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RESEARCH TRIANGLE PARK, NC 27711

AUG 09 2001

OFFICE OF  
AIR QUALITY PLANNING  
AND STANDARDS

MEMORANDUM

SUBJECT: Limited Maintenance Plan Option for Moderate PM<sub>10</sub> Nonattainment Areas

FROM: *John A. Edwards*  
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TO: Director, Office of Ecosystem Protection, Region I  
Director, Division of Environmental Planning & Protection, Region II  
Director, Air Protection Division, Region III  
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Director, Air and Radiation Division, Region V  
Director, Air Pesticides & Toxics, Region VI  
Director, Air and Toxics Division, Regions VII, IX  
Director, Air Program, Region VIII  
Director, Office of Air Quality, Region X

I. What is a Limited Maintenance Plan?

This memorandum sets forth new guidance<sup>1</sup> on maintenance plan submissions for certain moderate particulate matter (PM<sub>10</sub>) nonattainment areas seeking redesignation to attainment (see section IV for further details on qualifying for the policy). If the area meets the criteria listed in this policy the State may submit a maintenance plan at the time it is requesting redesignation that is more streamlined than would ordinarily be permitted. This new option is being termed a limited maintenance plan (LMP)<sup>2</sup>.

II. Why is there a need for a limited maintenance plan policy?

Before the U.S. Court of Appeals for the District of Columbia handed down its decision vacating the 1997 PM<sub>10</sub> national ambient air quality standards (NAAQS)(see American Trucking Associations, et al. v. Environmental Protection Agency (EPA), 175 F.3d 1027 (D.C. Cir. 1999),

<sup>1</sup>This memorandum is intended to provide EPA's preliminary views on how certain moderate PM<sub>10</sub> nonattainment areas may qualify to submit a maintenance plan that meets certain limited requirements. Since it represents only the Agency's preliminary thinking that is subject to modification, this guidance is not binding on States, Tribes, the public, or EPA. Issues concerning the applicability of the limited maintenance plan policy will be addressed in actions to redesignate moderate PM<sub>10</sub> nonattainment areas under § 107 of the CAA. It is only when EPA promulgates redesignations applying this policy that those determinations will become binding on States, Tribes, the public, and EPA as a matter of law.

<sup>2</sup>Moderate PM<sub>10</sub> areas that do not meet the applicability criteria of this policy, and all serious PM<sub>10</sub> nonattainment areas, should submit maintenance plans that meet our guidance for submission of a full maintenance plan as described in the September 4, 1992 memorandum. "Procedures for Processing Requests to Redesignate Areas to Attainment," from John Calcagni, former Director of the Office of Air Quality Planning and Standards (OAQPS) Air Quality management Division to the Regional Air Division Directors (hereafter known as the Calcagni Memo).

we were prepared to make case-by-case determinations that would make the 1987 PM<sub>10</sub> NAAQS no longer applicable in any area meeting the standards. In taking actions to remove the applicability of the 1987 NAAQS, we would have removed, as well, the nonattainment designation and Clean Air Act (CAA) part D requirements from qualifying areas. As a result of the D.C. Circuit's decision, for areas subject to the 1987 NAAQS, the only route to recognized attainment of the NAAQS and removal of nonattainment status and requirements is formal redesignation to attainment, including submittal of a maintenance plan. Since many areas have been meeting the PM<sub>10</sub> NAAQS for 5 years or more and have a low risk of future exceedances, we believe a policy that would allow both the States and EPA to redesignate speedily areas that are at little risk of PM<sub>10</sub> violations would be useful.

### III. How did EPA develop the approach used in the LMP option?

The EPA has studied PM<sub>10</sub> air quality data information for the entire country over the past eleven years (1989-1999) and has determined that some moderate PM<sub>10</sub> nonattainment areas have had a history of low PM<sub>10</sub> design values with very little inter-annual variation. When we looked at all the monitoring sites reporting data for those years, the data indicate that most of the average design values fall below 2 levels,  $98 \cdot \text{g}/\text{m}^3$  for the 24-hr PM<sub>10</sub> NAAQS and  $40 \cdot \text{g}/\text{m}^3$  for the annual PM<sub>10</sub> NAAQS. For most monitoring sites these levels are also below their individual site-specific critical design values (CDV). The CDV is an indicator of the likelihood of future violations of the NAAQS given the current average design value and its variability. The CDV is the highest average design value an area could have before it may experience a future exceedance of the NAAQS with a certain probability. A detailed explanation of the CDV is found in Attachment A<sup>3</sup> to this policy which, because of its length, is a separate document accompanying this memorandum.

We believe that the very small amount of variation between the peaks and means in most of the data indicates a very stable relationship that can be reasonably expected to continue in the future absent any significant changes in emissions. The period we assessed provides a fairly long historical record and the data could therefore be expected to have been affected by a full range of meteorological conditions over the period. Therefore, the amount of emissions should be the only variable that could affect the stability in the air quality data. We believe we can reliably make estimates about the future variability of PM<sub>10</sub> concentrations across the country based on our statistical analysis of this data record, especially in areas where the amount of emissions is not expected to change.

### IV. How do I qualify for the LMP option ?

To qualify for the limited maintenance plan option, an area should meet the following applicability criteria. The area should be attaining the NAAQS and the average PM<sub>10</sub> design

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<sup>3</sup> Dr. Shao-Hang Chu's paper entitled "Critical Design Value and Its Applications" explains the CDV approach and is included in its entirety in Attachment A. This paper has been accepted for publication and presentation at the 94th Air and Waste Management Association (A&WMA) Annual Conference in June 2001 in Orlando, Florida.

value<sup>4</sup> for the area, based upon the most recent 5 years of air quality data at all monitors in the area, should be at or below  $40 \cdot \text{g/m}^3$  for the annual and  $98 \cdot \text{g/m}^3$  for the 24-hr  $\text{PM}_{10}$  NAAQS with no violations at any monitor in the nonattainment area<sup>5</sup>. If an area cannot meet this test it may still be able to qualify for the LMP option if the average design values of the site are less than their respective site-specific CDV.

We believe it is appropriate to offer this second method of qualifying for the LMP because, based on the air quality data we have studied, we believe there are some monitoring sites with average design values above  $40 \cdot \text{g/m}^3$  or  $98 \cdot \text{g/m}^3$ , depending on the NAAQS in question, that have experienced little variability in the data over the years. When the CDV calculation was performed for these sites we discovered that their average design values are less than their CDVs, indicating that the areas have a very low probability (1 in 10) of exceeding the NAAQS in the future. We believe it is appropriate to provide these areas the opportunity to qualify for the LMP in this circumstance since the  $40 \cdot \text{g/m}^3$  or  $98 \cdot \text{g/m}^3$  criteria are based on a national analysis and don't take into account each local situation.

The final criterion is related to mobile source emissions. The area should expect only limited growth in on-road motor vehicle  $\text{PM}_{10}$  emissions (including fugitive dust) and should have passed a motor vehicle regional emissions analysis test. It is important to consider the impact of future transportation growth in the LMP, since the level of  $\text{PM}_{10}$  emissions (especially from fugitive dust) is related to the level of growth in vehicle miles traveled (VMT). Attachment B (below) should be used for making the motor vehicle regional emissions analysis demonstration.

If the State determines that the area in question meets the above criteria, it may select the LMP option for the first 10 year maintenance period. Any area that does not meet these criteria should plan to submit a full maintenance plan that is consistent with our guidance in the Calcagni Memo in order to be redesignated to attainment. If the LMP option is selected, the State should continue to meet the qualifying criteria until EPA has redesignated the area to attainment. If an area no longer qualifies for the LMP option because a change in air quality affects the average design values before the redesignation takes effect, the area will be expected to submit a full maintenance plan.

Once an area selects the LMP option and it is in effect, the State will be expected to recalculate the average design value for the area annually and determine if the criteria used to qualify for the LMP will still be met. If, after performing the annual recalculation of the area's average design value in a given year, the State determines that the area no longer qualifies for the LMP, the State should take action to attempt to reduce  $\text{PM}_{10}$  concentrations enough to requalify for the LMP. One possible approach the State could take is to implement a contingency measure

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<sup>4</sup>The methods for calculating design values for  $\text{PM}_{10}$  are presented in a document entitled the "PM<sub>10</sub> SIP Development Guideline", EPA-450/2-86-001, June 1987. The State should determine the most appropriate method to use from this Guideline in consultation with the appropriate EPA Regional office staff.

<sup>5</sup>If the EPA determines that the meteorology was not representative during the most recent five-year period, we may reject the State's request to use the LMP option and request, instead, submission of a full maintenance demonstration.



or measures found in its SIP. If, in the next annual recalculation the State is able to re-qualify for the LMP, then the LMP will go back into effect. If the attempt to reduce  $PM_{10}$  concentrations fails, or if it succeeds but in future years it becomes necessary again to address increasing  $PM_{10}$  concentrations in the area, that area no longer qualifies for the LMP. We believe that repeated increases in  $PM_{10}$  concentrations indicate that the initial conditions that govern air quality and that were relied on to determine the area's qualification for the LMP have changed, and that maintenance of the NAAQS can no longer be assumed. Therefore, the LMP cannot be reinstated by further recalculations of the design values at this point. Once the LMP is determined to no longer be in effect, a full maintenance plan should be developed and submitted within 18 months of the determination.

Treatment of data used to calculate the design values.

Flagged Particulate Matter Data:

Three policies allow PM-10 data to be flagged for special consideration:

- Exceptional Events Policy (1986) for data affected by infrequent events such as industrial accidents or structural fires near a monitoring site;
- Natural Events Policy (1996) for data affected by wildfires, high winds, and volcanic and seismic activities, and;
- Interim Air Quality Policy on Wildland and Prescribed Fires for data affected by wildland fires that are managed to achieve resource benefits.

We will treat data affected by these events consistently with these previously-issued policies. We expect States to consider all data (unflagged and flagged) when determining the design value. The EPA Regional offices will work with the State to determine the validity of flagged data. Flagged data may be excluded on a case-by-case basis depending on State documentation of the circumstances justifying flags. Data flagged as affected by exceptional or natural events will generally not be used when determining the design value. However, in order for data affected by a natural event to be excluded, an adequate Natural Events Action Plan is required as described in the Natural Events policy.

Data flagged as affected by wildland and prescribed fires will be used in determining the design value. If the State is addressing wildland and prescribed fire use with the application of smoke management programs, the State may submit an LMP if the design value is too high only as a result of the fire-affected data.

We are in the process of developing a policy to address agricultural burning. When it is finalized we will amend the LMP option to account



for the new policy.

V. What should an LMP consist of?

Under the LMP, we will continue to satisfy the requirements of Section 107(d)(3)(E) of the Act which provides that a nonattainment area can be redesignated to attainment only if the following criteria are met:

1. The EPA has determined that the NAAQS for the applicable pollutant has been attained.
2. The EPA has fully approved the applicable implementation plan under section 110(k).
3. The EPA has determined that the improvement in air quality is due to permanent and enforceable reductions in emissions.
4. The State has met all applicable requirements for the area under section 110 and part D.
5. The EPA has fully approved a maintenance plan, including a contingency plan, for the area under section 175A.

However, there are some differences between what our previous guidance (the Calcagni memo) recommends that States include in a maintenance plan submission and what we are recommending under this policy for areas that qualify for the LMP. The most important difference is that under the LMP the demonstration of maintenance is presumed to be satisfied. The following is a list of core provisions which should be included in an LMP submission. Note that any final EPA determination regarding the adequacy of an LMP will be made following review of the plan submitted in light of the particular circumstances facing the area proposed for redesignation and based upon all available information.

a. Attainment Plan

The State's approved attainment plan should include an emissions inventory (attainment inventory) which can be used to demonstrate attainment of the NAAQS. The inventory should represent emissions during the same five-year period associated with the air quality data used to determine whether the area meets the applicability requirements of this policy (i.e., the most recent five years of air quality data). If the attainment inventory year is not one of the most recent five years, but the State can show that the attainment inventory did not change significantly during that five-year period, it may still be used to satisfy the policy. If the attainment inventory is determined to not be representative of the most recent 5 years, a new inventory must be developed. The State should review its inventory every three years to ensure emissions growth is incorporated in the attainment inventory if necessary.

b. Maintenance Demonstration

The maintenance demonstration requirement of the Act will be considered to be satisfied for the moderate PM<sub>10</sub> nonattainment areas meeting the air quality criteria discussed above. If

the tests described in Section IV are met, we will treat that as a demonstration that the area will maintain the NAAQS. Consequently, there is no need to project emissions over the maintenance period.

c. Important elements that should be contained within the redesignation request

1. Monitoring Network Verification of Continued Attainment

To verify the attainment status of the area over the maintenance period, the maintenance plan should contain a provision to assure continued operation of an appropriate, EPA-approved air quality monitoring network, in accordance with 40 CFR part 58. This is particularly important for areas using an LMP because there will be no cap on emissions.

2. Contingency Plan

Section 175A of the Act states that a maintenance plan must include contingency provisions, as necessary, to promptly correct any violation of the NAAQS which may occur after redesignation of the area to attainment. These contingency measures do not have to be fully adopted at the time of redesignation. However, the contingency plan is considered to be an enforceable part of the SIP and the State should ensure that the contingency measures are adopted as soon as possible once they are triggered by a specific event. The contingency plan should identify the measures to be adopted, and provide a schedule and procedure for adoption and implementation of the measures if they are required. Normally, the implementation of contingency measures is triggered by a violation of the NAAQS but the State may wish to establish other triggers to prevent a violation of the NAAQS, such as an exceedance of the NAAQS.

3. Approved attainment plan and section 110 and part D CAA requirements:

In accordance with the CAA, areas seeking to be redesignated to attainment under the LMP policy must have an attainment plan that has been approved by EPA, pursuant to section 107(d)(3)(E). The plan must include all control measures that were relied on by the State to demonstrate attainment of the NAAQS. The State must also ensure that the CAA requirements for PM<sub>10</sub> pursuant to section 110 and part D of the Act have been satisfied. To comply with the statute, the LMP should clearly indicate that all controls that were relied on to demonstrate attainment will remain in place. If a State wishes to roll back or eliminate controls, the area can no longer qualify for the LMP and the area will become subject to full maintenance plan requirements within 18 months of the determination that the LMP is no longer in effect.

V. How is Conformity treated under the LMP option?

The transportation conformity rule (40 CFR parts 51 and 93) and the general conformity rule (58 FR 63214; November 30, 1993) apply to nonattainment areas and maintenance areas operating under maintenance plans. Under either conformity rule one means of demonstrating conformity of Federal actions is to indicate that expected emissions from planned actions are consistent with the emissions budget for the area. Emissions budgets in LMP areas may be treated as essentially not constraining for the length of the maintenance period because it is unreasonable to expect that an area satisfying the LMP criteria will experience so much growth during that period of time such that a violation of the PM<sub>10</sub> NAAQS would result. While this policy does not exempt an area from the need to affirm conformity, it does allow the area to demonstrate conformity without undertaking certain requirements of these rules. For transportation conformity purposes, EPA would be concluding that emissions in these areas need not be capped for the maintenance period, and, therefore, a regional emissions analysis would not be required. Similarly, Federal actions subject to the general conformity rule could be considered to satisfy the "budget test" specified in section 93.158 (a)(5)(i)(A) of the rule, for the same reasons that the budgets are essentially considered to be unlimited.

EPA approval of an LMP will provide that if the LMP criteria are no longer satisfied and a full maintenance plan must be developed to meet CAA requirements (see Calcagni Memo referenced in footnote #2 for full maintenance plan guidance), the approval of the LMP would remain applicable for conformity purposes only until the full maintenance plan is submitted and EPA has found its motor vehicle emissions budgets adequate for conformity purposes under 40 CFR parts 51 and 93. EPA will condition its approval of all LMPs in this fashion because in the case where the LMP criteria are not met and a full maintenance plan is required EPA believes that LMPs would no longer be an appropriate mechanism for assuring maintenance of the standards.

For further information concerning the LMP option for moderate PM<sub>10</sub> areas please



contact Gary Blais at (919) 541-3223, or for questions about the CDV approach contact Dr. Shao-Hang Chu at (919) 541-5382. For information concerning transportation conformity requirements, please contact Meg Patulski of the Office of Transportation and Air Quality at (734) 214-4842.

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## **ATTACHMENT A**

# **Critical Design Value Estimation and Its Applications**

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### **ABSTRACT**

The air quality design value is the mathematically determined pollutant concentration at a particular site that must be reduced to, or maintained at or below the National Ambient Air Quality Standards (NAAQS) in order to assure attainment. The design value may be calculated based on ambient measurements observed at a local monitor in a 3-year period or on model estimates. The design value, however, varies from year to year due to both the pollutant emissions and natural variability such as meteorological conditions, wildfires, dust storms, volcanic activities etc. In order to investigate certain policy options related to pollution controls it would be desirable to estimate a critical design value above which the NAAQS is likely to be violated with a certain probability.

In this paper, a statistical technique has been developed to estimate a critical design value that is based on the average design value and its variability in the past. The critical design value could be used as a planning tool for regulatory agencies because it is an indicator of the likelihood of future violations of the NAAQS given the current average design value and its variability. The approach is general and could be applied to estimate the critical design value for any pollutant.

As an example, eleven years (1989-1999) of PM<sub>10</sub> data nationwide were extracted from the US EPA AIRS database to estimate the PM<sub>10</sub> critical design values. The analyses indicate that PM<sub>10</sub> design values in the West have much larger inter-annual variability than those in the East as reflected in their much lower critical design values. This, in turn, suggests that the inter-annual variability in meteorology, wildfires, and dust storms may have played a more significant role in the West, and also this larger variability could be partly explained by the once every six days sampling schedule at most PM<sub>10</sub> monitoring sites.

### **INTRODUCTION**

The air quality design value is the mathematically determined pollutant concentration at a particular site that must be reduced to, or maintained at or below the National Ambient Air Quality Standards (NAAQS) in order to assure attainment<sup>1</sup>. The design value may be calculated based on ambient measurements observed at a local monitor in a 3-year period or on model estimates. The detailed calculation of the design values for various criteria pollutants is described in the Appendices of the Code of Federal Regulations<sup>2</sup>. In certain cases, the design value has been used for regulatory purposes to determine whether the local pollutant



concentration has violated the National Ambient Air Quality Standard (NAAQS). Most often, however, the design value is used to determine the level of control needed to reduce the pollutant concentration to the NAAQS<sup>3,4,5</sup>.

The design value, however, varies from year to year due to both the pollutant emissions and natural variability such as meteorological conditions, wildfires, dust storms, volcanic activities etc. In order to investigate certain policy options related to pollution controls it would be desirable to define a critical design value above which future violations of the air quality standard are likely to occur with a certain probability.

In this paper, an effort has been made to statistically estimate a critical design value based on the average of these yearly design values and their variability in the past. This critical design value is defined in such a way as it is the highest average design value any monitoring site could have before it runs a risk of violating the NAAQS in the future at a certain probability. The technical basis of this estimation approach and its applications will be discussed in the following paragraphs.

## CRITICAL DESIGN VALUE ESTIMATION

Our intention is to find a critical design value (CDV) that is the highest possible average design value (ADV) any site could have before it risks a future violation of the standard at a certain probability. First, we try to formulate a relationship among a set of variables involved: such as the CDV, NAAQS, the ADV, the standard deviation of the design values in the past, and a desirable risk factor. We find that if we assume that the design values are normally distributed and the coefficient of variation (CV), which is the ratio of the standard deviation versus the mean of the design values, does not change in the near future, then we can write the relationship as:

$$CDV = NAAQS / (1 + t_c * CV) \quad (1)$$

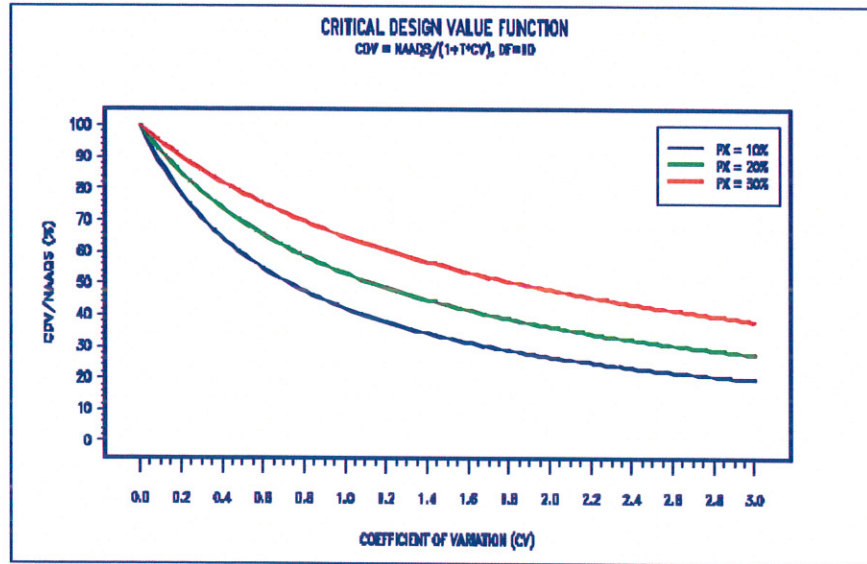
Where CDV is the critical design value, CV is the coefficient of variation of the annual design values (the ratio of standard deviation divided by the mean design value in the past), and  $t_c$  is the critical t-value corresponding to a probability,  $c$  %, of exceeding the NAAQS in the future and the degree of freedom in the estimate to the CV. Equation (1) says that based on the variability of the design values in the past, the probability of any monitoring site with an ADV less than or equal to the CDV to exceed the NAAQS in the future would be no more than  $c$  % given the same CV. In other words, the CDV is the highest ADV any monitoring site could have before it may record a future violation of the NAAQS with a certain probability. The percent probability,  $c$ , is the chosen risk factor. One can choose either a more, or less, conservative  $c$  value depending on how much risk one is willing to take.

The inter-annual variability of the air quality design values at a monitoring site can be estimated from historical data at that station. Using the air quality data in the past, one can calculate the design values for each year. With these design values one can calculate the ADV and its

variability in terms of the coefficient of variation (CV). Thus, one can calculate the CDV for any site with a minimum of five years of data.

## CHARACTERISTICS OF THE CRITICAL DESIGN VALUE

From equation (1) we see that the CDV is a nonlinear function of the NAAQS of the pollutant, the critical t-value,  $t_c$ , and the coefficient of variation, CV, of the design values. The normalized



relationship of the CDV to the product of  $t_c$  and CV is shown in figure 1.

Figure 1.

The dependency of CDV on the other two variables can be summarized as:

1. The larger the variability (CV) of the design values in the past, the smaller the CDV will be;
2. The lower the probability of risk for future violations (PX), the lower the CDV will be;
3. If  $CV=0$ , i.e., no variability in the design values in the past, then from Figure 1 and Equation (1) we find the highest CDV equal to the NAAQS;
4. As CV increases, the CDV approaches zero;
5. If CV is not zero but  $t_c = 0$ , then we will also have a CDV equal to the NAAQS, but it will have a 50% chance of violating the standard in the future because  $t_c = 0$  corresponds to a probability of 50%.

In Figure 2 we have chosen a risk factor of 10% probability of future violation and plotted two examples using generated data with significantly different variability in the annual PM10 design values. It is intended to illustrate the relationship among design values, ADV, CDV, and the PM10 annual NAAQS of 50  $\mu\text{g}/\text{m}^3$ . In this example we see that the CDV depends strongly on the inter-annual variability of the design values rather than on their means. Also, from the upper

panel of Figure 2 we see that once the ADV is higher than the CDV, the probability of violating the standard will be higher than the risk we have chosen (in this case, it is one out of ten).

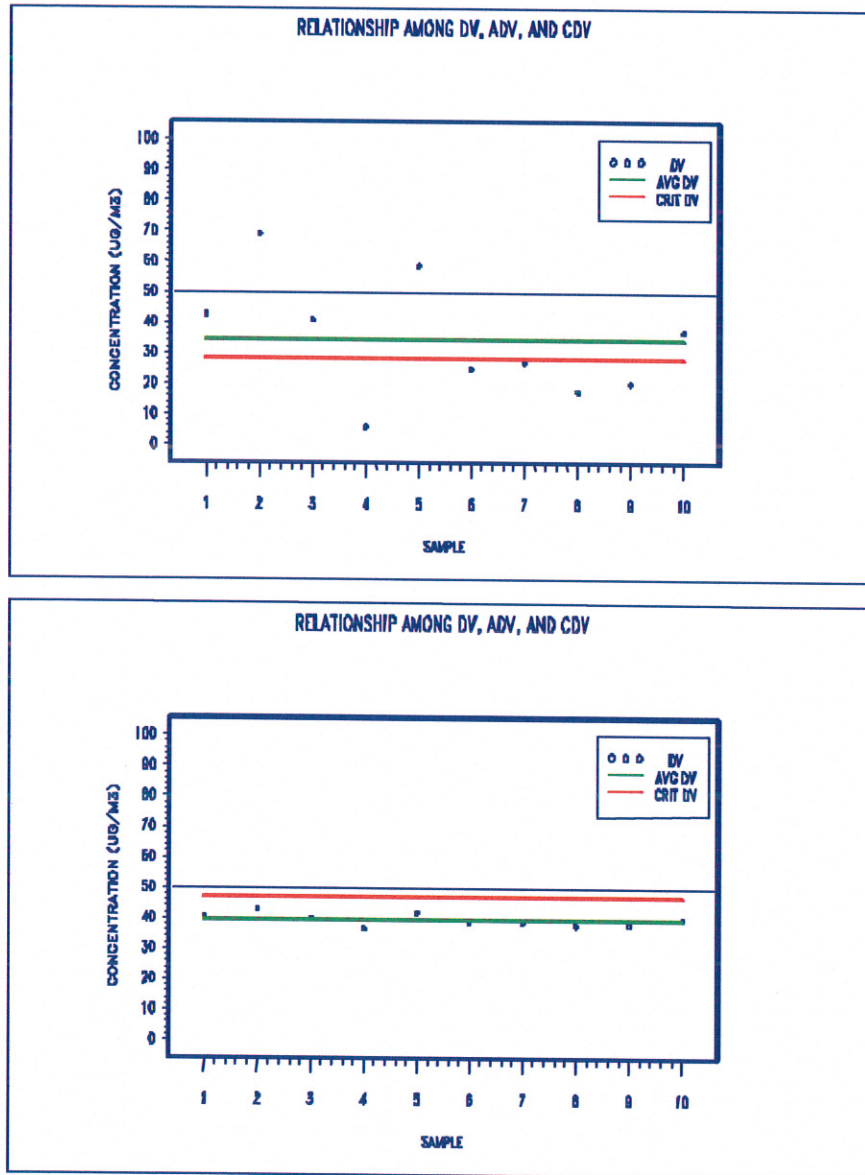


Figure 2.

Contrasting the two panels of Figure 2, we see that whether a site will have a higher or lower risk of violating the NAAQS in the future depends on how much higher or lower the ADV is to the CDV. Thus, unless some drastic change in emissions occurred in the past or should occur in the future, the CDV can be used to assess the likelihood of violating the NAAQS in the future in that area based on normal probability predictions. For this reason, this technique and



the estimated CDV could be used as a planning tool for regulatory agencies to decide whether more or fewer pollutant controls are needed in a specific area.

## **PM10 CRITICAL DESIGN VALUES AND DISCUSSIONS**

To demonstrate this approach, eleven years (1989-1999) of PM10 data nationwide were extracted from the United States Environmental Protection Agency AIRS database. The annual and 24-hr PM10 design values were calculated following the US EPA Guidance<sup>1</sup>. Then the methodology described in the previous section was applied using a tolerable risk factor of 10% probability of future violation of the NAAQS to calculate the CDVs for all monitor sites with more than five years of valid data. The analyses are discussed and presented in the following figures.

Figure 3 is a frequency distribution of these calculated annual and 24-hr CDVs. We see that the distributions of both the annual and the 24-hr CDVs are skewed to the left with a median annual CDV of 45.3 ug/m<sup>3</sup> and a median 24-hr CDV of 123.2 ug/m<sup>3</sup>. The long tails to the left (low values) suggest that there are places where the inter-annual variability of the design values are quite large. It also suggests that these areas are likely to have a higher probability of violating the standards if they are already in a major PM10 source region with relatively high PM10 concentrations.

In Figure 4 a longitudinal scatter plot of both the ADVs and the CDVs at all sites spanning from Maine to California, was produced to see whether there is a difference from the East to the West. Comparing the differences between these overlaid ADVs and CDVs we see clearly that most of the higher risk areas (i.e., the areas where the ADVs are greater than the CDVs) are in the West and Midwest. The geographical distribution of the CDVs and the actual ADVs are shown in Figures 5 and 6 respectively. For comparison purposes, the ADVs in Figure 6 are color coded to show their probability of future violation of the NAAQS. The probability of future violation of the NAAQS at each site is calculated by inverting the t-values using equation (1).

The East-West difference in CDVs can be explained largely by the fact that the West, in general, has a much larger inter-annual variability of the design values than the East. However, since the anthropogenic emissions in a region usually do not change very much from year to year, the large variability in the inter-annual PM10 design values in the West may be largely attributable to the inter-annual variation in natural conditions such as meteorology, wildfires, dust storms, and volcanic emissions, etc. The higher occurrences of wildfires and dust storms in the West are known to be associated with its much drier climate, meteorological conditions, and topography. Another influencing factor on the inter-annual variability could be related to the sampling frequency of the PM10 data, which for many sites is only once every six days. However, this is more likely in the East because fewer sites are in non-attainment status and thus not required to sample more frequently than once in six days.

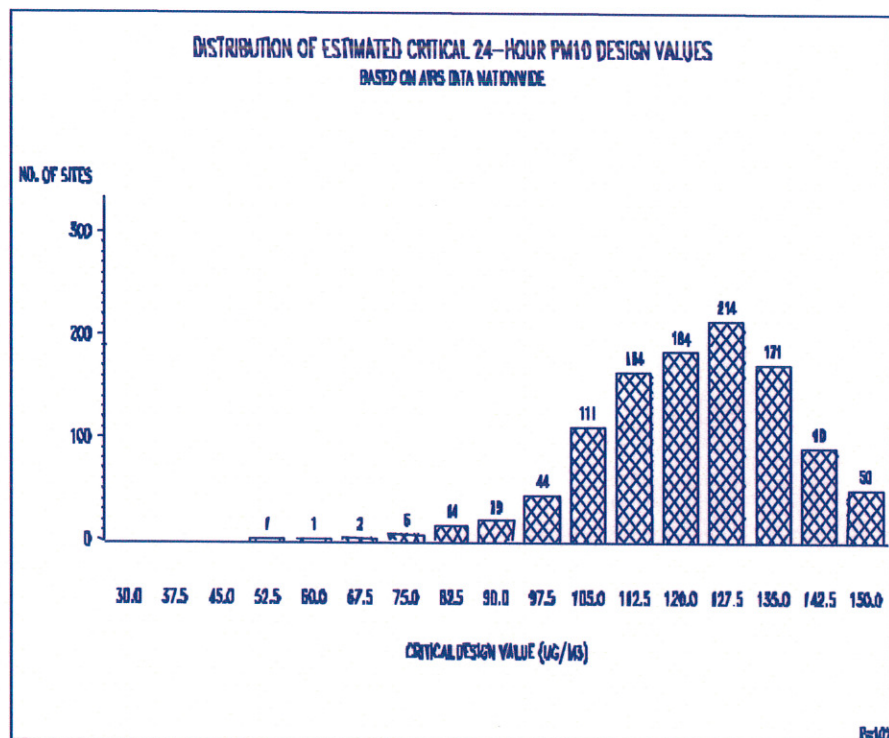
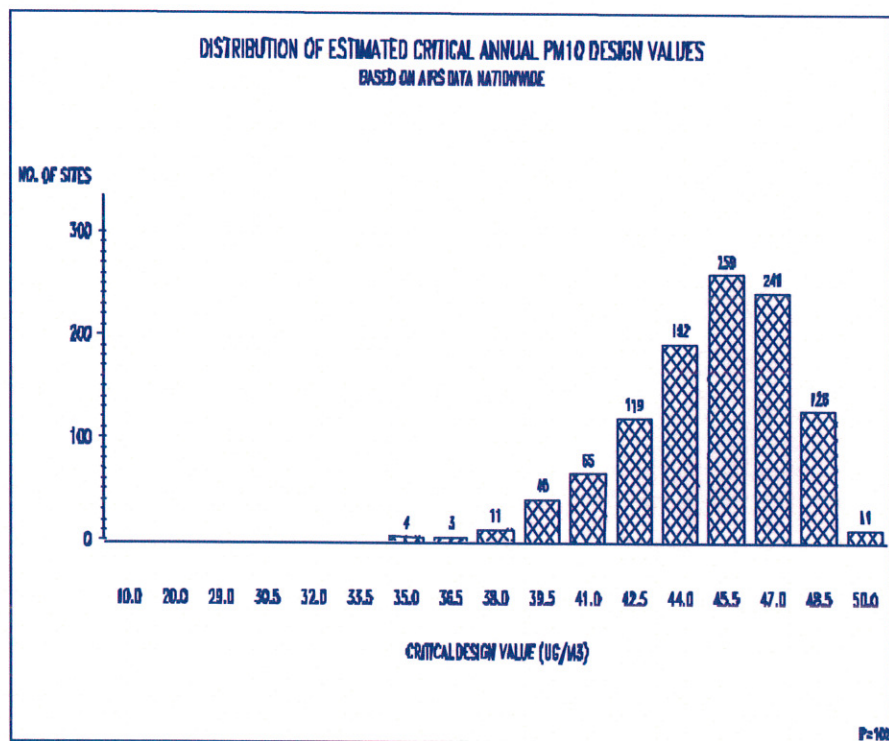


Figure 3.

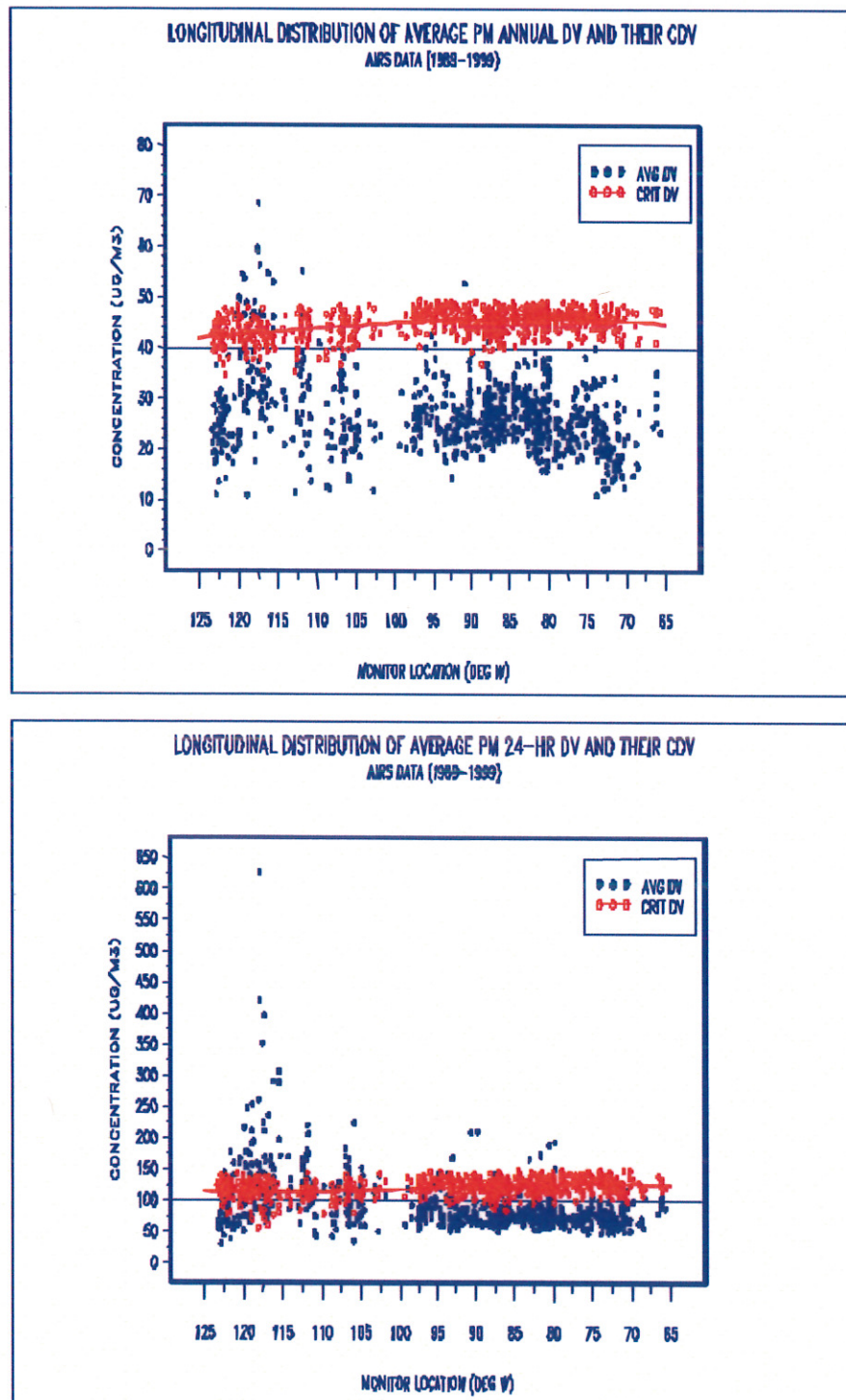


Figure 4.



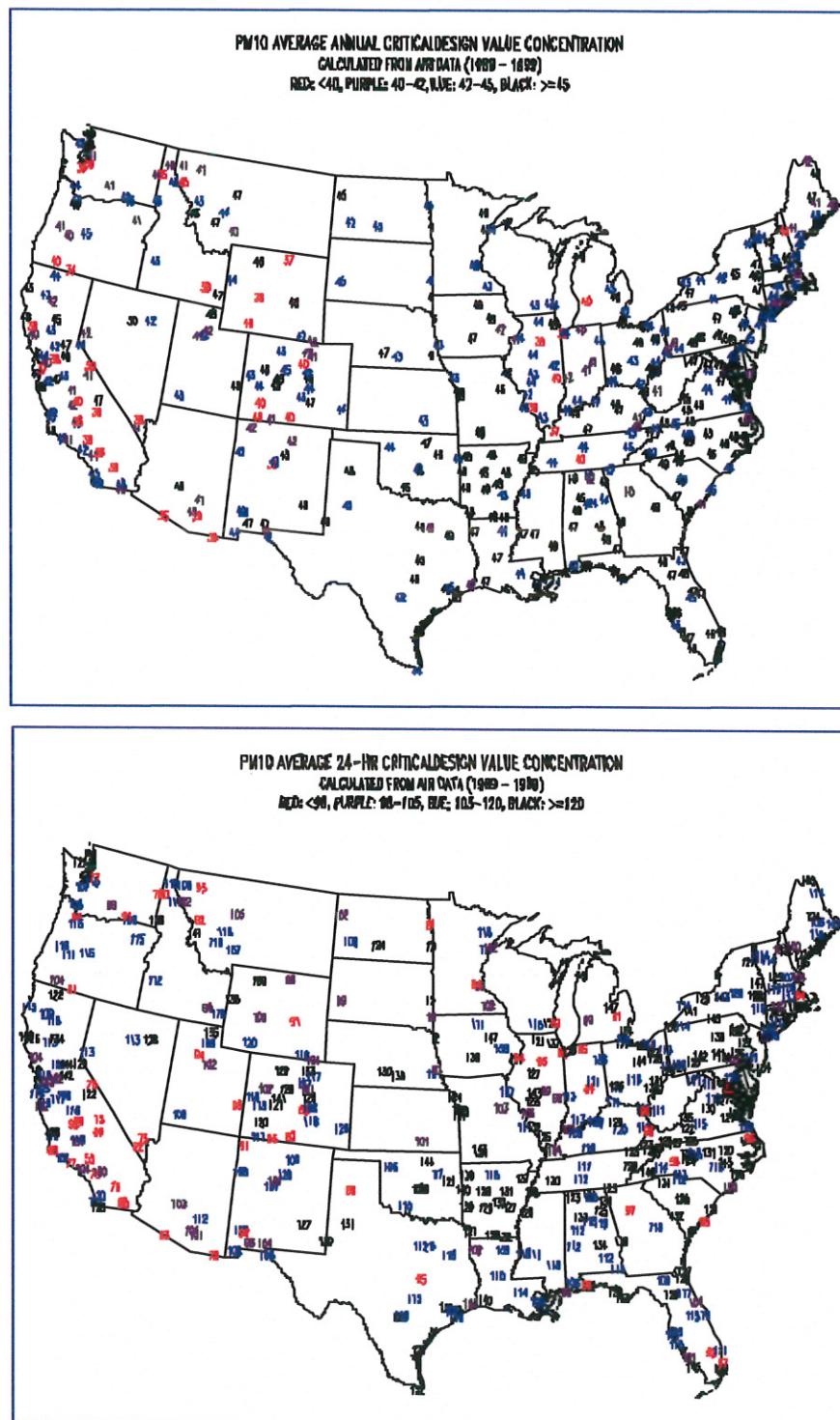


Figure 5.

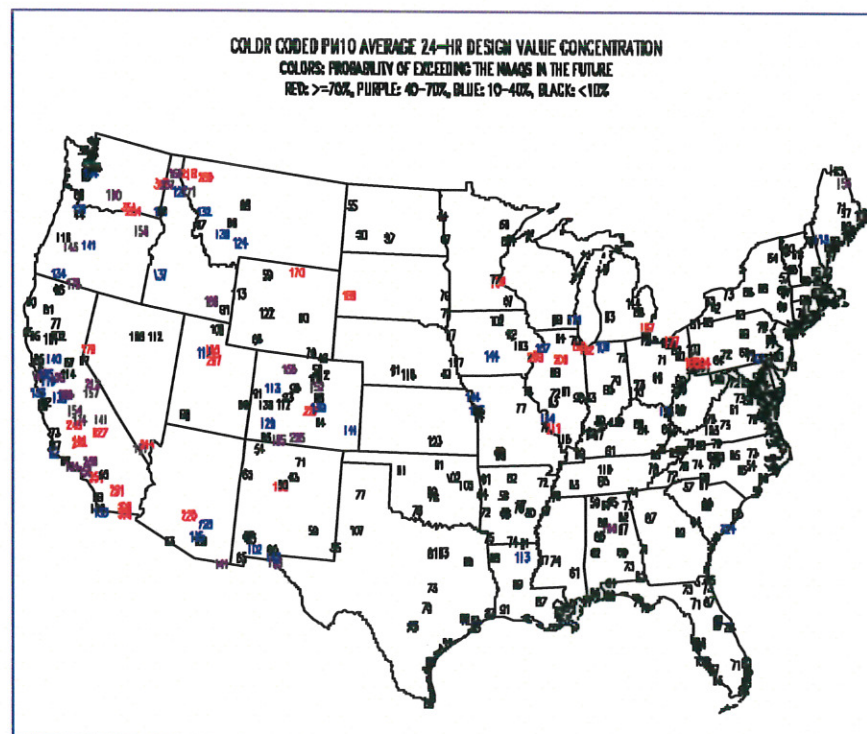
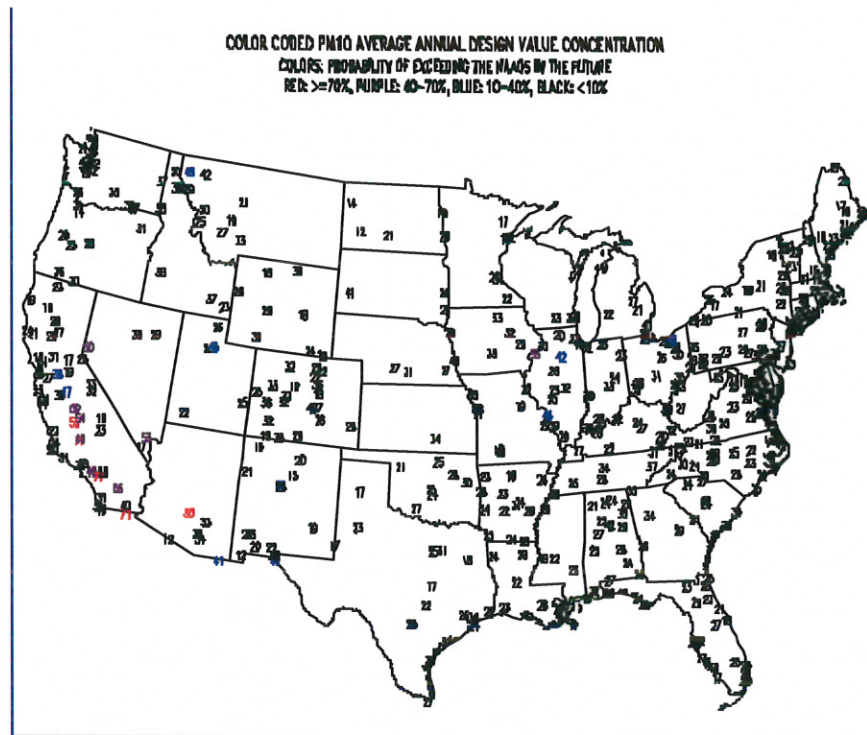


Figure 6.

## CONCLUSIONS

In this paper a statistical technique has been developed to determine the CDV which is the highest possible average design value any monitoring site could have before it may record a future violation of the NAAQS with a certain probability. The critical design value is calculated based on the average design value and its variability in the past, and it also involves a risk factor of our choice in the estimation. The difference between the ADV and CDV is a good indicator of whether the site is running a higher or lower risk of violating the NAAQS in the future than one is willing to take. Using this approach, one can even predict the probability of violating the NAAQS in the near future at any given site with adequate data length. Thus, this technique could be used as a planning tool for regulatory agencies to assess the risk of future violation of the NAAQS at any monitoring site and to make decisions about emissions controls. Further, since this technique is very general, it can be applied to any pollutant with a minimum of five years of valid data.

As an example, 11 years (1989-1999) of PM<sub>10</sub> data were analyzed using this technique. The results suggest that the inter-annual variability of the design values in the West is, on the average, much larger than that in the East, which is reflected in the calculated CDVs. Since anthropogenic emissions in a region usually do not change very much from year to year, the large variability in the inter-annual PM<sub>10</sub> design values in the West may be largely attributable to the inter-annual variation in natural conditions such as meteorology, wildfires, dust storms, and volcanic activities, etc. The higher occurrences of wildfires and dust storms in the West are known to be associated with its much drier climate, meteorological conditions, and topography. The once every six days sampling practice of PM<sub>10</sub> monitoring may also have some influence on the inter-annual variability of PM<sub>10</sub> design values.

## FUTURE WORK

Some further studies have been planned which include applying the same technique to other pollutants, and searching for a better estimate of CV in case when significant trend exists in the yearly design values. Since the variance estimate could be affected by an underlying trend and that a better estimate could be made of the CV if the trend and/or serial correlation could be removed from the estimate.

## ACKNOWLEDGMENTS

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## REFERENCES

1. US EPA, *PM<sub>10</sub> SIP Development Guideline*. EPA-450/2-86-001, US Environmental Protection Agency, Research Triangle Park, NC 27711, 1986.



2. Code of Federal Regulations, *Protection of Environment*, 40 CFR part 50, 1998.
3. US EPA, *Guideline on Air Quality Models (Revised)*. EPA-450/2-78-27 R. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, 1986.
4. US EPA, *Guideline for the Interpretation of Ozone Air Quality Standards*. EPA-450/4-79-003, US Environmental Protection Agency, Research Triangle Park, NC 27711, 1979.
5. Curran, T.C. and W.M. Cox, *Data Analysis Procedures for the Ozone NAAQS Statistical Format*. J. Air Pollution Control Association, 1980.

## **KEYWORDS**

Critical design value, design value, inter-annual variability, PM10, probability

## ATTACHMENT B: MOTOR VEHICLE REGIONAL ANALYSIS METHODOLOGY

The following methodology is used to determine whether increased emissions from on-road mobile sources could, in the next 10 years, increase concentrations in the area and threaten the assumption of maintenance that underlies the LMP policy. This analysis must be submitted and approved in order to be eligible for the LMP option.

The following equation should be used:

$$DV + (VMT_{pi} \times DV_{mv}) \cdot MOS$$

Where:

DV	=	the area's design value based on the most recent 5 years of quality assured data in $\bullet \text{ g/m}^3$
$VMT_{pi}$	=	the projected % increase in vehicle miles traveled (VMT) over the next 10 years
$DV_{mv}$	=	motor vehicle design value based on on-road mobile portion of the attainment year inventory in $\bullet \text{ g/m}^3$
MOS	=	margin of safety for the relevant PM-10 standard for a given area: $40 \bullet \text{ g/m}^3$ for the annual standard or $98 \bullet \text{ g/m}^3$ for the 24-hour standard

Please note that  $DV_{mv}$  is derived by multiplying DV by the percentage of the attainment year inventory represented by on-road mobile sources. This variable should be based on both primary and secondary  $PM_{10}$  emissions of the on-road mobile portion of the attainment year inventory, including re-entrained road dust.

States should consult with EPA regarding the three inputs used in the above calculation, and all EPA comments and concerns regarding inputs and results should be addressed prior to submitting a limited maintenance plan and redesignation request.

The VMT growth rate ( $VMT_{pi}$ ) should be calculated through the following methods:

- 1) an extrapolation of the most recent 10 years of Highway Performance Monitoring System (HPMS) data over the 10-year period to be addressed by the limited maintenance plan; and
- 2) a projection of VMT over the 10-year period that would be covered by the limited maintenance plan, using whatever method is in practice in the area (if different than #1).

Areas where method #1 is the current practice for calculating VMT do not also have to do calculation #2, although this is encouraged. All other areas should use methods #1 and #2, and  $VMT_{pi}$  is whichever growth rate produced by methods #1 and #2 is highest. Areas will be expected to use transportation models for method #2, if transportation models are available.

Areas without transportation models should use reasonable professional practice.

### Examples

1.  $DV = 80 \cdot \text{g}/\text{m}^3$   
 $VM_{pi} = 36\%$   
 $DV_{mv} = 30 \cdot \text{g}/\text{m}^3$   
 $MOS = 98 \cdot \text{g}/\text{m}^3$  for 24-hour PM-10 standard

$$80 + (.36 * 30) = 91$$

Less than 98 – Area passes regional analysis criterion.

2.  $DV = 35 \cdot \text{g}/\text{m}^3$   
 $VM_{pi} = 25\%$   
 $DV_{mv} = 6 \cdot \text{g}/\text{m}^3$   
 $MOS = 40 \cdot \text{g}/\text{m}^3$  for annual PM-10 standard

$$35 + (.25 * 6) = 37$$

Less than 40 – Area passes regional analysis criterion.

3.  $DV = 115 \cdot \text{g}/\text{m}^3$   
 $VM_{pi} = 25\%$   
 $DV_{mv} = 60 \cdot \text{g}/\text{m}^3$   
 $MOS = 98 \cdot \text{g}/\text{m}^3$  for 24-hour PM-10 standard

$$115 + (.25 * 60) = 130$$

More than 98 – Area does not pass criterion. Full section 175A maintenance plan required.