

and (e) the ozone modeling results for (b), (c), and (d) were compared considering the domain-wide peak ozone concentrations and temporal and spatial extent of ozone concentrations above 120 ppb. In addition, ozone impacts resulting from increasing new source growth  $\text{NO}_x$  emissions were analyzed.

For all modeled days using 1996 and 2007 conditions, domain-wide peak ozone concentrations for "VOC-only" controls were found to be lower than or equal to those for " $\text{NO}_x$ -only" controls or those for "VOC plus  $\text{NO}_x$ " controls. The "VOC-only" control scenario leads to the smallest areas with predicted peak ozone concentrations exceeding 120 ppb. In addition, the  $\text{NO}^{12x}$  point source growth is not expected to exacerbate the nonattainment problem.

### III. Analysis of Submittal

As stated earlier in this document, for purposes of their  $\text{NO}_x$  exemption submission, the LMOS States elected to rely on the statutory test provided in section 182(f)(1)(A), which requires a demonstration that  $\text{NO}_x$  reductions would not contribute to attainment of the ozone NAAQS "in the area". Under the EPA Guideline, this would ordinarily mean that the demonstration should show that in a single nonattainment area  $\text{NO}_x$  emissions reductions from sources in the same nonattainment area would not contribute to attainment. However, the EPA Guideline goes on to encourage petitioners relying on modeling under the contribute to attainment test to include consideration of the entire modeling domain for two key reasons. First, because the test focuses on the effects of  $\text{NO}_x$  reductions on attainment, to fully realize those effects, the attainment control strategy often needs to extend beyond the geographic bounds of the designated nonattainment area. This is especially warranted for the nonattainment areas in the Lake Michigan air basin given the meteorological indications noted previously. Second, when photochemical grid modeling is utilized for this demonstration, it is generally advisable, as a technical matter, to use a modeling domain larger than the designated nonattainment area in order to consider multi-day episodes, to establish realistic boundary conditions, and to accommodate the geometry of the model grid cells. Again, as noted previously, the location of the nonattainment areas and the meteorology characteristic of the Lake Michigan area made it reasonable for the LMOS study to analyze domain-wide precursor effects rather than attempting

to identify such effects in each individual nonattainment area. Because of this, the modeling protocol lacks the type of precision that would make it capable, for example, of analyzing particularized, individual local area effects. However, a region-wide modeling assessment may—and, in the case of the LMOS modeling, clearly did—include consideration of general, directional effects in specific areas.

Review of the modeling results by EPA show a very definite directional signal that general, across-the-board  $\text{NO}_x$  emission reduction controls in the ozone nonattainment areas throughout the LMOS modeling domain would not contribute to attainment, but, in fact, would exacerbate peak ozone concentrations. Specifically, the LMOS modeling runs demonstrate that reductions in  $\text{NO}_x$  emissions result in increases in the domain-wide peak ozone concentrations, in the areal coverage of hours greater than 120 ppb (the current ozone standard), and in the number of hours greater than 120 ppb. Nitrogen oxide reductions also increased hourly ozone concentrations within and immediately downwind of the major urban areas of Chicago, Milwaukee, Gary, and Grand Rapids. Additional model sensitivity tests involving alternative VOC: $\text{NO}_x$  emissions ratios and alternative photolysis rates produced similar results. In addition, independent analyses of the LMOS field data also conclude that  $\text{NO}_x$  controls would increase ozone concentrations in and downwind of Chicago. In light of all this evidence in support of the conclusion that application of  $\text{NO}_x$  controls in the nonattainment areas throughout the LMOS domain would be counterproductive, EPA believes the LADCo States have made an acceptable case for approval of their  $\text{NO}_x$  exemption petition.

However, data provided to the EPA to date by LADCo indicate that some adjustments in the modeling results may be expected when certain aspects of the modeling are subject to more detailed inputs. Specifically, the LMOS analysis projected emissions for conditions expected in the attainment years of 1996 (for Moderate areas) and 2007 (for Severe areas with a design value between 0.190 and 0.280 ppm). However, the analysis did not rely on source category-specific emission projection factors, but instead used simple, region-wide adjustment factors for point, area, and mobile (motor vehicular) sources to account for both known controls (i.e., 15 percent reasonable further progress and other mandatory Clean Air Act Amendment

controls) and for growth. Therefore, some changes in the modeling results are to be expected if area-specific and source category-specific emission projection factors are used. And, in fact, these more detailed projection factors will be used in the final demonstration of attainment for the LMOS domain. It should be noted, however, that nothing in the data presented, and in the analysis of that data, leads EPA to believe either that these adjusted modeling results will reverse the directional signal provided by the modeling done to date, or alter the preliminary conclusion that  $\text{NO}_x$  reductions in the nonattainment areas throughout the domain would not contribute to attainment of the ozone NAAQS.

Finally, although this document earlier points out that the version of the photochemical grid model utilized in the LMOS study (UAM-V) was approved by EPA for LADCo's section 182(f) and attainment demonstrations, it is noted here by EPA that the Lake Michigan States and LADCo had not completed the appropriate validation process for the UAM-V modeling system utilized in the LMOS study at the time the  $\text{NO}_x$  exemption petition was submitted. In this regard, the EPA Guideline states that an assessment of the model's performance and a copy of the modeling protocol should be included in States'  $\text{NO}_x$  exemption analysis "for informational purposes." On the basis of that guidance, the use of the UAM-V model by LADCo to support the section 182(f) "contribute to attainment" test is acceptable. In any event, however, the validation process has now been completed, and a model validation report has been submitted to EPA by LADCo. With respect to the emission projection factors, it is also likely that some adjustments in the modeling results may be expected based on the completed validation process. However, as in the previous case, nothing in the existing modeling data, or in the analyses, leads EPA to believe that any subsequent adjustments would be sufficient to reverse the directional indication that  $\text{NO}_x$  reductions in the nonattainment areas throughout the LMOS modeling domain would not contribute to attainment of the ozone NAAQS.

In summary, then, the EPA believes that the modeling data contained in the LADCo  $\text{NO}_x$  exemption petition demonstrates that, for the nonattainment areas throughout the LMOS domain in general, additional reductions of  $\text{NO}_x$  would not contribute to attainment of the ozone standard. However, other data submitted to EPA