQ may review these assessments and provide ENVIRON with an alternative opinion on SIP acceptability.

Step 2. Preliminary Scoring

Master List control strategies that pass the SIP screening in Step 1 are qualitatively evaluated against the following criteria:

- *Practical to implement* based on technical and/or implementation feasibility;
- *Probable public acceptance*, including the acceptance of directly affected stakeholders;
- *Emission reduction potential*; and
- *Cost effectiveness*.

Each measure is assigned a score of 1 to 4 for each criterion with a score of "4" representing the highest valuation (i.e. most practical, most acceptable, highest benefit, most cost effective) and a score of "1" representing the lowest valuation (i.e. least practical, least acceptable, lowest benefit, least cost effective). Scoring for each criterion is based on the following.

- *Practical to Implement*. Subjective assessment based on reviewer's regulatory experience of the measure's technical and/or implementation feasibility. Scoring:

  4 = highly practical
  3 = may be practical if carefully implemented
  2 = appears to be impractical
  1 = too impractical to be implemented successfully

- *Probable Public Acceptance*. Subjective assessment based on reviewer's experience. Scoring:

  4 = public likely to react positively
  3 = public will accept if carefully implemented
  2 = will generate controversy regardless of how it is implemented
  1 = public unlikely to accept measure

- *Emission Reduction Potential*. Based on the relative size of the emission source grouping affected. ENVIRON has selected these scoring brackets using our best judgment and considering the 2009 baseline emissions inventory.

  NO_X:

  4 = 25 tons per day or greater
  3 = 10 tons per day or greater, but less than 25 tons per day
  2 = 1 ton per day or greater, but less than 10 tons per day
  1 = less than 1 ton per day

VOC:

4 = 25 tons per day or greater
3 = 10 tons per day or greater, but less than 25 tons per day
2 = 1 ton per day or greater, but less than 10 tons per day
1 = less than 1 ton per day

- *Cost Effectiveness.* Ideally, cost effectiveness would be a quantitative assessment of estimated annual depreciated capital and operating costs unitized to a cost per ton controlled basis. However, at this stage of the evaluation, insufficient information is available to make this assessment for most potential control strategies and/or to establish appropriate brackets for the numerical scores. Therefore, at this time cost effectiveness is only evaluated on a qualitative basis.

  4 = Strategy is considered to be *inexpensive* to implement relative to the potential for emission reductions.
  3 = Strategy is considered to be *moderately inexpensive* to implement relative to the potential for emission reductions.
  2 = Strategy is considered to be *moderately expensive* to implement relative to the potential for emission reductions.
  3 = Strategy is considered to be *expensive to very expensive* to implement relative to the potential for emission reductions.

Suggested Short List of Control Strategies

Based on the results of the evaluation process described above, stakeholder input, and discussions with TCEQ staff, ENVIRON has developed a list of suggested control strategies for inclusion on a Short List. These measures are presented in Table 3. Detailed evaluations of each suggested short list measure are presented in Appendix A.

Table 3. Suggested Short List of Point and Area Source Control Measures

Short List Measure #	Pollutant	Source Type	Control Strategy	Additional Description / Comments
1	NO_X	Combustion Sources	Lower NO_X MECT program cap for sources located in the HGB area by reallocating allowances based on lower Emission Specifications for Attainment Demonstration in 30 TAC §§117.106, 206 and 475.	Allowances could be allocated using 1997-1999 baseline or another, more recent baseline period. Additional work may be required to develop appropriate ESADs.
2	NO_X	Combustion Sources	Revise or eliminate some or all exemptions as listed in 30 TAC §§117.103 and 203 for NO_X MECT program applicability.	Existing exemptions include: startup engines and turbines at electric utilities, temporary sources (such as engines in test cells), sources in limited use applications (e.g. exemptions for emergency generators and diesel engines installed prior to 1 October 2001), heat treat and reheat furnaces rated less than 20 MMBtu/hr, incinerators rated less than 40 MMBtu/hr, boilers and process heaters rated 2 MMBtu/hr or less, dryers and ovens, chemical processing gas turbines and flares.
3	NO_X	Combustion Sources	Regulate non-stationary sources under Chapter 117.	Reciprocating internal combustion engines that are moved at least once every 12 months are considered to be non-stationary sources and are not subject to the existing Chapter 117 requirements.
4	NO_X	Combustion Sources	Revise existing and/or establish new Emission Specifications for Attainment Demonstration for sources located in 3-county Beaumont-Port Arthur (BPA) nonattainment area.	It has been suggested that BPA area emissions contribute significantly to HGB area ozone concentrations.
5	NO_X	Combustion Sources	Establish emission limits for combustion sources located within counties surrounding the HGB area that are not currently regulated under Chapter 117.	Could include, but not necessarily be limited to, engines associated with oil and gas production. No recommendation is made at this time as to the geographic extent of this control strategy.

Short List Measure #	Pollutant	Source Type	Control Strategy	Additional Description / Comments
6	NO_X	Electric Generating Facilities	Establish NO_X emission limits for electric generating facilities located within counties surrounding the HGB area that are more stringent than the current requirements of 30 TAC 117, Subchapter B, Division 2.	No recommendation is made at this time as to the geographic extent of this control strategy.
7	VOC	Fugitive Emissions	Establish more stringent control requirements for fugitive emission sources.	Could include lowering detection limits, monitoring of additional components, use of new technologies to supplement current detection methods, and/or application of HRVOC or MACT fugitive monitoring programs to sources currently not subject to these requirements.
8	VOC	Industrial Processes	Add to the list of chemicals subject to the Highly Reactive Volatile Organic Compound (HRVOC) rules, including HRVOC emissions cap-and-trade (HECT), short-term emission limits and fugitive emissions monitoring.	Additions could include those compounds that were not in the 2002 HRVOC rulemaking but are highly reactive or have lower reactivity but are emitted in large quantities.
9	VOC	Industrial Processes	Revoke HECT program exemption for HGB counties other than Harris County.	Requirements for HECT program outside of Harris County have already been established by rule in 30 TAC 115, Subchapter H, Division 6. Section 101.392(c) defines process for revoking exemption. Cap would need to be reduced and reallocated since current permitted HRVOC emissions in the surrounding counties are less than the
10	VOC	Industrial Processes	Improve identification and integration of affected stationary sources that are currently operating outside of existing VOC emission control requirements.	Infrared cameras and/or other new technologies could be used to identify unknown or underrepresented emission sources for purposes of inclusion in improved emission inventories, supplementing existing control strategies, and/or developing future emission control strategies.
11	VOC	Oil & Gas Production	Establish control requirements for flash emissions from separators and storage tanks.	No recommendation is made at this time as to the geographic extent of this control strategy.

Short List Measure #	Pollutant	Source Type	Control Strategy	Additional Description / Comments
12	VOC	Storage Vessels	Establish more stringent control requirements for storage vessels.	Revise 30 TAC §115.112.
13	VOC	Storage Vessels	Establish control requirements for landing floating roofs.	Recommend inclusion of both management options (e.g. lifting roof within specified time after landing) and control options (e.g. degassing to flare).
14	VOC	Storage Vessels	Establish more stringent controls for the degassing and cleaning of stationary, marine and transport vessels.	Revise 30 TAC 115, Subchapter F, Division 3.
15	VOC	Transfer Operations	Establish more stringent control requirements for loading and unloading operations, including marine loading.	Revise 30 TAC §115.212.
16	VOC	Wastewater Treatment	Expand applicability of the industrial wastewater regulations beyond the current list of affected source categories.	Revise 30 TAC §115.140(1).
17	VOC	Wastewater Treatment	Establish more stringent control requirements for industrial wastewater treatment operations.	Revise 30 TAC 115, Subchapter B, Division 4.

APPENDIX A

Evaluation of Suggested Short List Control Measures

Short List Measure #: *1*

Control Measure: *Lower NO_X MECT program cap for HGB area sources*

Category: *Point Sources*

BACKGROUND

Under the current Texas State Implementation Plan (SIP), industrial and electric generating facility point sources located in the Houston-Galveston Brazoria (HGB) ozone nonattainment area are subject to the nitrogen oxides (NO_X) mass emission cap and trade (MECT) program. Initially adopted in December 2000, the MECT program was an effort to achieve deep reductions in point source NO_X emissions at lowest cost by employing a market-based cap-and-trade program. Initially capping NO_X emissions at 90% less than average actual emissions during the three-year (1997 to 1999) baseline period, the MECT cap was revised in December 2002, establishing a new cap that was approximately 80% less than baseline emissions.[5]

Facilities that were operational prior to January 1, 1997, are allocated NO_X allowances based on level of activity during the three-year baseline period and emission specifications for attainment demonstrations (ESADs) found in 30 TAC 117, sections 106 (electric power generating facilities), 206 (major combustion sources), and 475 (small combustion sources). For sources that were not operational prior to January 1, 1997, but had submitted administratively complete new source construction permit applications prior to January 2, 2001, allowances are allocated based on permit allowable emissions until such time as the source has established two consecutive years of baseline data during the first five years of operation. After that time, allowances are allocated based on the two baseline years. Those new sources that did not submit an administratively complete permit application prior to January 2, 2001, must obtain allowances from other participating facilities.

Starting in 2002, allowances are allocated by the Texas Commission on Environmental Quality (TCEQ) on an annual basis and deposited into affected sources accounts. Under the MECT program, NO_X allowance allocations have been reduced since the first compliance period on a schedule specified by rule. For electric power generating facilities, the last reduction in allowance allocations occurred for the 2005 compliance period. For all other affected facilities, the last reduction in allowance allocations will occur for the 2008 compliance period. At that time, NO_X emissions from point sources located in the Houston-Galveston-Brazoria (HGB) 8-county ozone nonattainment will be approximately 80% below average actual emissions during the 1997-1999 baseline period. As required by rule, most affected sources utilize continuous NO_X monitors to collect emissions data reported to the TCEQ on an annual basis.

While specific information on the number of affected combustion sources and/or the control strategies used by these sources to comply with the current cap is not available to ENVIRON, it is our general understanding that affected sources have used a combination of emission reduction and, to a lesser extent, allowance purchase strategies. Emission reduction strategies primarily include combustion modifications, such as the use of various low-NO_X burner technologies, and application of add-on controls such as selective catalytic

[5] The MECT program is found in 30 TAC 101, Subchapter H, Division 3.

reduction (SCR). Use of add-on control systems seems to be common among the largest combustion sources (utility boilers, large industrial boilers, large combined cycle gas turbines, etc.) while combustion modifications are widespread. The shutdown of facilities that were included in the 1997-1999 baseline may have also played a role in reducing the overall cost of compliance with the MECT cap.

CONTROL MEASURE DESCRIPTION

Under this control strategy, the MECT annual NO_X emission cap would be reduced. There are two options by which the cap could be reduced:

1. *Establishing more stringent ESADs*. Under this option, the ESADs would be revised based on technical feasibility and economic considerations. Allowances could be allocated using the current 1997-1999 baseline or another baseline period.
2. *Across-the-board reductions*. Under this option, facilities would be allocated allowances as a percentage of the allowances allocated under the current program.

Design and implementation of Option 1 will require the development of ESADs that are appropriate for the retrofit of existing combustion sources; many of which have recently undergone burner replacements, combustion chamber modifications, and/or the installation of add-on pollution control systems in order to reduce emissions under the current MECT program. Option 2 could be implemented without a detailed technical evaluation.

ANALYSIS

Potential Emission Reductions

The 2009 baseline emissions inventory developed by the TCEQ identifies approximately 168 tons per day (TPD) of NO_X emissions from point sources. Of these emissions, approximately 153 TPD are from MECT program affected sources and 15 TPD are from sources that are not currently subject to the MECT program.

Option 1: Establishing More Stringent ESADs

At this time, ENVIRON does not have sufficient information to accurately determine what additional NO_X emission reductions from MECT-affected sources, if any, are technically feasible. At a minimum, information required to make this determination includes:

- Identification of each emission unit under the existing MECT cap, including fuel used, design rating, age, etc.
- Methods used to control NO_X emissions from each of these emission units.
- NO_X emissions before and after implementation of controls.

With this information, one could identify for each group of similar sources the best controlled facilities and the methods used to achieve that level of control in practice. This could be the basis for a revised ESAD. Once a full suite of appropriate ESADs have been developed, then one could determine what additional NO_X reductions may be technically feasible. As with the current market-based program, affected facilities would determine an appropriate course of action based on their individual situation: implement additional

emission controls, optimize existing controls, purchase allowances, curtailments, shutdowns, etc.

Option 2: Across-the-Board Reductions in Allowance Allocations

As an alternative, the TCEQ could reduce the MECT cap via an across-the-board reduction in allowance allocations. Under this option, the NO_X cap would be set strictly on the basis of the required emissions reduction target without reference to specific control technologies or methods. As with Option 1, affected sources would determine an appropriate course of action based on their individual situation.

Affected Emission Sources

At a minimum, this control strategy would affect all sources in the 8-county HGB ozone nonattainment area that: a) are either major or small combustion sources,[6] b) are not exempt, and c) have at least one emission unit with a published ESAD. ESADs have been published for the following HGB emission sources.

Electric Generating Facilities

- Utility boilers
- Auxiliary steam boilers
- Stationary Gas Turbines

Major Combustion Sources

- Gas-fired boilers
- Fluid catalytic cracking units
- Certain boilers and industrial furnaces subject to 40 CFR 266, Subpart H
- Coke-fired boilers
- Wood-fired boilers
- Rice hull-fired boilers
- Liquid-fired boilers
- Process heaters
- Stationary, reciprocating internal combustion engines
- Stationary gas turbines, including duct burners
- Pulping liquor recovery furnaces
- Kilns
- Metallurgical furnaces
- Magnesium chloride fluidized bed dryers
- Incinerators

[6] A major combustion source is defined in 30 TAC 117.10 as "*Any stationary source or group of sources located within a contiguous area and under common control that emits or has the potential to emit: . . . (C) at least 25 tpy of NOX and is located in the Houston/Galveston ozone nonattainment area.*" A small combustion source is one that emits or has the potential to emit less than 25 tpy of NO_X.

Small Combustion Sources

- Boilers
- Process heaters
- Stationary, reciprocating internal combustion engines
- Stationary gas turbines, including duct burners

Exemptions are identified in 30 TAC 117.103, 203 and 473.

Anticipated Methods of Compliance

Compliance options that may be available to achieve additional NO_X emission reductions include:

- Implementation of low-NO_X combustion technologies
- Expanded use of post-combustion emission control systems
- Optimization of existing emission control systems
- Replace engines and turbines that power prime movers (pumps, blowers, compressors, fans) and other equipment with electric motors
- Purchase allowances
- Shutdowns and curtailments

Implementation of Low-NO_X Combustion Technologies

Use of combustion modifications – such as low-NO_X burners, water/steam injection and flue gas recirculation (FGR) – were, we believe, widespread during implementation of the current MECT program. It is reasonable to assume that any additional reduction in the MECT cap would result in some sources deciding to make combustion modifications to some or all of the NO_X sources that were not modified to comply with the current cap. Ultimately, though, the technical feasibility and anticipated performance of any combustion modifications must be determined unit-by-unit.

Expanded Use of Post-Combustion Emission Control Systems

Potential post-combustion emission controls include both catalytic and non-catalytic systems. An example of a catalytic system is selective catalytic reduction (SCR). Examples of non-catalytic systems include selective non-catalytic reduction (SNCR) and oxidation/absorption systems.

Theoretically, SCR can be applied to a wide variety of small, medium and large combustion sources. However, technical issues and economic considerations have limited its use mainly to large installations such as utility boilers, large industrial boilers and large gas turbines. In those applications, SCR can be highly effective.[7]

[7] The use of SCR to control NO_X may result in emissions of ammonia at low concentrations (limited by rule to less than 10 ppm) to the atmosphere. Fine particulate matter ($PM_{2.5}$) is emitted both directly (primary) as well as formed in the atmosphere (secondary) as a result of the reactions of gas-phase emissions. The formation of secondary $PM_{2.5}$ is directly influenced by ammonia emissions (Source: *Particulate Matter Concentrations, Compositions and Sources in Southeast Texas: State of the Science and Critical Research Needs*, prepared by

Many non-catalytic applications involving direct reagent injection into the combustion device or flue gas perform best when operated with a relatively high NO_X inlet loading. Therefore, use may be limited in situations where combustion modifications have already resulted in substantial reductions in NO_X concentrations. An exception may be multi-chemical wet scrubbers (oxidation/absorption) that claim, under certain circumstances, to achieve levels of performance – less than 5 parts per million (ppm) – equal to or better than SCR. Additional research would be necessary to identify the types of sources and the levels of performance where this technology has been demonstrated for retrofits.

As with the combustion modification option, the technical feasibility and anticipated performance of any add-on control system must be determined unit-by-unit.

Optimization of Existing Emission Control Systems

It may be possible to improve the performance of existing combustion and post-combustion control systems. For example, with an SCR unit one could add catalyst and/or inject additional reducing reagent (e.g. ammonia) in an effort to reduce NO_X emissions. It is reasonable to assume, however, that existing control systems were designed and are operated to achieve near-optimal performance and that any incremental improvements in performance due to further attempts at optimization would be limited.

Replacement of Engines and Turbines with Electric Motors

In situations where this option is available, site emissions associated with the engine or turbine are reduced to zero. This approach increases demand for electricity and, ultimately, increases emissions from power generation facilities.

Purchase Allowances

The MECT program allows affected sources to comply with the cap by either reducing NO_X emissions to levels that are at or below their allowance allocation or by buying allowances from other account holders.

Shutdowns and Curtailments

It is reasonable to assume that if the MECT cap is lowered and allowances become more expensive or unavailable, some sources may elect to shutdown or curtail their operations in lieu of expending capital on additional emission control projects. Additionally, some sources may view high allowance pricing as an opportunity to realize financial gain via shutdown and/or curtailment. In either case, shutdowns and curtailments will increase the availability of allowances and, potentially, make allowances less expensive to purchase.

Cost Effectiveness

Without conducting source-specific engineering feasibility assessments, there is insufficient information to accurately predict the technical feasibility or cost of lowering NO_X emissions

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David Allen, University of Texas, for the Houston Advanced Research Center, December 2002). The impact of this "ammonia slip" on ambient $PM_{2.5}$ concentrations in the HGB area should be considered during SIP development.

for individual emission units or affected sources. Determining an appropriate approach for demonstrating compliance with any revised MECT cap will require that each affected source perform an engineering and economic assessment of their options and make a decision that is appropriate for their circumstances. The discussion of cost effectiveness is, therefore, limited to MECT allowance pricing.

The price of any futures-traded commodity reflects the marketplace's best estimate of what future prices will be. In a robust trading program allowance pricing should reflect the incremental cost of control under the current regulatory regime and across the breadth of affected sources.

Following is a summary of stream of allowance transactions through early 2006 provided by the TCEQ.

Year	Number of Trades	Tons Traded	Average Price Per Ton
2002	16	564	$33,290
2003	40	2,425	$38,609
2004	30	2,243	$35,216
2005	23	2,822	$45,826
2006*	2	15	$27,680
Total:	111	8,069	$39,798

*One transaction was at $40,000 per ton, the other at $16,000 per ton. Does not include 79.3 ton transaction referenced in text.

The most recent transactions shown in the table seem to suggest that streams of allowances are trading in the range of $40,000 to $50,000 per ton. However, a very recent trade of 79.3 tons was concluded at nearly $73,000 per ton. This is what the marketplace says the cost of control is for the first ton controlled beyond the current MECT program. However, reductions in NO_X emissions beyond the requirements of the current program are not factored into these prices and historical allowance transactions may not be indicative of future allowance availability or pricing. Unanticipated marketplace, technological and/or economic developments could also significantly affect allowance pricing. For example:

- The prospect of significant capital and operating costs to comply with a revised MECT cap could result in a higher than anticipated number of unit and plant shutdowns and/or curtailments. This could create additional allowances for sale and lower allowance pricing.
- Development and commercialization of new high-efficiency, low-cost NO_X control technologies could reduce control costs and, ultimately, allowance pricing. [Note: ENVIRON has no information to suggest that such technologies are forthcoming. This is a hypothetical example to illustrate developments that potentially could impact allowance pricing.]
- A large demand for new and expanded emission sources in the HGB area with the concurrent increase in demand for NO_X allowances driving prices higher. An example is Southern California in 2000 and early 2001. Due to increased demand and limited supply, South Coast Air Quality Management District NO_X RECLAIM Trading Credits (RTCs) sold for as much as $39,000 per ton (2000 dollars) –

significantly higher than the target price at that time of $15,000. A $39,000 per ton cost is equivalent to a stream of allowances trading at approximately $195,000 per ton.[8]

No attempt is made to predict allowance pricing under a future regulatory regime.

[8] Assumes the purchase of a one ton allowance each year for 5 years with a 0% interest rate. Values are in 2000 dollars.

Short List Measure #: *2*

Control Measure: *Revise or Eliminate MECT Program Exemptions*

Category: *Point Sources*

BACKGROUND

Under the current Texas State Implementation Plan (SIP), industrial and electric generating facility point sources located in the Houston-Galveston Brazoria (HGB) ozone nonattainment area are subject to the nitrogen oxides (NO_X) mass emission cap and trade (MECT) program. Initially adopted in December 2000, the MECT program was an effort to achieve deep reductions in point source NO_X emissions at lowest cost by employing a market-based cap-and-trade program. Initially capping NO_X emissions at 90% less than average actual emissions during the three-year (1997 to 1999) baseline period, the MECT cap was revised in December 2002, establishing a new cap that was approximately 80% less than baseline emissions.[9]

Sections 117.103 (electric generating facilities), 117.203 (major combustion sources) and 117.473 (small combustion sources) identify those emission sources that do not have an Emission Specification for Attainment Demonstration (ESAD) and, thus, are not part of the MECT cap. These sources are as follows.

Electric Generating Facilities

- Stationary gas turbines and engines which are used solely to power other engines or gas turbines during start-ups

Major Combustion Sources

- Heat treating and reheat furnaces with a maximum rated capacity of less than 20 MMBtu/hour heat input
- Flares
- Incinerators with a maximum rated capacity of less than 40 MMBtu/hour heat input
- Sulfur recovery units
- Sulfuric acid regeneration units
- Molten sulfur oxidation furnaces
- Sulfur plant reaction boilers
- Dryers, kilns and ovens used for drying, baking, cooking, calcining and vitrifying except for magnesium chloride fluidized bed dryers, lime kilns, and lightweight aggregate kilns
- Stationary gas turbines and stationary internal combustion engines, which are used:
    - In research and testing
    - For purposes of performance verification and testing
    - Solely to power other engines or gas turbines during startups

[9] The MECT program is found in 30 TAC 101, Subchapter H, Division 3.

- Exclusively in emergency situations (includes operation for testing and maintenance purposes up to 52 hours per year)
- Response to and during the existence of any officially declared disaster or state of emergency
- Directly and exclusively by the owner or operator of agricultural operations necessary for the growing of crops or raising of fowl or animals
- As chemical processing gas turbines

- Boilers and process heaters with a maximum rated capacity of less than 2.0 MMBtu/hour heat input
- Stationary diesel engines that operate less than 100 hours per year

Small Combustion Sources

- Boilers and process heaters with a maximum rated capacity of less than 2.0 MMBtu/hour heat input
- Stationary engines:
  - With a rating of less than 50 horsepower (HP), or used for any of the following
  - Used in research and testing
  - Used for purposes of performance verification and testing
  - Used solely to power other engines or gas turbines during startup
  - Used exclusively in emergency situations (includes operation for testing and maintenance purposes up to 52 hours per year)
  - Used in response to and during the existence of any officially declared disaster or state of emergency
  - Used directly and exclusively by the owner or operator of agricultural operations necessary for the growing of crops or raising of fowl or animals
  - That are diesel-fired and operate less than 100 hours per year
- Stationary gas turbines rated at less than 1.0 megawatt (MW) that started operation on or before October 1, 2001

CONTROL MEASURE DESCRIPTION

Under this control strategy, applicability of the MECT annual NO_X emission cap would be expanded to include some or all of the currently exempted emission sources. Allowances for these sources could be allocated based on level of activity for a baseline period (1997 to 1999 or other) and ESADs – existing or revised (refer to Short List Measure #1). For certain sources, such as flares, ESADs would need to be developed. Alternatively, the TCEQ could allocate no additional allowances and affected sources would need to cover the emissions under their current allowance allocation or by purchasing allowances.

ANALYSIS

Potential Emission Reductions

The 2009 baseline emissions inventory developed by the TCEQ identifies approximately 168 tons per day (TPD) of NO_X emissions from point sources. Of these emissions, approximately 153 TPD are from MECT program affected sources and 15 TPD are from sources that are not currently subject to the MECT program. ENVIRON does not currently have emission estimates by exempt source category for the 2009 baseline inventory. However, 1997 emissions information contained in December 2000 SIP development documents may provide some insight into NO_X emissions from sources that are not currently subject to the MECT program cap.[10]

Source Category	1997 NO_X Emissions (TPD)	
	Tons/day	% of Total Exempt Emissions
Turbines:		
• *Test Cells*	0.52	3.2
• *Chemical Processing*	0.30	1.8
• *Emergency*	0.02	0.1
Internal Combustion (IC) Engines:		
• *Emergency Diesel*	5.40	33.1
• *Other Diesel*	0.20	1.2
• *Test Cell*	0.08	0.5
• *Emergency Gas-Fired*	0.02	0.1
Incinerators (<40 MMBtu/hr)	1.93	11.8
Flares	5.37	33.0
Dryers (Other)	1.26	7.7
Heat Treat & Reheat Furnaces (<20 MMBtu/hr)	0.16	1.0
Kilns (Other)	0.08	0.5
Nitric Acid Production	0.41	2.5
Ovens	0.23	1.4
Vents (Other)	0.18	1.1
Miscellaneous	0.12	0.7
Fugitives	0.01	0.1
Total:	**16.29**	**100**

[10] Rule Log 2000-011H-117-AI

Per the 2000 SIP document, in 1997, four of the listed source categories – emergency diesel IC engines, small incinerators, flares, and other dryers – account for 86 percent of the NO_X emissions from exempt sources.

ENVIRON does not have sufficient information to accurately determine potential emission reductions via application of technically feasible control technologies. The maximum reduction – 100% of exempt source emissions, or 15 TPD (2009 baseline emissions inventory) – would occur via inclusion of all exempt sources under the existing MECT program cap without issuance of additional allowances. Smaller reductions would occur using other inclusion mechanisms, such as issuance of allowances based on ESADs and baseline period level of activity.

Affected Emission Sources

Affected emission sources could be some or all of the currently exempted sources listed in the Background section of this document.

Anticipated Methods of Compliance

Compliance options that may be available to achieve required NO_X emission reductions include:

- Implement emission controls
- Reduce emissions at other sources
- Replace engines and turbines that power prime movers (pumps, blowers, compressors, fans) and other equipment with electric motors
- Buy allowances

Implement Emission Controls

Emission control options that may be available for the four largest exempt source categories are as follows.[11]

Diesel IC Engines:	Combustion modifications, non-selective catalytic reduction (NSCR), selective catalytic reduction (SCR), non-thermal plasma reactor, absorption
Small Incinerators:	Low-NO_X burners, SCR
Flares:	Reduced flaring
Dryers:	Low-NO_X burners

Reduce Emissions at Other Sources

In lieu of reducing emissions from the currently exempt small emission units, affected sources may opt to pursue reductions at other emission units at the site that are already under the MECT program cap. This approach may allow an affected source to generate sufficient excess allowances through control of one or more larger emission units to cover the actual emissions from currently exempt sources.

[11] U.S. EPA, *Technical Bulletin: Nitrogen Oxides (NOX), Why and How They are Controlled*, EPA 456/F-99-006R, Office of Air Quality Planning and Standards, November 1999.

Replace Engines and Turbines with Electric Motors

In situations where this option is available, site emissions associated with the engine or turbine are reduced to zero. This approach, however, increases demand for electricity and, ultimately, increases emissions from power generation facilities.

Purchase Allowances

The MECT program allows affected sources to comply with the cap by either reducing NO_X emissions to levels at or below their allowance allocation or by buying allowances from other account holders.

Cost Effectiveness

Without conducting source-specific engineering feasibility assessments, there is insufficient information to accurately predict the technical feasibility or cost of lowering NO_X emissions for individual emission units or affected sources. Determining an appropriate approach for demonstrating compliance with any revised MECT cap will require that each affected source perform an engineering and economic assessment of their options and make a decision that is appropriate for their circumstances.

The price of any futures-traded commodity reflects the marketplace's best estimate of what future prices will be. In a robust trading program, allowance pricing should reflect the incremental cost of control under the current regulatory regime and across the breadth of affected sources. For a discussion of NO_X allowance pricing, please refer to the evaluation document for Control Strategy #1: Lower NO_X MECT program cap for HGB area sources.

Short List Measure #: *3*

Control Measure: *Regulate Non-Stationary Sources Under Chapter 117*

Category: *Point Sources*

BACKGROUND

In a Texas Commission of Environmental Quality air rule interpretation summary, dated June 2, 2003,[12] the following is stated regarding applicability of 30 TAC Chapter 117 requirements to portable or transportable engines:

> *"A portable or transportable engine that remains or will remain at a single point or location for less than or equal to 12 consecutive months is not considered a stationary source and will not be subject to Chapter 117."*

Therefore, portable or transportable engines that remain at a single location for less than 12 consecutive months are not subject to Chapter 117 emissions specifications for emissions of nitrogen oxides (NO_X). However, as noted in §117.10(46),

> *"any engine (or engines) that replaces an engine at a location and is intended to perform the same or similar function as the engine being replaced is included in calculating the consecutive residence time period. An engine is considered stationary if it is removed from one location for a period and then returned to the same location in an attempt to circumvent the consecutive residence time requirement."*

CONTROL MEASURE DESCRIPTION

Under this control strategy, non-stationary sources – specifically, portable or transportable engines – would be subject to regulation under 30 TAC Chapter 117. Implementation options include:

- Establishing an emission specification for attainment demonstration (ESAD) for portable or transportable engines and keeping these sources outside of the NO_X mass emission cap and trade (MECT) program;
- Establishing an ESAD specifically for portable or transportable engines and including these sources in the MECT program; or
- Changing the definition of stationary source to include portable or transportable engines, making these units subject to existing ESADs, and integrating them into the MECT program.

ANALYSIS

Potential Emission Reductions

It is unclear at this time whether or not emissions from non-stationary engines are included in the 2009 baseline emissions inventory for non-road mobile sources and, if they are, the

[12] Code Numbers: R01-211.003, R06-1.001, R6-110.003, R7-201.003, R12-10.004

accuracy of the estimated emissions. While not specific to non-stationary engines, a 2003 study funded by the Houston Advanced Research Center indicated that, under certain conservative scenarios, emissions from small diesel engines could be significantly underestimated.[13]

Affected Emission Sources

Affected emission sources would be portable and transportable engines.

Anticipated Methods of Compliance

Compliance options that may be available to achieve required NO_X emission reductions include:

- Implement emission controls
- Reduce emissions at other sources
- Replace engines with electric motors
- Purchase allowances

Implement Emission Controls

Control options appropriate for the reduction of NO_X emissions from portable or transportable engines would need to be determined on a source-by-source basis. Options that may be available, however, to control NO_X emissions from portable and transportable engines include combustion modifications such as injection timing retard (ITR), pre-ignition chamber combustion, air-to-fuel (AF) ratio adjustments and de-rating. Post combustion controls may include non-selective catalytic reduction (NSCR), selective catalytic reduction (SCR) and absorption technologies.[14,15] The referenced EPA documents list control efficiencies for stationary internal combustion engines (all fuels) as follows.

Combustion modifications: 20-97%
SCR / NSCR: 80-90%
Chemical absorption: 60-95%

This information is for reference purposes only. No representations are made about the potential applicability and/or performance of the listed control technologies for individual applications.

Reduce Emissions at Other Sources

In lieu of reducing emissions from the currently exempt portable and transportable engines, affected sources may opt to pursue reductions at other emission units at the site that are already under the MECT program cap. This option only applies if the referenced non-stationary sources are integrated into the MECT program.

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[13] Houston Advanced Research Center, *Estimates of Emissions for Small-Scale Diesel Engines*, Project H-10, December 2003

[14] U.S. EPA, *Technical Bulletin: Nitrogen Oxides (NOX), Why and How They are Controlled*, EPA 456/F-99-006R, Office of Air Quality Planning and Standards, November 1999.

[15] U.S. EPA, *Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources*, AP-42, Fifth Edition.

Replace Engines with Electric Motors

In situations where this option is available, associated emissions associated are reduced to zero. This approach increases demand for electricity and, ultimately, increases emissions from power generation facilities.

Buy Allowances

The MECT program allows affected sources to comply with the cap by either reducing NO_X emissions to levels that are at or below their allowance allocation or by buying allowances from other account holders.

Cost Effectiveness

EPA reference document 456/F-99-0006R presents cost data for stationary internal combustion engines. A summary follows.

Control Technology	Fuel	Percent Reduction	Cost Effectiveness ($/ton)[16,17]	
			Small Engines	Large Engine
ITR	Gas	20	$3,800	$2,100
AF Ratio	Gas	20	$5,800	$1,400
AF Ratio + ITR	Gas	30	$5,300	$1,700
SCR	Gas	90	$8,500	$1,700
ITR	Gas, Diesel, LPG	25	$2,900	$1,800
SCR	Gas, Diesel, LPG	80	$7,200	$2,900

This information is presented for reference purposes only. Source-specific engineering feasibility assessments are necessary to determine what control approaches are feasible, the emission reductions that may be realized, the required capital investment and operating costs.

The price of any futures-traded commodity reflects the marketplace's best estimate of what future prices will be. In a robust trading program, allowance pricing should reflect the incremental cost of control under the current regulatory regime and across the breadth of affected sources. For a discussion of NO_X allowance pricing, please refer to the evaluation document for Control Strategy #1: Lower NO_X MECT program cap for HGB area sources.

[16]Values in referenced document are presented in 1990 dollars. These are adjusted to 2006 dollars using average Consumer Price Index values published by the U.S. Department of Labor, Bureau of Labor Statistics (ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt). Average 1990 CPI = 130.7. March 2006 value of 199.8 is used for 2006.

[17]A small engine is one with NO_X emissions below 1 TPD. A large engine is one with NO_X emissions greater than 1 TPD.

Short List Measure #: *4*

Control Measure: *Revise Beaumont-Port Arthur Area ESADs*

Category: *Point Sources*

BACKGROUND

There are currently two emission specifications for attainment demonstrations (ESADs) that apply to sources in the 3-county Beaumont-Port Arthur (BPA) ozone nonattainment area: [18]

- Boilers at 0.10 lb nitrogen oxides (NO_X) per MMBtu heat input, and
- Process heaters at 0.08 lb NO_X per MMBtu heat input.

Exempted are boilers and process heaters rated at less than 40 MMBtu/hour heat input.

CONTROL MEASURE DESCRIPTION

Under this control strategy, new and/or more stringent ESADs would be established for sources located in the BPA area.

ANALYSIS

Potential Emission Reductions

2009 baseline NO_X emissions for the BPA area are provided by the Texas Commission on Environmental Quality (TCEQ) as follows:

Point Sources	=	86.2 tons/day (TPD)
Area Sources	=	8.3 TPD
On-Road Mobile Sources	=	22.9 TPD
Non-Road Mobile Sources	=	12.9 TPD
Marine Sources	=	9.8 TPD
TOTAL	=	140.1 TPD

Potential emission reductions under this control measure would be limited to point sources with, perhaps, some participation by certain industrial area sources. Potential emission reductions would depend upon the number and scope of sources affected and the stringency of the ESADs.

Affected Emission Sources

Affected emission sources could be limited to currently regulated sources (boilers and process heaters) or expanded to include some or all of the source categories in the Houston-Galveston-Brazoria (HGB) ozone nonattainment area with published ESADs.

[18] Found in 30 TAC 117.206(a).

Anticipated Methods of Compliance

Compliance options that may be available to achieve required NO_X emission reductions include:

- Implement emission controls
- Purchase allowances

The second option would require implementation of a cap-and-trade program similar to or part of the HGB area Mass Emission Cap and Trade (MECT) program.

Implement Emission Controls

Control options appropriate for the reduction of NO_X emissions would need to be determined on source by source basis.

Buy Allowances

The MECT program allows affected sources to comply with the cap by either reducing NO_X emissions to levels that are at or below their allowance allocation or by buying allowances from other account holders. As noted, this option would require implementation of a cap-and-trade program in the BPA area.

Cost Effectiveness

Without conducting source-specific engineering feasibility assessments, there is no means to accurately predict the technical feasibility or cost of lowering NO_X emissions for individual emission units or affected sources. Determining an appropriate approach for demonstrating compliance with any revised ESADs will require that each affected source perform an engineering and economic assessment of their options and make a decision that is appropriate for their circumstances. However, an assessment of historical NO_X emission reduction credit pricing (ERC) may provide some insight into the average cost of control across the BPA area.

ERCs result from real reductions in surplus emissions. While not as effective a predictor as allowance pricing, in a robust trading program, ERC pricing could, to some degree, reflect the incremental cost of control across the air shed. Following is a summary of BPA area NO_X ERC transactions through early 2006 provided by the TCEQ.

Year	Number of Trades	Tons Traded	Average Price Per Ton[19]
2004	7	520.3	$2,800
2005	1	11.1	$0
2006	1	276.3	$0
Total:	9	807.7	$2,800

[19]The two trades listed for 2005 and 2006 were inter-company trades at a price of $0 per ton. These trades are excluded from the average trading price.

As shown, ERCs seem to be trading, on average, close to $3,000 per ton. This is equivalent to a price of approximately $600 per ton of NO_X.[20] Reductions in NO_X emissions beyond the requirements of current programs are not factored into these prices and historical ERC transactions may not be indicative of future availability or pricing.

[20] The price per ton assumes the cost of a one ton ERC equally distributed over a five-year period with a 0% interest rate.

Short List Measure #: *5*

Control Measure: *Establish Emission Limits for Combustion Sources in Surrounding Area*

Category: *Point & Area Sources*

BACKGROUND

With the exception of utility electric generating facilities, currently there are no 30 TAC Chapter 117 (Control of Air Pollution from Nitrogen Compounds) emission specifications that apply to sources of nitrogen oxides (NO_X) in the attainment areas surrounding the 8-county Houston-Galveston-Brazoria (HGB) ozone nonattainment area.

CONTROL MEASURE DESCRIPTION

Under this control strategy, emission specifications would be established for combustion sources located outside of the HGB nonattainment area. No recommendation has been made as to which emission source categories should be included or the geographic extent of this control measure.

ANALYSIS

Potential Emission Reductions

The 2009 baseline emissions inventory developed by the TCEQ identifies approximately 845 tons per day (TPD) of NO_X emissions from point, area and marine sources 2009 located within 200 kilometers of the HGB area, but excluding those sources within the HGB area.

Point Sources[21]	=	644.3 tons/day (TPD)
Area Sources[22]	=	191.1 TPD
Marine Sources[23]	=	9.8 TPD
TOTAL	=	845.2 TPD

Data for on-road and non-road mobile emission sources has not been provided.

Potential emission reductions under this control measure would be limited to point sources with, perhaps, some participation by certain area sources. Potential emission reductions would depend upon the number and scope of sources affected and the stringency of the ESADs.

Affected Emission Sources

The scope of this control measure could be narrow, with ESADs established for a single or limited number of emission source categories, or it could be broad, with ESADs established

[21] Includes 86.2 TPD for sources located in the Beaumont-Port Arthur (BPA) nonattainment area.

[22] Includes 8.3 TPD for sources located in the BPA nonattainment area.

[23] All are located in the BPA nonattainment area.

for a wide range of emission source categories. No recommendation is made at this time as to the scope of any application of ESADs to emission sources outside of the HGB area.

Anticipated Methods of Compliance

Compliance options that may be available to achieve required NO_X emission reductions include:

- Implement emission controls
- Purchase allowances.

The second option would require implementation of a cap-and-trade program similar to or part of the HGB area Mass Emission Cap and Trade (MECT) program.

Implement Emission Controls

Control options appropriate for the reduction of NO_X emissions would need to be determined on a source-by-source basis.

Buy Allowances

The MECT program allows affected sources to comply with the cap by either reducing NO_X emissions to levels that are at or below their allowance allocation or by buying allowances from other account holders. As noted, this option would require implementation of a cap-and-trade program for the affected sources.

Cost Effectiveness

Without conducting source-specific engineering feasibility assessments, there is insufficient information to accurately predict the technical feasibility or cost of lowering NO_X emissions for individual emission units or affected sources. Determining an appropriate approach for demonstrating compliance with any new or revised emission specifications will require that each affected source perform an engineering and economic assessment of their options and make a decision that is appropriate for their circumstances. Additionally, since there are no significant air quality-related commodities (e.g. emission reduction credits, MECT program allowances, Clean Air Interstate Rule allowances, etc.) currently trading in these attainment areas, there is no clear marketplace guidance on what the incremental cost of control may be across the affected sources and geography.

Short List Measure #: *6*

Control Measure: *Establish More Stringent Emission Limits for Electric Generating Facilities in Surrounding Area*

Category: *Point Sources*

BACKGROUND

30 TAC 117, Subchapter B, Division 2, establishes nitrogen oxides (NO_X) emission specifications for utility electric generation facilities located in East and Central Texas. These limits are as follows:

- Electric power boilers
  - Gas-fired: ..... 0.14 lb/MMBtu heat input
  - Coal-fired: ..... 0.165 lb/MMBtu heat input
- Stationary gas turbines (including duct burners)
  - Subject to Texas Utility Code (TUC), §39.264: ..... 0.14 lb/MMBtu heat input
  - Not subject to TUC, §39.264:..... 0.15 lb/MMBtu heat input
  - Units designated in accordance with TUC, §39.264(i): . 0.15 lb/MMBtu heat input

Affected sources are those utility electric generation facilities located in the following counties: Atascosa, Bastrop, Bexar, Brazos, Calhoun, Cherokee, Fannin, Fayette, Freestone, Goliad, Gregg, Grimes, Harrison, Henderson, Hood, Hunt, Lamar, Limestone, Marion, McLennan, Milam, Morris, Nueces, Parker, Red River, Robertson, Rusk, Titus, Travis, Victoria, or Wharton.

CONTROL MEASURE DESCRIPTION

Under this control strategy, emission specifications for utility electric generation facilities outside of the Houston-Galveston-Brazoria (HGB) nonattainment area would be made more stringent. No recommendation has been made as to how the emission specifications should be modified or to the geographic extent of this control measure.

ANALYSIS

Potential Emission Reductions

The 2009 baseline emissions inventory developed by the TCEQ identifies approximately 283.7 tons per day (TPD) of NO_X emissions from utility electric generating facilities located within 200 kilometers, of the HGB area. This value is exclusive of sources located within the 8-county HGB area.

Affected Emission Sources

Affected emission sources would be utility electric generating facilities located within a yet-to-be determined distance from the HGB area, but outside of the HGB area. Excluded may be utility electric generating facilities located within the Beaumont-Port Arthur (BPA) and

Dallas-Fort Worth (DFW) nonattainment areas that are already subject to Emission Specifications for Attainment Demonstrations (ESADs) in 30 TAC 117.206(a) and (b).

Anticipated Methods of Compliance

Control options appropriate for the reduction of NO_X emissions would need to be determined on a source-by-source basis. Technologies generally considered available for the control of NO_X from electric utility boilers may include:[24,25]

Combustion modifications: Low-NO_X burners (LNB), low excess air, burners out of service, biased burner firing, overfire air, reburn, reduced oxygen, staged combustion, flue gas recirculation (FGR), water/steam injection, reduced air preheat, pure oxygen, fuel reburning

Post combustion control: Selective catalytic reduction (SCR), selective non-catalytic reduction, (SNCR), oxidation/absorption

Technologies generally considered available for the control of NO_X from stationary gas turbines may include:

Combustion modifications: Natural gas reburning, low-NO_X combustors (LNC), water/steam injection, reduced air preheat, catalytic combustion

Post combustion control:: SCR, SNCR, oxidation/absorption

The referenced EPA documents present the following control efficiencies for boilers (all fuels):

Combustion modifications: 50-70%

SCR/SNCR: 35-90%

Oxidation/absorption: 60-90%

Control efficiencies for stationary gas turbines are presented as follows:

Combustion modifications: 70-85%

SCR/SNCR: 70-90%

Oxidation/absorption: 60-90%

This information is for reference purposes only. No representations are made about the potential applicability and/or performance of the listed control technologies for individual applications.

Cost Effectiveness

Without conducting source-specific engineering feasibility assessments, there is insufficient information to accurately predict the technical feasibility or cost of lowering NO_X emissions for individual emission units or affected sources. Determining an appropriate approach for demonstrating compliance with any new or revised emission specifications will require that

[24] U.S. EPA, *Technical Bulletin: Nitrogen Oxides (NOX), Why and How They are Controlled*, EPA 456/F-99-006R, Office of Air Quality Planning and Standards, November 1999.

[25] U.S. EPA, *Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources*, AP-42, Fifth Edition.

each affected source perform an engineering and economic assessment of their options and make a decision that is appropriate for their circumstances.

EPA reference document 456/F-99-0006R does, however, presents cost data for the control of NOX emissions from boilers and stationary gas turbines. Only select values are presented.

Combustion Source	Fuel	Control Technology	% Reduction	Cost Effectiveness ($/ton)[26,27]	
				Small	Large
Boiler: Wall-Fired	Coal	SNCR	40	$2,900	$2,200
Boiler: Wall-Fired	Coal	LNB	50	$5,400	$4,000
Boiler: Wall-Fired	Coal	SCR	70	$4,500	$3,800
Boiler: Fluidized Bed	Coal	SNCR	75	$1,900	$1,400
Boiler: Cyclone	Coal	Fuel Reburn	50	$5,800	$1,100
Boiler	Natural Gas	LNB	50	$3,000	$2,400
Boiler	Natural Gas	SNCR	50	$12, 900	$4,500
Boiler	Natural Gas	LNB + FGR	60	$9,400	$2,200
Boiler	Natural Gas	SCR	80	$8,000	$4,300
Gas Turbine	Natural Gas	Steam Injection	80	$3,900	$1,900
Gas Turbine	Natural Gas	LNC	84	$1,800	$400
Gas Turbine	Natural Gas	LNC + SCR	94	$7,500	$1,800
Gas Turbine	Natural Gas	Steam + SCR	95	$7,800	$3,200

This information is presented for reference purposes only. Source-specific engineering feasibility assessments are necessary to determine what control approaches are feasible, the emission reductions that may be realized, the required capital investment and operating costs.

[26]Values in referenced document are presented in 1990 dollars. These are adjusted to 2006 dollars using average Consumer Price Index values published by the U.S. Department of Labor, Bureau of Labor Statistics (ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt) and rounded up to the nearest $100. Average 1990 CPI = 130.7. March 2006 value of 199.8 used for 2006.

[27]A small source is one with NO_X emissions below 1 TPD. A large source is one with NO_X emissions greater than 1 TPD.

Short List Measure #: *7*

Control Measure: *Establish more stringent fugitive emissions monitoring and control requirements*

Category: *Point Sources*

BACKGROUND

30 TAC 115, Subchapter D, Division 3, establishes fugitive emission control requirements for petroleum refineries, petrochemical manufacturing facilities, and natural gas processing plants located in ozone nonattainment areas, including the Houston-Galveston-Brazoria (HGB) area. In general, all compressor seals, pump seals, accessible valves and pressure relief valves are to be monitored each calendar quarter according to EPA Test Method 21 (40 CFR 60, Appendix A) at a screening concentration of 10,000 parts per million (ppm) for pump seals and compressor seals and 500 ppm for all other components. Flanges are to be inspected by visual, audio or olfactory means weekly. Details of the program are found in §115.354 of the referenced chapter. Leaking components are to be repaired according to the schedule in §115.352. Exemptions are noted in §115.357.

Petroleum refineries, petrochemical manufacturing facilities, and natural gas processing facilities which process, use or produce a highly reactive volatile organic compound (HRVOC) are also subject to the fugitive emission control requirements of 30 TAC, Subchapter H, Division 3.[28] Requirements are similar to the requirements of Subchapter D, Division 3, but more stringent. For example, the HRVOC fugitive monitoring program also requires Method 21 monitoring of blind flanges, caps, plugs, connectors, heat exchanger heads, sight glasses, meters, gauges, sampling connections, bolted manways, hatches, agitators, sump covers, junction box vents, covers and seals on separators and process drains according to the frequency identified in §115.781. Leaks must be repaired more rapidly as specified in §115.782. The HRVOC fugitive monitoring program also establishes standards for equipment in HRVOC service and requires annual third-party program audits.

CONTROL MEASURE DESCRIPTION

Under this control strategy, existing fugitive emissions monitoring programs would be made more stringent. One option would to be to revise the current requirements of Subchapter D, Division 3, to reflect the more stringent requirements of the HRVOC fugitive emissions monitoring program.

ANALYSIS

Potential Emission Reductions

The 2009 baseline emissions inventory developed by the TCEQ identifies 14.3 tons per day (TPD) of process fugitive volatile organic compounds (VOC) emissions from facilities located within the 8-county HGB nonattainment area. ENVIRON does not have

[28] An HRVOC is defined as ethylene, propylene, 1,3-butadiene and isomers of butene in Harris County. In HGB area counties other than Harris County, an HRVOC is defined as ethylene and propylene.

information about the quantity of fugitive emissions from facilities currently subject to HRVOC monitoring requirements and those that are not subject to these requirements; therefore, an estimate of potential emission reductions is not made. However, it is reasonable to assume that emission reductions at currently unaffected facilities would be similar to the reductions realized by affected facilities under the existing program.

Affected Emission Sources

If the current requirements of Subchapter D, Division 3, were revised to reflect the more stringent requirements of the HRVOC fugitive emissions monitoring program, affected fugitive emission sources would be those at petroleum refineries, petrochemical manufacturing facilities, and natural gas processing plants not currently subject to HRVOC program requirements.

Anticipated Methods of Compliance

If the current requirements of Subchapter D, Division 3, were revised to reflect the more stringent requirements of the HRVOC fugitive emissions monitoring program, affected sources would need to:

- Revise, expand or extend, as necessary, current Method 21 field investigations to conform with HRVOC rule requirements;
- Follow the more stringent leak repair and follow-up requirements of §115.782;
- Upgrade equipment, as necessary, to meet the standards of §115.783; and
- Perform third-party audits according to the requirements and schedule of §115.788.

Cost Effectiveness

The cost of implementing a more stringent fugitive emissions monitoring and control program – such as the HRVOC program – must be determined source-by-source.

In the 2002 HRVOC rule development documents, the TCEQ estimated compliance costs for bringing 121 potentially-affected sources in the HGB into compliance with the HRVOC fugitive emission monitoring and control requirements as follows:[29]

Program Element	Unit Cost	Total Cost (121 Sites)
Valve monitoring	$0.50-$1.00 per component	$3,256,000 - $6,512,000 per year
Monitoring of new components	$0.50-$1.00 per component	$26,046,000 - $52,093,000 per year
Water seal inspection	--	$19,570,000 per year
Valve repair	$150 each	$16,662,000 - $39,862,000
Valve replacement	--	$9,300,000 - $38,700,000 per year
Pressure relief valve rupture disks	--	$2,025,000 per year
Shaft sealing systems	--	$15,264,000 per year
Process drain inspections	--	$19,570,000 per year
Process drain alarms	--	$70,400,000 per year
Third-party audit	$0.50-$1.00 per component	$260,466 - $520,930 per year

[29] Rule Log No. 2002-046B-15-AI

This information is presented for reference purposes only. ENVIRON makes no representation as to the appropriateness, completeness, or accuracy of these costs. As stated previously, source-specific assessments are necessary to determine what control approaches are feasible, the emission reductions that may be realized, the required capital investment and operating costs.

Short List Measure #: **8**

Control Measure: *Add chemicals to HRVOC list*

Category: *Point Sources*

BACKGROUND

Highly reactive volatile organic compounds (HRVOC) are currently defined as ethylene, propylene, 1,3-butadiene and all isomers of butene in Harris County. The definition is limited to ethylene and propylene in the other seven counties that constitute the Houston-Galveston-Brazoria (HGB) nonattainment area.[30] The HRVOC rules were originally adopted in December 2002 and revised substantially in December 2004. HRVOC control was a key element of the Texas Commission on Environmental Quality's (TCEQ) strategy to bring the HGB into attainment with the now rescinded one-hour ozone standard.

Affected facilities are those that emit, or have the potential to emit, HRVOC. Program requirements published in 30 TAC 115, Subchapter H, include:

- Monitoring of HRVOC emissions from process vents, flares, and cooling towers as specified in §§115.725 and 115.764
- Implementing the fugitive emissions monitoring and control requirements of Division 3
- Compliance with the HRVOC emissions cap and trade (HECT) programs described in 30 TAC Chapter 101, Subchapter H, Division 6 (Harris County only)
- Compliance with the 1,200 pounds per hour short-term emission limit (Harris County only)

Affected sources were required to implement the monitoring provisions of the rule by the end of January 2006. The short-term emission limit went into effect April 1, 2006. The first compliance period for the HECT program cap begins January 1, 2007. At this time, affected sources located in counties other than Harris County are exempt from the HECT cap and the short-term emission limit; but not the monitoring requirements of §115.725. Sites that emit or have the potential to emit less than 10 tons per year of HRVOC are also exempt from the HECT program. However, they are still subject to the short-term emission limitation as well as the monitoring requirements of §115.725.

Affected sources are allocated HECT allowances based on certified level of activity during the baseline period. On March 20, 2006, the TCEQ published a list of HECT allowance allocations. A total of 51 sites were allocated 3,451.5 tons of HRVOC. Specific information on the control strategies to be used by these sources to comply with the HECT cap is not available to ENVIRON. However, it is our general impression based upon discussions with representatives of affected facilities and related consulting engagements that affected sources may use a combination of strategies including enhanced maintenance and repair, equipment replacements, revised operating procedures, installation and/or upgrading of emission control equipment and the purchase of allowances to comply with the cap. An upcoming

[30] Brazoria, Chambers, Fort Bend, Galveston, Liberty, Montgomery and Waller counties

study by the Houston Advanced Research Center will be investigating HRVOC program compliance costs and strategies.[31] It is anticipated that this study will be complete by August 31, 2006.

CONTROL MEASURE DESCRIPTION

Under this control strategy, the definition of HRVOC would be expanded to include additional compounds. No recommendation is made on which compounds to add, if any, to this list. However, it is noted that the following eight compounds were also defined as HRVOCs in the original 2002 HRVOC rule proposal: acetaldehyde, ethyltoluenes, formaldehyde, isoprene, pentenes, toluene, trimethylbenzenes, and xylenes. Production volumes, emissions and reactivity were considered in adopting the final list of four HRVOC compounds.

ANALYSIS

Potential Emission Reductions

While speciated emissions for the 2009 baseline inventory are not available, the TCEQ has provided the following information regarding 2003 actual emissions. This information was culled from air emission inventory filings.

Pollutant	2003 Actual Emissions by County (Tons)								
	Brazoria	*Chambers*	*Fort Bend*	*Galveston*	*Harris*	*Liberty*	*Montgomery*	*Waller*	**TOTAL**
Acetaldehyde	0.4	0.7	0.8	18.8	22.6	1.0	0.0	0.0	**44.3**
1,3-Butadiene	83.1	2.2	0.0	17.1	279.9	0.0	0.0	0.0	**382.3**
Butenes	68.8	21.9	0.9	107.3	46.4	0.0	0.0	0.0	**245.3**
Ethylene	836.2	322.0	0.0	259.9	1,463.0	54.7	0.0	0.0	**2,935.8**
Ethyltoluenes	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	**4.3**
Formaldehyde	7.2	36.6	30.1	12.4	111.4	11.0	8.3	18.1	**235.1**
Isoprene	7.1	0.0	0.0	0.1	58.3	0.0	0.0	0.0	**65.5**
Pentenes	5.2	0.0	0.0	0.2	47.9	0.0	0.0	0.0	**53.3**
Propylene	699.6	115.6	0.0	211.8	1,676.5	13.2	0.0	0.0	**2,716.7**
Toluene	62.6	11.7	12.4	121.0	458.9	1.3	17.1	1.0	**686.1**
Trimethylbenzene	4.7	0.0	0.1	19.6	81.3	0.0	0.1	0.0	**105.7**
Xylenes	50.1	4.4	59.3	596.2	545.1	6.6	17.4	2.2	**1,281.3**
TOTAL	1,824.9	515.1	103.7	1,364.5	4,795.5	87.8	42.9	21.3	**8,755.7**

[31] Houston Advanced Research Center, *How Chemical Manufacturing Facilities in Harris County are using Point Source Monitoring to Identify and Reduce HRVOC Emissions*, Study H-76

Note that 2003 emissions are prior to implementation of the HRVOC regulations.

As can be seen, emissions of ethylene, propylene, 1,3-butadiene and butenes make up nearly 72% of the total emissions of the listed compounds. Emissions of xylenes, toluene and formaldehyde make up approximately 15%, 8%, and 3%, respectively of the total emissions of the listed compounds.

Affected Emission Sources

Affected emission sources would be those emitting one or more compounds added to the list of HRVOCs.

Anticipated Methods of Compliance

Affected sources would be required to:

- Monitor HRVOC emissions from process vents, flares, and cooling towers as specified in §115.725.
- Implement the fugitive emissions monitoring and control requirements of Division 3
- Comply with the HRVOC emissions cap and trade (HECT) as described in 30 TAC Chapter 101, Subchapter H, Division 3
- Comply with the 1,200 pounds per hour short-term emission limit
- Implement measures necessary to comply with the HECT cap and short-term emission limit that may include, but are not necessarily limited to: enhanced maintenance and repair, equipment replacements, revised operating procedures, installation and/or upgrading of emission control equipment, and/or the purchase of allowances to comply with the cap

Cost Effectiveness

The cost of complying with HRVOC rules for an expanded set of compounds must be determined source-by-source; however, it is reasonable to assume that such costs will vary greatly one site to another. The cost for one site may be quite low if it is has already implemented HRVOC program requirements at all potentially affected units. The cost at another site may be quite high if it is not currently subject to HRVOC monitoring and control requirements.

In the 2002 HRVOC rule development documents, the TCEQ estimated HRVOC rule compliance costs for potentially-affected sources in the HGB area:[32] These cost estimates follow.

Program Element	No. of Affected Units	Unit Cost	Total Costs
Vent Gas Testing	1,333	$1,000 per vent	$1,333,000 (one-time)
Vent Gas Control Devices	1,333	$600,000 (capital) $360,000 (annual)	$86,400,000 (capital) $51,840,000 (annual)

[32] Rule Log No. 2002-046B-15-AI

Program Element	No. of Affected Units	Unit Cost	Total Costs
Vent Gas Control Device Testing	215	$9,000 (Method 25)	$1,935,000 (one-time)
Flare Monitoring	337	$90,000 (first year) $20,000 (following years)	$30,330,000 (first year) $6,740,000 (following years)
Flare Recordkeeping	337	$500 (per year)	$168,500 (per year)
Cooling Tower Monitoring (> 8,000 gpm)	--	$88,000 (first year) $20,000 (following years)	--
Cooling Tower Monitoring (< 8,000 gpm)	--	$70,000 (first year) $52,000 (following years)	--
Cooling Tower Recordkeeping	68	$500 (per year)	$168,500 (per year)

Please refer to the evaluation document for *Control Strategy #7: Establish more stringent fugitive emissions monitoring and control requirements* for a discussion of costs for implementing an HRVOC fugitive emissions monitoring and control program.

This information is presented for reference purposes only. ENVIRON makes no representation as to the appropriateness, completeness, or accuracy of these costs nor to the cost effectiveness of this control strategy. With regard to certain costs, such as continuous emission monitoring systems, we believe that the cost estimates presented underestimate actual costs. It is our understanding that the cost for a typical continuous emission monitoring system for a flare is several hundred thousand dollars per installation, inclusive of instrumentation, housing, electrical, labor, testing, etc.

As stated previously, source-specific assessments are necessary to determine compliance costs.

Short List Measure #: **9**

Control Measure: *Revoke HRVOC program exemption for HGB counties other than Harris County*

Category: *Point Sources*

BACKGROUND

Highly reactive volatile organic compounds (HRVOC) are currently defined as ethylene, propylene, 1,3-butadiene and all isomers of butene in Harris County. The definition is limited to ethylene and propylene in the other seven counties that constitute the Houston-Galveston-Brazoria (HGB) nonattainment area.[33] Affected facilities are those that emit, or have the potential to emit, HRVOC. Program requirements published in 30 TAC 115, Subchapter H, include:

- Monitoring of HRVOC emissions from process vents, flares, and cooling towers as specified in §§115.725 and 115.764
- Implementing the fugitive emissions monitoring and control requirements of Division 3
- Compliance with the HRVOC emissions cap and trade (HECT) programs described in 30 TAC Chapter 101, Subchapter H, Division 6 (Harris County only)
- Compliance with the 1,200 pounds per hour short-term emission limit (Harris County only)

Affected sources were required to implement the monitoring provisions of the rule by the end of January 2006. The short-term emission limit went into effect April 1, 2006. The first compliance period for the HECT program cap begins January 1, 2007. Sites that emit or have the potential to emit less than 10 tons per year of HRVOC are also exempt from the HECT program. However, they are still subject to the short-term emission limitation as well as the monitoring requirements of §115.725.

While the regulations define a cap for the seven counties surrounding Harris County, as specified in §§101.392(c), 115.727(f) and 115.767(6), affected sources located in counties other than Harris County are exempt from the HECT cap and the short-term emission limits. As stated in §101.392(c), however:

> *"the commission may revoke this exemption upon public notice of this revocation. If the exemption is revoked, sites subject to this division located in the Houston/Galveston/Brazoria ozone nonattainment area, excluding Harris County, must comply by January 1, 2007, or within 180 days of public notice, whichever is later."*

These sources are still subject to the emission monitoring requirements of §115.725.

[33] Brazoria, Chambers, Fort Bend, Galveston, Liberty, Montgomery and Waller counties

CONTROL MEASURE DESCRIPTION

Under this control strategy, the exemption from the HECT program cap and the short-term emission limit would be revoked for the HGB area counties, other than Harris County.

ANALYSIS

Potential Emission Reductions

While speciated emissions for the 2009 baseline inventory are not available, the TCEQ has provided the following information regarding HRVOC allowable emissions from sources in the seven counties in the HGB outside of Harris County.

Ethylene:	1,882.24 tons/year
Propylene:	1,627.43 tons/year
Total:	**3,509.67 tons/year**

The current cap for the seven surrounding counties is 4,878.7 tons/year – split between production and use sites (4,390.8 tons/year) and storage/loading sites (487.87 tons/year). Therefore, allowable HRVOC emissions in the potentially affected seven counties are currently less than the cap. To achieve any annual emission reductions via revocation of the aforementioned exemption would require establishment of a cap lower than current allowable emissions.

Affected Emission Sources

Affected emission sources would be those emitting HRVOCs located in one of the seven HGB area counties surrounding Harris County.

Anticipated Methods of Compliance

Affected sources would be required to:

- Comply with the HECT program cap as described in 30 TAC Chapter 101, Subchapter H, Division 6 (exempt are sources that emit or have the potential to emit less than 10 tons per year HRVOC)
- Comply with the short-term emission limit
- Implement measures necessary to comply with the HECT cap and short-term emission limit that may include, but are not necessarily limited to: enhanced maintenance and repair, equipment replacements, revised operating procedures, installation and/or upgrading of emission control equipment, and/or the purchase of allowances to comply with the cap

Cost Effectiveness

The cost of complying with the HRVOC cap and short-term emission limit must be determined source-by-source. It is reasonable to assume, however, that such costs will vary greatly from site to site, depending upon actual emissions compared to any future allocation of allowances.

Short List Measure #: **10**

Control Measure: *Use of new technologies to identify and manage emission sources*

Category: *Point Sources*

BACKGROUND

During 2001 and 2002, the Texas Commission on Environmental Quality (TCEQ) conducted a scientific evaluation based in large part on aircraft data collected by the Texas 2000 Air Quality Study (TexAQS). The TexAQS, a comprehensive research project conducted in August and September 2000 involving more than 40 research organizations and over 200 scientists, studied ground-level ozone air pollution in the Houston-Galveston-Brazoria (HGB) area and east Texas regions. The study revealed that while emissions of nitrogen oxides (NO_X) from industrial sources were generally correctly accounted for, industrial volatile organic compound (VOC) emissions were likely understated in earlier emissions inventories. A contributing factor to underreporting of VOC emissions may be the technical limitations of traditional leak detection and repair (LDAR) approaches – specifically EPA Method 21 (40 CFR 60, Appendix A) – in detecting both the sources and magnitude of emissions.

In recent years, remote sensing technologies have been developed and successfully used in detecting pollutants. These include active gas plume imaging, passive gas plume imaging, open path Fourier transform infrared (OP-FTIR), light detection and ranging (LDIR), and tunable diode laser absorption spectroscopy (TDLAS).[34]

The EPA has issued a proposed rule that would establish use of active and passive gas plume imaging technologies as an alternative work practice to Method 21 for compliance with EPA regulations.[35] In the proposed rule, EPA states that in laboratory and field studies these technologies have demonstrated an ability to detect leaks as small as 1 gram/hour. This technology also has the distinct advantage of being able to monitor components that are difficult or dangerous to monitor using Method 21. Optical technologies have also demonstrated value in finding previously unknown or underestimated sources of emissions.

It should be noted, however, that current TCEQ requirements for LDAR programs in the HGB nonattainment area – e.g. HRVOC fugitive emissions monitoring – are more stringent than current federal program requirements. This is necessary in order to achieve State Implementation Plan (SIP) creditable reductions.

CONTROL MEASURE DESCRIPTION

New and emerging technologies – such as the aforementioned remote sensing approaches – would be used to identify unknown or underrepresented emission sources for purposes of

[34] Houston Advanced Research Center, *Survey and Demonstration of Monitoring Technology for Houston Industrial Emissions*, Project H31.2004, January 2005.

[35] U.S. EPA, *Alternative Work Practice to Detect Leaks from Equipment*, proposed rule amendment, 71 FR 17401, April 6, 2006

inclusion in improved emission inventories, supplementing existing control strategies, and/or developing future emission control strategies.

ENVIRON does not currently have sufficient information to determine if emission reductions associated with implementation of this strategy would be quantifiable and, therefore, result in SIP-creditable reductions. Regardless, it could be an important and valuable management and planning tool.

ANALYSIS

Potential Emission Reductions

Potential emission reductions have not been identified.

Affected Emission Sources

Potentially affected emission sources have not been identified.

Anticipated Methods of Compliance

Anticipated methods of compliance have not been identified.

Cost Effectiveness

It is ENVIRON's understanding that an optical gas imaging camera costs approximately $80,000 to $100,000 to purchase. This price is exclusive of any operating and maintenance costs.

Short List Measure #: **11**

Control Measure: *Establish control requirements for flash emissions from separators and storage tanks*

Category: *Point & Area Sources*

BACKGROUND

Flashing losses of volatile organic compound (VOCs) occur when a liquid with entrained gas goes from a higher pressure to a lower pressure. As the pressure on the liquid drops, some of the lighter compounds dissolved in the liquid evaporate rapidly or "flash." The flashed gases may also entrain some of the heavier compounds in the liquids. Two potential sources of VOC emissions from oil and natural gas production operations are flash separators and storage tanks. Flash emissions also occur at wellhead sites, compressor stations, tanks batteries and gas plants when produced liquids are sent to atmospheric pressure storage tanks. Flash may be recovered or vented to atmosphere, controlled or uncontrolled.

Emissions from flash tank separators located within the 8-county Houston-Galveston-Brazoria (HGB) ozone nonattainment area are subject to the vent gas control requirements of 30 TAC 115, Subchapter B, Division 2. As specified in §115.122(a), process vents must reduce emissions by at least 90% or to a concentration of less than 20 parts per million (ppm). Exemptions are specified in §115.127. Vent gas control requirements also apply in certain counties not located within a nonattainment area. Specifically, the vent gas control requirements of §115.122(a) apply to sources located in Nueces and San Patricio counties and the requirements of §115.122(c) apply to sources located in Aransas, Bexar, Calhoun, Matagorda, San Patricio, and Travis counties. However, the regulations may not be clear as to the applicability of vent gas control requirements to flash separators.

Emissions from petroleum liquids storage tanks are subject to the storage tank control requirements of 30 TAC 115, Subchapter B, Division 1. Table II(a) identifies the specific control requirements for crude oil and condensate storage tanks as a function of size and vapor pressure of the material stored. These requirements apply to sources located within the HGB. Emission control requirements are also established by rule for sources located in Matagorda, San Patricio, in Aransas, Bexar, Calhoun, Matagorda, San Patricio, Travis, Nueces and Victoria counties. Section 115.117(a)(2) exempts tanks with a capacity less than 210,000 gallons, prior to custody transfer, from control requirements.

It is believed that, in many instances, affected sources are not taking the flashing gases into consideration when determining the true vapor pressure of the stored material and the applicability of Table II(a) control requirements. Additionally, the regulations were not written with the intent of controlling flash. Certain control approaches allowed by regulation – submerged fill pipe, floating roof tank – are not effective in controlling flash emissions.

Often, upstream oil and gas producers are not aware of and do not report flash emissions. They may also be unaware of the need to evaluate compliance with Chapter 115 requirements for process vents and storage tanks. Consequently, the Texas Commission on Environmental Quality (TCEQ) is of the opinion that emissions data for these sources is incomplete and, most likely, inaccurate.

CONTROL MEASURE DESCRIPTION

Under this control strategy, the regulations would be made clearer regarding the applicability of vent gas control requirements to flash separators and emission control requirements would be established for storage tank flash emissions.

ANALYSIS

Potential Emission Reductions

It is ENVIRON's understanding that, at this time, there are no accurate estimates of flash emissions from oil and natural gas production operations located within the 8-county HGB area. However, the Texas Commission on Environmental Quality (TCEQ) has estimated – using Texas Railroad Commission production data and conservative estimates for flash of 100 standard cubic feet (scf) per barrel of oil and 200 scf per barrel of natural gas condensate – that flash emissions in the HGB area may be as high as 163 tons per day (TPD) of VOC. Working with the Houston Advanced Research Center (HARC), the TCEQ is in the process of trying to establish a more accurate estimate of emissions from upstream oil and natural gas production operations. The project is currently underway with the final findings report due by July 31, 2006.

Affected Emission Sources

Flash separators and crude oil and condensate storage tanks at upstream oil and gas production facilities.

Anticipated Methods of Compliance

Flash may be recovered using a vapor recovery unit (VRU) for use as a fuel gas, further processing, and/or for sale. The flash may also be combusted, typically in a flare, before being vented to atmosphere. VRUs may recover 95% or more of the flashing VOCs. A flare that is conformant with 40 CFR 60.18 design criteria is assumed to reduce VOC emissions by at least 98%.

Cost Effectiveness

Source-specific assessments are necessary to determine what control approaches, if any, are feasible, the emission reductions that may be realized, the required capital investment and operating costs. However, in a document entitled *Lessons Learned From Natural Gas STAR Partners*,[36] EPA presents costs for VRUs installed on crude oil storage tanks. The capacity of the VRUs range from 4.9 to 96.0 million cubic feet (MMcf) of gas per year. Installed costs range from $26,470 to $77,000 and annual operating costs range from $5,250 to $12,000. At a price of $3.00 per thousand cubic feet (Mcf), EPA estimates the payback on the VRU investment from 3 months to 3.4 years.

[36] http://www.epa.gov/gasstar/pdf/lessons/ll_final_vap.pdf

The cost of flares can range widely. In a 2003 air pollution control fact sheet, EPA provides the following cost information on flares.[37]

Capital Cost:	$13 - $21,000 per standard cubic foot per minute (scfm)
O&M Cost:	$1 - $10 per scfm (annually)
Annual Costs:	$3 to $300 per scfm
Cost Effectiveness:	$15 to $5,800 per ton of VOC controlled

A survey of the number of affected facilities is necessary to provide an estimate of VRU or flare cost effectiveness.

This information is presented for reference purposes only. ENVIRON makes no representation as to the appropriateness, completeness, or accuracy of these costs. As stated previously, source-specific assessments are necessary to determine what control approaches are feasible, the emission reductions that may be realized, the required capital investment and operating costs.

[37] U.S. EPA, Air Pollution Control Technology Fact Sheet: Flares, EPA-452/F-03-019 (http://www.epa.gov/ttn/catc/dir1/fflare.pdf).

Short List Measure #: **12**

Control Measure: *Establish more stringent control requirements for storage tanks*

Category: *Point Sources*

BACKGROUND

Organic liquid storage tanks can be significant sources of volatile organic compound (VOC) emissions. Emissions result from filling the tank (working losses) and from evaporation (breathing or standing losses). Emissions may also result from flash: losses that occur when liquid with entrained gas goes from a higher pressure to a lower pressure.

Emissions from storage tanks are regulated in 30 TAC 115, Subchapter B, Division 1. For sources located in the Houston-Galveston-Brazoria (HGB) ozone nonattainment area, Table I(a) in the regulation identifies the specific control requirements for organic liquid storage vessels, excepting crude oil and condensate storage tanks. Table II(a) in the regulation identifies the control requirements for storage of those materials. Control requirements are a function of tank size and the vapor pressure of the material stored. If applicable, vapor control systems must be at least 90% efficient in reducing emissions. Exemptions are presented in §115.117.

CONTROL MEASURE DESCRIPTION

Under this control strategy, the control requirements for storage tanks would be made more stringent. ENVIRON makes no recommendations as to how to make the control requirements more stringent. Options, however, may include:

- Lowering the vapor pressure threshold for triggering emission control requirements
- Lowering the storage capacity threshold for triggering emission control requirements
- Increasing the minimum performance requirements (currently 90%) for vapor recovery systems
- Requiring compliance with other, more stringent standards, such as 40 CFR 60, Subpart Kb (Standards of Performance for Volatile Organic Liquid Storage Vessels (Including petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984), Best Available Control Technology (BACT) guidance, and/or Permit by Rule requirements (30 TAC 106.478).

ANALYSIS

Potential Emission Reductions

The 2009 baseline emissions inventory developed by the TCEQ identifies 45.9 tons per day (TPD) of VOC emissions from storage tanks at facilities located within the 8-county HGB nonattainment area.

Affected Emission Sources

Organic liquid storage tanks at sources located within the 8-county HGB area.

Anticipated Methods of Compliance

There are a number of methods owners/operators of organic liquid storage tanks may potentially use to reduce VOC emissions. These may include:

- Upgrading floating roof tanks to conform to the requirements of 40 CFR 60, Subpart Kb, or other, more stringent standards
- Venting fixed roof and internal floating roof tanks through a closed vent to a vapor recovery and control system such as a flare, enclosed combustor, condenser, activated carbon or other
- Installing a floating roof in a fixed roof tank
- Replacing a fixed roof tank with a floating roof tank
- Replacing a venting tank (fixed or floating roof) with a pressure vessel (no working or standing losses)

Cost Effectiveness

Source-specific assessments are necessary to determine what control approaches, if any, are feasible, the emission reductions that may be realized, the required capital investment and operating costs. It is anticipated that control costs will vary widely depending upon the size, condition and age of a tank as well as the existing controls employed, proximity to existing vent gas control systems, etc. For example the owner/operator of one fixed roof tank may have the opportunity to connect the vents into a flare header in close proximity at relatively low cost. However, for a similar tank in similar service, the design and condition of the tank may preclude installation of a floating roof or connection to a flare header or other control device, requiring that the tank be retired and another tank built.

Short List Measure #: **13**

Control Measure: *Establish control requirements for the lifting of landed floating roofs*

Category: *Point Sources*

BACKGROUND

Organic liquid storage tanks can be significant sources of volatile organic compound (VOC) emissions. Emissions result from filling the tank (working losses) and from evaporation (breathing or standing losses). Emissions may also result from flash – losses that occur when liquid with entrained gas goes from a higher pressure to a lower pressure.

Emissions from storage tanks are regulated in 30 TAC 115, Subchapter B, Division 1. For sources located in the Houston-Galveston-Brazoria (HGB) ozone nonattainment area, Table I(a) in the regulation identifies the specific control requirements for organic liquid storage vessels, excepting crude oil and condensate storage tanks. Table II(a) identifies the control requirements for storage of those materials. Control requirements are a function of tank size and the vapor pressure of the material stored. If applicable, vapor control systems must be at least 90% efficient in reducing emissions. Exemptions are presented in §115.117.

Currently, the regulations do not specifically address working losses from floating roof tanks when the roof is lifted after having been landed.[38] Under these circumstances, the headspace between the top of the liquid and the roof is purged to atmosphere. Emissions associated with lifting of floating roofs are reported to the Texas Commission on Environmental Quality (TCEQ) in annual emission inventory filings. However, the TCEQ is of the opinion that these emissions are underreported and have requested that affected facilities revise their emission estimation methodologies and report the new values. It is ENVIRON's understanding that these revised estimates are due sometime in the summer of 2006.

CONTROL MEASURE DESCRIPTION

Under this control strategy, the regulatory requirements for storage tanks would be modified to reduce emissions associated with the lifting of landed floating roofs. ENVIRON recommends that affected sources be given the option to control emissions: a) through use of add-on pollution controls; or b) through management techniques. Examples of the later would be limiting the length of time that a roof could be landed, limiting the headspace of a landed roof, potentially as a function of size and/or vapor pressure, and/or limiting the number of times a roof may be landed.

[38] While they may not be specifically addressed in Chapter 115, these emissions do require authorization under Chapter 106 and/or Chapter 116.

ANALYSIS

Potential Emission Reductions

As noted, the TCEQ is in the process of gathering information to allow a more informed and accurate estimate of emissions from lifting landed roofs. At this time, ENVIRON has no estimate of total emissions from the lifting of landed roofs in the HGB area. However, for illustrative purposes, an estimate can be made for the lifting of a single landed roof. For:

- A 200-foot diameter floating roof tank,
- Storing gasoline, with
- A Reid Vapor Pressure of 7 psia,
- An average molecular weight of 100,
- At 100°F, and
- Purging six feet of saturated headspace when lifting the landed roof,

Uncontrolled emissions for this single lifting of a landed roof are estimated as approximately 11 tons.[39] This suggests that lifting of landed floating roofs may potentially be a large source of VOC emissions.

Affected Emission Sources

Affected sources would be floating roof storage tanks – both internal floating and external floating roof tanks – storing organic liquids.

Anticipated Methods of Compliance

As noted previously, ENVIRON recommends that affected sources be given the option to control emissions through the use of add-on pollution controls or through implementation of allowable management techniques. Examples of potentially allowable management techniques are as follows.

- Limiting the length of time between when a roof is landed and when it must be lifted again, reducing the amount of stored organic liquid that could evaporate into the headspace and be purged when the roof is lifted. The time limitation could be based on the vapor pressure of the stored material, the size of the tank, or other factors.
- Limiting the headspace between the top of the stored liquid and the roof when it is landed, thus reducing the amount of gas purged when the roof is lifted again.
- Limiting the number of times during any given period (monthly, rolling 12 months, etc.) that a floating roof may be landed.

With respect to add-on pollution controls, flares are most commonly used to control working losses from storage tanks. Not all storage tanks, however, are amenable to the use of add-on controls. A specific example is external floating roof tanks.

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[39] Calculated using the Ideal Gas Law: Mass = $PVM_W/RT=nRT$, where P = the partial pressure of the gasoline (7 psia), V = the volume of purged headspace ($\pi hD^2/4$ = 188,496 ft^3), M_W = molecular weight (100 lbs/lbmole), R = the Gas Constant (10.73 psia•ft^3/lbmole•°R), and T = the temperature (100°F or 560°R)

Cost Effectiveness

Source-specific assessments are necessary to determine what control approaches, if any, are feasible, the emission reductions that may be realized, the required capital investment and operating costs. The use of management techniques to reduce emissions from the lifting of landed roofs would dramatically reduce the cost of compliance when compared to installing add-on pollution controls.

Short List Measure #: **14**

Control Measure: *Establish more stringent control requirements for degassing and cleaning of stationary, marine and transport vessels*

Category: *Point Sources*

BACKGROUND

Prior to a change in service or entry for repair, a storage tank must typically be cleaned. This may involve purging the tank of organic vapors, also known as *degassing* the tank. Emissions from the degassing and cleaning of stationary, marine and transport vessels are regulated under 30 TAC 115, Subchapter F, Division 3. The regulations require emissions from the following degassing operations be managed using a vapor control system with a control efficiency of at least 90%:

- Stationary volatile organic compound (VOC) storage tanks with a nominal capacity of one million gallons or more;
- Transport vessels (truck or rail) with a capacity of 8,000 gallons or more; and
- Marine vessels with a capacity of 10,000 barrels (420,000 gallons) or more.

During degassing, vapors must be controlled until at least four turnovers of the vapor space volume have occurred or until the partial pressure of the VOC is less than 0.5 pounds per square inch (psia). Degassing is not required if the initial partial pressure of the VOC is less than 0.5 psia. Once one of these conditions has been met, the tank may be vented to atmosphere. Exemptions are noted in §115.547.

CONTROL MEASURE DESCRIPTION

Under this control strategy, the control requirements for degassing of stationary, marine and transport vessels would be made more stringent. Options for implementing this control measure may include:

- Lowering the capacity thresholds for triggering emission control requirements
- Lowering the vapor pressure threshold for triggering emission control requirements
- Increasing the control efficiency requirements from 90% to a higher value
- Eliminate the four turnover criteria, requiring control until the partial pressure of the VOC is less than 0.5 psia

The maximum emission reduction would be achieved by implementing all four options.

ANALYSIS

Potential Emission Reductions

The 2009 baseline emissions inventory for the Houston-Galveston-Brazoria (HGB) ozone nonattainment area developed by the TCEQ identifies the following sources of emissions:

1. *Marine Vessels:* 57 tons per day (TPD)
2. *Organic Liquid Storage & Transport:* 60 TPD
3. *Organic Liquid Storage Working & Breathing Losses:* 45.9 TPD

Number 3 is a subset of number 2. If one assumes that the remainder of the emissions for organic liquid storage and transport are due to degassing and cleaning, the emissions from these operations are then 14.1 TPD. With regard to marine vessels, it is unknown what part of the 57 TPD is due to degassing and cleaning and what part is due to loading/unloading and fugitive losses.

Insufficient information is available to determine the TPD emission reductions that would be achieved by each of the control measures. We do know, however, that application of a higher control efficiency would result in a proportional decrease in emissions from affected emission sources. For example, 10 tons of emissions assuming a control efficiency of 90% would be reduced to 5 tons if the control efficiency were revised to 95% or 2 tons at 98% control.

Revising the size thresholds would result in a large decrease in emissions from those tanks that are currently degassed and cleaned without use of emission control systems. For example, 10 tons from an uncontrolled degassing operation would be reduced to 1.0 ton at 90% control or 0.2 ton at 98% control.

Extending degassing and cleaning control requirements to lower vapor pressure materials would probably require adding large quantities of natural gas or other high heat content material to the vent gas stream in order for it to burn properly in a flare. The emission reduction benefit of controlling low vapor pressure vent streams is, most likely, small with a disadvantage being the generation of additional nitrogen oxides (NO_X) emissions from the flaring of large quantities of natural gas.

Affected Emission Sources

Affected sources would be degassing and cleaning operations of stationary, marine and transport vessels within the 8-county HGB nonattainment area.

Anticipated Methods of Compliance

It is anticipated that flaring will continue to be the preferred method of controlling VOC emissions during degassing and cleaning operations with, perhaps, activated carbon or other adsorbents used for small scale operations. If the control efficiency requirements are increased above 90%, flares would, most likely, need to be upgraded to conform to the requirements of 40 CFR 60.18. In general, the requirements are:

- Maintain a net heating value of 300 Btu per standard cubic foot (Btu/scf) for air or steam-assisted flares, 200 Btu/scf for non-assisted flares
- Exit velocity of less than 60 feet per second with higher velocities allowed with higher net heating values
- Continuously monitor for the presence of a flame

It is often difficult or impossible to demonstrate that small flares and/or transportable flares meet the requirements of §60.18. As mentioned previously, low organic content streams

may require the addition of natural gas or other combustible gas to achieve and maintain the required minimum net heating value

Cost Effectiveness

Lowering the size and/or vapor thresholds for controlling emissions during degassing and cleaning operations would result in additional costs during these operations. Compliance may require that some vessels be modified to accommodate venting to control during degassing and cleaning. It is possible that some tanks cannot be modified to accommodate control and may need to be retired and/or replaced. Increasing the control requirement above 90% may require modification or replacement of an existing flare with one that can demonstrate conformance with 40 CFR 60.18 requirements. [For a discussion of flare costs, please refer to the evaluation document for Control Strategy #11: *Establish control requirements for flash emissions from separators and storage tanks*.]

At this time ENVIRON does not have sufficient information on emissions from degassing and cleaning operations, the character of the affected sources, the number of affected sources, the frequency of occurrence, how sources are currently being controlled and the effectiveness of the controls used to determine potential emission reductions and cost effectiveness. Source-specific assessments are necessary to determine what control approaches, if any, are feasible, the emission reductions that may be realized, as well as the required capital investment and operating costs.

Short List Measure #: **15**

Control Measure: *Establish more stringent control requirements for loading and unloading operations, including marine loading*

Category: *Point Sources*

BACKGROUND

Air emissions result from the loading and unloading of transport vessels such as trucks, railcars, ships and barges with petroleum products, solvents and other chemicals containing volatile organic compounds (VOC). Emissions associated with these operations are regulated under 30 TAC 115, Subchapter C, Division 1. In the Houston-Galveston-Brazoria (HGB) ozone nonattainment area, emissions from gasoline terminals are limited to 0.09 pound VOC per 1,000 gallons loaded into transport vessels. With the exception of gasoline terminals, gasoline bulk plants and marine vessels, loading of a VOC with a true vapor pressure of 0.5 pounds per square inch (psia) or greater must be controlled by:

- A vapor control system with a minimum control efficiency of 90%, or
- A vapor balance system, or
- Pressurized loading.

Gasoline bulk terminals are to use a vapor balance system or a 90%+ efficient vapor control system to control VOC emissions. After unloading, transport vessels must be kept vapor-tight until they are loaded again or cleaned and degassed in accordance with 30 TAC 115, Subchapter F, Division 3. With respect to marine terminals, emissions are limited to 0.09 pounds per 1,000 gallons loaded, use of a 90%+ efficient vapor control system, use of a vapor balance system, or pressurized loading.

Section 115.217 identifies exemptions. These include loading operations (excluding bulk gasoline plants) that load into transport vessels, on average, less than 20,000 gallons of VOC per day. Gasoline bulk plants that load less than 4,000 gallons per day are also exempt.

CONTROL MEASURE DESCRIPTION

Under this control strategy, the control requirements for loading and unloading operations would be made more stringent. Options for implementing this control measure may include:

- Lowering the throughput thresholds for triggering emission control requirements
- Lowering the vapor pressure threshold for triggering emission control requirements
- Increasing the control efficiency requirements from 90% to a higher value

The maximum emission reduction would be achieved by implementing a combination of all three options.

ANALYSIS

Potential Emission Reductions

The 2009 baseline emissions inventory developed by the TCEQ identifies 11.3 tons per day (TPD) of VOC emissions from loading and unloading operations within the 8-county HGB nonattainment area. Insufficient information is available to determine the TPD emission reductions that would be achieved by each of the three control options. We do know, however, that application of a higher control efficiency would result in a proportional decrease in emissions from affected emission sources. For example, 10 ton of emissions assuming a control efficiency of 90% would be reduced to 5 ton if the control efficiency were revised to 95% or 2 ton at 98% control.

Revising the throughput thresholds would result in a large percentage decrease in emissions from those loading and unloading operations that are conducted without the use of emission control systems. For example, an uncontrolled bulk gasoline distribution facility with an average throughput of 3,500 gallons per day will emit, at most, approximately 10 tons per year of VOC.[40] Employing a 90% efficient control device would reduce annual emissions by approximately 9 tons per year. However, ENVIRON has no information as to the number of facilities that are currently exempt due to throughput.

With respect to lowering the vapor pressure threshold, benefits would be dependent upon throughput and the material(s) loaded. For example, an uncontrolled facility loading 100,000 gallons per day, on average, of a VOC with a vapor pressure of 0.1 psia will emit, at most, approximately 4 tons per year.[41] Employing a 90% efficient control device would reduce annual emissions by approximately 3.6 tons per year. ENVIRON has no information as to the number of facilities that are exempt due to vapor pressure.

Affected Emission Sources

Affected sources would be loading and unloading operations, including marine loading operations, within the 8-county HGB nonattainment area

Anticipated Methods of Compliance

Currently affected sources use a variety of methods to conform to the requirements of the rule. These include use of vapor control systems – such as flares, thermal oxidizers, activated carbon and/or other adsorption media – as well as vapor balancing and loading to a pressure vessel. It is anticipated that, if the vapor pressure and/or throughput thresholds were revised, newly affected facilities would employ the same suite of emission control measures. If the control efficiency requirements were increased above 90%, affected facilities may need to upgrade existing vapor control systems (with the exception of fugitive

[40] Calculated using the Ideal Gas Law: Mass = $PVM_W/RT=nRT$, where P = the partial pressure of the gasoline (7 psia), V = the volume of purged headspace (170,766 ft^3 per year), M_W = molecular weight (100 lbs/lbmole), R = the Gas Constant (10.73 psia•ft^3/lbmole•°R), and T = the temperature (100°F or 560°R)

[41] Calculated using the Ideal Gas Law: Mass = $PVM_W/RT=nRT$, where P = the partial pressure of the gasoline (7 psia), V = the volume of purged headspace (170,766 ft^3 per year), M_W = molecular weight (100 lbs/lbmole), R = the Gas Constant (10.73 psia•ft^3/lbmole•°R), and T = the temperature (100°F or 560°R)

emissions, vapor balancing and loading to pressure vessels are considered to be 100% efficient control approaches). For example, some flares currently in use would need to be upgraded to conform to the requirements of 40 CFR 60.18. In general, the requirements are:

- Maintain a net heating value of 300 Btu per standard cubic foot (Btu/scf) for air or steam-assisted flares, 200 Btu/scf for non-assisted flares
- Exit velocity of less than 60 feet per second with higher velocities allowed with higher net heating values
- Continuously monitor for the presence of a flame

It is often difficult or impossible to demonstrate that small flares and/or transportable flares meet the requirements of §60.18. As mentioned previously, low organic content streams may require the addition of natural gas or other combustible gas to achieve and maintain the required minimum net heating value

Cost Effectiveness

Lowering the size and/or vapor thresholds for controlling emissions for loading and unloading operations would result in additional costs for previously unaffected operations. Compliance may require that some loading racks be modified to accommodate either vapor balancing or vapor controls. It is possible that some loading racks cannot be modified to accommodate control and may need to be retired and/or replaced. Increasing the control requirement above 90% may require modification or replacement of an exiting flare or activated carbon adsorption system with one that can demonstrate a higher degree of control. [For a discussion of flare costs, please refer to the evaluation document for Control Strategy #11: *Establish control requirements for flash emissions from separators and storage tanks*.]

At this time ENVIRON does not have sufficient information on emissions from loading and unloading operations – specifically, the character of the affected sources, the number of affected sources, how sources are currently being controlled and the effectiveness of the controls used – to determine potential emission reductions and cost effectiveness. Source-specific assessments are necessary to determine what control approaches, if any, are feasible, the emission reductions that may be realized, as well as the required capital investment and operating costs.

Short List Measure #: **16 & 17**

Control Measure: *Establish more stringent control requirements for industrial wastewater treatment operations*

Category: *Point Sources*

BACKGROUND

Air emissions result from the evaporation of volatile organic compounds (VOC) during the collection and treatment of industrial wastewater streams. Emissions associated with wastewater collection and treatment operations in the Houston-Galveston- Brazoria (HGB) ozone nonattainment area are regulated under 30 TAC 115, Subchapter B, Division 4. Affected sources include:

- Organic chemicals, plastics and synthetic fibers manufacturing facilities
- Pesticides manufacturing facilities
- Pharmaceutical manufacturing facilities
- Petroleum refineries
- Hazardous waste treatment, storage and disposal facilities

The control requirements are specified in §115.142. In general the regulations require that wastewater components – storage tanks, surface impoundments, drains, junction boxes, lift stations, weirs and oil-water separators – be covered, closed and/or vented to control. As an alternative, affected facilities can demonstrate a minimum 90% reduction in emissions relative to the 1990 baseline emissions. Biological treatment systems must demonstrate that the VOC content of the wastewater is reduced at least 90% by weight.

Wastewater treatment facilities with an annual VOC loading of less than 10 megagrams (11.03 tons) are exempt from control requirements. Facilities with annual VOC loading of more than 10 megagrams may exempt one or more affected wastewater streams for which the VOC loadings in those exempt streams is no more than 10 megagrams.

CONTROL MEASURE DESCRIPTION

Under this control strategy, the control requirements for wastewater collection and treatment facilities would be made more stringent. Options for implementing this control measure may include:

- Increasing the alternative control requirement from 90 to 95%
- Increasing the biological treatment VOC removal efficiency requirement from 90 to 95%
- Lowering or eliminating the 10 megagram exemption for facilities and/or exempted streams within affected facilities
- Expanding the list of affected sources to include sources such as bakeries, breweries, and manufacturing facilities that own/operate their own wastewater treatment facilities

The maximum emission reduction would be achieved by implementing a combination of all four options. However, upon further investigation, ENVIRON has come to a position that VOC emissions from industrial wastewater treatment facilities other than those currently regulated are limited and, most likely, would yield very limited reductions in emissions. Therefore, we don't recommend further consideration of this option.

ANALYSIS

Potential Emission Reductions

The 2009 baseline emissions inventory developed by the TCEQ identifies 7.65 tons per day (TPD) of VOC emissions from industrial wastewater operations within the 8-county HGB nonattainment area. Insufficient information is available to determine the TPD emission reductions that would be achieved by each of the four control options individually or in combination. Information needs include:

- Identification of currently affected sources, current emissions and control efficiencies
- Identification of exempted sources and streams along with the associated VOC emissions
- Identification of unaffected sources, current emissions and VOC control efficiencies

We do know, however, that application of a higher control efficiency would result in a proportional decrease in emissions from affected emission sources. For example, if the 7.65 TPD of VOC is emitted exclusively from affected sources achieving a 90% emission reduction, increasing the control efficiency to 95% would reduce the emissions by 3.8 TPD.

Affected Emission Sources

Affected sources would be industrial wastewater treatment facilities within the 8-county HGB nonattainment area.

Anticipated Methods of Compliance

Methods available to achieve a higher level of VOC emission control from industrial wastewater treatment facilities would need to be determined on a source-by-source basis. It is anticipated that a number of facilities – such as those affected by one or more federal maximum achievable control technology (MACT) standards in 40 CFR 63 – are already achieving greater than 90% control. For example, the Miscellaneous Organic NESHAP standard (the MON) requires that Group 1 wastewater streams (those requiring control) achieve 99% or greater control of hazardous air pollutant (HAP) emissions or, for biological systems, at least 95% HAP mass removal.

For those wastewater treatment systems that are not currently subject to the Chapter 115 industrial wastewater regulations or any federal emission standard, it is reasonable to assume that wastewater components will need to be covered and/or vented to control. Biological treatment systems may need to be upgraded or replaced to achieve a higher control efficiency.

Cost Effectiveness

Each of the four options listed for implementing this control measure may result in substantial financial investments in upgrading and/or replacing wastewater collection and treatment systems. However, at this time, ENVIRON does not have sufficient information to determine the potential emission reductions, capital investments, or associated operating costs for each of the four control options listed, either individually or collectively. Source-specific assessments are necessary to determine what control approaches, if any, are feasible, the emission reductions that may be realized, as well as the required capital investment and operating costs.