Source Category: Airport Related Activities

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 candidate control measure for airport related activities.

TABLE 1 – CONTROL MEASURE SUMMARY FOR GROUND SERVICE EQUIPMENT

Control Measure Summary	**NO_x Emissions (tons/year) in 5-State MRPO Region**	
2002 existing measure: None Identified	2002 Base:	1,266
2009 On-the-Books measures: None identified	Reduction: 2009 Remaining:	-0 1,266
Candidate measure: Convert or replace gasoline and diesel GSE engines to alternative fuels *Measure ID:* GSE01 *Emission Reductions*: 90% reduction of NOx emissions over a ten year period *Control Cost*: Varies from cost savings to $5,800 per ton, depending upon the type of equipment being replaced *Timing of Implementation*: 25% reduction by 2009, 50% reduction by 2012, and 90% reduction by 2018 *Implementation Area*: primarily large metropolitan areas in the 5-state MRPO region	2002 Base: 2009 Reduction: 2009 Remaining: 2012 Reduction: 2012 Remaining: 2018 Reduction: 2018 Remaining:	1,266 -316 949 -633 633 -1,139 127

SOURCE CATEGORY DESCRIPTION

Airport related activities include aircraft (military, commercial, general aviation, and air taxi), auxiliary power units, ground service equipment, ground access vehicles, and stationary sources (boilers, aircraft and vehicle refueling stations). Most aircraft emissions are emitted during the landing-takeoff cycle (LTO), where the aircraft makes it initial approach, taxis to the gate and idles, takes-off, and climbs out. Emissions are calculated using a formula that includes the pollutant emission factor, fuel flow per engine, each LTO time-in-mode, total number of aircraft engines onboard, and the number of total LTOs. Auxiliary power units (APU) are small engines that provide electricity and conditioned air to aircraft while parked at the gate, and provides auxiliary power in the even of failure during flight. Ground service equipment (GSE) includes a variety of equipment that facilitates passenger access, aircraft flight preparation, and aircraft maintenance. Another important air pollution source at airports are ground access vehicles (GAV). GAV account for airport-related trips, including commercial vehicles that serve the airport (taxis, rental cars, buses, and shuttles), employee ad passenger private vehicles, and cargo vehicles for deliveries.

Table 2 summarizes the LADCO airport emission inventory by state and category. GAV at airports are not separated out as a distinct category in the LADCO inventory, but are included only in a general manner in the LADCO mobile source inventory. As an example of the relative importance of emissions from airport-related vehicle traffic, Table 3 provides a summary of the 2002 emission inventory for O'Hare International Airport, which specifically quantifies emissions from vehicles on airport roadways.

REGULATORY HISTORY

The U.S. Environmental Protection Agency (EPA) has conducted several rulemakings establishing emission standards and related requirements for several classes (commercial and general aviation engines) of aircraft and aircraft engines. In 1974, standard were issued for engine smoke (which have revised several times since) and fuel venting; in 1984, hydrocarbon emission standards were issued; in 1997 for NOx and carbon monoxide; and in 2005 additional NOx emission standards were finalized. The new standard for NOx emissions is expected to have a very small impact on reducing NOx emissions.

EPA has historically worked with the Federal Aviation Administration (FAA) and International Civil Aviation Organization (ICAO) in the development of international aircraft emission standards. The FAA is responsible for enforcing the aircraft emissions standards established by EPA. ICAO was established by the United Nations to ensure safety, equality, and consistency among international air transport services. One of ICAO's objectives is to lead international bodies in the development of standards and procedures for aircraft engines. The EPA has generally adopted the standards recommended by ICAO as the applicable federal standards in the U.S.

The *Vision 100—Century of Aviation Reauthorization Act* (*Vision 100*), signed into law in December 2003, established a voluntary program to reduce airport ground emissions at commercial service airports in air quality nonattainment and maintenance areas. The new provisions are intended to help airports meet their obligations under the Clean Air Act (CAA) and to assist regional efforts to meet health-based National Ambient Air Quality Standards (NAAQS). *Vision 100* directs the Federal Aviation Administration (FAA) to issue guidance describing eligible airport low-emission modifications and improvements and how airport sponsors should demonstrate program benefits. Developed in consultation with the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE), this guidance discusses program eligibility for converting vehicles to alternative and clean conventional fuels and for obtaining related infrastructure improvements.

TABLE 2 – SUMMARY OF LADCO 2002 AIRPORT EMISSION INVENTORY

			2002 Annual Emissions (tons per year)				
State	**SCC**	**SCC Description**	**CO**	**NOX**	**PM2.5**	**SO2**	**VOC**
IL	2265008005	GSE: Gasoline	507	17	0	0	20
IL	2267008005	GSE: LPG	70	18	0	0	5
IL	2270008005	GSE: Diesel	281	604	46	80	51
IL	2275001000	Aircraft: Military	462	2	5	0	19
IL	2275020000	Aircraft: Commercial	5,238	4,654	0	432	842
IL	2275050000	Aircraft: General Aviation	2,076	8	23	1	61
IL	2275060000	Aircraft: Air Taxi	2,930	14	40	0	125
IL	2501080050	Aviation Gas Refueling	0	0	0	0	312
		Total for Illinois	**11,564**	**5,316**	**115**	**514**	**1,436**
IN	2265008005	GSE: Gasoline	148	4	0	0	6
IN	2267008005	GSE: LPG	18	5	0	0	1
IN	2270008005	GSE: Diesel	69	150	11	20	13
IN	2275001000	Aircraft: Military	186	0	2	0	7
IN	2275020000	Aircraft: Commercial	845	728	0	69	131
IN	2275050000	Aircraft: General Aviation	862	3	9	0	25
IN	2275060000	Aircraft: Air Taxi	1,504	7	20	0	62
IN	2501080050	Aviation Gas Refueling	0	0	0	0	788
		Total for Indiana	**3,634**	**896**	**43**	**89**	**1,032**
MI	2265008005	GSE: Gasoline	298	6	0	0	11
MI	2267008005	GSE: LPG	34	9	0	0	2
MI	2270008005	GSE: Diesel	125	269	20	36	23
MI	2275001000	Aircraft: Military	421	2	5	0	19
MI	2275020000	Aircraft: Commercial	2,247	1,944	0	184	350
MI	2275050000	Aircraft: General Aviation	2,070	8	25	1	61
MI	2275060000	Aircraft: Air Taxi	2,963	14	42	1	127
MI	2501080050	Aviation Gas Refueling	0	0	0	0	34
		Total for Michigan	**8,159**	**2,251**	**92**	**222**	**625**
OH	2265008005	GSE: Gasoline	150	4	0	0	6
OH	2267008005	GSE: LPG	18	5	0	0	1
OH	2270008005	GSE: Diesel	75	162	12	22	14
OH	2275001000	Aircraft: Military	663	2	8	0	29
OH	2275020000	Aircraft: Commercial	1,521	1,312	0	125	237
OH	2275050000	Aircraft: General Aviation	1,601	6	19	0	45
OH	2275060000	Aircraft: Air Taxi	3,714	18	52	1	134
OH	2501080050	Aviation Gas Refueling	0	0	0	0	0
		Total for Ohio	**7,741**	**1,508**	**92**	**148**	**465**
WI	2265008005	GSE: Gasoline	55	2	0	0	2
WI	2267008005	GSE: LPG	8	2	0	0	1
WI	2270008005	GSE: Diesel	23	50	4	7	4
WI	2275001000	Aircraft: Military	445	2	6	0	20
WI	2275020000	Aircraft: Commercial	719	619	0	58	111
WI	2275050000	Aircraft: General Aviation	1,426	5	16	0	41
WI	2275060000	Aircraft: Air Taxi	1,555	6	19	0	64
WI	2501080050	Aviation Gas Refueling	0	0	0	0	821
		Total for Wisconsin	**4,231**	**685**	**45**	**66**	**1,064**
		Total for MRPO States	**35,329**	**10,656**	**385**	**1,038**	**4,622**

Source: Data are from EPA's 2002 Draft National Emission Inventory
Note: Neither EPA's nor LADCO's emission inventory explicitly includes emissions from ground access vehicles at airports. Emissions from these sources are included more generally in the mobile source inventory.

TABLE 3 – 2002 EMISSION INVENTORY FOR O'HARE INTERNATIONAL AIRPORT

	2002 Annual Emissions (tons per year)				
Source Category	**CO**	**NOX**	**PM2.5**	**SO2**	**VOC**
Aircraft (a)	4,052	3,956	53	340	424
GSE/APU	9,083	479	10	36	414
Roadways	15,698	2,134	43	66	1,149
Parking Lots	68	10	<1	<1	11
Stationary Sources	42	50	4	<1	23
Training Fires	4	1	15	<1	2
Total for Airport	**28,947**	**6,629**	**124**	**443**	**2,023**

Source: Chicago O'Hare International Airport Final Environmental Impact Statement (EIS), Chapter 5 Environmental Consequences, July 2005
(a) Includes VOC emissions from aircraft refueling activities

The FAA has initiated a new Voluntary Airport Low Emissions (VALE) program to allow airport sponsors to finance low-emission vehicles, refueling and recharging stations, gate electrification, and other measures.

States have limited authority to require emission reductions from airport sources. The Clean Air Act (CAA) generally preempts states from regulating emissions from aircraft engines. Likewise, the CAA generally restricts the states ability to regulate emission standards for motor vehicles (including airport ground access vehicles) and from nonroad engines (including airport ground support equipment). However, states and airport operators have initiated a variety of both regulatory and voluntary programs to control airport related emissions. For example,

- The operators of Logan International Airport (Massport) have established an emission cap for airport emissions – any emission increases that result from airport activity must be offset by on-airport emission reductions, reductions near the airport, or by purchasing credits.
- The Texas Commission on Environment Quality (TCEQ) adopted a SIP revision requiring the Dallas Fort Worth (DFW) Airport to reduce NOx emissions by 90 percent from GSE over an 8-year period.
- The California Air Resources Board (CARB) has been regulating new airport ground support equipment since 2001, when it adopted emission standards to be phased in over time applicable to new off-road GSE powered by internal combustion engines.

Refer to the NESCAUM report (Reference 1) and FAA guidance (Reference 2) for a full discussion of the regulatory context and policy options for states to control airport-related emissions.

CANDIDATE CONTROL MEASURES

The NESCAUM report identified a number of options for reducing emissions at airports and examined the constraints, potential emission reductions, and the costs associated with these options. For each category of emissions at the airport, the report identified technological measures (such as engine improvements, electrification of support equipment, alternative fuels) and operational control options (such as congestion management, and changes in taxiing, takeoff, and landing procedures). Options identified in the NESCAUM report below are summarized in Table 4.

TABLE 4 – OPTIONS TO REDUCE EMISSIONS AT AIRPORTS

Option Type	Emission Source	Control Option	Description
Technology	Aircraft Engines	Cleaner Engines	Develop cleaner technologies for new aircraft engines and retrofits for existing engines
	Ground Support Equipment (GSE)	Alternative Fuels	Convert gasoline or diesel powered GSE to electricity or cleaner burning alternative fuels such as LPG or CNG
		Gate Electrication	Install gate-based electrical equipment to eliminate on-site emissions from mobile GSE
		Retrofits and Fuel Improvement	Install particulate filters and oxidation catalysts
	Ground Access Vehicles	Alternative Fuels	Promote use CNG-powered or hybrid taxis, rental cars, buses, and shuttles
Operations	Aircraft Engines	Improved Airline Efficiency	Maximize number of passengers on each flight to minimize emissions per passenger
		Reduced Taxi Time	Dispatch towing to move aircraft from gate to runway more efficiently; decentralize gates, ground congestion reduction measures
		Minimized Engine Use	Minimize use in low-power modes during taxi/landing; derated takeoff and minimized use of reverse thrust to slow the aircraft
	Ground Access Vehicles	Reduced Employee Trips	Encourage employees to choose transportation options (car pools, bus, rail) to reduce employee VMT
		Reduced Passenger Trips	Encourage passengers to choose public transport as alternatives to taxi, rental car, and private car trips
		Reduced Congestion	Implement strategies to reduce idling and to improve the efficiency of traffic flow

Due to the variety of emissions sources at airports and strategies available for reducing emissions (and some of the legal barriers which preempt states from regulation aircraft engine emissions), it is difficult to prescribe a particular control measures that is appropriate for any individual airport or for the various types of equipment, operations, and functions. While cost-effective technical and operational options are available to reduce emissions from all airport sources, the feasibility of the different measures can vary from airport to airport. For example, installing electrified gates can be done more easily at newer airports than at older airports.

Some of the most cost effective options outlined in the NESCAUM report are reducing NOx emissions through GSE and GAV electrification or use of alternative fuels. For this White Paper, we are suggesting that NOx emissions from GSE can be reduced by up to 90 percent over a ten-year period after adoption of the measure. This is similar to the reductions expected to occur from the Memorandum of Agreement

between the DFW Airport and TCEQ. For the purposes of this White Paper, we are suggesting a candidate control measure based on the use of a cap-and-trade or "bubble" program to allow flexibility in how and where emissions reductions occur at a particular airport.

Measure GSE1 – Convert or Replace Gasoline and Diesel GSE Engines to Alternative Fuels or Electricity. This measure will encourage (or require) airports in the MRPO region to reduce their NOx emissions from GSE by 90 percent over the next 10 years. The airports may choose their own means of compliance, which may include converting or retrofitting these GSE fleet or implementing controls on other equipment (such as aircraft APUs or ground access vehicles).
Other control measures should also be considered by the MRPO, but there is not enough information currently available to quantify the emission reduction benefits from measures such as alternative fuel GAV, decreased idling time of GAV, or improved traffic flow around airports. We suggest a more detailed (microscale) analysis be conducted to quantify the emission reduction benefits of these control measures. , or

EXPECTED EMISSION REDUCTIONS

We calculated the approximate NOx emission reductions expected from adoption of the candidate control measure in the following manner:

- Obtained 2002 actual emissions from the MRPO's 2002 inventory;
- Assumed that the NOx emissions from gasoline- and diesel-fired GSE can be reduced by 25 percent from 2002 levels by 2009, 50 percent by 2012, and 90 percent by 2018;

Table 5 shows the anticipated NOx emission reductions from the adoption of this control measure. Emissions for other pollutants may also be reduced as a result of this measure.

TIMING OF IMPLEMENTATION

Under the Memorandum of Understanding between the DFW Airport and TCEQ, a period of 8 years was provided to allow the airport to convert or retrofit their GSE fleet or implement other controls to achieve the 90 percent emission reduction. For this White Paper, we are suggesting a 10-year compliance period that requires a 25 percent reduction by 2009, a 50 percent reduction by 2012, and a 90 percent reduction by 2018.

COST EFECTIVENESS AND BASIS

The NESCAUM report provides the following cost-effectiveness information for replacing gasoline/diesel GSE with CNG/LPG equipment or electric GSE:

Measure	**NOx Emission Decrease**	**Cost-Effectiveness**
CNG/LPG replacement of Diesel GSE	65%	$1,000 to $3,000 per ton
CNG/LPG conversion from gasoline GSE	25%	Cost of conversion is more than covered by fuel cost savings over several years
Electric GSE replacement of diesel and gasoline equipment	100%	Varies from cost savings to $5,800 per ton depending upon the type of GSE

TABLE 5 – COMPARISON OF 2002, 2009, 2012, AND 2018 NOx EMISSION SCENARIOS FOR GASOLINE AND DIESEL POWERED GROUND SUPPORT EQUIPMENT

	Annual NOx Emissions (tons per year)						
State	**2002 Actual**	**2009 Reduction**	**2009 Remaining**	**2012 Reduction**	**2012 Remaining**	**2018 Reduction**	**2018 Remaining**
IL	621	155	465	310	310	558	62
IN	153	38	115	77	77	138	15
MI	275	69	206	137	137	247	27
OH	165	41	124	83	83	149	17
WI	51	13	39	26	26	46	5
MRPO	**1,266**	**316**	**949**	**633**	**633**	**1139**	**127**

1. The future year emission estimates presented here are not growth-adjusted.

RULE DEVELOPMENT ISSUES

There are a variety of regulatory and voluntary approaches available to promote the use of cleaner technologies and operations at airports. States could require operators of GSE fleets to replace or convert their existing fleet to alternative fuels or electric vehicles, as was done for the DFW Airport. Another approach is to establish a voluntary or regulatory emission cap (or declining cap over time) for the airport to encourage the purchase of cleaner alternatives when fleet equipment is replaced or added. Opportunities may also be available from the FAA's Voluntary Airport Low Emission Program. The NESCAUM report identifies a number of regulatory and voluntary policy approaches and legal barriers for reducing emissions at airports.

GEOGRAPHIC APPLICABILITY

Emission reductions would be realized primarily in large metropolitan areas with large commercial airports, which in many cases are ozone nonattainment counties.

TEMPORAL APPLICABILITY

Emission reductions would be realized throughout the year.

AFFECTED SCCs

22-60-008-000	Airport GSE: Off-Highway Vehicle Gasoline, 2-stroke
22-65-008-000	Airport GSE: Off-Highway Vehicle Gasoline, 4-stroke
22-70-008-000	Airport GSE: Off-Highway Vehicle Diesel
22-75-001-000	Military Aircraft
22-75-020-000	Commercial Aircraft
22-75-050-000	General Aviation
22-75-060-000	Air Taxi
22-75-070-000	Auxiliary Powered Units
22-75-900-000	Refueling, all fuels

REFERENCES

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