Source Category: Petroleum Refineries

INTRODUCTION

The purpose of this document is to provide a forum for public review and comment on the evaluation of candidate control measures that may be considered by the States in the Midwest Regional Planning Organization (MRPO) to develop strategies for ozone, PM2.5, and regional haze State Implementation Plans (SIPs). Additional emission reductions beyond those due to mandatory controls required by the Clean Air Act may be necessary to meet SIP requirements and to demonstrate attainment. This document provides background information on the mandatory control programs and on possible additional control measures.

The candidate control measures identified in this document represent an initial set of possible measures. The MRPO States have not yet determined which measures will be necessary to meet the requirements of the Clean Air Act. As such, the inclusion of a particular measure here should not be interpreted as a commitment or decision by any State to adopt that measure. Other measures will be examined in the near future. Subsequent versions of this document will likely be prepared for evaluation of additional potential control measures.

The evaluation of candidate control measures is presented in a series of "Interim White Papers." Each paper includes a title, summary table, description of the source category, brief regulatory history, discussion of candidate control measures, expected emission reductions, cost effectiveness and basis, timing for implementation, rule development issues, other issues, and a list of supporting references. Table 1 summarizes this information for the petroleum refinery sector.

SOURCE CATEGORY DESCRIPTION

The petroleum refining industry converts crude oil into more than 2500 refined products, including liquefied petroleum gas, gasoline, kerosene, aviation fuel, diesel fuel, fuel oils, lubricating oils, and feedstocks for the petrochemical industry. Petroleum refinery activities start with receipt of crude for storage at the refinery, include all petroleum handling and refining operations, and terminate with storage preparatory to shipping the refined products from the refinery. No two refineries are alike. The refining operations at a particular refinery are determined by the composition of the crude oil received and the chosen slate of commodities produced. Refineries vary in size, age, and the type of separation, conversion, and treatment processes located at each refinery.

Air emission sources at petroleum refineries generally include:

- **Boilers, Engines, and Turbines.** Boilers are used to produce steam and to raise the temperature of feed materials to meet reaction or distillation requirements. Boilers are typically fired with residual oil, distillate oil, refinery gas, or natural gas. CO-rich regenerator flue gas also may be used as a fuel. Reciprocating engines are used to drive gas compressors and are usually fueled by natural gas or refinery gas. Gas turbines can fire a variety of fuels and are used as cogeneration units that produce electricity and steam for process needs.
- **Process Heaters.** Process heaters are used to indirectly heat process fluids to a moderate processing temperature. Fuel is combusted in an insulated chamber and the heat transferred to either tubes or a cylindrical vessel containing the process fluid. Process heaters use natural gas, refinery fuel gas, fuel oil or residual oil as fuel.

TABLE 1 – CONTROL MEASURE SUMMARY FOR PETROLEUM REFINERIES

Control Measure Summary	**SO2 Emissions (tons/year) in 5-state MRPO Region**	
2002 Existing measures : NSPS; PSD/NSR; State RACT Rules, MACT standards	2002 Base:	75,223
On-the-Books measures: Refinery Enforcement Settlements (contols on FCCUs, boilers/heaters, sulfur recovery units, flaring, equipment leaks, and wastewater treatment)	2009 Reduction: 2009 Remaining: 2012 Reduction: 2012 Remaining:	-49,942 25,281 -55,641 19,582

Control Measure Summary	**NOx Emissions (tons/year) in 5-state MRPO Region**	
2002 Existing measures : NSPS; PSD/NSR; State RACT Rules, MACT standards	2002 Base:	31,831
On-the-Books measures: Refinery Enforcement Settlements (contols on FCCUs, boilers/heaters, sulfur recovery units, flaring, equipment leaks, and wastewater treatment); NOx SIP Call	2009 Reduction: 2009 Remaining: 2012 Reduction: 2012 Remaining:	-9,299 22,532 -13,941 17,890

Control Measure Summary	**PM10 Emissions (tons/year) in 5-state MRPO Region**	
2002 Existing measures : NSPS; PSD/NSR; State RACT Rules, MACT standards	2002 Base:	4,954
On-the-Books measures: Refinery Enforcement Settlements (contols on FCCUs, boilers/heaters, sulfur recovery units, flaring, equipment leaks, and wastewater treatment); post-2002 MACT standards	2009 Reduction: 2009 Remaining: 2012 Reduction: 2012 Remaining:	-1,469 3,485 -1,802 3,152

Control Measure Summary	**VOC Emissions (tons/year) in 5-state MRPO Region**	
2002 Existing measures : NSPS; PSD/NSR; State RACT Rules, MACT standards	2002 Base:	9,229
On-the-Books measures: Refinery Enforcement Settlements (contols on FCCUs, boilers/heaters, sulfur recovery units, flaring, equipment leaks, and wastewater treatment); post-2002 MACT standards	2009 Reduction: 2009 Remaining: 2012 Reduction: 2012 Remaining:	-1,129 8,100 -1,129 8,100

- **Process Vents – MACT I Sources.** This category includes separation, conversion, and treatment process vents covered by the final MACT I rule. Process vents covered under this rule have low inorganic HAP emissions relative to organic HAP emissions. Process vents emitting inorganic HAPs are included in the MACT II rule.
- **Process Vents – MACT II Sources.** This category includes three specific process vents (catalytic cracking unit catalyst regeneration vent, catalytic reformer catalyst regeneration vent, and sulfur plant) covered by the MACT II rule.
- **Flares.** Flares are commonly used for the disposal of waste gases during process upsets (e.g., start-up, shutdown) and emergencies.
- **Blowdown Systems.** Blowdown systems permit the removal of liquids and vapors from process units in order to permit shutdown of the process unit for maintenance/repair or to prevent dangerous high temperature or high pressure conditions from occurring. A refinery blowdown system consists of valves, piping, surge vessels, etc. to allow safe transfer of process liquids or vapors out of each process unit. Because this transfer can allow the release of very concentrated air emissions, the blowdown system is usually connected to a refinery flare unit in order to destroy these high concentration air emissions.
- **Process Equipment Leaks.** Emissions occur from process equipment whenever components in the liquid or gas stream leak. Components such as pumps, valves, pressure relief valves, and flanges are potential sources that can leak due to seal failure.
- **Wastewater Treatment.** All refineries employ some form of wastewater treatment prior to discharge to the environment or reuse in the refinery. Many of these collection and treatment system units are open to the atmosphere and allow organic-containing water to contact ambient air. Emission sources from wastewater collection and treatment systems include process drains and collectors, oil-water separators, air flotation systems, and surface impound basins and ponds.
- **Cooling Water Towers.** Refineries use large quantities of water for cooling throughout the refining process. Cooling towers are used to transfer heat from the cooling water to the atmosphere. Water that enters the tower may contain hydrocarbons from leaking equipment.
- **Storage Vessels.** Storage vessels are used throughout the refining process to store crude oil and intermediate process feeds for cooling and further processing. Finished petroleum products are also kept in storage tanks before transport off-site. Tanks are equipped with either a fixed roof, an external floating roof, or an internal floating roof.
- **Loading Operations.** Crude oil is transported from production operations to a refinery by marine vessels (tankers and barges), rail tank cars, tank trucks, and pipelines. Refined petroleum products are conveyed to fuel marketing terminals and petrochemical industries by these same modes. Loading losses occur as organic vapors in empty cargo tanks are displaced to the atmosphere by the liquid being loaded into the tanks.

Table 2 identifies the 13 major petroleum refineries in the 5-state MRPO area (the Premcor refinery in Hartford, IL, was shut down in October 2002). To represent the size of each refinery, the table shows the atmospheric crude oil distillation capacity and the catalytic cracking capacity of each refiney. In 2002, these refineries accounted for about 1 percent of the anthropogenic SO2 emissions in the 5-state area, 0.7 percent of NOx emissions, and 0.3 percent of VOC emissions.

Table 3 summarizes emissions by refinery process. The catalytic cracking units are the largest sources of SO2 and PM emissions and a sizeable of NOx. Boilers and process heaters are large sources of SO2 and NOx. Sulfur recovery, flaring, and blowdown systems are also important SO2 and NOx sources.

TABLE 2 – EMISSIONS BY REFINERY

State	Refinery	Capacity (barrels/day)		2002 Annual Emissions (tons/year)			
		Crude Distillation	Catalytic Cracking	SO2	NOx	VOC	PM10
IL	Premcor*, Hartford	64,000	27,000	1,609	576	792	178
IL	Marathon Ashland, Robinson	192,000	50,000	380	1,658	1,365	364
IL	ConocoPhillips, Wood River	306,000	96,300	12,762	3,761	603	1,630
IL	Citgo Petroleum, Lemont	160,000	64,000	15,934	1,818	317	114
IL	ExxonMobil, Joliet	238,000	98,000	20,545	3,926	588	440
IN	BP Products, Whiting	410,000	165,000	6,643	10,952	1,554	954
IN	Countrymark Coop, Mt Vernon	23,000	8,200	1,431	510	657	52
MI	Marathon Ashland, Detroit	74,000	29,000	874	1,323	605	191
OH	Premcor Refining, Lima	158,400	40,000	3,138	2,131	634	312
OH	Sunoco, Toledo	160,000	70,800	8,623	1,768	638	267
OH	BP Products, Toledo	160,000	55,000	1,101	2,219	799	320
OH	Marthon Ashland, Canton	73,000	25,000	510	601	485	50
WI	Murphy Oil, Superior	33,000	11,000	1,659	537	140	170
	MRPO Total	2,051,400	739,300	75,209	31,780	9,177	5,042

*Note: The Premcor refinery in Hartford, IL, was shut down in October 2002; on July 31, 2003, ConocoPhillips purchased several assets at the Hartford refinery which is located adjacent to the Wood River refinery. Future operations at the Hartford refinery are unclear at present.

TABLE 3 – REFINERY EMISSIONS BY PROCESS

Process Type	2002 Annual Emissions (tons/year)			
	SO2	NOx	VOC	PM10
Boilers, Engines, Turbines	4,932	10,085	358	417
Process Heaters	2,555	12,391	456	460
Process Vents	1,712	267	375	191
Sulfur Recovery	4,127	33	29	3
Cracking/Coking	46,605	7,489	914	2,529
Flares	5,210	1,212	62	0
Blowdown System	325	267	95	14
Equipment Leaks	9,637	52	3,293	96
Wastewater Treatment	119	0	1,181	0
Cooling Towers	0	0	322	1,318
Storage Tanks	0	0	1,504	0
Loading Operations	0	2	565	0
MRPO Total	75,209	31,780	9,177	5,042

REGULATORY HISTORY

Petroleum refineries are governed by multiple state and federal regulations under the Titles I and III of the Clean Air Act. Attachment 1 lists the potentially applicable federal requirements. Each of these regulatory programs is discussed in the following paragraphs.

Title I regulates criteria pollutants by requiring local governments to adopt State Implementation Plans (SIPs) that set forth their strategy for achieving reductions in the particular criteria pollutant(s) for which they are out of attainment. The SIP requirements includes Reasonably Available Control Technology (RACT) requirements, but more stringent requirements may be imposed depending on both the locale's degree of nonattainment with ambient air standards and the local air quality impacts. The MRPO States have developed regulations limiting emissions from refineries based in part on the Control Technique Guidelines (CTGs) or Alternative Control Techniques (ACT) documents developed by EPA, or case-by-case RACT determinations.

Another element of the SIP was finalized by EPA in the NOx SIP in 1998. The final version of the rule called for NOx emission reductions in twenty-two states (including Ohio, Indiana, Illinois, and the southern half of Michigan, but not Wisconsin) that contributed to 1-hour ozone nonattainment in other states. The rule required affected states to amend their SIPs and limit NOx emissions. EPA set an ozone season NOx budget for each affected state, essentially a cap on emissions from May 1 to September 30 in the state. The cap results in about a 30 percent reduction from statewide baseline emissions. The first control period was scheduled for the 2004 ozone season. States adopted a NOx emissions trading program and assigned 5-month ozone season NOx allowances for large ICI boilers in the NOx SIP call region, including units at several refineries in MRPO region.

Title I also imposes New Source Performance Standards (NSPS) on certain specified categories of new and modified large stationary sources. There are NSPS that affect the petroleum refining industry. Most of these standards were developed during the 1980s, and may or may not be applicable to a particular refinery depending on whether it has been modified since the adoption of the NSPS. The USEPA is in the process of revising and updating NSPS standards. For example, in 2005 USEPA proposed revisions to the NSPS for stationary combustion turbines and boilers.

Title I also subjects new and modified large stationary sources that increase their emissions to permitting requirements that impose control technologies of varying levels of stringency (known as New Source Review, or NSR). NSR prescribes control technologies for new plants and for plant modifications that result in a significant increase in emissions, subjecting them to Best Available Control Technology (BACT) in attainment areas and to the Lowest Achievable Emission Rate (LAER) in nonattainment areas. The control strategies that constitute BACT and LAER evolve over time and are reviewed on a case-by-case basis in state permitting proceedings.

EPA has also published several final rules under Title III of the CAA to substantially reduce emissions of toxic air pollutants from petroleum refineries. These Maximum Achievable Control Technology (MACT) standards apply to major sources of hazardous air pollutants (HAPs). The petroleum refinery MACT (Subpart CC) was promulgated in 1995, and most of its requirements affecting primarily organic HAP sources have already been implemented. Several other MACT standards became effective in the 1990s that affected specific refinery processes such as cooling towers and fuel storage/transfer.

Additional MACT standards may result in post-2002 emission reductions. These MACT standards include the petroleum refinery MACT II (Subpart UUU – catalytic cracking, catalytic reforming, sulfur plant units), ICI boilers and heaters, organic liquids distribution (non-gasoline), reciprocating engines, stationary combustion turbines, and remediation sites. While designed to reduce HAP emissions, the

requirements of the post-2002 MACT standard may require control technologies that reduce both the level of HAP emitted from affected sources and also the VOC and PM, and to a lesser extent, SO2 emissions.

On June 15, 2005, EPA issued final amendments to its July 1999 regional haze rule. These amendments require emissions controls known as best available retrofit technology or BART for industrial facilities emitting air pollutants that reduce visibility. The BART requirements of the regional haze rule apply to facilities built between 1962 and 1977 that have the potential to emit more than 250 tons a year of visibility-impairing pollutants. Those facilities fall into 26 categories, including petroleum refineries. Some of these facilities previously have not been subject to pollution control requirements for these pollutants. Under the final BART guidelines, states are required to conduct source-by-source BART determinations to identify which facilities must install controls and the type of controls to be used.

EPA's national Petroleum Refinery Initiative is an integrated enforcement and compliance strategy to address air emissions from the nation's petroleum refineries. Since March 2000, the agency has entered into 17 settlements with U.S. companies that refine nearly 77 percent of the nation's petroleum. Both EPA and State/local agencies have negotiated settlements that will require significant investment in pollution control technology and will result in emission reductions in the future. Listed below are the recent enforcement settlements under EPA's Petroleum Refinery Initiative that affect petroleum refineries in the MRPO region:

Settlement Company	**Lodging Date**	**MRPO Refineries Affected by Action**
ExxonMobil	10/11/2005	Joliet, IL
Sunoco	6/16/2005	Toledo, OH
Conoco Phillips	1/27/2005	Wood River, IL
CITGO	10/6/2004	Lemont, IL
Murphy Oil	1/24/2002	Superior, WI
Premcor	7/12/2001	Hartford, IL
Marathon Ashland	5/11/2001	Robinson, IL Detroit, MI Canton, OH
BP Amoco	1/19/2001	Whiting, IN Toledo, OH
Countrymark Coop	n/a	Mount Vernon, IN
Premcor	n/a	Lima, OH

The major refinery sources that are affected by the judicial settlements are: FCCUs/ (FCUs), process heaters and boilers, sulfur recovery plants, flare gas recovery, equipment leaks, and wastewater treatment.

CANDIDATE CONTROL MEASURES

The "on-the-books" refinery enforcement settlements will result in substantial reductions of SO2 and NOx from refineries in the MRPO region, with smaller amounts of VOC and PM reductions. No additional candidate control measures have been analyzed at this time. Possible candidate control measures for further investigation include requirements more stringent than those required by the settlements, applying the controls required by the settlements to the two refineries not affected by the enforcement actions (Premcor, Lima, OH; and Countrymark, Mount Vernon, IN), and further control of

VOC emissions from equipment leaks, wastewater treatment, cooling towers, storage tanks, and fuel loading operations.

In general, the refinery consent decrees required the following types of emission controls:

Process Type	**Typical Settlement Control Requirements**
Boilers and Heaters	NOx Control: SCR/SNCR/Ultra-low NOx burners SO2 Control: Elimination of fuel oil burning
Catalytic Cracking Units	NOx Control: SCR/SNCR; NOx combustion promotor SO2 Control: Wet Gas Scrubber or SO2 Adsorbing Catalyst PM Control: Wet Gas Scrubber
Flaring	NSPS compliance, root cause analysis, corrective actions, flare gas recovery
Equipment Leaks	Implement enhanced LDAR, increase training, increase monitoring frequency
Sulfur Recovery	Install new sulfur recovery units and tail gas control devices

Attachments 2 and 3 summarize the settlement requirements for FCCUs and boilers/heaters.

EMISSION REDUCTIONS

We estimated the emission reductions expected from implementation of the refinery enforcement settlements and post-2002 MACT standards in the following manner:

1. Obtained 2002 actual emissions from the MRPO's Base J 2002 inventory.
2. Used the post-2002 MACT control factors developed by E.H. Pechan.
3. For FCCUs required to install wet gas scrubbers, used a 90% SO2 control efficiency; for FCCUs required to use catalyst additives, used a 50% SO2 control efficiency.
4. For FCCU NOx emissions, used a 90% control efficiency for units required to install SCR; a 60% control efficiency for units required to install SNCR, thermal Denox; or Low-TOX system, and a 45% control efficiency use of NOx combustion promoters and catalyst additives.
5. For boiler/heater NOx reductions, used the company-wide emission reductions specified in the consent order to develop a control efficiency for each refinery for all heaters/boilers greater than 40 mmBtu/hr as identified in the consent order.
6. For boiler/heater SO2 reductions, used a 100% control efficiency when fuel oil was to be eliminated and a 90% control efficiency for compliance was required with NSPS limits.
7. For SRUs where new controls were required, used a 90% SO2 control efficiency (this is in addition to the Claus Process).
8. Calculated the emission reductions from the above controls for 2009 and 2012, depending on the compliance date specified in the consent order.

Tables 4a-4d summarize the actual annual emissions for 2002, the estimated emission reductions and remaining emissions in 2009, and the estimated emission reductions and remaining emissions in 2012.

While the other requirements of the settlements are expected to produce additional emission reductions beyond those applied to FCCUs/FCUs and boilers and heaters, we did not incorporate these emission reductions in our emission projections. The flare gas recovery, leak detection and repair, and benzene/wastewater requirements are expected to produce less significant changes in criteria air pollutant emissions, plus these are source types for which the 2002 emissions estimates are expected to be much more uncertain than they are for the combustion categories.

TABLE 4a
COMPARISON OF ACTUAL AND PROJECTED SO2 EMISSIONS

		Annual SO2 Emissions (tons per year)				
State	**Refinery**	**2002**	**Reduction from 2002 by 2009**	**2009 Remaining**	**Reduction from 2002 by 2012**	**2012 Remaining**
IL	Marathon Ashland, Robinson	380	0	380	0	380
IL	Premcor*, Hartford	1,609	1,609	0	1,609	0
IL	ConocoPhillips, Wood River	12,762	5,216	7,546	10,915	1,847
IL	Citgo Petroleum, Lemont	15,934	11,573	4,361	11,573	4,361
IL	ExxonMobil, Joliet	20,545	17,203	3,342	17,203	3,342
IN	BP Products, Whiting	6,643	5,420	1,223	5,420	1,223
IN	Countrymark Coop, Mt Vernon	1,431	0	1,431	0	1,431
MI	Marathon Ashland, Detroit	879	292	587	292	587
OH	Premcor Refining, Lima	3,138	0	3,138	0	3,138
OH	Sunoco, Toledo	8,623	7,606	1,017	7,606	1,017
OH	BP Products, Toledo	1,101	473	628	473	628
OH	Marthon Ashland, Canton	510	338	172	338	172
WI	Murphy Oil, Superior	1,668	212	1,456	212	1,456
	MRPO Total	**75,223**	**49,942**	**25,281**	**55,641**	**19,582**

TABLE 4b
COMPARISON OF ACTUAL AND PROJECTED NOx EMISSIONS

		Annual NOx Emissions (tons per year)				
State	**Refinery**	**2002**	**Reduction from 2002 by 2009**	**2009 Remaining**	**Reduction from 2002 by 2012**	**2012 Remaining**
IL	Marathon Ashland, Robinson	1,664	777	887	777	887
IL	Premcor*, Hartford	580	580	0	580	0
IL	ConocoPhillips, Wood River	3,773	0	3,773	1,824	1,949
IL	Citgo Petroleum, Lemont	1,826	456	1,370	761	1,065
IL	ExxonMobil, Joliet	3,937	0	3,937	2,086	1,851
IN	BP Products, Whiting	10,952	5,300	5,652	5,300	5,652
IN	Countrymark Coop, Mt Vernon	510	0	510	0	510
MI	Marathon Ashland, Detroit	1,330	431	899	431	899
OH	Premcor Refining, Lima	2,131	0	2,131	0	2,131
OH	Sunoco, Toledo	1,768	388	1,380	815	953
OH	BP Products, Toledo	2,220	1,103	1,117	1,103	1,117
OH	Marthon Ashland, Canton	601	264	337	264	337
WI	Murphy Oil, Superior	539	0	539	0	539
	MRPO Total	**31,831**	**9,299**	**22,532**	**13,941**	**17,890**

TABLE 4c
COMPARISON OF ACTUAL AND PROJECTED PM10 EMISSIONS

		Annual PM10 Emissions (tons per year)				
State	**Refinery**	**2002**	**Reduction from 2002 by 2009**	**2009 Remaining**	**Reduction from 2002 by 2012**	**2012 Remaining**
IL	Marathon Ashland, Robinson	354	0	354	0	354
IL	Premcor*, Hartford	173	173	0	173	0
IL	ConocoPhillips, Wood River	1,609	272	1,337	605	1,004
IL	Citgo Petroleum, Lemont	105	68	37	68	37
IL	ExxonMobil, Joliet	435	334	101	334	101
IN	BP Products, Whiting	948	265	683	265	683
IN	Countrymark Coop, Mt Vernon	48	0	48	0	48
MI	Marathon Ashland, Detroit	187	159	28	159	28
OH	Premcor Refining, Lima	308	0	308	0	308
OH	Sunoco, Toledo	260	181	79	181	79
OH	BP Products, Toledo	312	0	312	0	312
OH	Marthon Ashland, Canton	44	17	27	17	27
WI	Murphy Oil, Superior	171	0	171	0	171
	MRPO Total	**4,954**	**1,469**	**3,485**	**1,802**	**3,152**

TABLE 4d
COMPARISON OF ACTUAL AND PROJECTED VOC EMISSIONS

		Annual VOC Emissions (tons per year)				
State	**Refinery**	**2002**	**Reduction from 2002 by 2009**	**2009 Remaining**	**Reduction from 2002 by 2012**	**2012 Remaining**
IL	Marathon Ashland, Robinson	1,369	98	1,271	98	1,271
IL	Premcor*, Hartford	795	795	0	795	0
IL	ConocoPhillips, Wood River	605	10	595	10	595
IL	Citgo Petroleum, Lemont	317	6	311	6	311
IL	ExxonMobil, Joliet	589	18	571	18	571
IN	BP Products, Whiting	1,554	51	1,503	51	1,503
IN	Countrymark Coop, Mt Vernon	658	121	537	121	537
MI	Marathon Ashland, Detroit	609	18	591	18	591
OH	Premcor Refining, Lima	634	0	634	0	634
OH	Sunoco, Toledo	638	5	633	5	633
OH	BP Products, Toledo	799	3	796	3	796
OH	Marthon Ashland, Canton	486	4	482	4	482
WI	Murphy Oil, Superior	176	0	176	0	176
	MRPO Total	**9,229**	**1,129**	**8,100**	**1,129**	**8,100**

Note: The VOC reductions shown result from the shutdown of the Premcor-Hartford refinery and implementation of post-2002 MACT standards. Additional VOC reductions will result from the enhanced LDAR and other provisions in the refinery consent orders. However, the quantity of these additional reductions is difficult to quantify. It is anticipated that the VOC emission reductions may be on the order of 100 tpy or greater depending on the facility.

COST EFECTIVENESS AND BASIS

Cost-effectiveness was not evaluated as detailed information on the cost-effectiveness of the requirements in the consent orders is not available.

TIMING OF IMPLEMENTATION

Each of the consent orders from the petroleum refinery settlements provides a unique timetable for implement the emission reduction requirements. A few of the settlements were signed in 2001 and most of the requirements for affected FCCUs and heaters/boilers will have to be met prior to 2009. Other settlements were not signed until 2005, and the compliance date for achieving the specified emission can be as late of 2012. We used the information in the consent decrees to make our best estimate of when the emission reductions for each refinery might be achieved, noting that there is some uncertainty with the timing of the emission reductions.

RULE DEVELOPMENT ISSUES

Implementation of and compliance with the consent orders will achieve the emission reductions identified in this paper.

GEOGRAPHIC APPLICABILITY

The anticipated emission reductions would occur at refineries throughout the MRPO region, not just in nonattainment areas.

AFFECTED SCCs

The primary SCCs affected by this candidate control measure are:

1-02-xxx-xx	External Combustion, Industrial Boilers
3-01-032-xx	Elemental Sulfur Production
3-06-001-xx	Petroleum Refinery Process Heaters
3-06-002-01	Fluid Catalytic Cracking Units
3-06-009-xx	Petroleum Refinery Flares

For modeling purposes, we have identified specific sources in the 2002 inventory for which we will develop control factors. These sources are those FCCUs, boilers/heaters, SRUs and flares that have been identified in the various consent decrees.

REFERENCES

1. Air and Waste Management Association (edited by Anthony J. Buonicore and Wayne T. Davis). *Air Pollution Engineering Manual*. 1992.
2. Energy Information Agency. *Petroleum Supply Annual 2004: Table 38 Capacity of Operable Petroleum Refineries by State as of January 1, 2005*.
3. U.S. EPA. *National Petroleum Refinery Enforcement Initiative*. Web site: http://www.epa.gov/compliance/resources/cases/civil/caa/oil/

Attachment 1 – Potentially Applicable Federal Requirements for the Petroleum Refining Industry

Name	Subpart	Effective Date
CONTROL TECHNOLOGY GUIDELINES (CTGs)		
Storage of Petroleum Liquids in Fixed Roof Tanks		1977
Refinery Vacuum Producing Systems, Wastewater Separators, and Process Unit Turnarounds		1977
Tank Truck Gasoline Loading Terminals		1977
Leaks from Petroleum Refinery Equipment		1978
Petroleum Liquid Storage in External Floating Roof Tanks		1978
SOCMI Air Oxidation Processes		1984
ALTERNATIVE CONTROL TECHNIQUES (ACT) DOCUMENTS		
Process Heaters		1993
Stationary Gas Turbines		1993
ICI Boilers		1994
Utility Boilers		1994
Internal Combustion Engines		1993
NEW SOURCE PERFORMANCE STANDARDS (NSPS) PART 60		
General Provisions	A	1970s
Sulfuric Acid Production Plants	Cd	1991
Fossil Fuel Fired Steam Generators Constructed After 8/17/71	D	1977
Electric Utility Steam Generating Units Constructed After 9/18/79	Da	1978
ICI Steam Generating Units	Db	1987
Small ICI Steam Generating Units	Dc	1990
Sulfuric Acid Plants	H	1977
Petroleum Refineries	J	1978
Storage Vessels for Petroleum Liquids Constructed Between 6/11/73 and 5/19/78	K	1977
Storage Vessels for Petroleum Liquids Constructed Between 5/18/78 and 7/23/84	Ka	1980
Organic Liquid Storage Vessels (including Petroleum Liquid Storage Vessels) Constructed After 7/23/1984	Kb	1987
Stationary Gas Turbines	GG	1978
Asphalt Processing and Asphalt Roofing Manufacture	UU	1982
Equipment Leaks - SOCMI	VV	1983
Bulk Gasoline Terminals	XX	1983

Name	Subpart	Effective Date
NEW SOURCE PERFORMANCE STANDARDS (NSPS) PART 60 (continued)		
Equipment Leaks of VOC in Petroleum Refineries	GGG	1984
VOC Emissions from SOCMI Air Oxidation Unit Processes	III	1990
VOC Emissions from SOCMI Distillation Operations	NNN	1990
VOC Emissions from Petroleum Refinery Wastewater Systems	QQQ	1988
VOC Emissions from SOCMI Reactor Processes	RRR	1993
Commercial and Industrial Solid Waste Incineration Units	CCCC	2001
NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP) PART 61		
General Provisions	A	1973
Equipment Leaks of Benzene	J	Mid-1980s
Asbestos	M	1984
Equipment Leaks	V	Mid-1980s
Benzene Storage Vessels	Y	Mid-1980s
Benzene Transfer Operations	BB	Mid-1980s
Benzene Waste Operations	FF	1993
NESHAP FOR SOURCE CATEGORIES PART 63		
General Provisions	A	1994
Control Technology Determinations	B	1994
SOCMI Industry	F	1994
SOCMI Industry for Process Vents, Storage Vessels, Transfer Operations, and Wastewater	G	1994
Equipment Leaks	H	1994
Certain Processes Subject to the Negotiated Regulation for Equipment Leaks	I	1994
Industrial Cooling Towers	Q	1994
Gasoline Distribution Facilities (Bulk Gasoline Terminals and Pipeline Breakout Stations)	R	1994
Halogenated Solvent Cleaning	T	1994
Marine Tank Vessel Loading Operations	Y	1995
Petroleum Refineries (MACT I)	CC	1995
Hazardous Waste Combustors	EEE	1999
Petroleum Refineries (MACT II – catalytic cracking, catalytic reforming, sulfur plant units)	UUU	2002
Asphalt Processing and Asphalt Roofing Manufacturing	LLLLL	2003
ICI Boilers and Process Heaters	DDDDD	2004

Name	**Subpart**	**Effective Date**
Site Remediation	GGGGG	2003
Organic Liquids Distribution (non gasoline)	EEEE	2004
Misc. Organic Chemical Manufacturing	FFFF	2003
Reciprocating Internal Combustion Engines	ZZZZ	2004
Stationary Combustion Turbines	YYYY	2004

Attachment 2 - Summary of Recent Enforcement Settlements for FCCUs

Refiney/FCCU	Required NOx Controls or Emission Limitation	Required SO2 Controls or Emission Limitation	Required PM Controls or Emission Limitation
Premcor* Hartford IL EU=0074	Apply for new source permits prior to re-start	Apply for new source permits prior to re-start	Apply for new source permits prior to re-start
Marathon Ashland Robinson IL EU=0043	Low-NOx combustion promotor by March 31,2002; SNCR at Robinson, Garyville or Detroit by Dec. 31, 2005	Operate existing wet gas scrubber	Comply with NSPS
ConocoPhillips Wood River IL EU=0043 Unit#1	Scrubber-based NOx emission reduction technology by Dec. 31, 2010	Wet gas scrubber by Dec. 31, 2008	Wet gas scrubber by Dec. 31, 2008
ConocoPhillips Wood River IL EU=0047 Unit#2	Enhanced SNCR by Dec. 31, 2012	Wet gas scrubber by Dec. 31, 2012	Wet gas scrubber by Dec. 31, 2012
Citgo Petroleum Lemont IL EU=0007	Low-NOx combustion promoter by Dec. 31, 2009	Wet gas scrubber by Dec. 31, 2007	Wet gas scrubber by Dec. 31, 2007
ExxonMobil Joliet IL EU=0015	SCR by Dec. 31, 2012	Wet gas scrubber by Dec. 31, 2008	Wet gas scrubber by Dec. 31, 2008
BP Products Whiting IN EU=003 FCCU500	Low-NOx combustion promoter and catalyst additive by March 31, 2002	Wet gas scrubber by 2006	Wet gas scrubber by 2006
BP Products Whiting IN EU=017 FCCU600	SCR in calendar year 2003	SO2 adsorbing catalyst by June 30, 2003	Nothing specified
Countrymark Coop Mt Vernon IN EU=010	Not subject to enforcement	Not subject to enforcement	Not subject to enforcement
Marathon Ashland Detroit MI EU=EU0111	Low-NOx combustion promotor by March 31,2002; SNCR or equivalent at either Robinson, Garyville or Detroit by Dec. 31, 2005	SO2 Adsorbing catalyst additive beginning March 30, 2002	Electrostatic precipitator by Dec. 31, 2005
Premcor Refining Lima OH EU=P010	Not subject to enforcement	Not subject to enforcement	Not subject to enforcement
Sunoco Toledo OH EU=P011	SCR by Dec. 31, 2009	Wet gas scrubber by Dec. 31, 2009.	Wet gas scrubber by Dec. 31, 2009
BP Products Toledo OH EU=P007	SNCR in 2003	SO2 adsorbing catalyst by June 30, 2001	Electrostatic precipitator by 2007
Marthon Ashland Canton OH EU=P002	Low-NOx combustion promotor by March 31, 2002	SO2 adsorbing catalyst additive beginning March 30, 2002	Electrostatic precipitator by Dec. 31, 2005
Murphy Oil Superior WI EU=P31	Nothing specified	Use SOx transfer catalyst and limit emissions to 34.7 tons/month by May 1, 2002	Nothing specified

Attachment 3 - Summary of Recent Enforcement Settlements for Boilers/Heaters

Refiney/FCCU	Required NOx Controls or Emission Limitation	Required SO2 Controls or Emission Limitation
Premcor* Hartford IL	Apply for new source permits prior to re-start	Apply for new source permits prior to re-start
Marathon Ashland Robinson IL	Use qualifying controls (SCR, SNCR, Low-NOx Burners, other technologies, shutdowns) to reduce NOx from units >40 mmBtu/hr by 45% by Dec. 31, 2008 across 7 refineries	Discontinue or reduce burning of fuel oil in all heaters and boilers by April 1, 2003
ConocoPhillips Wood River IL	Use qualifying controls (SCR, SNCR, Low-NOx Burners, other technologies, shutdowns) to reduce NOx from units >40 mmBtu/hr by 45% by Dec. 31, 2012 across 9 refineries	Effective on entry date, shall not burn fuel oil in any combustion unit
Citgo Petroleum Lemont IL	Reduce NOx emissions from the heaters and boilers > 40 mmBtu/hr by 50% by June 30, 2011	Effective on entry date, shall not burn fuel oil in any combustion unit
ExxonMobil Joliet IL	Use qualifying controls (SCR, SNCR, Low-NOx Burners, other technologies, shutdowns) to reduce NOx from units >40 mmBtu/hr by 41% by Sept. 30, 2010 across 6 refineries	Effective on entry date, shall not burn fuel oil in any combustion unit
BP Products Whiting IN	Use qualifying controls to reduce emissions by 9.632 tpy across 8 refineries by Jan. 2005	Eliminate all fuel oil burning at heaters and boilers by June 1, 2003
Countrymark Coop Mt Vernon IN	Not subject to enforcement	Not subject to enforcement
Marathon Ashland Detroit MI	Use qualifying controls (SCR, SNCR, Low-NOx Burners, other technologies, shutdowns) to reduce NOx from units >40 mmBtu/hr by 45% by Dec. 31, 2008 across 7 refineries	Discontinue or reduce burning of fuel oil in all heaters and boilers by Dec. 31, 2003
Premcor Refining Lima OH	Not subject to enforcement	Not subject to enforcement
Sunoco Toledo OH	Use qualifying controls (SCR, SNCR, Low-NOx Burners, other technologies, shutdowns) to reduce NOx from units >40 mmBtu/hr by 41% by May 2013 across 4 refineries	Effective on entry date, shall not burn fuel oil in any combustion unit
BP Products Toledo OH	Use qualifying controls to reduce emissions by 9.632 tpy across 8 refineries by Jan. 2005	Restrict H2S in refinery fuel gas
Marthon Ashland Canton OH	Use qualifying controls (SCR, SNCR, Low-NOx Burners, other technologies, shutdowns) to reduce NOx from units >40 mmBtu/hr by 45% by Dec. 31, 2008 across 7 refineries	Discontinue or reduce burning of fuel oil in all heaters and boilers by April 30, 2003
Murphy Oil Superior WI	Nothing specified	Reduce emissions to 33.3 tons per month from boilers and process heaters