High Wind Exceptional Events And Control Measures for PM_{10} Areas

Air Quality Division

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1.0 Background

Under the authority of the Clean Air Act (CAA), the Environmental Protection Agency (EPA) develops National Ambient Air Quality Standards (NAAQS) for each of the criteria pollutants (carbon monoxide, lead, nitrogen oxides, ozone, particulate matter, and sulfur dioxide). For each of these pollutants, EPA tracks air concentrations based on actual measurements of pollutant concentrations in the ambient (outside) air at selected monitoring sites throughout the country. Once an air quality standard for a particular pollutant is established, monitors record when ambient concentrations of that pollutant exceed a level at which human health is no longer protected.[1] Should these exceedances continue or grow in intensity, the regulatory remedy is to declare the area in violation of the standard and designate the area nonattainment for that pollutant. The only time an exceedance would not count toward a violation of a standard is if that exceedance could be classified as an exceptional event.

Exceptional Events impact air quality when their influence results in ambient air concentrations of particulate matter that fall outside the range of normal statistical fluctuations. For particulate matter, these events can be the result of large fires, high winds, man-made events such as explosions, or natural events such as volcanic eruptions. In the Western United States, high winds can accompany large storms (e.g., haboobs) that move across a regional or state-wide swath of land, or high winds can accompany "micro-bursts" with or without rain that descend upon a small, localized area. When a monitor within a planning area registers an exceedance of the PM_{10} NAAQS – or 150 micrograms per cubic meter ($\mu g/m^3$) over 24 hours – the exceedance is flagged in the EPA Air Quality System (AQS) database and an examination of the event begins to determine if the event could be classified as exceptional.[2] More than three exceedances at the same particulate matter monitor within three consecutive years add up to a violation of the NAAQS. A violation has a consequence to a planning area of either preventing an area from reaching attainment or returning an area to nonattainment that was previously redesignated to attainment. If an exceedance is flagged as an exceptional event, however, and the EPA's Regional Office concurs, the exceedance is not counted toward a violation of the NAAQS.

Control measures are established to bring a nonattainment area into attainment for a particular NAAQS; the control measures are to remain in place even after the area is redesignated to attainment. These control measures can include Best Available Control Measures (BACM) or Technology (BACT), Reasonable Control Measures (RACM) or Technology (RACT), Most Stringent Measures (MSM), and Lowest Achievable Emission Rate (LAER). Other control measures can be case-by-case control measures or practices that have been shown to be effective in reducing pollution from a particular source; for PM_{10} examples include Agricultural Best Management Practices (AgBMPs), stabilization of vacant lots, or paving unpaved roads or shoulders. A nonattainment area can be classified as Moderate, Serious, or Severe. The CAA requires areas designated as serious nonattainment for PM_{10} to implement BACM and BACT on all significant sources of PM_{10}.

1.1 PM_{10} Planning Areas in Arizona

[1] A primary NAAQS standard prevents damage to human health; a secondary standard prevents environmental and property damage.

[2] Areas redesignated to attainment are subject to maintenance plans. An exceedance of the NAAQS is treated the same way as a nonattainment area; however, maintenance plan design values can be flagged as well but are not addressed by the federal Exceptional Events Rule. Maintenance plans are in place for 20 years.

Arizona has nine PM_{10} planning areas:

Ajo	Nonattainment; new plan under development
Bullhead City	Redesignated to attainment under a Limited Maintenance Plan
Douglas-Paul Spur	Nonattainment; new plan under development
Hayden	Nonattainment; plan to be revised[3]
Maricopa County	Nonattainment; under Five Percent Plan[4]
Miami	Nonattainment; Limited Maintenance Plan submitted to EPA
Nogales	Nonattainment; plan to be revised; also nonattainment for $PM_{2.5}$
Payson	Redesignated to attainment under a Limited Maintenance Plan
Rillito	Nonattainment; Limited Maintenance Plan submitted to EPA
Yuma	Nonattainment; Maintenance Plan submitted to EPA

Detailed information about the planning areas can be obtained by going to ADEQ's Web site at http://www.azdeq.gov/environ/air/plan/index.html.

1.2 High Wind Exceptional Events Versus Fire Events

As previously stated, exceptional events can include among other events, fire events and high wind events. For the purposes of this discussion, however, the focus is on high wind events as they are often the more prevalent cause of exceedances in areas throughout Arizona as well as other parts of the Western United States due to complex terrain and unique weather patterns. The characteristics of these high wind events are discussed further in a white paper titled, *Impact of Exceptional Events 'Unusual Winds' on PM_{10} Concentrations*.

2.0 Control Measures

The development of a state implementation plan (SIP) for an area designated as nonattainment for PM_{10} includes at the minimum:

- a review of all relevant monitoring sites and ambient monitoring data;
- development of an emissions inventory of all contributing sources of PM_{10};
- application of emission factors to the ambient concentrations recorded in the emissions inventory; any controls already in place for PM_{10} emissions;
- any controls in place in areas throughout the country, particularly the West, with similar characteristics to the planning area;
- any current research on effective control measures; current level of enforcement for any control measures already in place;
- and any modeling that shows the effectiveness of control measures on PM_{10} emissions.

Fortunately, there is a moderate amount of information about control measures for PM_{10}; unfortunately, much of the information is source and area-specific. Information on the relative effectiveness of control measures is not as abundant, nor is it easily applicable to the specific conditions in most of the PM_{10} planning areas in Arizona. Because the demonstrations required to obtain a concurrence on an exceptional event should account for the relative complexity of the emitting source mix, parsing out a specific source or source category along with the applicable control measure for a determination of relative effectiveness can be difficult and may even be counter-productive. This is compounded by the

[3] The Hayden area was previously included with the Miami area; split into two planning areas later approved by EPA.

[4] Maricopa County nonattainment area also include Apache Junction portion of Pinal County.

fact that PM_{10} cannot be characterized by a specific source category through routine examination of the particulates deposited on a monitor's filter. Through the SIP development process, however, the overall make-up of the planning area is known and fairly reliable assumptions about source contribution and implemented control measure effectiveness can be made in most cases.

2.1 Evaluating the Effectiveness of Control Measures; Implementation and Enforcement

There are several ways to evaluate the effectiveness of a control measure. The most direct approach is actual field testing. Planners can also query representatives of other planning areas for examples of effective control measures, sharing testing data, or replicating specific field tests. Another approach is to research control measures that have been recognized as BACM by EPA, other states, source emitters, or in some cases by the courts. Regardless of how a control measure is chosen and its relative effectiveness evaluated, it is often subjected to a computer model to demonstrate whether the control measure or measures actually show a reduction in emissions or prevent an increase in the concentration of emissions (i.e., reasonable further progress toward attaining the NAAQS).

Optimum effectiveness is measured by the degree of control efficiency; efficiency can be a set percentage or a range (i.e., the range can represent how the control measure is to be implemented over time) in relation to the level of compliance, or control efficiency multiplied by the compliance level. In the case where a control measure is a one-time, succinct action such as paving an unpaved road, the effectiveness should be high.[5] Other calculations of effectiveness can be less straightforward due to the variables in implementation and enforcement. Degree, range and timing of control measure implementation coupled with a variable level of enforcement make field inspections of vital importance to determine the true effectiveness of certain control measures. Without reliable or complete reporting of the implementation of control measures, the lower or lowest range of control efficiency is most likely reflective of actual field situations. It is difficult to calculate other types of control measure effectiveness when the implementation is more qualitative than quantitative in nature, even though the measure has proven effective in field tests (e.g., actions required only when special circumstances arise, or actions that rely on training and advanced communication). Field inspections, reporting, and a noticeable reduction in emissions provide verification of projected control efficiency for a particular control measure. A pattern of non-compliance would provide verification that the control efficiency has been compromised or the control measure itself was perhaps unenforceable as currently designed or implemented.

Due to the varied nature of control measures, a planning approach that commits to a series of control measures rather than relying solely on only a few is often the best way to gain an overall high level of control effectiveness for a planning area. The commitment to implement these measures suggests that an optimal level of enforcement will be in place, often strengthened further by permit conditions, rules, and ordinances with specific consequences for non-compliance. Control measures that are voluntary in nature can also have a high degree of effectiveness but often rely on ongoing outreach and inspections. Contingency measures are designed to provide additional emission reductions should the committed control measures fail to provide sufficient reductions. These measures are often not modeled toward progress in reducing emissions of a particular pollutant, but they can be effective should sources not wish to move to the higher degree of control these measures can represent.

By considering a control measure or suite of control measures in place around the time of an exceptional event, such as those triggered by high winds, it should be possible to determine the following: either (a) the control measure effectiveness was insufficient to control the background concentration of emissions thereby contributing to cumulative emissions sufficient to exceed the NAAQS when coupled with high

[5] In areas where a maintenance plan is in place, control measures that may appear permanent must be routinely revisited to assure that they are in good condition, or authority to enforce certain measures is still in place.

winds, or (b) the wind conditions were unique and severe enough to overwhelm the control measures regardless of control effectiveness.

3.0 Effect of Exceptional Events (High Winds) on Control Measures; Overwhelmed Controls

In parts of the Western United States high wind events can generally be classified as one of two types: mesoscale events or synoptic scale events. Mesoscale high winds associated with thunderstorm development are localized events that are often initially devoid of rain and cause a reduction in visibility due to lofted particles from disturbed arid land or certain soil types. Synoptic scale high wind events, on the other hand, have a greater tendency to transport particles over long distances. Both types of high wind events are capable of transporting particles into an area from distances outside of a specific planning area. This paper does not attempt to explain in detail the effect of these types of high winds, but in relation to planning area control measures it is important to note that at times these winds can overwhelm or greatly reduce the effectiveness of a control measure or suite of control measures.

Unfortunately, information on the effects of high wind events on control measures, specifically measures for the control of particulate matter, is not readily available. Most of the information is anecdotal in nature, observations after the fact. There are studies on the effects of high winds on particulate matter itself – effects of particle size bombardment and particle size relative to transport – but the information does not always translate well to control measure applications or is too case-specific. More to the point, however, is an understanding that certain measured high wind speeds do cause lifting of certain soil types or increase background concentrations of already existing particulates. There is a fair amount of agreement and observations to support that high winds over a certain speed can overwhelm most controls regardless of the level of implementation or enforcement. The phenomenon is discussed further in a corresponding white paper titled, *Impact of Exceptional Events 'Unusual Winds' on PM_{10} Concentrations*.

4.0 Tracking Relative Effectiveness of Implemented Control Measures During High Winds

As stated previously, it is essential that the control measures for a planning area be routinely inspected for implementation and level of enforcement in order to have a meaningful sense of control measure effectiveness. Text of permit conditions needs to be periodically reviewed, dust complaints need to be properly logged and the subject of timely and appropriate response, inspections and any enforcement actions that resulted need to be reported, along with any other action necessary to determine the full implementation of a control measure. When comparing the control measures to the effects of a high wind event, it is helpful to know what the conditions were on the ground and in the air prior to the high wind event, the day of the high wind event, and after the high wind event. The time before the event can determine possible contributors to elevated PM_{10} concentrations while the time after the event could expose non-compliance patterns that would not otherwise be directly tied to the event.

In order to obtain a better picture of what control measures are in place during the intervals of a high wind event, a simple reporting form has been constructed. This form, when reviewed by analysts of the high wind event, should provide a clearer picture of what could have contributed to the exceedance and could add to an argument that the event was indeed exceptional. The form requires several pieces of useful information. (1) Because some, but not all, planning areas have High Pollution Advisory (HPA) notification procedures, including high wind watches for particulate matter pollution, noting the existence of a HPA action on the day of or days prior to the event is important.[6] (2) Complaints are useful bits of

[6] For areas that do not have a HPA program in place, the National Weather Service issues storm watches and warnings to alert the public to possible heavy rain, flooding, gusty winds and blowing dust. Airports, both large and small regional air fields, also have data sources that register high winds and reduced visibility so aircraft warnings can be issued.

information as they often reveal insufficient implementation or enforcement of control measures, especially if the complaints are for the same source or group of sources; in the case of voluntary measures they can be the only available measure of effectiveness. (3) Inspections completed routinely or for special purposes (e.g., nighttime inspections) give specific information on what is happening in and around the planning area, particularly inspections required during a HPA. (4) Finally, any record of notices or actual enforcement actions on a source in the planning area tells a story of serious non-compliance with implemented control measures, or it tells of control measures that have been insufficiently implemented.

A sample form is attached to this paper. Each party responsible (i.e., State, County, or any other relevant public officer/agency) for sources in the planning area would complete the form, which would then be reviewed by those preparing the analysis that demonstrates whether the high wind event is truly an exceptional event. For those events that are obviously of such severity that control measures would be overwhelmed, it is still useful to note the control measure actions for the planning area, especially an issuance of a HPA or pertinent weather forecast. The reverse side of the form contains the committed control measures for the planning area. Control measures can vary considerably for particular planning areas, but including them on the form reminds everyone that they need to be considered in the exceptional event analysis.

5.0 Conclusion

A demonstration that a high wind event is in fact an exceptional event requires a robust analysis of the wind conditions coupled with an examination of the control measures in place in and around the area in which the monitor registered an exceedance. This demonstration must not only pass the scrutiny of regulators but also the general public. Should the high wind event that caused the exceedance truly reflect an influence that resulted in ambient air concentrations of particulate matter that fell outside the range of normal statistical fluctuations, then EPA's concurrence with the demonstration allows for a focus on PM_{10} emissions that can be controlled.

PM_{10} Control Measures Reporting Form
High Wind Exceptional Event Demonstration

Date of Flagged Event _____

PM_{10} Planning Area _____

Exceeding Monitor(s) _____

AQI/High Wind/Dust Forecast (rolling three day forecast) Issued?

Yes	**No**
☐	☐

Type: _____

In the spaces below, please provide information about the 72-hour period preceding the event, the day of the event, and the 72-hour period following the event. For a list of control measures for the planning area, see back of this form. Account for minimum 2 mile area around exceeding monitor(s). *Please attach additional information if necessary.*

Complaints:

_____
_____
_____

Inspections:

_____
_____
_____

Notices or Enforcement Actions:

_____
_____
_____

Regulating Agency _____

Information Supplied By _____

Date Completed _____

FOR INTERNAL PURPOSES ONLY
Reviewed by / date: _____

Measures included in the Maricopa County PM_{10} 5 Percent Plan
(25 committed measures in parentheses)

1. Extensive dust control training program (2).
2. Dust managers/Coordinators at earthmoving sites < than or equal to 5 acres (3,16).
3. Increase proactive Rule 310 and 316 inspections (9, 10, 44).
4. Strengthen Rule 310 to promote continuous compliance (36 thru 38, 28).
5. Conduct nighttime and weekend inspections (8).
6. Ban leaf blowers from blowing debris into streets (21).
7. Prohibit use of leaf blowers on unstabilized surfaces (45).
8. Implement a leaf blower outreach program (22).
9. Ban ATV use on high pollution advisory days (23).
10. Pave or stabilize existing unpaved parking lots (25).
11. Pave or stabilize unpaved road shoulders (28).
12. Strengthen and increase enforcement of Rule 310.01 for vacant lots (31, 32)
13. Recover costs for stabilizing vacant lots (33).
14. Restrict and enforce vehicle use/parking on vacant lots (31, 32).
15. Increase fines for open burning (34).
16. Restrict use of outdoor fireplaces/pits/ambience fireplaces (35).
17. Other wood burning restrictions in SB 1552 (47, 48).
18. Repave or overlay paved roads with rubberized asphalt (53).

Various additional SIP measures or sources:

1. Agriculture – Agricultural Best Management Practices (AgBMP) Program
2. Point sources – Permit Conditions (stack, fugitive, and area source emissions)
3. Rule 310 and 310.01; sand and gravel – Rule 316
4. Windblown, area sources – mobile, roadway, vacant lots, fires, et al.
5. Maintenance of micro-scale Salt River stabilization/improvement
6. Pave and stabilize public dirt roads and alleys
7. Covered loads
8. Registered subcontractors