
Review of Exceptional Event Request

Folsom, CA 1-Hour Ozone

- June 23, 2008
 - June 27, 2008
 - July 10, 2008
-

U.S. Environmental Protection Agency
Region 9

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Contents

1.0	Introduction.....	3
2.0	Summary of the Events.....	4
3.0	Requirements of the Exceptional Events Rule.....	4
4.0	Criteria Set Forth in 40 CFR §50.1(j).....	5
5.0	Clear Causal Relationship.....	7
6.0	Concentration in Excess of Normal Historical Fluctuations.....	9
7.0	No Exceedances But For the Event	9
8.0	Procedural Requirements	11
9.0	Conclusion	11

1.0 Introduction

On March 22, 2007, EPA adopted the rule *Treatment of Data Influenced by Exceptional Events*,¹ also known as the Exceptional Events Rule (EER), to govern the review and handling of certain air quality monitoring data for which the normal planning and regulatory processes are not appropriate. Under the terms of the EER, a state may request EPA to exclude data showing exceedances or violations of the National Ambient Air Quality Standard (NAAQS) that are directly due to an exceptional event from use in regulatory determinations. It may do so by demonstrating to EPA's satisfaction that such event caused a specific air pollution concentration at a particular air quality monitoring location.² Before EPA will exclude data from these regulatory determinations, the state must flag the data in EPA's Air Quality System (AQS) database and, after notice and an opportunity for public comment, submit a demonstration to justify the exclusion. After considering the weight of the evidence provided, EPA will then evaluate the demonstration in accordance with the requirements of the EER for the purposes of either concurring or nonconcurring with the State's requested flag.

On September 17, 2009, the California Air Resources Board (CARB) submitted to EPA a preliminary demonstration for twenty-three 1-hour ozone exceedances on six days and at five monitoring sites in the Sacramento Regional Ozone Nonattainment Area. EPA reviewed this demonstration and sent a letter to CARB on July 29, 2010, requesting more information. On March 30, 2011 CARB submitted final demonstrations for eight 1-hour exceedances on three days at the Folsom monitoring site, a subset of the originally requested exceedances.

This document sets forth the legal and factual basis for EPA's decisions regarding exceedances of the 1-hour Ozone NAAQS in 2008 at the Folsom monitoring site on June 23, June 27, and July 10, 2008 that CARB has flagged as due to "wildfire" exceptional events. EPA has not yet completed its analysis of the remaining dates and is not making a concurrence or non-concurrence determination for them at this time.

The documentation submitted by CARB in support of the exceptional events claims includes the following:

- Exceptional Events Demonstration for High Ozone in the Sacramento Regional Nonattainment Area Due to Wildfires; Sacramento Metropolitan Air Quality Management District and California Air Resources Board – July 8, 2009; Submitted to EPA on September 17, 2009 ("September 2009 Submittal"); and
- Exceptional Events Demonstration for 1-Hour Ozone Exceedances in the Sacramento Regional Nonattainment Area Due to 2008 Wildfires– Updated Documentation; March 30, 2011 ("March 2011 Submittal").

Although EPA reviewed both of these documents in developing our decisions, we believe that the document submitted on March 30, 2011 is a stand-alone exceptional events demonstration that provides revised documentation and support for all rule criteria independently of the

¹ 72 FR 13560 (March 22, 2007).

² 40 CFR §50.14 (a).

September 2009 submittal. Therefore, this document primarily cites evidence from the March 2011 demonstration.

2.0 Summary of the Events

In the summer of 2008, California experienced a confluence of events resulting in one of California's worst summer fire seasons in history. The Governor's Office of Emergency Services reported the 2008 June Fire Siege as the largest single fire event in California's recorded history (since 1936). CARB's description of the 2008 Lightning Wildfire Complex events in section 2C of the March 2011 Submittal explains how lightning strikes from a series of thunderstorms hit California from June 20 to June 22, 2008, igniting numerous wildfires. A combination of dry conditions over 2007-2008 and other weather conditions such as record-breaking heat waves, low humidity and a foehn (dry, downslope) wind event, exacerbated the fires and hampered firefighting efforts.

The information CARB submitted about these wildfires is corroborated in a report prepared by an interagency team of investigators at the request of California Department of Forestry and Fire Protection (CAL Fire), the U.S. Forest Service, Office of Emergency Services, and the National Park Service.³ The following is an excerpt from that report, "The 2008 Fire Siege":

On June 20th and 21st a series of severe, dry thunderstorms carpeted the state from Big Sur to Yreka with more than 5,000 lightning strikes, and igniting over 2,000 fires. During the following months, thirteen firefighters were killed and many others were injured on fires in this siege. Over 350 structures were destroyed and hundreds of millions of dollars of property and natural resources were damaged. Thousands of people were evacuated and smoke adversely effected air quality over much of the state for weeks. Communications, power delivery, and transportation systems were disrupted. Despite the intensive firefighting effort, some fires in remote areas continued to burn throughout the summer. By fall, over 1,200,000 acres had burned.

The June 2008 Fire Siege report also describes the increases in firefighting resources and public awareness efforts that resulted from an Executive Order signed by Governor Schwarzenegger on May 9, 2008 in anticipation of a severe fire season.

3.0 Requirements of the Exceptional Events Rule

Pursuant to 40 CFR §50.14(c)(3)(iv) a State's request that EPA exclude data showing exceedances or violations of the NAAQS must be accompanied by a demonstration to justify data exclusion that provides evidence that:

- (A) The event satisfies the criteria set forth in 40 CFR §50.1(j) that it:
- affects air quality;
 - is not reasonably controllable or preventable;

³ California Department of Forestry and Fire Protection, "2008 Fire Siege" (retrieved April 1, 2011) available at http://www.fire.ca.gov/fire_protection/downloads/siege/2008/2008FireSiege_full-book_r6.pdf (Multiagency Fire Investigation Report).

- is caused by human activity that is unlikely to recur at a particular location, or is a natural event;
- (B) There is a clear causal relationship between the measurement under consideration and the event that is claimed to have affected the air quality in the area;
- (C) The event is associated with a measured concentration in excess of normal historical fluctuations, including background; and
- (D) There would have been no exceedance or violation but for the event.

The demonstrations must fully meet all the above criteria to EPA's satisfaction; failure to meet any one of the criteria will result in EPA's non-concurrence with the flagging of the exceedance in question. In addition to technical criteria, the EER also contains procedural requirements. 40 CFR §50.14(c)(2)(iii) requires that data claimed to be due to an exceptional event must be flagged in the AQS database, and that an initial description of the event be provided to EPA; both must occur by July 1 of the year following the event. In addition, 40 CFR §50.14(c)(3)(i) requires that the State:

- submit a demonstration to EPA within three years of the calendar quarter of the event or 12 months prior to an EPA regulatory decision;
- provide notice and opportunity for public comment; and
- submit any public comments along with the demonstration.

EPA's will then concur or non-concur with a State's flag indicating that an exceedance resulted from an exceptional event. However, such concurrence or nonconcurrence does not constitute final agency action. The data that are the subject of the concurrence or nonconcurrence may become the basis for a subsequent EPA determination regarding an area's attainment status. Only when EPA makes a final determination, after notice-and-comment rulemaking, to exclude from consideration the data that were flagged by the State as due to an exceptional event, does the concurrence or nonconcurrence become part of a final agency action that is judicially reviewable under CAA section 307(b)(1).

The following sections evaluate CARB's submission regarding the events of June 23, June 27, and July 10, 2008, with respect to the requirements of the Exceptional Events Rule.

4.0 Criteria Set Forth in 40 CFR §50.1(j)

The criteria in 40 CFR §50.1(j) state that the exceptional event must affect air quality, be not reasonably controllable or preventable, and be caused by human activity that is unlikely to recur at a particular location or a natural event.

EPA generally considers the emissions of ozone precursors from lightning-induced wildfires as meeting the regulatory definition of a natural event, defined as one "in which human activity plays little or no direct causal role" (40 CFR 50.1(k)).

As stated in the preamble to the EER, the event in question shall be considered to have affected air quality if it can be shown that there is a clear causal relationship between the monitored exceedance and the event, and that the event is associated with a measured concentration in excess of normal historical fluctuations.⁴ EPA's review of these criteria is discussed in sections 5 and 6 below.

A determination of whether a particular event was “not reasonably controllable or preventable” depends on the specific facts and circumstances surrounding the event. Therefore, EPA addresses this and the other criteria of the EER on a case-by-case basis. With respect to whether these wildfire events and their effects on ozone concentrations were not reasonably controllable or preventable, EPA notes a number of considerations, all of which support concurrence on the state's exceptional events flags for the three days in question. First, the initiation of the numerous fires by lightning strikes under dry conditions means that the occurrence of the fires was not reasonably preventable. Second, it would not have been reasonable for the state to have required or to have itself accomplished prior removal of all or part of the fuel loadings that contributed to the fire emissions, given the scattered and unpredictable locations of the fires over a huge land area, given that at least some of the lands are intended to be left undisturbed, and given that federal land management agencies already had adopted forest plans for many of the areas in question after extensive research and public input. Third, it would have been inappropriate for the state or its districts to have had rules in place prior to the fires requiring specific approaches towards management of wildfires once ignited, given that wildfire situations occur without warning of their time or locations, such that resources to manage them cannot be deployed in advance and therefore it would be unreasonable to expect that such rules could always be adhered to by fire managers. Fourth, once the fires had started, it is reasonable that those responsible for managing them should have considered protection of human life and property to be their priorities, and it is reasonable that the state did not attempt to influence their decisions more towards minimization of ozone precursor emissions. The multiagency report “2008 Fire Siege” also states that the firefighting efforts for this “unprecedented” fire event were large and extensive – by July 13, over 20,000 firefighters, from as far away as Australia and New Zealand, were engaged in firefighting operations – but that still “[w]eather and fuel conditions and competition for resources made fire control efforts difficult.”⁵ Therefore, EPA agrees with CARB that the event (ozone precursor emissions from the 2008 Lightning Wildfire Complex) was not reasonably controllable or preventable (see demonstration section 5B in CARB's March 2011 Submittal).

⁴ 72 FR at 13569; see also Approval and Promulgation of Implementation Plans; Designation of Areas for Air Quality Planning Purposes; State of California; PM-10; Affirmation of Determination of Attainment for the San Joaquin Valley Nonattainment Area; Final Rule, 73 FR 14687, 14702 (March 19, 2008); and Approval and Promulgation of Implementation Plans; Designation of Areas for Air Quality Planning Purposes; State of California; PM-10; Affirmation of Determination of Attainment for the San Joaquin Valley Nonattainment Area; Proposed Rule, 72 FR 49046, 49051 (Aug. 27, 2007).

⁵ California Department of Forestry and Fire Protection, “2008 Fire Siege” (retrieved April 1, 2011) available at http://www.fire.ca.gov/fire_protection/downloads/siege/2008/2008FireSiege_full-book_r6.pdf (Multiagency Fire Investigation Report).

5.0 Clear Causal Relationship

Section 319 of the CAA and 40 CFR § 50.14(c)(3)(iv)(B) require the State to demonstrate that there is a clear causal relationship between the measurement under consideration and the event that is claimed to have affected air quality in the area.

The relationship between wildfire emissions and resulting air quality impacts is complicated. Fire can generate ozone precursors, but it can also reduce solar radiation needed to drive ozone formation. Also, fire plumes containing ozone and ozone precursors can pass over a monitoring site without mixing down to ground level and affecting the monitored concentration. Therefore, to demonstrate the clear causal relationship between the wildfire emissions and the 1-hour O₃ exceedances at Folsom, CARB demonstrated that (1) the wildfires occurred, (2) these wildfires produced emissions that were transported to the Folsom monitor, and (3) these wildfire emissions elevated ozone concentrations measured at the Folsom monitor.

Demonstration that the Wildfires Occurred

Section 2 and Appendix A of CARB's March 2011 Submittal provide an extensive description of the fires. The evidence presented includes a map and tables showing the location of the fire complexes burning in northern California at this time and average distances from Folsom, and satellite images showing smoke plumes on June 23, June 27 and July 10, 2008. Appendix F of the state's demonstration also includes numerous news reports of the fires throughout the summer of 2008.

Demonstration that Wildfire Emissions Were Transported to the Folsom Monitor

CARB's demonstration presents several types of evidence to show that the fire emissions reached the Folsom monitor. First, an analysis of the meteorology summarized in sections 3.C.1, 3.D.1 and 3.E.1 shows that conditions were favorable for the transport of emissions from fires in the Coastal and Sierra Nevada Mountain Ranges surrounding the northern part of the Sacramento Valley to Folsom (see Appendices B, C and D of the March 2011 Submittal for a detailed analysis). Satellite images show smoke over the entire Sacramento Valley on these three days and observations at the airports in the area confirm that the wildfire smoke was present at the surface, enough to impact visibility.

Because PM_{2.5} is directly emitted during combustion and because there are filter-based PM_{2.5} monitoring sites in the Sacramento region, CARB used PM_{2.5} sampling data to demonstrate that emissions from the wildfires reached ground level monitors in the Sacramento region. The State identified "surrogate" days for each fire-affected day in the request, based on similar meteorological indicators and local- to synoptic-scale conditions. These surrogate days provide an indication of what the air quality would have been without the presence of emissions from wildfires (see Appendix X of the March 2011 Submittal). In comparison to the surrogate days, 24-hour PM_{2.5} concentrations on June 23, June 27, and July 10, as well as throughout the fire-affected months, were much higher than normal and widespread throughout the area (see Section 3, Figures 9, 17 and 24 of the March 2011 Submittal). Levoglucosan and organic carbon concentrations while the fires were burning were evaluated from PM_{2.5} filter samples collected during June and July at monitoring stations close to Folsom showed elevated levels as well. This evidence of elevated PM_{2.5} concentrations and anomalous PM_{2.5} composition demonstrates

clearly that emissions from the wildfire were present at ground level throughout the Sacramento area during June and July 2008.

In order to show that the wildfire emissions transported to the monitor also contained the expected ozone precursors, NO_x and VOCs, CARB compared the monitored NO_x concentrations on the surrogate days and the fire-affected days. The fire-affected days show regionally elevated NO_x, similar to the 24-hour PM_{2.5} observation. Column NO₂ satellite measurements also show the same elevated pattern. Observed hourly PM_{2.5} surface concentrations, which increase as the height of the mixing layer decreases, are provided as evidence that the NO₂ concentration is also likely to increase at the surface.

Demonstration that Wildfire Emissions Elevated Ozone at the Folsom Monitor

As CARB discusses in section 2 of the March 2011 Submittal, emissions from wildfires can increase or decrease ambient ozone concentrations. While the research on this topic is ongoing, it is clear that relevant factors include: (i) the fuel being burned; (ii), whether smoke is thick enough to inhibit the photochemical production of ozone; and (iii) the distance from the location where the fire is producing emissions to the location where the air quality impact is measured. CARB argues that the sources of the fire emissions were too far away from the monitoring stations for the plume to contain enough NO remaining to titrate the ozone and have an ozone-lowering affect on air quality at Folsom. CARB also presents evidence of a regional increase in ozone that is consistent with the extent and timing of the observed increase in PM_{2.5}, indicating that it is more likely that the fire emissions increased ozone (due to increased precursors), rather than decreased ozone (due to decreased solar insolation or increased ozone titration).

Section 2 of the March 2011 Submittal depicts the evidence that ozone was elevated throughout the Sacramento air basin on the fire-affected days. Table 4, which lists exceedances that occurred at nearby monitoring sites from June 25 through August 13, 2008 while the fires were burning, shows that there were more exceedances than normal, all likely affected by wildfire emissions. Also, Figures 15, 21, and 28 in Section 3 of the March 2011 Submittal are maps comparing 1-hour maximum ozone concentrations on June 23, June 27 and July 10, 2008 to their surrogate days, which exhibit significant regional increases in ozone concentrations on fire-affected days. The measured 1-hour maximum ozone concentrations at Folsom on the three surrogate days were below the NAAQS, and were only 49 to 65 percent of the concentrations measured on the corresponding fire-affected days. Lastly, the minimum ozone concentrations on June 27 and July 10, 2008 were higher than normal. These concentrations occurred early in the morning, before daily ozone production had fully started, indicating that there was anomalously high ozone carryover from previous days.

Conclusion

In conclusion, the evidence contained in CARB's March 2011 Submittal indicates that there was an anomalous increase in ozone on these days and that the cause that most likely accounts for those differences was the presence of wildfire emissions. EPA has determined that the weight of evidence analysis presented in section 3 of CARB's March 2011 submittal adequately demonstrates a clear causal relationship between the wildfire emissions, which constitute the event, and the 1-hour ozone exceedances at Folsom on June 23, June 27, and July 10, 2010.

6.0 Concentration in Excess of Normal Historical Fluctuations

Pursuant to 40 CFR 50.14(c)(3)(iv)(C), the demonstration must show that “the event is associated with a measured concentration in excess of normal historical fluctuations.” In section 3F of the March 2011 Submittal, CARB provided a plot of the daily ozone maximum concentration at Folsom for the high ozone seasons (May through October) from 2004 through 2008. June 23, June 27, and July 10, 2008 all fall above the 99th percentile of data from these five ozone seasons at this site.

While there is no specific threshold test for this requirement, the statistical analysis presented strengthens the overall weight of evidence for the exceptional events demonstration and fulfills the requirement of 40 CFR §50.14(c)(3)(iv)(C) that there be evidence showing the event is associated with measured concentrations in excess of normal historical concentrations.

7.0 No Exceedances But For the Event

Pursuant to 40 CFR §50.14(c)(3)(iv)(D), the demonstration must show that “there would have been no exceedance or violation but for the event.” The weight of evidence in a demonstration does not require a precise estimate of the air quality impact from the event,⁶ though such information is often useful. EPA recognizes that since effects of a fire on ozone are complex, meeting this requirement may be more difficult for many, if not all ozone fire exceptional events. This is primarily due to the fact that wildfires often occur during the same seasons that exhibit high ozone caused by anthropogenic precursor emissions, making it difficult to separate the wildfire contribution from a high ozone event that would have occurred without the fire. However, this is still a required showing.

Section 4 of the March 2010 Submittal presents the evidence used to demonstrate the requirement of 40 CFR §50.14(c)(3)(iv)(D). The first method of analysis that CARB uses is a regression model developed for Sacramento County that predicts maximum ozone concentrations in the county from various meteorological parameters. Since the maximum concentration of ozone in Sacramento County occurs at Folsom for the general wind direction observed on these three days, EPA agrees that the model can be used to predict what the 1-hour maximum ozone concentrations at Folsom may have been on these three days without the emissions from the wildfire. CARB discusses the inherent uncertainties with this method and their potential impact on the predicted results in Section 4B and Appendix X of the March 2011 Submittal. Despite these uncertainties, EPA agrees that the evidence that the predicted 1-hour maximum ozone concentrations from the regression model are below the NAAQS for these three days (ranging from 77 to 95 ppb) indicates that the ozone concentrations at Folsom would not have exceeded the 1-hour O₃ NAAQS without the impact of the wildfire emissions.

In order to evaluate the performance and uncertainties in the regression model results, CARB calculated the 95th percentile of the daily differences between the observed and predicted ozone concentrations for May through October 2007 and May through June 22 and September 2008. This value, 27.6 ppb, was then added to the daily predicted concentrations to give a conservative

⁶ 72 FR at 13570.

statistical threshold of expected maximum concentration, called a regular upper limit. In general, this regular upper limit should only be exceeded 5 percent of the time, but during the fire period, it was exceeded 16 of the 34 days (47 percent). This is further evidence supporting the conclusion that ozone was anomalously elevated at Folsom during the fire period, and that since there are no known variations in anthropogenic sources during this time, it is very likely that the wildfire emissions constituted the anomalous source.

The 1-hour ozone maximum concentrations measured on the surrogate days as described in section 5 of this document were below the NAAQS and were similar in magnitude to the concentrations predicted by the regression model analysis (see table 8 in section 4.C of the March 2011 Submittal), providing additional support for the conclusion that without the emissions from the wildfire, the ozone concentrations on these three days would not have exceeded the 1-hour standard.

Another method used by CARB to estimate the expected 1-hour ozone maximum concentration without the influence of the wildfire emissions is outlined in section 4.C of their March 2011 demonstration.⁷ This analysis identifies both meteorological indicators generally necessary to produce 8-hour ozone concentrations greater than 95 ppb and the synoptic-scale conditions that the Sacramento Metropolitan Air Quality Management District has determined are conducive to typical high ozone events. These indicators, referred to as the rules of thumb, are specifically developed for a certain 8-hour ozone threshold in Sacramento County, but can give a rough indication of the likelihood of a 1-hour ozone maximum above the NAAQS at Folsom.

While the synoptic-scale conditions are different for typical high ozone events and for the days requested for exclusion, some of the meteorological indicators on the wildfire-affected days are conducive to 8-hour ozone concentrations above 95 ppb. Therefore, to address the uncertainties in using the rules of thumb to predict 1-hour ozone, CARB evaluated the likelihood of a 1-hour ozone exceedance occurring on days with 8-hour ozone concentrations above 95 ppb. The analysis shows that there are no 1-hour ozone exceedances on days with 8-hour concentrations below 95 ppb between 2004 and 2010. Also, seven of the 46 days with 8-hour concentrations above 95 ppb from 2004 to 2010 had corresponding 1-hour ozone exceedances, six of which were or may have been affected by wildfire emissions. CARB argues that this shows that even for days in Sacramento County with 8-hour ozone concentrations above 95 ppb, a 1-hour ozone exceedance is very unlikely.

Considering the weight of evidence, the evaluation for all three days provides sufficient evidence to establish that there would not have been exceedances at the Folsom monitor on June 23, June 27 and July 10, 2008 but for the event.⁸

⁷ See Appendix Y: *Evaluation of Exceptional Events Based on Rules of Thumb* of the March 2010 Submittal for the complete analysis.

⁸ EPA notes, however, that this conclusion is based on the facts and circumstances that pertain here, and application of the EER to other fire events will depend similarly on the specific circumstances of those events.

8.0 Procedural Requirements

The EER at 40 CFR §50.14(c)(2) requires that data claimed to be due to an exceptional event must both be flagged in the AQS database and an initial description of the event must be provided to EPA by July 1 of the year following the event. The EER at 40 CFR §50.14(c)(3)(i) requires that the State submit a demonstration to EPA within three years of the event that has been subject to public notice and opportunity for comment, and that any public comments be submitted along with the demonstrations.

CARB flagged the events in AQS in accordance with 40 CFR §50.14. CARB issued its demonstration for public notice on July 29, 2009. Notices were published in the following counties that comprise the Sacramento Regional Ozone Nonattainment area: Sacramento, El Dorado, Placer, Yolo, Solano and Sutter. Two public comments were received that focused on the issue of fire management. The District has included these comments and the District's responses to these comments in Appendix G of the March 2011 submittal. The District's responses highlight the "Wildland Fire Use Coordination and Communication Protocol" that is already in place to manage the forests and minimize smoke impacts. On September 17, 2009, CARB submitted their demonstration for the 2008 wildfire ozone events in the Sacramento Regional Ozone Nonattainment Area. CARB sent additional clarification to EPA via email on March 30, 2011.

9.0 Conclusion

Documentation submitted by CARB claims that emissions from the summer 2008 wildfires elevated ozone levels throughout the Sacramento Regional Ozone Nonattainment Area and caused exceedances of the 1-hour Ozone NAAQS at the Folsom monitoring station on three days. EPA reviewed the weight of evidence provided by CARB to demonstrate that the exceedances at the Folsom monitor on June 23, June 27, and July 10, 2008 meet the criteria in the EER for the purposes of EPA's concurrence on the flagging of the data for these days. While the information and analyses presented in CARB's submittal documents do not represent the entire suite of possible evidence for exceptional event packages, and additional or alternate evidence may be necessary to make an exceptional event determination for other wildfire or other types of events, in this particular instance EPA finds that the weight of evidence is sufficient for concurrence on the flagging of the data for the Folsom monitor on June 23, June 27, and July 10, 2008. These concurrences do not constitute final EPA action to exclude these data from consideration for purposes of determining the attainment status of the area. Final actions will come only after EPA completes notice and comment rulemaking on those determinations.