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SUBJECT: Lake Michigan Ozone Control Program: Preliminary Regional Control Strategies

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TO: LMOS Technical Steering Committee

The purpose of this memorandum is to describe the progress to date in identifying possible control measures and the regional strategies to be modeled. Please understand that additional modeling and strategy analyses are needed before we can begin to formulate a regional attainment demonstration. The strategy development effort has, however, accomplished much to date, including an understanding of the control path (i.e., VOC v. NOx control).

Possible Control Measures

The regional control strategy will be built on the mandatory control measures required by the Clean Air Act Amendments of 1990 ("the Act") and certain additional control measures. Additional emission reductions (beyond those due to the mandatory controls) are necessary to meet the Reasonable Further Progress requirements of the Act and, also, to demonstrate attainment. The procedures for identifying, evaluating, and selecting possible additional control measures are defined in a protocol document established pursuant to the Memoradum of Agreement signed by the States in 1991/1992.

The protocol established a means of identifying potential control measures, some of which may be modeled in conjunction with the development of a regional control strategy; and an objective guideline for evaluating which of the potential control measures are selected for modeling. Its purposes were as follows:

* to insure that no reasonable control measures are omitted from consideration;

* to establish a process by which to analyze and assess the potential impacts of each potential control measure in as objective and equitable a manner as possible;

* to reduce the large number of potential measures to a more manageable total for further examination;

* to provide a means for the formulation of alternative control strategies based on various combinations of the recommended control measures; and

* to enable the States and the Lake Michigan Air Directors Consortium to make the most efficient and effective use of their time and resources in the preparation of the regional ozone control strategy.

Several environmental, technological, economic, and implementation criteria will be considered in evaluating, ranking, and selecting control measures, or sets of measures, to be modeled. Together with the modeled air quality results, these criteria will also serve as the primary basis for establishing the regional ozone control strategy. The list of measures which make up the regional control strategy may change, as control technologies are improved and as future needs arise.

The attached table identifies an initial list of possible control measures. "White Papers" addressing these measures in more detail were prepared and issued for public comment in April 1993 (Round 1 measures) and December 1993 (Round 2 measures). Further evaluation of these measures will continue.

Assessment of Control Path

A series of modeling simulations of across-the-board reductions in VOC and NOx emissions were performed for LMOS Episodes 1 - 4 with the latest model basecase (Basecase C). In addition, simulations were performed with lower boundary conditions. The purpose of these modeling runs was to determine the response of modeled ozone concentrations to reductions in precursor emissions inputs and in boundary conditions.

Based on this modeling, it can be concluded that:

* VOC reductions are more effective than NOx reductions in lowering domain-wide peak ozone concentrations in the Lake Michigan area.

* The greatest reductions in ozone concentrations in the major urban areas and immediately downwind (including in the area of highest predicted ozone concentrations) occur with VOC only control.

* NOx reductions have a negative impact on ozone concentrations in the major urban areas (especially, Chicago) and immediately downwind (as far as 50 - 200 km, depending on the episode). These negative impacts occur generally in the area of highest predicted ozone concentrations and in the area of highest population.

* NOx reductions have a positive impact on ozone concentrations farther downwind of the major urban areas. Although there are measured exceedances in these far downwind areas, there are no modeled exceedances. It is unclear to what extent NOx reductions are needed to ensure attainment and maintenance in these areas.

* The greatest reductions in ozone concentrations farther downwind occur with combined VOC and NOx control. Although the findings above indicate a preference for VOC control, it must be recognized that certain NOx control will occur due to various requirements of the Clean Air Act Amendments of 1990 (e.g., Title I - National off-highway emission standards; Title II - motor vehicle tailpipe emission standards; and Title IV - NOx emissio limitations). Because any regional control strategy will include VOC and some NOx controls, the benefits farther downwind may be realized even if the strategy emphasizes VOC control.

* The regional attainment demonstration must include both substantial reductions in local ozone precursor emissions (especially, VOC) and significant, realistic reductions in boundary conditions.

Control Strategies to be Modeled

The Strategy Project Team has identified eight initial control strategies to be modeled. A brief description of these strategies is provided below:

Strategy 1 All control measures mandated by the Act to be in place by 1996, including Federal mandatory controls and the States' 15% VOC RFP plans

Strategy 2 All control measures mandated by the Act to be in place by 2007, including Federal mandatory controls and the States' 15% VOC RFP plans (but not certain NOx controls)

The reason for excluding these NOx controls is that, as noted above, photochemical modeling runs indicate that additional reductions of NOx emissions showed certain negative impacts (i.e., increased domain-wide peak ozone concentrations and increased ozone concentrations in and immediately downwind of major urban areas). Strategy 3 is designed to assess model response for specific NOx controls.

Strategy 3 All control measures mandated by the Act to be in place by 2007, including Federal mandatory controls, the States' 15% VOC RFP plans, and all NOx controls

Strategy 4a Strategy 2, plus all "doable" controls in the severe nonattainment counties to meet as much of the additional "3% per year" RFP requirement as possible

Strategy 4b Strategy 4a, plus sufficient additional emission reductions to meet the full additional "3% per year" RFP requirement

Strategy 4 is designed to achieve the full (48%) RFP reduction for each State with severe nonattainment counties (i.e., Illinois, Indiana, and Michigan) and for each of two major source sectors (i.e., point/area and motor vehicle/fuel/transportation).

Strategy 5 Strategy 2, plus lower boundary conditions

Strategy 6 Strategy 2, plus geographic expansion of certain control measures beyond the nonattainment counties

Strategy 7 Strategy 2, plus accelerated adoption of certain Strategy 4a and 4b measures to achieve early attainment (e.g., by 2002)

The stationary and mobile source measures included in Strategies 1 - 4 are identified in Table 2.

It should be noted that preliminary modeling of Strategies 1 and 2 shows that these emission reductions, by themselves, are not enough to provide for attainment. Furthermore, the model sensitivity tests described above indicate that the (VOC) control level needed to show attainment is very large. It, therefore, appears that the regional attainment demonstration must account for reductions in boundary conditions. Given the overwhelming magnitude of the base year boundary conditions (i.e., on the order of 40 to 60% of the domain-wide peak surface ozone concentration), it is not surprising that the attainment plan includes signficant reductions in both local emissions and boundary conditions.

WHITE PAPER CONTROL MEASURES

	ROUND 1 CONTROL MEASURES	ROUND 2 CONTROL MEASURES
INDUSTRIAL (VOC):	VOL Storage	Petroleum Refineries
	Marine Vessel Loading	Bakeries
	Plastic Parts Coating	Textile Manufacturing
	Wood Furniture Coating	Paint/Ink Manufacturing
	SOCMI (Reactor, Distillation)	SBR Rubber Manufacturing
	SCOMI (Batch Processing)	Rubber Products Manufacturing
	Organic Chemical Manufacturing	Fiberboard Manufacturing
	Coke Oven Batteries	Wet Corn Milling
	Solvent Metal Cleaning(Degreasing)	Clean-up Solvents
	Graphic Arts (Lithographic)	Graphic Arts (Letterpress Printing)
	Municipal Solid Waste Landfills	POTWs
	TSDFs	Aerosol Can Filling/Crushing
	Industrial Wastewater Treatment	
	Major Non-CTG Sources in Illinois	
	Major Non-CTG Sources in Indiana	
	Sinter Plants	
	Major Non-CTG	
	Major Non-CTG Sources in Michigan	
	Leather Coating	
	Major Non-CTG Sources in Wisconsin	
	Yeast Manufacturing	
	Foundries	
	Misc. Wood Parts/Prod.	
	Screen Printing	
	Air Toxics Rule	
INDUSTRIAL (NOX):	Coal-Fired Utility Boilers	Title IV Requirements
	Gas/Oil-Fired Utility Boilers	
	Coal-Fired I/C/I Boilers	
	Gas/Oil-Fired I/C/I Boilers	
	Stationary Gas Turbines	
	Rec. Internal Combustion Engines	
	Glass Melting Furnaces	
	Petroleum Ref. - Process Heaters	
	Iron and Steel Mills	
NON-INDUSTRIAL:	Vehicle Refueling	Petroleum Dry Cleaning
	Service Station Tank Breathing	Agricultural Pesticide Applications
	Architectural Coatings	Emulsified Asphalt
	Automobile Refinishing	
	Traffic Maintenance Painting	
	Commercial and Consumer Solvents	
	Agricultural Equipment	Off-Highway (Switching Technology to
	Construction Equipment	Electric-Powered Devices)
	Industrial Equipment	
	Off-Road Motorcycles	
	Lawn and Garden Equipment	
	Recreational Marine Vessels	
MOBILE:	Reformulated Gasoline	Reformulated Gasoline (more comprehensive)
	Inspection/Maintenance	I/M (more comprehensive)
	Clean Fuel Fleets Program	Clean Fuel Fleets Program (more comprehensive)
	Employee Commute Options (ECO)	Tier I Standards
		Tier II Standards
		LEV Program

Lake Michigan Ozone Control Program
STRATEGIES

STRATEGY	DESCRIPTION	STATIONARY SOURCES	TRANSPORTATION	MOTOR VEHICLE	FUEL
1	1996 CAAA Mandatory Control Measures	Point Source Measures (New CTGs, Title IV NOx-Phase 1, RACT tight., Major Source Non-CTG, RACT Fix-Ups/Catch-Ups, MACT) Area Source Measures (Stage II,AIM) State-Specific 15% Measures (e.g.,IL-bakeries; IN-coke battery shutdowns; WI-yeast manufacturing)	Trans. Scenario 1 (current TIP/build scenario, partial ECO)	Tier I Enhanced I/M Clean Fuel Fleets	RFG-Phase I/Class C
2	2007 CAAA Mandatory Control Measures (w/o extra NOx controls)	Strat.1 Point Source Measures (Title IV NOx Phase 2) Area Source Measures (off-highway standards, comm/consumer solvents)	Trans. Scenario 2 (current TIP/build scenario, full ECO, long-range trans.plan)	Tier I Enhanced I/M (no NOx "cut-points") Clean Fuel Fleets	RFG-Phase II/Class C
3	2007 CAAA Mandatory Control Measures (w/ extra NOx controls)	Strat.2, plus NOx RACT	Trans. Scenario 2	Tier I Enhanced I/M (w/ NOx "cut-points") Clean Fuel Fleets	RFG-Phase II/Class C
4a	2007 CAAA Mandatory Control Measures, plus "Achievable" RFP Reduction (w/o extra NOx controls)	Phased Emis. Reduction Program Improved Rule Effectiveness Area Source Measures (Strat.2, degreasing, ag. pest. application, pet. dry clng, small eng. buy back, effect of RFG Class B on Stage I,II) Point Source Measures (Strat.2, effect of RFG Class B on bulk stations/term.)	Trans. Scenario 2	National LEV/2001 Specific I/M (no NOx "cut-points") Clean Fuel Fleets	RFG-Phase II/Class B
4b	2007 CAAA Mandatory Control Measures, plus Full (48%) RFP Reduction (w/o extra NOx controls)	Strat.4a, plus Category "Z"	Trans. Scenario 3 (Trans. Scenario 2 with VMT reduced by 10% in severe NA counties to reflect pricing strategy)	National LEV/2001 Specific/Extreme I/M (no NOx "cut-points") Clean Fuel Fleets	RFG-Phase II/Class B