ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 50, 53, and 58

[EPA–HQ–OAR–2007–0352; 9160–4]

RIN 2060–A048

Primary National Ambient Air Quality Standard for Sulfur Dioxide

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: Based on its review of the air quality criteria for oxides of sulfur and the primary national ambient air quality standard (NAAQS) for oxides of sulfur as measured by sulfur dioxide (SO_2), EPA is revising the primary SO_2 NAAQS to provide requisite protection of public health with an adequate margin of safety. Specifically, EPA is establishing a new 1-hour SO_2 standard at a level of 75 parts per billion (ppb), based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations. The EPA is also revoking both the existing 24-hour and annual primary SO_2 standards.

DATES: This final rule is effective on August 23, 2010.

ADDRESSES: EPA has established a docket for this action under Docket ID No. EPA–HQ–OAR–2007–0352. All documents in the docket are listed on the *http://www.regulations.gov* Web site. Although listed in the index, some information is not publicly available, *e.g.,* confidential business information or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, will be publicly available only in hard copy form. Publicly available docket materials are available either electronically through *http://www.regulations.gov* or in hard copy at the Air and Radiation Docket and Information Center, EPA/DC, EPA West, Room 3334, 1301 Constitution Ave., NW., Washington, DC. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566–1744 and the telephone number for the Air and Radiation Docket and Information Center is (202) 566–1742.

FOR FURTHER INFORMATION CONTACT: Dr. Michael J. Stewart, Health and Environmental Impacts Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Mail code C504–06, Research Triangle Park, NC 27711; telephone: 919–541–7524; fax: 919–541–0237; e-mail: *stewart.michael@epa.gov*.

SUPPLEMENTARY INFORMATION:

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The following topics are discussed in this preamble:

I. Background

A. Summary of Revisions to the SO_2 Primary NAAQS

Based on its review of the air quality criteria for oxides of sulfur and the primary national ambient air quality standard (NAAQS) for oxides of sulfur as measured by sulfur dioxide (SO_2), EPA is making revisions to the primary SO_2 NAAQS so the standards are requisite to protect public health with an adequate margin of safety, as appropriate under section 109 of the Clean Air Act (Act or CAA). Specifically, EPA is replacing the current 24-hour and annual standards with a new short-term standard based on the 3-year average of the 99th percentile of the yearly distribution of 1-hour daily maximum SO_2 concentrations. EPA is setting the level of this new standard at 75 ppb. EPA is adding data handling conventions for SO_2 by adding provisions for this new 1-hour primary standard. EPA is also establishing requirements for an SO_2 monitoring network. These new provisions require monitors in areas where there is an increased coincidence of population and SO_2 emissions. EPA is also making conforming changes to the Air Quality Index (AQI).

B. Statutory Requirements

Two sections of the Clean Air Act (Act or CAA) govern the establishment and revision of National Ambient Air Quality Standards NAAQS. Section 108 of the Act directs the Administrator to identify and list air pollutants that meet certain criteria, including that the air pollutant "in his judgment, cause[s] or contribute[s] to air pollution which may reasonably be anticipated to endanger public health and welfare" and "the presence of which in the ambient air results from numerous or diverse mobile or stationary sources." CAA section 108(a)(1)(A) and (B). For those air pollutants listed, section 108 requires the Administrator to issue air quality criteria that "accurately reflect the latest scientific knowledge useful in indicating the kind and extent of all identifiable effects on public health or welfare which may be expected from the presence of [a] pollutant in ambient air * * *" Section 108(a)(2).

Section 109(a) of the Act directs the Administrator to promulgate "primary" and "secondary" NAAQS for pollutants for which air quality criteria have been issued. Section 109(b)(1) defines a primary standard as one "the attainment and maintenance of which in the judgment of the Administrator, based on [the air quality] criteria and allowing an adequate margin of safety, are requisite to protect the public health." [1] Section 109(b)(1). A secondary standard, in turn, must "specify a level of air quality the attainment and maintenance of which, in the judgment of the Administrator, based on [the air quality] criteria, is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of such pollutant in the ambient air." [2] Section 109(b)(2) This rule concerns exclusively the primary NAAQS for oxides of sulfur.

The requirement that primary standards include an adequate margin of safety is intended to address uncertainties associated with inconclusive scientific and technical information available at the time of standard setting. It is also intended to provide a reasonable degree of protection against hazards that research has not yet identified. *Lead Industries Association* v. *EPA,* 647 F.2d 1130, 1154 (DC Cir 1980), *cert. denied,* 449 U.S. 1042 (1980); *American Petroleum Institute* v. *Costle,* 665 F.2d 1176, 1186 (DC Cir. 1981), *cert. denied,* 455 U.S. 1034 (1982). Both kinds of uncertainties are components of the risk associated with pollution at levels below those at which human health effects can be said to occur with reasonable scientific certainty. Thus, in selecting primary standards that include an adequate margin of safety, the Administrator is seeking not only to prevent pollution levels that have been demonstrated to be harmful but also to prevent lower pollutant levels that may pose an unacceptable risk of harm, even if the risk is not precisely identified as to nature or degree. The CAA does not require the Administrator to establish a primary NAAQS at a zero-risk level or at background concentration levels, *see Lead Industries Association* v. *EPA,* 647 F.2d at 1156 n. 51, but rather at a level that reduces risk sufficiently so as to protect public health with an adequate margin of safety.

In addressing the requirement for a margin of safety, EPA considers such factors as the nature and severity of the health effects involved, the size of the at-risk population(s), and the kind and degree of the uncertainties that must be addressed. The selection of any particular approach to providing an adequate margin of safety is a policy choice left specifically to the Administrator's judgment. *Lead Industries Association* v. *EPA,* 647 F.2d at 1161–62.

In setting standards that are "requisite" to protect public health and welfare, as provided in section 109(b), EPA's task is to establish standards that are neither more nor less stringent than necessary for these purposes. In so doing, EPA may not consider the costs of implementing the standards. *Whitman* v. *American Trucking*

[1] The legislative history of section 109 indicates that a primary standard is to be set at "the maximum permissible ambient air level * * * which will protect the health of any [sensitive] group of the population," and that for this purpose "reference should be made to a representative sample of persons comprising the sensitive group rather than to a single person in such a group." S. Rep. No. 91–1196, 91st Cong., 2d Sess. 10 (1970). *See also American Lung Ass'n* v. *EPA,* 134 F. 3d 388, 389 (DC Cir. 1998) ("NAAQS must protect not only average healthy individuals, but also 'sensitive citizens'—children, for example, or people with asthma, emphysema, or other conditions rendering them particularly vulnerable to air pollution. If a pollutant adversely affects the health of these sensitive individuals, EPA must strengthen the entire national standard."); *Coalition of Battery Recyclers Ass'n* v. *EPA,* No. 09–1011 (DC Cir. May 14, 2010) slip op. at 7 (same).

[2] EPA is currently conducting a separate review of the secondary SO_2 NAAQS jointly with a review of the secondary NO_2 NAAQS (*see http://www.epa.gov/ttn/naaqs/standards/no2so2sec/index.html* for more information).

Associations, 531 U.S. 457, 471, 475–76 (2001).

Section 109(d)(1) of the Act requires the Administrator to periodically undertake a thorough review of the air quality criteria published under section 108 and the NAAQS and to revise the criteria and standards as may be appropriate. The Act also requires the Administrator to appoint an independent scientific review committee composed of seven members, including at least one member of the National Academy of Sciences, one physician, and one person representing State air pollution control agencies, to review the air quality criteria and NAAQS and to "recommend to the Administrator any new * * * standards and revisions of existing criteria and standards as may be appropriate under section 108 and subsection (b) of this section." CAA section 109(d)(2). This independent review function is performed by the Clean Air Scientific Advisory Committee (CASAC) of EPA's Science Advisory Board.

C. Related SO_2 Control Programs

States are primarily responsible for ensuring attainment and maintenance of ambient air quality standards once EPA has established them. Under section 110 of the Act, and related provisions, States are to submit, for EPA approval, State implementation plans (SIPs) that provide for the attainment and maintenance of such standards through control programs directed to sources of the pollutants involved. The States, in conjunction with EPA, also administer the prevention of significant deterioration program that covers these pollutants. *See* CAA sections 160–169. In addition, Federal programs provide for nationwide reductions in emissions of these and other air pollutants through the Federal motor vehicle and motor vehicle fuel control program under title II of the Act (CAA sections 202–250) which involves controls for emissions from all moving sources and controls for the fuels used by these sources; new source performance standards under section 111; and title IV of the Act (CAA sections 402–416), which specifically provides for major reductions in SO_2 emissions. EPA has also promulgated the Clean Air Interstate Rule (CAIR) to require additional SO_2 emission reductions needed in the eastern half of the United States to address emissions which contribute significantly to nonattainment with, or interfere with maintenance of, the PM NAAQS by downwind States in the CAIR region. This rule was remanded by the DC Circuit, and although it remains in effect, EPA is reevaluating it pursuant to the court remand.

Currently, there are several areas designated as being in nonattainment of the primary SO_2 NAAQS (*see* section VI). Moreover, as a result of this final rule, additional areas could be classified as non-attainment. Certain States would then be required to develop SIPs that identify and implement specific air pollution control measures to reduce ambient SO_2 concentrations to attain and maintain the revised SO_2 NAAQS, most likely by requiring air pollution controls on sources that emit oxides of sulfur (SO_x).

D. History of Reviews of the Primary NAAQS for Sulfur Oxides

On April 30, 1971, the EPA promulgated primary SO_2 NAAQS (36 FR 8187). These primary standards, which were based on the findings outlined in the original 1969 Air Quality Criteria for Sulfur Oxides, were set at 0.14 parts per million (ppm) averaged over a 24-hour period, not to be exceeded more than once per year, and 0.030 ppm annual arithmetic mean. In 1982, EPA published the Air Quality Criteria for Particulate Matter and Sulfur Oxides (EPA, 1982) along with an addendum of newly published controlled human exposure studies, which updated the scientific criteria upon which the initial standards were based (EPA, 1982). In 1986, EPA published a second addendum presenting newly available evidence from epidemiologic and controlled human exposure studies (EPA, 1986). In 1988, EPA published a proposed decision not to revise the existing standards (53 FR 14926) (April 26, 1988). However, EPA specifically requested public comment on the alternative of revising the current standards and adding a new 1-hour primary standard of 0.4 ppm (400 ppb) to protect asthmatics against 5–10 minute peak SO_2 concentrations.

As a result of public comments on the 1988 proposal and other post-proposal developments, EPA published a second proposal on November 15, 1994 (59 FR 58958). The 1994 re-proposal was based in part on a supplement to the second addendum of the criteria document, which evaluated new findings on 5–10 minute SO_2 exposures in asthmatics (EPA, 1994a; EPA, 1994b). As in the 1988 proposal, EPA proposed to retain the existing 24-hour and annual standards. EPA also solicited comment on three regulatory alternatives to further reduce the health risk posed by exposure to high 5-minute peaks of SO_2 if additional protection were judged to be necessary. The three alternatives were: (1) Revising the existing primary SO_2 NAAQS by adding a new 5-minute standard of 0.6 ppm (600 ppb) SO_2; (2) establishing a new regulatory program under section 303 of the Act to supplement protection provided by the existing NAAQS, with a trigger level of 0.6 ppm (600 ppb) SO_2, one expected exceedance; and (3) augmenting implementation of existing standards by focusing on those sources or source types likely to produce high 5-minute peak concentrations of SO_2.

On May 22, 1996, EPA announced its final decision not to revise the NAAQS for SO_x (61 FR 25566). EPA found that asthmatics—a susceptible population group—could be exposed to short-term SO_2 bursts resulting in repeated 'exposure events' such that tens or hundreds of thousands of asthmatics could be exposed annually to lung function effects "distinctly exceeding * * * [the] typical daily variation in lung function" that asthmatics routinely experience, and found further that repeated occurrences should be regarded as significant from a public health standpoint. 61 FR at 25572, 25573. Nonetheless, the agency concluded that "the likelihood that asthmatic individuals will be exposed * * * is very low when viewed from a national perspective", that "5-minute peak SO[2] levels do not pose a broad public health problem when viewed from a national perspective", and that "short-term peak concentrations of SO[2] do not constitute the type of ubiquitous public health problem for which establishing a NAAQS would be appropriate." *Id.* at 25575. EPA concluded, therefore, that it would not revise the existing standards or add a standard to specifically address 5-minute exposures. EPA also announced an intention to propose guidance, under section 303 of the Act, to assist States in responding to short-term peaks of SO_2 and later initiated a rulemaking to do so (62 FR 210 (Jan. 2, 1997).

The American Lung Association and the Environmental Defense Fund challenged EPA's decision not to establish a 5-minute standard. On January 30, 1998, the Court of Appeals for the District of Columbia Circuit found that EPA had failed to adequately explain its determination that no revision to the SO_2 NAAQS was appropriate and remanded the determination back to EPA for further explanation. *American Lung Ass'n* v. *EPA,* 134 F. 3d 388 (DC Cir. 1998). Specifically, the court held that EPA had failed to adequately explain the basis for its conclusion that short-term SO_2 exposures to asthmatics do not constitute a public health problem,

noting that the agency had failed to explain the link between its finding that repeated short-term exposures were significant, and that there would be tens to hundreds of thousands of such exposures annually to a susceptible subpopulation. 134 F. 3d at 392. The court also rejected the explanation that short-term SO_2 bursts were "localized, infrequent, and site-specific" as a rational basis for the conclusion that no public health problem existed for purposes of section 109: "[N]othing in the Final Decision explains why 'localized', 'site-specific', or even 'infrequent' events might nevertheless create a public health problem, particularly since, in some sense, all pollution is local and site-specific * * *". *Id.* The court accordingly remanded the case to EPA to adequately explain its determination or otherwise take action in accordance with the opinion. In response, EPA has collected and analyzed additional air quality data focused on 5-minute concentrations of SO_2. These air quality analyses conducted since the last review helped inform the current review, which (among other things) address the issues raised in the court's remand of the Agency's last decision.

EPA formally initiated the current review of the air quality criteria for oxides of sulfur and the SO_2 primary NAAQS on May 15, 2006 (71 FR 28023) with a general call for information. EPA's draft Integrated Review Plan for the Primary National Ambient Air Quality Standards for Sulfur Dioxide (EPA, 2007a) was made available in April 2007 for public comment and was discussed by the CASAC via a publicly accessible teleconference on May 11, 2007. As noted in that plan, SO_X includes multiple gaseous (*e.g.,* SO_3) and particulate (*e.g.,* sulfate) species. Because the health effects associated with particulate species of SO_X have been considered within the context of the health effects of ambient particles in the Agency's review of the NAAQS for particulate matter (PM), the current review of the primary SO_2 NAAQS is focused on the gaseous species of SO_X and does not consider health effects directly associated with particulate species.

The first draft of the Integrated Science Assessment for Oxides of Sulfur-Health Criteria (ISA) and the Sulfur Dioxide Health Assessment Plan: Scope and Methods for Exposure and Risk Assessment (EPA, 2007b) were reviewed by CASAC at a public meeting held on December 5–6, 2007. Based on comments received from CASAC and from the public, EPA developed the second draft of the ISA and the first draft of the Risk and Exposure Assessment to Support the Review of the SO_2 Primary National Ambient Air Quality Standard (Risk and Exposure Assessment (REA)). These documents were reviewed by CASAC at a public meeting held on July 30–31, 2008. Based on comments received from CASAC and the public at this meeting, EPA released the final ISA in September of 2008 (EPA, 2008a; henceforth referred to as ISA). In addition, comments received were considered in developing the second draft of the REA. Importantly, the second draft of the REA contained a draft staff policy assessment that considered the evidence presented in the final ISA and the air quality, exposure, and risk characterization results presented in the second draft REA, as they related to the adequacy of the current SO_2 NAAQS and potential alternative primary SO_2 standards. This document was reviewed by CASAC at a public meeting held on April 16–17, 2009. In preparing the final REA report, which included the final staff policy assessment, EPA considered comments received from CASAC and the public at and subsequent to that meeting. The final REA containing the final staff policy assessment was completed in August 2009 (EPA 2009a; henceforth referred to as REA)).

On December 8, 2009 EPA published its proposed revisions to the primary SO_2 NAAQS. 74 FR 64810 presented a number of conclusions, findings, and determinations proposed by the Administrator. EPA invited general, specific, and/or technical comments on all issues involved with this proposal, including all such proposed judgments, conclusions, findings, and determinations. EPA invited specific comment on the level, or range of levels, appropriate for such a standard, as well as on the rationale that would support that level or range of levels. These comments were carefully considered by the Administrator as she made her final decisions, as described in this notice, on the primary SO_2 NAAQS

The schedule for completion of this review is governed by a judicial order resolving a lawsuit filed in September 2005, concerning the timing of the current review. *Center for Biologic Diversity* v. *Johnson* (Civ. No. 05–1814) (D.D.C. 2007). The order that now governs this review, entered by the court in August 2007 and amended in December 2008, provides that the Administrator will sign, for publication, a final rulemaking concerning the review of the primary SO_2 NAAQS no later than June 2, 2010.

E. Summary of Proposed Revisions to the SO_2 Primary NAAQS

For the reasons discussed in the preamble of the proposal for the SO_2 primary NAAQS, EPA proposed to make revisions to the primary SO_2 NAAQS (and to add SO_2 data handling conventions) so the standards provide requisite protection of public health with an adequate margin of safety. Specifically, EPA proposed to replace the current 24-hour and annual standards with a new short-term SO_2 standard. EPA proposed that this new short-term standard would be based on the 3-year average of the 99th percentile (or 4th highest) of the yearly distribution of 1-hour daily maximum SO_2 concentrations. EPA proposed to set the level of this new 1-hour standard within the range of 50 to 100 ppb and solicited comment on standard levels as high as 150 ppb. EPA also proposed to establish requirements for an SO_2 monitoring network at locations where maximum SO_2 concentrations are expected to occur and to add a new Federal Reference Method (FRM) for measuring SO_2 in the ambient air. Finally, EPA proposed to make corresponding changes to the Air Quality Index for SO_2.

F. Organization and Approach to Final SO_2 Primary NAAQS Decisions

This action presents the Administrator's final decisions regarding the need to revise the current SO_2 primary NAAQS, and what those revisions should be. Revisions to the primary NAAQS for SO_2, and the rationale supporting those revisions, are described below in section II.

An overview of the approach for monitoring and implementation is presented in section III. Requirements for the SO_2 ambient monitoring network and for a new, additional FRM for measuring SO_2 in the ambient air are described in section IV. EPA's current plans for designations and for implementing the revised SO_2 primary NAAQS are discussed in sections V and VI respectively. Related requirements for data completeness, data handling, data reporting, rounding conventions, and exceptional events are described in section VII. Communication of public health information through the AQI is discussed in section VIII. A recitation of statutory authority and a discussion of those executive order reviews which are relevant are provided in section IX.

Today's final decisions are based on a thorough review in the ISA of scientific information on known and potential human health effects associated with exposure to SO_2 in the

air. These final decisions also take into account: (1) Assessments in the REA of the most policy-relevant information in the ISA as well as quantitative exposure and risk analyses based on that information; (2) CASAC Panel advice and recommendations, as reflected in its letters to the Administrator and its public discussions of the ISA and REA; (3) public comments received during the development of the ISA and REA; and (4) public comments received on EPA's notice of proposed rulemaking.

II. Rationale for Decisions on the Primary Standards

This section presents the rationale for the Administrator's decision to revise the existing SO_2 primary standards by replacing the current 24-hour and annual standards with a new 1-hour SO_2 standard at a level of 75 ppb, based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations. As discussed more fully below, this rationale takes into account: (1) Judgments and conclusions presented in the ISA and the REA; (2) CASAC advice and recommendations as reflected in the CASAC panel's discussions of drafts of the ISA and REA at public meetings, in separate written comments, and in letters to the Administrator (Henderson 2008a; Henderson 2008b; Samet, 2009); (3) public comments received at CASAC meetings during the development of the ISA and the REA; and (4) public comments received on the notice of proposed rulemaking.

In reaching this decision, EPA has drawn upon an integrative synthesis of the entire body of evidence on human health effects associated with the presence of SO_2 in the ambient air, and upon the results of the quantitative exposure and risk assessments reflecting this evidence. As discussed below, this body of evidence addresses a broad range of health endpoints associated with exposure to SO_2 in the ambient air. In considering this entire body of evidence, EPA chose to focus most on those health endpoints for which the ISA found the strongest evidence of an association with SO_2 (*see* section II.B below). Thus, the rationale for this final decision on the SO_2 NAAQS focused primarily on respiratory morbidity following short-term (5-minutes to 24-hours) exposure to SO_2, for which the ISA found a causal relationship.

As discussed below, a substantial amount of new research has been conducted since EPA's last review of the SO_2 NAAQS, with important new information coming from epidemiologic studies in particular. In addition to the substantial amount of new epidemiologic research, the ISA considered a limited number of new controlled human exposure studies and re-evaluated key older controlled human exposure studies. In evaluating both the new and key older controlled human exposure studies, the ISA utilized updated guidelines published by the American Thoracic Society (ATS) on what constitutes an adverse effect of air pollution (*see* ISA, section 3.1.3; p. 3–4). Importantly, all controlled human exposure and epidemiologic studies evaluated in the ISA have undergone intensive scrutiny through multiple layers of peer review and opportunities for public review and comment. Thus, the review of this information has been extensive and deliberate.

After a background discussion of the principal emitting sources and current patterns of SO_2 air quality and a description of the current SO_2 monitoring network from which those air quality patterns are obtained (section II.A), the remainder of this section discusses the Administrator's rationale for her final decisions on the primary standards. Section II.B includes an overview of the scientific evidence related to the respiratory effects associated with ambient SO_2 exposure. This overview includes a discussion of the at-risk populations considered in the ISA. Section II.C summarizes the key approaches taken by EPA to assess exposures and health risks associated with exposure to ambient SO_2. Section II.D summarizes the approach that was used in the current review of the SO_2 NAAQS with regard to consideration of the scientific evidence and the air quality, exposure, and risk-based results related to the adequacy of the current standards and potential alternative standards. Sections II.E and II.F discuss, respectively, the Administrator's decisions regarding the adequacy of the current standards and the elements of a new short-term standard, taking into consideration public comments on the proposed decisions. Section II.G summarizes the Administrator's decisions with regard to the SO_2 primary NAAQS.

A. Characterization of SO_2 Air Quality

1. Anthropogenic Sources and Current Patterns of SO_2 Air Quality

Anthropogenic SO_2 emissions originate chiefly from point sources, with fossil fuel combustion at electric utilities (~66%) and other industrial facilities (~29%) accounting for the majority of total emissions (ISA, section 2.1). Other anthropogenic sources of SO_2 include both the extraction of metal from ore as well as the burning of high sulfur-containing fuels by locomotives, large ships, and equipment utilizing diesel engines. SO_2 emissions and ambient concentrations follow a strong east to west gradient due to the large numbers of coal-fired electric generating units in the Ohio River Valley and upper Southeast regions. In the 12 Consolidated Metropolitan Statistical Areas (CMSAs) that had at least four SO_2 regulatory monitors from 2003–2005, 24-hour average concentrations in the continental U.S. ranged from a reported low of ~1 ppb in Riverside, CA and San Francisco, CA to a high of ~12 ppb in Pittsburgh, PA and Steubenville, OH (ISA, section 2.5.1). In addition, outside or inside all CMSAs from 2003–2005, the annual average SO_2 concentration was 4 ppb (ISA, Table 2–8). However, spikes in hourly concentrations occurred. The mean 1-hour maximum concentration outside or inside CMSAs was 13 ppb, with a maximum value of greater than 600 ppb outside CMSAs and greater than 700 ppb inside CMSAs (ISA, Table 2–8).

Temporal and spatial patterns of 5-minute peaks of SO_2 are also important given that controlled human exposure studies have demonstrated that exposure to these peaks can result in adverse respiratory effects in exercising asthmatics (*see* section II.B below). For those monitors which voluntarily reported 5-minute block average data,[3] when maximum 5-minute concentrations were reported, the absolute highest concentration over the ten-year period exceeded 4000 ppb, but for all individual monitors, the 99th percentile was below 200 ppb (ISA, section 2.5.2 Table 2–10). Median concentrations from these monitors reporting 5-minute data ranged from 1 ppb to 8 ppb, and the average for each maximum 5-minute level ranged from 3 ppb to 17 ppb. Delaware, Pennsylvania, Louisiana, and West Virginia had mean values for maximum 5-minute data exceeding 10 ppb. Among aggregated within-State data for the 16 monitors from which all 5-minute average intervals were reported, the median values ranged from 1 ppb to 5 ppb, and the means ranged from 3 ppb to 11 ppb (ISA, section 2.5.2 at 2–43). The highest reported concentration was 921 ppb, but the 99th percentile values

[3] A small number of sites, 98 total from 1997 to 2007 of the approximately 500 SO_2 monitors, and not the same sites in all years, voluntarily reported 5-minute block average data to AQS (ISA, section 2.5.2). Of these, 16 reported all twelve 5-minute averages in each hour for at least part of the time between 1997 and 2007. The remainder reported only the maximum 5-minute average in each hour.

for aggregated within-State data were all below 90 ppb (*id*).

2. SO_2 Monitoring

Although EPA established the SO_2 standards in 1971, uniform minimum monitoring network requirements for SO_2 monitoring were only adopted in May 1979. From the time of the implementation of the 1979 monitoring rule through 2008, the SO_2 monitoring network has steadily decreased in size from approximately 1496 sites in 1980 to the approximately 488 sites operating in 2008. At present, except for SO_2 monitoring required at National Core Monitoring Stations (NCore stations), there are no minimum monitoring requirements for SO_2 in 40 CFR part 58 Appendix D, other than a requirement for EPA Regional Administrator approval before removing any existing monitors and a requirement that any ongoing SO_2 monitoring must have at least one monitor sited to measure the maximum concentration of SO_2 in that area. EPA removed the specific minimum monitoring requirements for SO_2 in the 2006 monitoring rule revisions, except for monitoring at NCore stations, based on the fact that there were no SO_2 nonattainment areas at that time, coupled with trends showing an increasing gap between national average SO_2 concentrations and the current 24-hour and annual standards. The rule was also intended to provide State, local, and Tribal air monitoring agencies flexibility in meeting perceived higher priority monitoring needs for other pollutants, or to implement the new multi-pollutant sites (NCore network) required by the 2006 rule revisions (71 FR 61236, (October 6, 2006)). More information on SO_2 monitoring can be found in section IV.

B. Health Effects Information

The ISA concluded that there was sufficient evidence to infer a "causal relationship" between respiratory morbidity and short-term (5-minutes to 24-hours) exposure to SO_2 (ISA, section 5.2). Importantly, we note that a "causal relationship" is the strongest finding the ISA can make.[4] This conclusion was based on the consistency, coherence, and plausibility of findings observed in controlled human exposure studies of 5–10 minutes, epidemiologic studies mostly using 1-hour daily maximum and 24-hour average SO_2 concentrations, and animal toxicological studies using exposures of minutes to hours (ISA, section 5.2). This evidence is briefly summarized below and discussed in more detail in the proposal (*see* sections II.B.1 to II.B.5, *see* 74 FR at 64815–821). We also note that the ISA judged evidence of an association between SO_2 exposure and other health categories to be less convincing; other associations were judged to be suggestive but not sufficient to infer a causal relationship (*i.e.,* short-term exposure to SO_2 and mortality) or inadequate to infer the presence or absence of a causal relationship (*i.e.,* short-term exposure to SO_2 and cardiovascular morbidity, and long-term exposure to SO_2 and respiratory morbidity, other morbidity, and mortality). Key conclusions from the ISA are described in greater detail in Table 5–3 of the ISA.

1. Short-Term (5-minute to 24-hour) SO_2 Exposure and Respiratory Morbidity Effects

The ISA examined numerous controlled human exposure studies and found that moderate or greater decrements in lung function (*i.e.,* ≥ 15% decline in Forced Expiratory Volume (FEV_1) and/or ≥ 100% increase in specific airway resistance (sRaw)) occur in some exercising asthmatics exposed to SO_2 concentrations as low as 200–300 ppb for 5–10 minutes. The ISA also found that among asthmatics, both the percentage of individuals affected, and the severity of the response increased with increasing SO_2 concentrations. That is, at 5–10 minute concentrations ranging from 200–300 ppb, the lowest levels tested in free breathing chamber studies, approximately 5–30% percent of exercising asthmatics experienced moderate or greater decrements in lung function (ISA, Table 3–1). At concentrations of 400–600 ppb, moderate or greater decrements in lung function occurred in approximately 20–60% of exercising asthmatics, and compared to exposures at 200–300 ppb, a larger percentage of asthmatics experienced severe decrements in lung function (*i.e.,* ≥ 20% decrease in FEV_1 and/or ≥ 200% increase in sRaw; ISA, Table 3–1). Moreover, at SO_2 concentrations ≥ 400 ppb (5–10 minute exposures), moderate or greater decrements in lung function were often statistically significant at the group mean level and frequently accompanied by respiratory symptoms. *Id.*

The ISA also found that in locations meeting the current SO_2 NAAQS, numerous epidemiologic studies reported positive associations between ambient SO_2 concentrations and respiratory symptoms in children, as well as emergency department visits and hospitalizations for all respiratory causes and asthma across multiple age groups. Moreover, the ISA concluded that these epidemiologic studies were consistent and coherent. This evidence was consistent in that associations were reported in studies conducted in numerous locations and with a variety of methodological approaches (ISA, section 5.2; p. 5–5). It was coherent in that respiratory symptom results from epidemiologic studies of short-term (predominantly 1-hour daily maximum or 24-hour average) SO_2 concentrations were generally in agreement with respiratory symptom results from controlled human exposure studies of 5–10 minutes. These results were also coherent in that the respiratory effects observed in controlled human exposure studies of 5–10 minutes further provided a basis for a progression of respiratory morbidity that could lead to the increased emergency department visits and hospital admissions observed in epidemiologic studies (ISA, section 5.2; p. 5–5). In addition, the ISA found that when evaluated as a whole, SO_2 effect estimates in multi-pollutant models generally remained positive and relatively unchanged when co-pollutants were included. Therefore, although recognizing the uncertainties associated with separating the effects of SO_2 from those of co-occurring pollutants, the ISA concluded that "the limited available evidence indicates that the effect of SO_2 on respiratory health outcomes appears to be generally robust and independent of the effects of gaseous co-pollutants, including NO_2 and O_3, as well as particulate co-pollutants, particularly $PM_{2.5}$" (ISA, section 5.3; p. 5–9).

The ISA also found that the respiratory effects of SO_2 were consistent with the mode of action as it is currently understood from animal toxicological and controlled human exposure studies (ISA, section 5.2; p. 5–2). The immediate effect of SO_2 on the respiratory system is bronchoconstriction. This response is mediated by chemosensitive receptors in the tracheobronchial tree. Activation of these receptors triggers central nervous system reflexes that result in

[4] A causal relationship is based on "[e]vidence [that] is sufficient to conclude that there is a causal relationship between relevant pollutant exposures and the health outcome. That is, a positive association has been observed between the pollutant and the outcome in studies in which chance, bias, and confounding could be ruled out with reasonable confidence. Evidence includes, for example, controlled human exposure studies; or observational studies that cannot be explain by plausible alternatives or are supported by other lines of evidence (*e.g.* animal studies or mechanism of action information). Evidence includes replicated and consistent high-quality studies by multiple investigators." ISA Table 1–2, at 1–11.

bronchoconstriction and respiratory symptoms that are often followed by rapid shallow breathing (*id*). The ISA noted that asthmatics are likely more sensitive to the respiratory effects of SO_2 due to pre-existing inflammation associated with the disease. For example, pre-existing inflammation may lead to enhanced release of inflammatory mediators, and/or enhanced sensitization of the chemosensitive receptors (*id*).

Taken together, the ISA concluded that the controlled human exposure, epidemiologic, and toxicological evidence supported its determination of a causal relationship between respiratory morbidity and short-term (5-minutes to 24-hours) exposure to SO_2.

a. Adversity of Short-Term Respiratory Morbidity Effects

As discussed more fully in the proposal (section II.B.1.c, 74 FR at 64817) and in section II.E.2.b below, based on: (1) American Thoracic Society (ATS) guidelines; (2) advice and recommendations from CASAC (*see* specific consensus CASAC comments in sections II.E.2.b and II.F.4.b below); and (3) conclusions from previous NAAQS reviews, EPA found that 5–10 minute exposures to SO_2 concentrations at least as low as 200 ppb can result in adverse health effects in some asthmatics (*i.e.,* 5–30% of the tested individuals in controlled human exposure studies of 200–300 ppb). As just mentioned, at SO_2 concentrations ≥ 400 ppb, controlled human exposure studies have reported decrements in lung function that are often statistically significant at the group mean level, and that are frequently accompanied by respiratory symptoms. Being mindful that the ATS guidelines specifically indicate decrements in lung function with accompanying respiratory symptoms as being adverse (*see* proposal section II.B.1.c, 74 FR at 64817 and section II.E.2.b below), exposure to 5–10 minute SO_2 concentrations ≥ 400 ppb can result in health effects that are clearly adverse.

The ATS also indicated that exposure to air pollution that increases the risk of an adverse effect to a population is adverse, even though it may not increase the risk of any individual to an unacceptable level (ATS 2000; *see* proposal section II.B.1.c, 74 FR at 64817). As an example, ATS states:

> A population of children with asthma could have a distribution of lung function such that no individual child has a level associated with significant impairment. Exposure to air pollution could shift the distribution toward lower levels without bringing any individual child to a level that is associated with clinically relevant consequences. Individuals within the population would, however, have diminished reserve function and are at potentially increased risk if affected by another agent, *e.g.,* a viral infection. Assuming that the relationship between the risk factor and the disease is causal, the committee considered that such a shift in the risk factor distribution, and hence the risk profile of the exposed population, should be considered adverse, even in the absence of the immediate occurrence of frank illness (ATS 2000, p. 668).

As mentioned above, the ISA reported that exposure to SO_2 concentrations as low as 200–300 ppb for 5–10 minutes results in approximately 5–30% of exercising asthmatics experiencing moderate or greater decrements in lung function (defined in terms of a ≥ 15% decline in FEV_1 or 100% increase in sRaw; ISA, Table 3–1). Even though these results were not statistically significant at the group mean level, in light of EPA's interpretation of how to apply the ATS guidelines for defining an adverse effect, as described above, the REA found that these results could reasonably indicate an SO_2-induced shift in these lung function measurements for this subset of the population. As a result, an appreciable percentage of exercising asthmatics exposed to SO_2 concentrations as low as 200 ppb would be expected to have diminished reserve lung function and would be expected to be at greater risk if affected by another respiratory agent, for example, viral infection. Importantly, as explained immediately above, diminished reserve lung function in a population that is attributable to air pollution is considered an adverse effect under ATS guidance. In addition to the 2000 ATS guidelines, the REA was also mindful of previous CASAC recommendations (Henderson 2006) and NAAQS review conclusions (EPA 2006, EPA 2007d) indicating that moderate decrements in lung function can be clinically significant in some asthmatics (discussed in detail below, *see* section II.E.2.b). The REA further considered that subjects participating in these controlled human exposure studies do not include severe asthmatics and that it was reasonable to presume that persons with more severe asthma than the study participants would have a more serious health effect from short-term exposure to 200 ppb SO_2.[5] Taken together, the REA concluded that exposure to SO_2 concentrations at least as low as 200 ppb can result in adverse health effects in asthmatics and that this conclusion was in agreement with consensus CASAC comments and recommendations expressed during the current SO_2 NAAQS review (*see* sections II.E.2.b and II.F.4.b below).

In addition to the controlled human exposure evidence, epidemiologic studies also indicate that adverse respiratory morbidity effects are associated with SO_2 (REA, section 4.3). As mentioned above, in reaching the conclusion of a causal relationship between respiratory morbidity and short-term SO_2 exposure, the ISA generally found positive associations between ambient SO_2 concentrations and emergency department visits and hospitalizations for all respiratory causes and asthma. Notably, emergency department visits, hospitalizations, episodic respiratory illness, and aggravation of respiratory diseases (*e.g.* asthma) attributable to air pollution are considered adverse health effects under ATS guidelines.

2. Health Effects and Long-Term Exposures to SO_2

There were numerous studies published since the last review examining possible associations between long-term SO_2 exposure and mortality and morbidity (respiratory morbidity, carcinogenesis, adverse prenatal and neonatal outcomes) endpoints. However, the ISA concluded that the evidence relating long-term (weeks to years) SO_2 exposure to adverse health effects was "inadequate to infer the presence or absence of a causal relationship" (ISA, Table 5–3). That is, the ISA found the long-term health evidence to be of insufficient quantity, quality, consistency, or statistical power to make a determination as to whether SO_2 was truly associated with these health outcomes (ISA, Table 1–2).

3. SO_2-Related Impacts on Public Health

Interindividual variation in human responses to air pollutants indicates that some populations are at increased risk for the detrimental effects of ambient exposure to SO_2. The NAAQS are intended to provide an adequate margin of safety for both the general population and susceptible populations that are potentially at increased risk for health effects in response to exposure to ambient air pollution (*see* footnote 1 above). To facilitate the identification of populations at increased risk for SO_2-related health effects, studies have identified factors that contribute to the susceptibility of individuals to SO_2. Susceptible individuals are broadly defined as those with a greater

[5] We also note that very young children were not included in the controlled human exposure studies and this absence of data on what is likely to be a sensitive life stage is a source of uncertainty for children's susceptibility to SO_2.

likelihood of an adverse outcome given a specific exposure in comparison with the general population (American Lung Association, 2001). The susceptibility of an individual to SO_2 can encompass a multitude of factors which represent normal developmental phases or life stages (*e.g.,* age) or biologic attributes (*e.g.,* gender); however, other factors (*e.g.,* socioeconomic status (SES)) may influence the manifestation of disease and also increase an individual's susceptibility (American Lung Association, 2001). In addition, populations may be at increased risk to SO_2 due to an increase in their exposure during certain life stages (*e.g.,* childhood or old age) or as a result of external factors (*e.g.,* SES) that contribute to an individual being disproportionately exposed to higher concentrations than the general population.[6] It should be noted that in some cases specific populations may be affected by multiple susceptibility factors. For example, a population that is characterized as having low SES may have less access to healthcare resulting in the manifestation of a disease, which increases their susceptibility to SO_2, while they may also reside in a location that results in disproportionately high exposure to SO_2.

To examine whether SO_2 differentially affects certain populations, stratified analyses are often conducted in epidemiologic investigations to identify the presence or absence of effect modification. A thorough evaluation of potential effect modifiers may help identify susceptible populations that are at increased risk to SO_2 exposure. These analyses are based on the proper identification of confounders and subsequent adjustment for them in statistical models, which helps separate a spurious from a true causal association. Although the design of toxicological and human clinical studies does not allow for an extensive examination of effect modifiers, the use of animal models of disease and the study of individuals with underlying disease or genetic polymorphisms do allow for comparisons between subgroups. Therefore, the results from these studies, combined with those results obtained through stratified analyses in epidemiologic studies, contribute to the overall weight of evidence for the increased susceptibility of specific populations to SO_2. Those populations identified in the ISA to be potentially at greater risk of experiencing an adverse health effect from SO_2 were described in detail in the proposal (section II.B.5) and include: (1) Those with pre-existing respiratory disease; (2) children and older adults; (3) persons who spend increased time outdoors or at elevated ventilation rates; (4) persons with lower SES; and (5) persons with certain genetic factors.

As discussed in the proposal (section II.B.5.g, 74 FR at 64821), large proportions of the U.S. population are likely to be at increased risk of experiencing SO_2-related health effects. In the United States, approximately 7% of adults and 9% of children have been diagnosed with asthma. Notably, the prevalence and severity of asthma is higher among certain ethnic or racial groups such as Puerto Ricans, American Indians, Alaskan Natives, and African Americans (EPA 2008b). Furthermore, a higher prevalence of asthma among persons of lower SES and an excess burden of asthma hospitalizations and mortality in minority and inner-city communities have been observed (EPA, 2008b). In addition, population groups based on age comprise substantial segments of individuals that may be potentially at risk for SO_2-related health impacts. Based on U.S. census data from 2000, about 72.3 million (26%) of the U.S. population are under 18 years of age, 18.3 million (7.4%) are under 5 years of age, and 35 million (12%) are 65 years of age or older. There is also concern for the large segment of the population that is potentially at risk to SO_2-related health effects because of increased time spent outdoors at elevated ventilation rates (those who work or play outdoors). Overall, the considerable size of the population groups at risk indicates that exposure to ambient SO_2 could have a significant impact on public health in the United States.

C. Human Exposure and Health Risk Characterization

To put judgments about SO_2-associated health effects into a broader public health context, EPA has drawn upon the results of the quantitative exposure and risk assessments. Judgments reflecting the nature of the evidence and the overall weight of the evidence are taken into consideration in these quantitative exposure and risk assessments. These assessments include estimates of the likelihood that asthmatic children at moderate or greater exertion (*e.g.* while exercising) in St. Louis or Greene County, Missouri would experience SO_2 exposures of potential concern. In addition, these analyses include an estimate of the number and percent of exposed asthmatic children in these locations likely to experience SO_2-induced lung function responses (*i.e.,* moderate or greater decrements in lung function defined in terms of sRaw or FEV_1) under varying air quality scenarios (*i.e.,* current air quality and air quality simulated to just meet the current or potential alternative standards). These assessments also characterize the kind and degree of uncertainties inherent in such estimates.

As previously mentioned, the ISA concluded that the evidence for an association between respiratory morbidity and short-term SO_2 exposure was "sufficient to infer a causal relationship" (ISA, section 5.2) and that the "definitive evidence" for this conclusion was from the results of 5–10 minute controlled human exposure studies demonstrating decrements in lung function and/or respiratory symptoms in exercising asthmatics (ISA, section 5.2). Accordingly, the air quality and exposure analyses and their associated risk characterizations focused on 5-minute concentrations of SO_2 in excess of potential health effect benchmark values derived from the controlled human exposure literature (*see* proposal section II.C.1, 74 FR at 64821, and REA, section 6.2). These benchmark levels are not potential standards, but rather are SO_2 exposure concentrations which represent "exposures of potential concern" which are used in these analyses to estimate potential exposures and risks associated with 5-minute concentrations of SO_2. The REA considered 5-minute benchmark levels of 100, 200, 300, and 400 ppb in these analyses, but especially noted exceedances or exposures with respect to the 200 and 400 ppb 5-minute benchmark levels. These benchmark levels were highlighted because (1) 400 ppb represents the lowest concentration in free-breathing controlled human exposure studies where moderate or greater lung function decrements occurred which were often statistically significant at the group mean level and were frequently accompanied by respiratory symptoms; and (2) 200 ppb is the lowest level at which moderate or greater decrements in lung function in free-breathing controlled human exposure studies were found in some individuals, although these lung function changes were not statistically significant at the group mean level. Notably, 200 ppb is also the lowest level that has been tested in free-breathing controlled human exposure studies (REA, section 4.2.2).[7]

[6] This aspect of susceptibility is referred to as vulnerability in the proposal and in the ISA.

[7] The ISA cites one chamber study with intermittent exercise where healthy and asthmatic

Continued

The REA utilized three approaches to characterize health risks. In the first approach, for each air quality scenario, statistically estimated 5-minute SO_2 concentrations [8] and measured ambient 5-minute SO_2 concentrations were compared to the 5-minute potential health effect benchmark levels discussed above (REA, chapter 7). This air quality analysis included all available ambient monitoring data as well as a more detailed analysis in 40 counties. The air quality analysis was considered a broad characterization of national air quality and human exposures that might be associated with these 5-minute SO_2 concentrations. An advantage of the air quality analysis is its relative simplicity; however, there is uncertainty associated with the assumption that SO_2 air quality can serve as an adequate surrogate for total exposure to ambient SO_2. Actual exposures might be influenced by factors not considered by this approach, including small-scale spatial variability in ambient SO_2 concentrations (which might not be represented by the current fixed-site ambient monitoring network) and spatial/temporal variability in human activity patterns. A more detailed overview of the air quality analysis and its associated limitations and uncertainties is provided in the proposal (*see* sections II.C.2, 74 FR at 64822 and II.C.3, 74 FR at 64823, respectively) and the air quality analysis is thoroughly described in the REA (chapter 7).

In the second approach, an inhalation exposure model was used to generate more realistic estimates of personal exposures in asthmatics (REA, chapter 8). This analysis estimated temporally and spatially variable microenvironmental 5-minute SO_2 concentrations and simulated asthmatics' contact with these pollutant concentrations while at moderate or greater exertion (*i.e.,* while at elevated ventilation rates). The approach was designed to estimate exposures that are not necessarily represented by the existing ambient monitoring data and to better represent the physiological conditions corresponding with the respiratory effects reported in controlled human exposure studies. AERMOD, an EPA dispersion model, was used to estimate 1-hour ambient SO_2 concentrations using emissions estimates from stationary, non-point, and where applicable, port sources. The Air Pollutants Exposure (APEX) model, an EPA human exposure model, was then used to estimate population exposures using the estimated hourly census block level SO_2 concentrations. From the 1-hour census block concentrations, 5-minute maximum SO_2 concentrations within each hour were estimated by APEX (REA, section 8.7.1) using the statistical relationship mentioned above in footnote 8. Estimated exposures to 5-minute SO_2 levels were then compared to the 5-minute potential health effect benchmark levels discussed above. This approach to assessing exposures was more resource intensive than using ambient levels as an indicator of exposure; therefore, the final REA included the analysis of two locations: St. Louis and Greene County, MO. Although the geographic scope of this analysis was limited, the approach provided estimates of SO_2 exposures in asthmatics and asthmatic children in St. Louis and Greene Counties, and thus served to complement the broader air quality characterization. A more detailed overview of this exposure analysis and its associated limitations and uncertainties is provided in the proposal (*see* sections II.C.2, 74 FR at 64822 and II.C.3, 74 FR at 64823, respectively) and the exposure analysis is thoroughly described in the REA (chapter 8).

The third approach was a quantitative risk assessment. This approach combined results from the exposure analysis (*i.e.,* the number of exposed total asthmatics or asthmatic children while at moderate or greater exertion) with exposure-response functions derived from individual level data from controlled human exposure studies (*see* ISA, Table 3–1 and Johns (2009) [9]) to estimate the percentage and number of exposed asthmatics and asthmatic children in St. Louis and Greene County likely to experience a moderate or greater lung function response (*i.e.,* decrements in lung function defined in terms of FEV_1 and sRaw) under the air quality scenarios mentioned above (REA, chapter 9). A more detailed overview of this analysis and its associated limitations and uncertainties is provided in the proposal (*see* sections II.C.2, 74 FR at 64822 and II.C.3, 74 FR at 64823, respectively) and the quantitative risk analysis is thoroughly described in the REA (chapter 9).

Notably, for the reasons described in the REA (REA, section 10.3.3) and the proposal (*see* section II.E.1.b, 74 FR at 64827), when considering the St. Louis and Greene County exposure and risk results as they relate to the adequacy of the current standards, the REA concluded that the St. Louis results were more informative in terms of ascertaining the extent to which the current standards protect against health effects linked to the various benchmarks (linked in turn to 5-minute SO_2 exposures). The results in fact suggested that the current standards may not adequately protect public health (REA, section 10.3.3, p. 364). Moreover, the REA judged that the exposure and risk estimates for the St. Louis study area provided useful insights into exposures and risks for other urban areas in the U.S. with similar population and SO_2 emissions densities (*id.*). For similar reasons, the St. Louis results were more informative for ascertaining the adequacy of the potential alternative standards under consideration.

Key results of the air quality, exposure, and risk analyses were presented in the policy assessment chapter of the REA (chapter 10) and summarized in the proposal (*see* Tables 2–4 in the preamble to the proposed rule). In considering these results, the proposal noted that these analyses support that 5-minute SO_2 exposures, reasonably judged important from a public health perspective, were associated with air quality adjusted upward to simulate just meeting the current standards (*see* proposal, section II.E.1.c, 74 FR at 64828). Moreover, these results indicated that 99th percentile 1-hour daily maximum standard levels in the range of 50–100 ppb could substantially limit exposures of asthmatic children at moderate or greater exertion from 5-minute SO_2 concentrations ≥400 ppb, and appreciably limit exposures of these children from 5-minute SO_2 concentrations ≥200 ppb (REA, p. 392–393). Results of these analyses also indicated that a 1-hour standard at 150

children were exposed to 100 ppb SO_2 in a mixture with ozone and sulfuric acid. The ISA notes that compared to exposure to filtered air, exposure to the pollutant mix did not result in statistically significant changes in lung function or respiratory symptoms (ISA, section 3.1.3.4).

[8] Benchmark values derived from the controlled human exposure literature were associated with a 5-minute averaging time. However, as noted in footnote 3 above, only 98 ambient monitors located in 13 States from 1997–2007 reported measured 5-minute SO_2 concentrations since such monitoring is not required (*see* section II.A.2 and section IV). In contrast, 809 monitors in 48 States, DC, Puerto Rico, and the Virgin Islands reported 1-hour SO_2 concentrations over a similar time period. Therefore, to broaden analyses to areas where measured 5-minute SO_2 concentrations were not available, the REA utilized a statistical relationship to estimate the highest 5-minute level in an hour, given a reported 1-hour average SO_2 concentration (REA, section 6.4). Then, similar to measured 5-minute SO_2 concentrations, statistically estimated 5-minute SO_2 concentrations were compared to 5-minute potential health effect benchmark values (REA, chapters 7 and 8, respectively).

[9] EPA recently conducted a complete quality assurance review of all individual subject data. The results of this review did not substantively change any of the entries in ISA, Table 3–1, and did not in any way affect the conclusions of the ISA (*see* Johns and Simmons, 2009).

ppb could still substantially limit exposures of asthmatic children at moderate or greater exertion from 5-minute SO_2 concentrations ≥400 ppb, but would provide these children appreciably less protection from exposure to 5-minute SO_2 concentrations ≥200 ppb (REA, p. 395–396).

D. Approach for Determining Whether To Retain or Revise the Current Standards

EPA notes that the final decision on retaining or revising the current primary SO_2 standards is a public health policy judgment to be made by the Administrator. This judgment has been informed by a recognition that the available health effects evidence reflects a continuum consisting of ambient levels of SO_2 at which scientists generally agree that health effects are likely to occur, through lower levels at which the likelihood and magnitude of the response become increasingly uncertain. The Administrator's final decisions draw upon scientific information and analyses related to health effects, population exposures and risks; judgments about the appropriate response to the range of uncertainties that are inherent in the scientific evidence and analyses; and comments received from CASAC and the public.

To evaluate whether the current primary SO_2 standards are adequate or whether revisions are appropriate, EPA has used an approach in this review described in chapter 10 of the REA which builds upon the approaches used in reviews of other criteria pollutants, including the most recent reviews of the NO_2, Pb, O_3, and PM NAAQS (EPA, 2008c; EPA, 2007c; EPA, 2007d; EPA, 2005), and reflects the latest body of evidence and information that is currently available, as reflected by the ISA. As in other recent reviews, EPA considered the implications of placing more or less weight or emphasis on different aspects of the scientific evidence and the exposure-/risk-based information, recognizing that the weight to be given to various elements of the evidence and exposure/risk information is part of the public health policy judgments that the Administrator will make in reaching decisions on the standard.

A series of general questions framed this approach to considering the scientific evidence and exposure-/risk-based information. First, EPA's consideration of the scientific evidence and exposure/risk information with regard to the adequacy of the current standards has been framed by the following questions:

- To what extent does evidence that has become available since the last review reinforce or call into question evidence for SO_2-associated effects that were identified in the last review?
- To what extent has evidence for different health effects and/or susceptible populations become available since the last review?
- To what extent have uncertainties identified in the last review been reduced and/or have new uncertainties emerged?
- To what extent does evidence and exposure-/risk-based information that has become available since the last review reinforce or call into question any of the basic elements (indicator, averaging time, form, and level) of the current standard?

To the extent that the available evidence and exposure-/risk-based information suggests it may be appropriate to consider revision of the current standards, EPA considers that evidence and information with regard to its support for consideration of a standard that is either more or less stringent than the current standards. This evaluation is framed by the following questions:

- Is there evidence that associations, especially causal or likely causal associations, extend to ambient SO_2 concentrations as low as, or lower than, the concentrations that have previously been associated with health effects? If so, what are the important uncertainties associated with that evidence?
- Are exposures above benchmark levels and/or health risks estimated to occur in areas that meet the current standard? If so, are the estimated exposures and health risks important from a public health perspective? What are the important uncertainties associated with the estimated risks?

To the extent that there is support for consideration of a revised standard, EPA then considers the specific elements of the standard (indicator, averaging time, form, and level) within the context of the currently available information. In so doing, the Agency addresses the following questions regarding the elements of the standard:

- Does the evidence provide support for considering a different indicator for gaseous SO_X?
- Does the evidence provide support for considering different, or additional averaging times?
- What ranges of levels and forms of alternative standards are supported by the evidence, and what are the associated uncertainties and limitations?
- To what extent do specific averaging times, levels, and forms of alternative standards reduce the estimated exposures above benchmark levels and risks attributable to exposure to ambient SO_2, and what are the uncertainties associated with the estimated exposure and risk reductions?

The questions outlined above have been addressed in the REA. The following sections present considerations regarding the adequacy of the current standards and conclusions on the elements of a new short-term standard in terms of indicator, averaging time, form, and level.

E. Adequacy of the Current Standards

This section discusses considerations related to the decision as to whether the current 24-hour and annual SO_2 primary NAAQS are requisite to protect public health with an adequate margin of safety. Specifically, section II.E.1 provides an overview of the rationale supporting the Administrator's proposal that the current standards do not provide adequate public health protection; section II.E.2 discusses public comments received on the adequacy of the current standards; and section II.E.3 discusses the Administrator's final decision on whether the current SO_2 primary NAAQS is requisite to protect public health with an adequate margin of safety, as required by sections 109(d) and (b) of the Act.

1. Rationale for Proposed Decision

In the proposal, the Administrator initially concluded that the current 24-hour and annual SO_2 NAAQS were not adequate to protect public health with an adequate margin of safety (*see* section II.E.4, 74 FR at 64829). In reaching this conclusion, she considered the: (1) Scientific evidence and conclusions in the ISA; (2) exposure and risk information presented in the REA; (3) conclusions of the policy assessment chapter of the REA; and (4) views expressed by CASAC. These considerations are discussed in detail in the proposal (*see* section II.E., 74 FR at 64826) and are summarized in this section.

In the proposal the Administrator noted the following in considering the adequacy of the current 24-hour and annual primary SO_2 standards:

- The conclusion of the ISA that the results of controlled human exposure and epidemiologic studies form a plausible and coherent data set that supports a causal relationship between short-term (5-minutes to 24-hours) SO_2 exposures and adverse respiratory effects, and that the epidemiologic evidence (buttressed by the clinical evidence) indicates that the effects seen in the epidemiologic studies are attributable to exposure to SO_2 (ISA, section 5.2).
- The conclusion of the ISA that "[i]n the epidemiologic studies, respiratory effects were observed in areas where the maximum ambient 24-h avg SO_2 concentration was below the current 24-

h avg NAAQS level * * *." (ISA, section 5.2, p. 5–2.) and so would occur at ambient SO_2 concentrations that are present in locations meeting the current 24-hour NAAQS.

- These respiratory effects also occurred in areas with annual air quality levels considerably lower than those allowed by the current annual standard, indicating that the current annual standard is also not providing protection against short-term health effects reported in epidemiologic studies (ISA, section 5.2).
- Analyses in the REA supporting that 5-minute exposures, reasonably judged important from a public health perspective (*i.e.,* respiratory effects judged to be adverse to the health of asthmatics, *see* sections II.B.1.c above, and II.E.2.b below), were associated with air quality adjusted upward to simulate just meeting the current 24-hour and annual standards.
- CASAC advice "that the current 24-hour and annual standards are not adequate to protect public health, especially in relation to short term exposures to SO_2 (5–10 minutes) by exercising asthmatics" (Samet, 2009, p. 15).

Based on these considerations (discussed in more detail in the proposal, *see* sections II.E.1 and II.E.2), the Administrator proposed that the current 24-hour and annual SO_2 standards are not requisite to protect public health with an adequate margin of safety against adverse respiratory effects associated with short-term (5-minute to 24-hour) SO_2 exposures. In considering approaches to revising the current standards, the Administrator initially concluded it appropriate to consider setting a new 1-hour standard. The Administrator noted that a 1-hour standard would likely provide increased public health protection, especially for members of at-risk groups, from the respiratory effects described in both epidemiologic and controlled human exposure studies.

2. Comments on the Adequacy of the Current Standards

This section discusses public comments on the proposal that either supported or opposed the Administrator's proposed decision to revise the current SO_2 primary NAAQS. Comments on the adequacy of the current standards that focused on the scientific and/or the exposure/risk basis for the Administrator's proposed conclusions are discussed in sections II.E.2.a–II.E.2.c. Comments on the epidemiologic evidence are considered in section II.E.2.a. Comments on the controlled human exposure evidence are considered in section II.E.2.b. Comments on human exposure and health risk assessments are considered in section II.E.2.c. To the extent these comments on the evidence and information are also used to justify commenters' conclusions on decisions related to indicator, averaging time, form, or level, they are noted as well in the appropriate sections below (II.F.1–II.F.4, respectively). The summaries of comments, and responses thereto, presented below are not exclusive: other comments and responses are being included in the Response to Comment (RTC) Document which is part of the record for this rulemaking (EPA, 2010).

Many public commenters agreed with the proposal that based on the available information, the current SO_2 standards are not requisite to protect public health with an adequate margin of safety and that revisions to the standards are therefore appropriate. Among those calling for revisions to the standards were environmental groups (*e.g.,* Sierra Club, WEACT for Environmental Justice, Center for Biological Diversity, (CBD) Environmental Defense Fund (EDF), Natural Resources Defense Council (NRDC)); medical/public health organizations (*e.g.,* American Lung Association (ALA), American Thoracic Society (ATS)); State environmental organizations (*e.g.,* National Association of Clean Air Agencies (NACAA), Northeast States for Coordinated Air Use Management (NESCAUM); State environmental agencies (*e.g.,* such agencies in DE, IA, IL, MI, NY, NM, OH, PA, TX, VT); the Fond du Lac Band of Lake Superior Chippewa (Fond du Lac) Tribe, local groups (*e.g.,* Houston-Galveston Area Council, Alexandria Department of Transportation and Environmental Services) and most individual commenters (~13,000). These commenters generally concluded that the current SO_2 standards need to be revised and that a more stringent standard is needed to protect the health of susceptible population groups. In supporting the need to adopt a more stringent NAAQS for SO_2, these commenters often referenced the conclusions of CASAC, as well as evidence and information presented in the proposal. As such, the rationale offered by these commenters was consistent with that presented in the proposal to support the Administrator's proposed decision to revise the current SO_2 NAAQS.

Most industry commenters (*e.g.,* Utility Air Regulatory Group (UARG), American Petroleum Institute (API), Arizona Public Service, National Petrochemical & Refiners Association (NPRA), Montana-Dakota Utilities Co., Dominion Resources, Council of Industrial Boiler Owners (CIBO), Edison Electric Institute (EEI), Duke Energy, National Mining Association (NMA)); and some organizations (*e.g.,* Texas Association of Business, The Annapolis Center for Science-Based Public Policy (ACSBPP), South Carolina Chamber of Commerce) opposed the proposed revisions to the SO_2 primary NAAQS. In supporting their views, industry commenters generally concluded that EPA did not appropriately consider uncertainties associated with the epidemiologic and controlled human exposure evidence.

More specifically, with respect to the epidemiologic studies, many of these commenters concluded that results of these studies are confounded by co-pollutants and thus too uncertain to determine whether SO_2 is truly associated with the health outcomes being measured (*e.g.,* hospital admissions; **Federal Register** *see* below). With respect to the controlled human exposure studies, many commenters were critical of the 5-minute benchmark levels that were derived from these studies and subsequently used by EPA in the air quality, exposure, and risk analyses. These groups were particularly concerned about the Administrator's reliance on the 200 ppb 5-minute benchmark level in assessing the adequacy of the current and potential alternative standards. In general, many industry groups maintained that adverse respiratory effects did not occur following 5–10 minute SO_2 exposures <400 ppb (*e.g.,* API, EEI, CIBO) and some groups stated that even at SO_2 concentrations ≥ 400 ppb, reported effects may not be of clinical concern, and thus are likely not adverse (*e.g.,* UARG). Many industry groups (*e.g.,* API, UARG) also disagreed with EPA's (and CASAC's) conclusions that severe asthmatics were not included in these controlled human exposure studies, and that severe asthmatics would likely have a more pronounced response to SO_2 exposures at a given level, or would respond to even lower levels of SO_2.

In responding to these specific comments, we note that the Administrator relied in the proposal on the evidence, information, and judgments contained in the ISA and the REA (including the policy assessment chapter), as well as on the advice of CASAC. In considering the evidence, information, and judgments of the ISA and the REA, the Agency notes that these documents have been reviewed and discussed extensively by CASAC at multiple public meetings (*see* above, section I.D) and in their letters to the

EPA Administrator. Thus, it is important to note that CASAC generally accepted the key findings and conclusions presented in both the ISA and REA (*see* Henderson 2008a, Henderson 2008b, and Samet, 2009).

a. Comments on EPA's Interpretation of the Epidemiologic Evidence

Many industry groups (*e.g.,* API, UARG, American Chemistry Council (ACC), Dominion Resources, ExxonMobil, Progress Energy, CIBO, The Fertilizer Institute, EEI, Dow Chemical Company (Dow), MeadWestvaco Corporation (MWV), (NMA) and some organizations (*e.g.,* ACSBPP) commented that, given the presence of numerous co-pollutants in the air, the epidemiologic studies do not support the contention that SO_2 itself is causing health effects. For example, UARG stated: "The epidemiological evidence cannot determine that SO_2 is a cause of or a contributor to hospital admissions ("HA"), emergency department ("ED") visits or respiratory symptoms, the effects cited in the Proposed Rule."

Although EPA has recognized that multiple factors can contribute to the etiology of respiratory disease and that more than one air pollutant could independently impact respiratory health, we continue to judge, as discussed in the ISA, that the available evidence supports the conclusion that there is an independent effect of SO_2 on respiratory morbidity. In reaching this judgment, we recognize that a major methodological issue affecting SO_2 epidemiologic studies concerns the evaluation of the extent to which other air pollutants, particular $PM_{2.5}$,[10] may confound or modify SO_2-related effect estimates. The use of multi-pollutant regression models is a common approach for evaluating potential confounding by co-pollutants in epidemiologic studies. It is therefore important to note that when the ISA evaluated U.S. and international epidemiologic studies employing multi-pollutant models, SO_2 effect estimates generally remained positive and relatively unchanged when co-pollutants, including PM, were included (*see* ISA, p. 5–5). Therefore, although recognizing the uncertainties associated with separating the effects of SO_2 from those of co-occurring pollutants, the ISA concluded that the limited available evidence indicates that the effect of SO_2 on respiratory health outcomes appears to be generally robust and independent of the effects of gaseous co-pollutants, including NO_2 and O_3, as well as particulate co-pollutants, particularly $PM_{2.5}$ (ISA, section 5.2; p. 5–9).

In considering questions of confounding and causation, the epidemiologic studies should not be considered in a vacuum. As emphasized by the ISA, and endorsed by CASAC, controlled human exposure studies provide support for the plausibility of the associations reported in epidemiologic studies (ISA, section 5–5; Henderson 2008a; Henderson 2008b). These controlled human exposure studies exposed exercising asthmatics to 5–10 minute peaks of SO_2 and reported decrements in lung function and/or respiratory symptoms in up to 60% of these individuals (depending on exposure concentration; *see* ISA, Table 5–3; p. 5–11). Thus, these experimental study results provide strong support for an independent contribution of SO_2 to the respiratory health effects reported in epidemiologic studies: "The effects of SO_2 on respiratory symptoms, lung function, and airway inflammation observed in the human clinical studies using peak exposures further provides a basis for a progression of respiratory morbidity resulting in increased emergency department visits and hospital admissions. Collectively, these findings provide biological plausibility for the observed association between ambient SO_2 levels and emergency department visits and hospitalizations for all respiratory diseases and asthma, notably in children and older adults. * * *" (ISA, section 5.2 at p. 5–5). Thus, EPA is not relying solely on the epidemiologic studies to evaluate whether associations reported in these studies (*e.g.,* associations with emergency department visits) are likely the result of ambient SO_2 exposure.

b. Comments on EPA's Interpretation of the Controlled Human Exposure Evidence

Many industry groups (*e.g.,* API, ACC, Progress Energy, EEI, CIBO) commented that adverse health effects do not occur following 5–10 minute SO_2 exposures < 400 ppb. In addition, some groups (*e.g.,* UARG) commented that adverse respiratory effects do not occur in exercising asthmatics following SO_2 exposures below 600 ppb. The disagreement is not whether effects occur in exercising asthmatics at these exposure levels and exposure durations. Rather, the issue is whether the effects experienced can properly be regarded as adverse. In general, these groups conclude that EPA's judgment of adverse health effects at SO_2 exposure levels below 600 or 400 ppb is inappropriately based on an unsound interpretation of ATS guidelines. More specifically, these groups generally contend that decrements in lung function without accompanying respiratory symptoms are not adverse effects of SO_2 exposure, and that decrements in lung function in a percentage of exercising asthmatics does not represent a shift in lung function at the population level. Some of these groups also contend that EPA followed the advice of individual CASAC members, rather than consensus CASAC written comments on the ISA and REA when concluding respiratory effects associated with SO_2 exposures below 600 or 400 ppb are adverse. Furthermore, some groups contend that effects below 400 ppb should not be considered adverse because compared to the number of asthmatics experiencing decrements in lung function, there were similar numbers of asthmatics experiencing increases in lung function. EPA disagrees with these comments, and believes that the clinical evidence also supports the conclusion that the current standards are not requisite to protect public health with and adequate margin of safety.

The Agency disagrees that adverse respiratory effects do not occur in exercising asthmatics following 5–10 minute SO_2 exposures ranging from 400–600 ppb. As previously mentioned, at SO_2 concentrations ranging from 400–600 ppb, moderate or greater decrements in lung function occur in approximately 20–60% of exercising asthmatics (again, defined in terms of a $\geq$ 15% decline in FEV_1 or 100% increase in sRaw; ISA, Table 3–1). Moreover, at concentrations $\geq$ 400 ppb, decrements in lung function are often statistically significant at the group mean level, and are frequently accompanied by respiratory symptoms (ISA, Table 5–1). ATS guidelines on what constitutes an adverse health effect of air pollution clearly state that reversible loss of lung function in combination with the presence of symptoms should be considered adverse (ATS 1985, 2000). Moderate or greater decrements in lung function accompanied by respiratory symptoms fit this description. Thus, the Agency's conclusion of adverse health effects associated with SO_2 concentrations $\geq$ 400 ppb is consistent with ATS guidelines.

The Agency also disagrees with industry commenters regarding the adversity of the respiratory effects seen in exercising asthmatics following 5–10 minute SO_2 exposures ranging from 200–300 ppb. As mentioned above (section II.B.1), and discussed more

[10] As noted in the proposal (*see* sections II.D.1, 74 FR at 64824–64825 and II.F.4.a, 74 FR at 64835), there is special sensitivity in this review in disentangling SO_2-related effects from PM-related effects (especially sulfate PM).

fully in the proposal (*see* section II.B.3, 74 FR at 64819), the ISA reported that exposure to SO_2 concentrations as low as 200–300 ppb for 5–10 minutes results in approximately 5–30% of exercising asthmatics experiencing moderate or greater decrements in lung function. In 2000, the ATS updated its guidelines on "what constitutes an adverse health effect of air pollution." These guidelines indicated that exposure to air pollution that increases the risk of an adverse effect to the entire population is adverse, even though it may not increase the risk of any individual to an unacceptable level (ATS 2000). For example, ATS notes that a population of asthmatics could have a distribution of lung function such that no individual has a level associated with significant impairment. Exposure to air pollution could shift the distribution to lower levels that still do not bring any individual to a level that is associated with clinically relevant effects. However, this would be considered adverse because individuals within the population would have diminished reserve function, and therefore would be at increased risk if affected by another agent (ATS 2000).

Considering the 2000 ATS guidelines, the results of the clinical studies conducted at 200–300 ppb were reasonably interpreted by EPA to indicate an SO_2-induced shift in these lung function measurements for a subset of this population. That is, an appreciable percentage of this population of exercising asthmatics would be expected to experience moderate or greater decrements in lung function in response to SO_2 concentrations as low as 200 ppb, and thus would be expected to have diminished reserve lung function. As a result, this sub-population would be at greater risk of a more severe response if affected by another respiratory agent (*e.g.,* viral infection, or O_3).

EPA is also mindful of CASAC comments on this issue following the second draft ISA. The second draft ISA placed relatively little weight on health effects associated with SO_2 exposures at 200–300 ppb. CASAC strongly disagreed with this characterization of the health evidence. Their consensus letter following the second draft ISA states:

> Our major concern is the conclusions in the ISA regarding the weight of the evidence for health effects for short-term exposure to low levels of SO_2. Although the ISA presents evidence from both clinical and epidemiological studies that indicate health effects occur at 0.2 ppm or lower, the final chapter emphasizes health effects at 0.4 ppm and above * * * CASAC believes the clinical and epidemiological evidence warrants stronger conclusions in the ISA regarding the available evidence of health effects at 0.2 ppm or lower concentrations of SO_2. The selection of a lower bound concentration for health effects is very important because the ISA sets the stage for EPA's risk assessment decisions. In its draft Risk and Exposure Assessment (REA) to Support the Review of the SO2 Primary National Ambient Air Quality Standards (July 2008), EPA chose a range of 0.4 ppm–0.6 ppm SO_2 concentrations for its benchmark analysis. As CASAC will emphasize in a forthcoming letter on the REA, we recommend that a lower bound be set at least as low as 0.2 ppm. (Henderson 2008a)

EPA also notes the similar CASAC comments on the first draft of the REA. The consensus CASAC letter following the 1st draft REA states:

> The CASAC believes strongly that the weight of clinical and epidemiology evidence indicates there are detectable clinically relevant health effects in sensitive subpopulations down to a level at least as low as 0.2 ppm SO_2. These sensitive subpopulations represent a substantial segment of the at-risk population. (Henderson 2008b; p. 1)

See Coalition of Battery Recyclers Association v. *EPA,* No. 09–1011 (DC Cir., May 14, 2010), slip opinion at 9, holding that it was reasonable for EPA to conclude that a two IQ point mean population loss is an adverse effect based in part on CASAC advice that such a decrement is significant. CASAC's strong advice regarding the adversity of effects at the 200 ppb level similarly supports EPA's conclusion that the observed lung decrements are adverse.

In addition to the considerations described above, we also note the following key points:

- In the current SO_2 NAAQS review, clinicians on the CASAC Panel advised that moderate or greater decrements in lung function can be clinically significant in some individuals with respiratory disease.[11]
- In the last O_3 NAAQS review, CASAC indicated that moderate decrements in lung function can be clinically significant in some asthmatics (Henderson 2006), and that in the context of standard setting, a focus on the lower end of the range of moderate functional responses is most appropriate for estimating potentially adverse lung function decrements in people with lung disease (*e.g.,* asthma; *see* 73 FR at 16463).
- In the last O_3 NAAQS review, the Criteria Document and the Staff Paper indicated that for many people with lung disease (*e.g.,* asthma), even moderate decrements in lung function or respiratory symptoms would likely interfere with normal activities and result in additional and more frequent use of medication (EPA 2006, EPA 2007d).
- Subjects participating controlled human exposure studies do not include severe asthmatics, and it is reasonable to presume that persons with more severe asthma than the study participants would have a more serious health effect from short-term exposure to 200 ppb SO_2.

Considering these key points along with the ATS guidelines and consensus CASAC comments on the draft ISA and REA described above, we reasonably conclude that 5–10 minute exposures to SO_2 concentrations at least as low as 200 ppb can result in adverse health effects in exercising asthmatics.

In addition, as noted above some groups (*e.g.,* API) contend that effects below 400 ppb should not be considered adverse because compared to the number of asthmatics experiencing decrements in lung function, there were similar numbers of asthmatics experiencing increases in lung function.

The commenters correctly point out that at the lowest concentration tested in free-breathing chamber studies (200 ppb), there are a similar number of asthmatics experiencing a moderate or greater decrease in lung function (*i.e.,* $\geq$ 100 increase in sRaw or $\geq$ 15 decrease in FEV_1) and experiencing what might be called a moderate improvement in lung function (*i.e.,* $\geq$ 100 decrease in sRaw or $\geq$ 15 increase in FEV_1). This observation is consistent with data presented in Figures 4–2 and 4–3 of the ISA showing essentially no SO_2 -induced change in lung function at 200 ppb when averaged across asthmatics participating in the three Lin *et al.,* controlled human exposure studies. However, these figures also demonstrate that asthmatics who are sensitive to SO_2 at a higher concentration (600 ppb) experience, on average, a greater decrement in lung function at lower concentrations, including 200 ppb, when compared with all subjects combined. Therefore, while some asthmatics are relatively insensitive to SO_2-induced respiratory effects even at concentrations $\geq$ 600 ppb, there is clear empirical evidence that others experience significant bronchoconstriction following exposures to both relatively high (600 ppb) and low (200 ppb) SO_2 concentrations. Among these SO_2-sensitive asthmatics, Figures 4–2 and 4–3 of the ISA show a clear increase in

[11] *See* hearing transcripts from EPA Clean Air Scientific Advisory Committee (CASAC), July 30–31 2008, Sulfur Oxides-Health Criteria (part 3 of 4) pages 211–213). These transcripts can be found in Docket ID No. EPA–HQ–ORD–2006–0260. Available at *http://www.regulations.gov.*

bronchoconstriction with increasing SO_2 concentrations from 200–400 ppb. Given this clear relationship of exposure and effect at all levels in the sensitive asthmatics (*i.e.* those who experienced significant decrements in lung function at the highest exposure concentration used (600 ppb)), EPA does not accept the commenter's premise that controlled human exposure studies do not demonstrate adverse effects in some asthmatics at 5–10 minute levels below 400 ppb.

In addition to disagreeing with EPA's proposed finding of adverse health effects following 5– 10 minute SO_2 exposures as low as 200 ppb, many industry groups (*e.g.,* API, UARG, ACC, ExxonMobil) also disagreed with EPA that severe asthmatics were not included in controlled human exposure studies. That is, these groups contend that EPA is incorrect in assuming that severe asthmatics would likely have a more pronounced response to SO_2 exposures at a given level, or would respond to even lower levels of SO_2 and that this should be taken into account when judging the adequacy of the current standards. As support for their assertion, multiple industry groups cite controlled human exposure studies in the ISA stating that they included "severe asthmatics" and also cite a study by Linn *et al.* (1987) which concluded that among asthmatics, responses to SO_2 exposure are not dependent on the clinical severity of asthma and that "the subjects with the highest risk [of temporary respiratory disturbances from ambient SO_2] can be identified only by actually measuring their responses to SO_2".

We disagree with the assertion that severe asthmatics have been evaluated in 5–10 minute controlled human exposure studies. Although studies cited in the ISA referred to a group of subjects as "moderate/severe" asthmatics, these individuals had well-controlled asthma, were able to withhold medication, were not dependent on corticosteroids, and were able to engage in moderate to heavy levels of exercise. By today's standards, these individuals would clearly be classified as moderate asthmatics. EPA therefore concludes that persons with asthma that is more severe than moderate asthma, as that term is currently understood, were not included in the controlled human exposure studies (and understandably so, for ethical reasons).

In addition, EPA agrees with the commenters that there is little evidence from controlled human exposure studies to suggest that the respiratory effects of SO_2 differ between mild and moderate asthmatics (*see* Linn *et al.,* 1987). However, this may very well be due, at least in part, to persistence of medication among the moderate asthmatic subjects. More importantly, the moderate asthmatics began the exposure with compromised lung function relative to the mild asthmatics. Therefore, similar functional declines from different baselines between mild and moderate asthmatics would clearly not have the same physiological importance. CASAC specifically addressed the issue of asthma severity in a letter to the Administrator: "For ethical reasons severe asthmatics were not part of these clinical studies, but it is not unreasonable to presume that they would have responded to even a greater degree (Henderson 2008a; p. v)." It is also important to note that in addition to the strict health-specific inclusion and exclusion criteria for a given controlled human exposure study, many asthmatics who might otherwise be able to participate choose not to participate because of anxiety related to what they viewed as potential adverse health risks. EPA concludes that it is appropriate to assume, as CASAC suggested, that persons with more severe asthma would respond to an even greater degree than the moderate asthmatics in the clinical studies.

c. Comments on EPA's Characterization of SO_2-Associated Exposures and Health Risks

Several commenters discussed the analyses of SO_2-associated exposures and health risks presented in the REA. As in past reviews (EPA 2005, 2007c, 2007d), EPA has estimated risks associated with the current standards to inform judgments on the public health risks that could exist under different standard options. Some industry commenters (*e.g.,* API, UARG, Lignite Energy Council (LEC), Jackson Walker, ASARCO, the National Rural Electric Cooperative Association) concluded that when considering the adequacy of the current standards, the Administrator should consider exposures and risks associated with actual SO_2 air quality rather than air quality allowed by the current NAAQS. They consequently challenged the relevance and appropriateness of EPA's use of SO_2 concentrations that have been simulated to just meet the current standards in assessing the adequacy of the current standards.

In addition to the objections noted above, we note that UARG generally concluded that the results of EPA's quantitative risk assessment are fundamentally flawed in that they substantially overestimate risks associated with the various air quality scenarios. UARG contends that this is because EPA did not use proper exposure-response functions in estimating risks associated with SO_2 exposure. Moreover, UARG contends EPA further overestimates risk because of the use of 50 ppb exposure bins in estimating the number of occurrences of an adverse lung function response (*see* below).

With respect to comments that when considering the adequacy of the current standards, the Administrator should consider exposures and risks associated with actual SO_2 air quality rather than that simulated to just meet the current standards, these commenters generally concluded: (1) It is more relevant to assess exposures and risks associated with actual SO_2 air quality since adjusting air quality to just meet the current standards require large adjustments to air quality that are highly uncertain; and (2) NAAQS are intended to address actual, rather than highly improbable, risks to human health. In addition, these groups generally concluded that exposure and risk estimates presented in the REA suggest relatively little health risk associated with current levels of SO_2, and thus, there is no need to revise the current SO_2 standards.

We disagree with these commenters that exposure- and risk-related considerations in the NAAQS reviews should rely only on actual air quality, and that EPA therefore improperly adjusted air quality in its risk and exposure analyses to simulate air quality allowed by the current primary SO_2 NAAQS. EPA is required to review whether the present standards—not present air quality—are requisite to protect public health with an adequate margin of safety. Section 109(b)(1). In making this determination it is relevant to consider exposures and risks which could be permissible under the current standards. *See American Trucking Associations* v. *EPA,* 283 F.3d 355, 370 (DC Cir. 2002) (existence of evidence showing adverse effects occurring at levels allowed by the current standards justifies finding that it is appropriate to revise the existing NAAQS). Consequently, it is at the very least reasonable for EPA, in its REA, to make air quality adjustments to estimate SO_2-related exposures and health risks that could exist in areas that just meet the present standards. Thus, although we acknowledge that exposure and health risk estimates associated with current ambient concentrations are substantially smaller than those associated with air quality adjusted to just meet the current standards, we also note that this is

irrelevant to the question of whether the current standards are requisite to protect public health with an margin of safety.

In both of these cases, EPA is not trying to evaluate whether areas would or would not be in attainment of the current standards. Those are issues that are addressed during the implementation of the NAAQS. Instead, in this rulemaking EPA is evaluating what NAAQS would be appropriate under section 109(b)(1), by evaluating the impact on or risks to public health from air quality that is at the level of the current standards, as well as evaluating air quality that is at the level of various alternative standards. EPA uses this information to inform the decision on what NAAQS would be requisite to protect public health with an adequate margin of safety.

If EPA determines that the current standards require revision, EPA is further required to determine what revisions are appropriate in light of the requirement that primary NAAQS be requisite to protect public health with an adequate margin of safety. Section 109(d)(1). It is thus similarly reasonable for EPA to make air quality adjustments to simulate different potential alternative standards to provide information on exposures and risks under these potential alternative standards.[12]

We agree that there are uncertainties inherent in making air quality adjustments. These uncertainties are discussed thoroughly in the REA (REA, sections 6.5 and 7.4.2.5). For example, the REA noted the following regarding adjustment of SO_2 concentrations:

> This procedure for adjusting either the ambient concentrations (*i.e.,* in the air quality characterization) or health effect benchmark levels (*i.e.,* in the exposure assessment) was necessary to provide insight into the degree of exposure and risk which would be associated with an increase in ambient SO_2 levels such that the levels were just at the current standards in the areas analyzed. Staff recognizes that it is extremely unlikely that SO_2 concentrations in any of the selected areas where concentrations have been adjusted would rise to meet the current NAAQS and that there is considerable uncertainty associated with the simulation of conditions that would just meet the current standards. Nevertheless, this procedure was necessary to assess the ability of the current standards, not current ambient SO_2 concentrations, to protect public health (REA, section 6.5; p. 64)

These air quality adjustments are not meant to imply an expectation that SO_2 concentrations will increase broadly across the United States or in any given area. Rather, as just noted above, they are meant to estimate SO_2-related exposures and health risks if air quality were at the level of the current and potential alternative standards. Such estimates can inform decisions on whether the current standards, or particular potential alternative standards, provide the requisite protection of public health.

As mentioned above, UARG generally concluded that under all air quality scenarios, the results of EPA's quantitative risk assessment (the third of the analyses conducted in the REA (chapter 9), *see* section II.C above) are substantially overestimated because EPA did not use proper methods to estimate the parameters of the exposure-response functions used in its analyses. UARG contends this is because many of the subjects in the controlled human exposure studies from which EPA's exposure-response functions were derived (*see* REA, Table 9–3) were exposed to more than one SO_2 concentration, yet EPA treated each exposure event as being independent (*e.g.,* if the same subject was exposed to 200 and 300 ppb SO_2, EPA considered these as representing two independent exposure events). UARG contends that observations from the same subject exposed to different SO_2 concentrations are not independent observations and should not be treated as such. Notably, when UARG derived their own exposure-response functions taking into account that observations from the same subject exposed to different SO_2 concentrations are not independent of each other, they estimated appreciably less risk than that estimated by EPA.

There are a variety of techniques and/or assumptions that can be used to fit individual subject data from the controlled human exposure studies (*see* REA, Table 9–3) to exposure-response curves. Moreover, any technique or assumption utilized will have inherent uncertainties. EPA discussed the uncertainties associated with our quantitative risk assessment in detail in the REA (REA, section 9.4); we also gave an overview of key uncertainties in the proposal (*see* section II.C.3, 74 FR at 64824). The approach used to estimate the exposure-response functions was not first introduced in the SO_2 risk assessment, it was previously recommended to EPA by an applied statistician serving on the O_3 CASAC Panel and used in the O_3 risk assessment (which had individual controlled human exposure data similar to that in the current SO_2 NAAQS review; *see* EPA 2007d and EPA 2007e). Importantly, this approach allowed EPA to use all the available individual subject data. Moreover, an inspection of the estimated exposure-response curve and the underlying data suggest that any biases in the parameter estimates are likely to be slight (*see* EPA 2010, section II.C). Consequently, EPA does not accept UARG's view that the methodology used in EPA's quantitative risk assessment was inappropriate.

We further note that UARG's exposure-response functions do not fit the underlying controlled human exposure data (the proportions of subjects who responded at each exposure level) nearly as well as the exposure-response functions estimated using EPA's approach. We believe this could be due to the methodology used in UARG's reanalysis of the individual-level data from the controlled human exposure studies used in the quantitative risk assessment. UARG attempted to estimate subject-specific exposure-response functions, and to use the results of these estimates to obtain estimates of the two parameters in the population-level exposure-response functions. As described in more detail in section II.C of the RTC document (EPA 2010), EPA does not believe there are sufficient data to properly estimate the parameters of subject-specific exposure-response functions. More specifically, UARG chose a three-parameter quadratic function for the subject-specific exposure-response functions. However, none of the subjects had more than three exposures, and many had only one or two. EPA believes that this information is particularly limited for estimating these subject-specific exposure-response functions, especially given that a large percentage of the total number of subjects had fewer exposures than the number of parameters UARG was attempting to estimate (*i.e.,* UARG estimated three parameters in its exposure-response functions, but over fifty percent of subjects only had one or two exposures). It appears that UARG's population-level exposure-response function estimates depended on these subject-specific exposure-response function estimates and thus could explain why UARG's estimated population-level exposure-response functions do not fit the underlying controlled human exposure data nearly as well as the approach used by EPA. A more detailed response to this comment can be found in section II.C of the RTC document (EPA 2010).

As mentioned above, UARG also concluded that EPA further overestimates the total number of occurrences of an adverse lung function response (*i.e.,* total number of

[12] In conducting these analyses, EPA is not trying to evaluate whether areas would or would not be in attainment of the current standards. Again, those issues are addressed during the implementation of the NAAQS.

occurrences of increases in sRaw ≥ 100 or 200% and/or declines in FEV_1 ≥ 15 or 20%) in its quantitative risk assessment. More specifically, UARG concluded that the use of 50 ppb bins, combined with assigning all exposures within a bin the probability of an adverse lung function response at the midpoint of that bin (*e.g.,* all exposures from 0–50 ppb were assigned the probability of an adverse lung function response occurring at 25 ppb), resulted in a substantial overestimate of the total number of occurrences of lung function responses in asthmatics at moderate or greater exertion. UARG generally concludes that this is because the vast majority of exposures of asthmatics at moderate or greater exertion are occurring below the midpoint of the 0–50 ppb exposure bin (*i.e.,* most exposures are occurring below 25 ppb), yet EPA is assigning these very low SO_2 exposures the higher probability of a lung function response associated with the midpoint of the 0–50 ppb exposure bin. UARG contends that this results in a substantial overestimation of the total number of occurrences of lung function response in asthmatics and asthmatic children at moderate or greater exertion. UARG further notes that this methodological concern was raised in its comments on the second draft REA, but EPA failed to address this issue and relied heavily on this metric in the proposal with respect to the adequacy of the current and potential alternative standards. EPA's response to this comment is discussed below and in more detail in section II.C of the RTC document (EPA 2010).

EPA generally agrees with UARG's technical comments that there is a substantial overestimation of the total occurrences of lung function responses because of the binning issues described above. However, we strongly disagree that: (1) This issue was not acknowledged in the final REA; and (2) the metric of total occurrences was relied on heavily in the policy assessment chapter of the REA (REA, chapter 10) and in the Administrator's rationale with respect to the adequacy of the current and potential alternative standards. First, EPA did respond to this concern in the final REA. More specifically, page 344 of the final REA states:

> As noted in public comments on the 2nd draft SO_2 REA, the assignment of response probability to the midpoint of the exposure bin combined with the lack of more finely divided intervals in this range can lead to significant overestimation of risks based on total occurrences of a defined lung function response. This is because the distribution of population exposures for occurrences is not evenly distributed across the bin, but rather is more heavily weighted toward the lower range of the bin. Thus, combining all exposures estimated to occur in the lowest bin with a response probability assigned to the midpoint of the bin results in a significant overestimate of the risk. Therefore, staff places less weight on the estimated number of occurrences of lung function responses.

Thus, as noted in the final REA, less weight was placed on this metric in the quantitative risk assessment chapter (REA, chapter 9), and importantly, no weight was placed on this metric in either the policy assessment chapter of the REA (REA, chapter 10) or in the Administrator's rationale sections of the proposal preamble. Rather, the policy assessment chapter of the REA and the Administrator's rationale at the proposal considered the percent of exposed asthmatic children at moderate or greater exertion estimated to have at least one defined lung function response per year in St. Louis. Importantly, this metric is not appreciably affected by the binning issue raised in UARG's comments. As stated on page 344–345 of the final REA:

> This overestimation of total occurrences does not impact the risk metric expressed as incidence or percent incidence of a defined lung function response 1 or more times per year because the bulk of the exposures contributing to these risk metrics are not skewed toward the lower range of the reported exposure bins.[13]

Finally, it is important to note that the Administrator's rationale in the proposal regarding the adequacy of the current and potential alternative standards in general placed only limited reliance on the results of the quantitative risk assessment in St. Louis, with no reliance on the estimates of total occurrences. Rather, in addition to the substantial weight that she placed on the scientific evidence as described in the ISA, the Administrator placed relatively more weight on the results of the St. Louis exposure analysis. For example, in discussing the adequacy of the current standards, the proposal states: "The Administrator especially notes the results of the St. Louis exposure analysis which, as summarized above, indicates that substantial percentages of asthmatic children at moderate or greater exertion would be exposed, at least once annually, to air quality exceeding the 400 and 200 ppb benchmarks" (*see* 74 FR at 64829). We note that results of the quantitative risk assessment in St. Louis, with respect to the percent of asthmatic children estimated to have at least one lung function response per year (using EPA's exposure-response functions), supports the Administrator's overall conclusions in the proposal regarding the adequacy of the current and potential alternative standards.

3. Conclusions Regarding the Adequacy of the Current 24-Hour and Annual Standards

In reviewing the adequacy of the current standards, the Administrator has considered the scientific evidence assessed in the ISA, the exposure and risk results presented in the REA, the conclusions of the policy assessment chapter of the REA, and comments from CASAC and the public. These considerations are described below.

As in the proposal, the Administrator accepts and agrees with the ISA's conclusion that the results of controlled human exposure and epidemiologic studies form a plausible and coherent data set that supports a causal relationship between short-term (5 minutes to 24 hours) SO_2 exposures and adverse respiratory effects. The Administrator acknowledges that there are uncertainties associated with the epidemiologic evidence (*e.g.,* potential confounding by co-pollutants). However, she agrees that the epidemiologic evidence, supported by the controlled human exposure evidence, generally indicates that the effects seen in these studies are attributable to exposure to SO_2, rather than co-pollutants, most notably $PM_{2.5}$. She also accepts and agrees with the conclusion of the ISA that "[i]n the epidemiologic studies, respiratory effects were observed in areas where the maximum ambient 24-h avg SO_2 concentration was below the current 24-h avg NAAQS level. * * *" (ISA, section 5.2, p. 5–2) and so would occur at ambient SO_2 concentrations that are present in locations meeting the current 24-hour NAAQS. The Administrator also notes that these effects occurred in areas with annual air quality levels considerably lower than those allowed by the current annual standard, indicating that the annual standard also

[13] Although in St. Louis, the percent of exposed asthmatic children at moderate or greater exertion estimated to have at least one defined lung function response per year was not appreciably affected, it was found that for this same metric, the already very low risk estimates in Greene County became appreciably lower when the binning issue discussed above was considered. However, as noted above in section II.C and discussed in more detail in the REA (REA, section 10.3.3) and the proposal (*see* section II.E.b, 74 FR at 64827), the St. Louis exposure and risk results were found to be more informative in addressing the adequacy of the current and potential alternative standards. Moreover, while the Administrator's rationale in the proposal relied minimally on the St. Louis quantitative risk results (*see* above), she importantly placed no weight on any metric from the Greene County quantitative risk assessment.

is not providing protection against such effects. Existence of epidemiologic studies showing adverse effects occurring at levels allowed by the current standards is an accepted justification for finding that it is appropriate to revise the existing standards. *See, e.g. American Trucking Associations* v. *EPA,* 283 F. 3d at 370*; see also American Farm Bureau* v. *EPA,* 559 F. 3d.512, 521–23 (DC Cir. 2009) (effects associated with short-term exposure seen in areas with ambient concentrations lower than long-term standard, so that without further explanation, standard does not adequately protect against short-term exposures).

With respect to the controlled human exposure studies, the Administrator judges that effects following 5–10 minute SO_2 exposures ≥ 400 ppb and ≥ 200 ppb can result in adverse health effects to asthmatics. This judgment is based on ATS guidelines, explicit CASAC consensus written advice and recommendations, and judgments made by EPA in previous NAAQS reviews. Thus, similar to the proposal, she notes analyses in the REA supporting that 5-minute exposures ≥ 400 ppb and ≥ 200 ppb were associated with air quality adjusted upward to simulate just meeting the current standards. The Administrator especially notes the results of the St. Louis exposure analysis which, as summarized in the proposal (*see* section II.E.1.b and Table 3, *see* 74 FR at 64841), indicates that substantial percentages of asthmatic children at moderate or greater exertion would be exposed, at least once annually, to air quality exceeding the 400 and 200 ppb 5-minute benchmarks given air quality simulated to just meet the current standards. The Administrator judged these 5-minute exposures to be significant from a public health perspective due to their estimated frequency: Approximately 24% of child asthmatics at moderate or greater exertion in St. Louis are estimated to be exposed at least once per year to air quality exceeding the 5-minute 400 ppb benchmark, a level associated with lung function decrements in the presence of respiratory symptoms. Additionally, approximately 73% of child asthmatics in St. Louis at moderate or greater exertion would be expected to be exposed at least once per year to air quality exceeding the 5-minute 200 ppb benchmark. This health evidence and risk-based information underlie CASAC's conclusion that the current SO_2 standards do not adequately protect public health. As discussed in the proposal, CASAC stated: "the current 24-hour and annual standards are not adequate to protect public health, especially in relation to short-term exposures to SO_2 (5–10 minutes) by exercising asthmatics" (Samet, 2009, p. 15). The Administrator agrees with this conclusion.

In considering approaches to revising the current standards, the Administrator concludes that it is appropriate to set a new standard, that such standard must provide requisite protection with an adequate margin of safety to a susceptible population (*i.e.,* asthmatics at elevated ventilation), and that the standard must afford protection from short-term exposures to SO_2 in order to prevent the adverse health effects reported in both the controlled human exposure and epidemiologic studies. The Administrator notes that a 1-hour standard could provide increased public health protection, especially for members of at-risk groups, from health effects described in both controlled human exposure and epidemiologic studies, and hence, health effects associated with 5-minute to 24-hour exposures to SO_2.[14] As discussed in section II.F.5 below, given the degree of protection afforded by such a standard, it may be appropriate to replace, and not retain, the current 24-hour and annual standards in conjunction with setting a new short-term standard.

F. Conclusions on the Elements of a New Short-Term Standard

In considering a revised SO_2 primary NAAQS, the Administrator notes the need to protect at-risk populations from: (1) 1-hour daily maximum and 24-hour average exposures to SO_2 that could cause the types of respiratory morbidity effects reported in epidemiologic studies; and (2) 5–10 minute SO_2 exposure concentrations reported in controlled human exposure studies to result in moderate or greater decrements in lung function and/or respiratory symptoms. Considerations with regard to potential alternative standards and the specific conclusions of the Administrator are discussed in the following sections in terms of indicator, averaging time, form, and level (sections II.F.1 to II.F.4 below).

[14] We also note that such a standard would, among other things, address the deficiency in the current NAAQS which occasioned the remand of that standard for failing to adequately explain the absence of protection from short-term SO_2 bursts which could cause adverse health effects in hundreds of thousands of heavily breathing asthmatics. *American Lung Ass'n* v. *EPA,* 134 F. 3d at 392–93.

1. Indicator

a. Rationale for Proposed Decision

In the last review, EPA focused on SO_2 as the most appropriate indicator for ambient SO_X. In making a decision in the current review on the most appropriate indicator, the Administrator has considered the conclusions of the ISA and REA as well as the views expressed by CASAC and the public. The REA noted that, although the presence of gaseous SO_X species other than SO_2 has been recognized, no alternative to SO_2 has been advanced as being a more appropriate surrogate for ambient gaseous SO_X. Controlled human exposure studies and animal toxicology studies provide specific evidence for health effects following exposure to SO_2. Epidemiologic studies also typically report levels of SO_2, as opposed to other gaseous SO_X. Because emissions that lead to the formation of SO_2 generally also lead to the formation of other SO_X oxidation products, measures leading to reductions in population exposures to SO_2 can generally be expected to lead to reductions in population exposures to other gaseous SO_X. Therefore, as noted in the proposal, meeting an SO_2 standard that protects the public health can also be expected to provide protection against potential health effects that may be independently associated with other gaseous SO_X even though such effects are not discernable from currently available studies indexed by SO_2 alone. *See American Petroleum Institute* v. *EPA,* 665 F, 2d 1176, 1186 (DC Cir. 1981) (reasonable for EPA to use ozone as the indicator for all photochemical oxidants even though health information on the other photochemical oxidants is unknown; regulating ozone alone is reasonable since it presents a "predictable danger" and in doing so EPA did not abandon its responsibility to regulate other photochemical oxidants encompassed by the determination that photochemical oxidants as a class may be reasonably anticipated to endanger public health or welfare). Given these key points, the REA concluded that the available evidence supports the retention of SO_2 as the indicator in the current review (REA, section 10.5.1). Consistent with this conclusion, CASAC stated in a letter to the EPA Administrator that: "for indicator, SO_2 is clearly the preferred choice" (Samet 2009, p. 14).

b. Comments on Indicator

A small number of commenters directly addressed the issue of the indicator for the standard. These

commenters generally endorsed the proposal to continue to use SO_2 as the indicator for ambient SO_X.

c. Conclusions on Indicator

Based on the available information discussed above, and consistent with the views of CASAC and other commenters, the Administrator concludes that it is appropriate to continue to use SO_2 as the indicator for a standard that is intended to address effects associated with exposure to SO_2, alone or in combination with other gaseous SO_X. In so doing, the Administrator recognizes that measures leading to reductions in population exposures to SO_2 will also reduce population exposures to other oxides of sulfur.

2. Averaging Time

This section discusses considerations related to the averaging time of the SO_2 primary NAAQS. Specifically, this section summarizes the rationale for the Administrator's proposed decision regarding averaging time (II.F.2.a below; *see* section II.F.2 of the proposal for more detail at 74 FR 64832–64833), discusses public comments and EPA responses related to averaging time (II.F.2.b), and presents the Administrator's final conclusions regarding averaging time (II.F.2.c). Notably, public comments and the Administrator's conclusions on whether to retain or revoke the current 24-hour and/or annual standards given a new 1-hour standard are discussed in section II.F.5.

a. Rationale for Proposed Decision

In considering the most appropriate averaging time for the SO_2 primary NAAQS, the Administrator noted in the proposal the conclusions and judgments made in the ISA about the available scientific evidence, air quality correlations discussed in the REA, conclusions of the policy assessment chapter of the REA, and CASAC recommendations (section II.F.2 in the proposal). Specifically, she noted the following:

- The REA conclusion that an appropriate averaging time should focus protection on SO_2 exposures from 5-minutes to 24-hours (REA, section, 10.5.2).
- Air quality, exposure, and risk analyses from the REA indicating it is likely a 1-hour standard—with the appropriate form and level—can substantially reduce 5–10 minute peaks of SO_2 shown in controlled human exposure studies to result in respiratory symptoms and/or decrements in lung function in exercising asthmatics (*i.e.* 5-minute SO_2 concentrations ≥ 200 and 400 ppb).
- Air quality analyses indicating that a 1-hour standard—with the appropriate form and level—can substantially reduce the upper end of the distribution of SO_2 levels more likely to be associated with adverse respiratory effects (*see* section II.F.3 below); that is: (1) 99th percentile 1-hour daily maximum air quality concentrations in U.S. cities where positive effect estimates in epidemiologic studies of hospital admissions and emergency department visits for all respiratory causes and asthma were observed; and (2) 99th percentile 24-hour average air quality concentrations found in U.S. cities where emergency department visit and hospitalization studies (for all respiratory causes and asthma) reported statistically significant associations in multi-pollutant models with PM.
- The REA conclusion that a 5-minute averaging time is undesirable because it would result in significant and unnecessary instability due to the likelihood that locations would frequently shift in and out of attainment—thereby reducing public health protection by disrupting an area's ongoing implementation plans and associated control programs.
- CASAC statement addressing whether a 1-hour averaging time can adequately control 5–10 minute peak exposures and whether there should be a 5-minute averaging time. CASAC stated that the REA's rationale for a one-hour standard was "convincing" (Samet 2009, p. 16), and that "a one-hour standard is the preferred averaging time" (Samet 2009, p. 15).
- CASAC's statement that they were "in agreement with having a short-term standard and finds that the REA supports a 1-hour standard as protective of public health" (Samet 2009, p. 1).

b. Comments on Averaging Time

A large number of public commenters also endorsed the establishment of a new standard with a 1-hour averaging time (although some groups' support hinged on the accompanying level). These included a number of State organizations (*e.g.,* NACAA, NESCAUM); State environmental agencies (*e.g.,* such agencies in IA, IL, NY, MI, NM, OH, PA, TX, VT); public health and environmental organizations (*e.g.,* ALA, ATS, New York Department of Health (NYDOH), Sierra Club, EDF); the Fond du Lac Tribe; local groups (*e.g.,* Houston-Galveston Area Council, New York City); and almost all of the individual commenters (13,000). The supporting rationales offered by these commenters often acknowledged the recommendations of CASAC and the Administrator's rationale as discussed in the proposal.

Though many industry commenters did not support the proposed revisions to the SO_2 primary NAAQS (as discussed above in section II.E.2), a few of these groups did express that if a short-term standard were to be set, a 1-hour averaging time could be appropriate, depending on the level and form selected (*e.g.,* ExxonMobil, Kean Miller). Other industry commenters (*e.g.,* ASARCO, RIO Tinto Alcan, Association of Battery Recyclers (ABR)) and the South Dakota Department of Environment and Natural Resources (SD DENR) expressed that EPA should have considered longer averaging times (*e.g.,* 3 hours). In addition, although health and environmental groups were supportive of setting a new 1-hour standard to protect against short-term exposures to SO_2 (again, depending on the level of the 1-hour standard selected), these groups also commented that a 5-minute standard to protect susceptible populations from health effects associated with 5-minute peaks of SO_2 would be optimal (*e.g.,* ALA, ATS, Sierra Club, EDF). These comments, and EPA's responses, are discussed in more detail below.

As discussed above, industry commenters who disagreed with setting a new 1-hour standard generally based this conclusion on their interpretation of the scientific evidence and their conclusion that this evidence does not support the proposed revisions to the current SO_2 NAAQS. EPA's responses to these commenters were presented above in section II.E.2.a and II.E.2.b.

Also noted above, some industry commenters (*e.g.,* ASARCO, RIO Tinto Alcan, ABR) and the SD DENR expressed that EPA should have considered longer averaging times (*e.g.,* 3-hour, 8-hour, 24-hour). In general, these groups concluded that a standard with a longer averaging time could potentially provide the same public health protection as a 1-hour standard, while also providing a more stable regulatory target. For example, in its comments, the SD DENR states: "DENR recommends EPA evaluate a 3-hour or 8-hour standard to determine if these averaging periods are also protective of the public health. If they are, EPA should propose a 3-hour or 8-hour sulfur dioxide standard instead of a 1-hour standard. A longer averaging period would smooth out the variability of the upper range measurements and provide a more stable standard." Similarly, Rio Tinto Alcan stated in its comments: "the short-term averaging period defined by EPA (*i.e.,* 5 minutes

to 24 hours) is not limited to only 5-minute, 1-hour and 24-hour averaging periods. EPA could explain in more detail why these three averaging periods were examined when considering appropriate averaging periods to limit short-term peaks of SO_2 * * * a longer term average could provide additional stability to the standard while at the same time effectively protecting public health."

Although we agree that alternative averaging times could potentially provide similar public health protection (assuming an appropriate form and level), we believe that a 1-hour averaging time is reasonably justified by the scientific evidence presented in the ISA and by the air quality information presented in the REA. As described in detail in the proposal (*see* section II.F.2), the controlled human exposure evidence presented in the ISA provided support for an averaging time that protects against 5–10 minute peak SO_2 exposures (REA, section 10.5.2, pp. 371–372), and results from epidemiologic studies most directly provided support for both 1-hour and 24-hour averaging times (REA, section 10.5.2, p. 372). Thus, we found it most reasonable to consider these averaging times for a revised SO_2 NAAQS given that there is very little basis in the health evidence presented in the ISA to consider other averaging times (*e.g.,* 3-hour or 8-hour). In so doing, we first noted the likelihood that averaging times of 1 and 24 hours could provide protection against 5-minute peak SO_2 exposures. As described in detail in the proposal (*see* section II.F.2, 74 FR at 64830–64833), it was initially concluded that a 1-hour averaging time, rather than a 24-hour averaging time, would be more appropriate for limiting 5-minute peaks of SO_2. Similarly, we concluded that a 1-hour standard, given the appropriate form and level, could likely limit 99th percentile 24-hour average air quality concentrations found in U.S. locations where emergency department visit and hospitalization studies (for all respiratory causes and asthma) observed statistically significant associations in multi-pollutant models with PM (*i.e.,* 99th percentile 24-hour average SO_2 concentration ≥ 36 ppb). Taken together, we reasonably concluded that a 1-hour standard, with an appropriate form and level, can provide adequate protection against the range of health outcomes associated with averaging times from 5 minutes to 24 hours (proposal section II.F.2 and REA, section 10.5.2.3). We also note that our conclusion is in agreement with CASAC comments on the second draft REA. CASAC stated that they were "in agreement with having a short-term standard and finds that the REA supports a one-hour standard as protective of public health" (Samet 2009, p. 1). In addition, as discussed in more detail below in section II.F.3, we found that a 1-hour standard in combination with the selected form, will provide a stable regulatory target.

As noted above, although health and environmental groups were supportive of setting a new 1-hour standard to protect against short-term exposures to SO_2 (again, depending on the level of the 1-hour standard selected), these groups generally commented that a 5-minute standard to protect against health effects associated with 5-minute peaks would be optimal (*e.g.,* ALA, Sierra Club, EDF). For example, in their combined comments ALA, EDF, NRDC, and Sierra Club (ALA *et al.,*) stated: "We need a short-term SO_2 standard, optimally a 5-minute standard, to protect against bursts of pollution that can result from start-up, shutdown, upset, malfunction, downwash, complex terrain, atmospheric inversion conditions, and other situations" and that "EPA has over emphasized a concern about the stability of a 5-minute standard * * * The record does not show that any alleged instability of a 5-minute standard has any relevance to whether such a standard is requisite to protect public health."

We agree that there needs to be a short-term standard to protect against 5-minute peaks of SO_2. However, we do not believe setting a 5-minute standard to be the best way of accomplishing that objective. As in past NAAQS reviews, EPA properly considered the stability of the design of pollution control programs in its review of the elements of a NAAQS, since more stable programs are more effective, and hence result in enhanced public safety. *American Trucking Associations* v. *EPA,* 283 F. 3d at 375 (choice of 98th percentile form for 24-hour PM NAAQS, which allows a number of high exposure days per year to escape regulation under the NAAQS, justifiable as "promot[ing] development of more 'effective [pollution] control programs' ", since such programs would otherwise be "less 'stable'—and hence * * * less effective—than programs designed to address longer-term average conditions", and there are other means (viz. emergency episode plans) to control those high exposure days). In this review, there were legitimate concerns about the stability of a standard using a 5-minute averaging time. Specifically, there was concern that compared to longer averaging times (*e.g.,* 1-hour, 24-hour), year-to-year variation in 5-minute SO_2 concentrations were likely to be substantially more temporally and spatially diverse. Thus, it is more likely that locations would frequently shift in and out of attainment thereby reducing public health protection by disrupting an area's ongoing implementation plans and associated control programs. Consequently, the REA concluded that a 5-minute averaging time would not provide a stable regulatory target and therefore would not be the preferred approach to provide adequate public health protection. A 1-hour averaging time does not have these drawbacks. As noted in the REA and the proposal (*see* proposal sections II.F.2.a and II.F.2.c), air quality, exposure, and risk analyses support that a 1-hour averaging time, given an appropriate form and level can adequately limit 5-minute SO_2 exposures and provide a more stable regulatory target than setting a 5-minute standard. More specifically, based on the air quality and exposure analyses presented in chapters 7 and 8 of the REA, there is also a strong likelihood that a 99th percentile 1-hour daily maximum standard will limit 5–10 minute peaks of SO_2 shown in controlled human exposure studies to result in decrements in lung function and/or respiratory symptoms in exercising asthmatics (*see* especially REA Tables 7–11 to 7–14 and Figure 8–19).

We also note that a 1-hour standard to protect against 5-minute exposures is in agreement with CASAC advice and recommendations. That is, CASAC stated that they were "in agreement with having a short-term standard and finds that the REA supports a 1-hour standard as protective of public health" (Samet 2009, p. 1). Similarly, in a CASAC statement addressing whether a 1-hour averaging time can adequately control 5–10 minute peak exposures and whether there should be a 5-minute averaging time, CASAC stated that the REA had presented a "convincing rationale" (Samet 2009, p. 16) for a 1-hour standard, and that "a one-hour standard is the preferred averaging time" (Samet 2009, p. 15).

c. Conclusions on Averaging Time

In considering the most appropriate averaging time(s) for the SO_2 primary NAAQS, the Administrator notes the conclusions and judgments made in the ISA about the available scientific evidence, air quality considerations from the REA, CASAC advice and recommendations, and public comments received. Based on these considerations, the Administrator concludes that a new standard based on

1-hour daily maximum SO_2 concentrations will provide increased protection against effects associated with short-term (5 minutes to 24 hours) exposures. The rationale for this decision is described below.

Similar to the proposal (*see* section II.F.2.c), the Administrator first agrees with the REA's conclusion that the standard should focus protection on short-term SO_2 exposures from 5 minutes to 24 hours. As noted above, CASAC's strong recommendation supports this approach as well.[15] The Administrator further agrees that the standard must provide requisite protection from 5–10 minute exposure events, but believes that this can be provided without having a standard with a 5-minute averaging time. The Administrator agrees with the REA conclusion that it is likely a 1-hour standard—with the appropriate form and level—can substantially reduce 5–10 minute peaks of SO_2 shown in controlled human exposure studies to result in respiratory symptoms and/or decrements in lung function in exercising asthmatics. The Administrator further believes that a 5-minute averaging time would result in significant and unnecessary instability and is undesirable for that reason. The Administrator also notes the statements from CASAC mentioned above addressing whether a 1-hour averaging time can adequately control 5–10 minute peak exposures and whether there should be a 5-minute averaging time. As noted above, addressing this question, CASAC stated that the REA had presented a "convincing rationale" (Samet 2009, p. 16) for a 1-hour standard, and that "a one-hour standard is the preferred averaging time" (Samet 2009, p. 15).

Second, as in the proposal the Administrator agrees that a 1-hour averaging time (again, with the appropriate form and level) would provide protection against the range of health outcomes associated with averaging times of 1 hour to 24 hours. Specifically, the Administrator finds that a 1-hour standard can substantially reduce the upper end of the distribution of SO_2 levels more likely to be associated with adverse respiratory effects (*see* discussion on Form, section II.F.3); that is: (1) 99th percentile 1-hour daily maximum SO_2 air quality concentrations in U.S. locations where positive SO_2 effect estimates were reported in epidemiologic studies of emergency department visits and hospital admissions for all respiratory causes and asthma; and (2) 99th percentile 24-hour average SO_2 air quality concentrations found in U.S. locations where emergency department visit and hospital admission studies using multi-pollutant models with PM reported statistically significant associations (for all respiratory causes or asthma) with ambient SO_2 (*see* REA, section 10.5.2.2 and proposal section II.F.2, 74 FR at 64831). Finally, the Administrator again notes that establishing a new 1-hour averaging time is in agreement with CASAC recommendations. As noted above, CASAC stated that they were "in agreement with having a short-term standard and finds that the REA supports a one-hour standard as protective of public health" (Samet 2009, p. 1). Moreover, CASAC agreed with the REA that a "one-hour standard is the preferred averaging time" (Samet 2009, p.15).

3. Form

This section discusses considerations related to the form of the 1-hour SO_2 primary NAAQS. Specifically, this section summarizes the rationale for the Administrator's proposed decision regarding form (II.F.3.a; *see* proposal section II.F.3, 74 FR at 64833–64834 of the proposal for more detail), discusses comments related to form (II.F.3.b), and presents the Administrator's final conclusions regarding form (II.F.3.c).

a. Rationale for Proposed Decision

In considering the most appropriate form for the SO_2 primary NAAQS, the Administrator noted in the proposal the conclusions and judgments made in the ISA about available scientific evidence, air quality information discussed in the REA, conclusions of the policy assessment chapter of the REA, and CASAC recommendations (*see* section II.F.3, 74 FR at 64833–64834 in the proposal). Specifically, the proposal referenced the following:

- Information in the ISA that suggested that adverse respiratory effects are more likely to occur at the upper end of the distribution of ambient SO_2 concentrations. That is, the ISA describes a few studies that reported an increase in SO_2-related respiratory health effects at the upper end of the distribution of SO_2 concentrations (ISA, section 5.3, p. 5–9).
- The REA conclusion that a concentration-based form averaged over three years would better reflect the continuum of health risks posed by increasing SO_2 concentrations (*i.e.* the percentage of asthmatics affected and the severity of the response increases with increasing SO_2 concentrations; REA, section 10.5.3) by giving proportionally greater weight to years when 1-hour daily maximum SO_2 concentrations are well above the level of the standard, than just above the level of the standard.
- Analyses in the REA that suggested for a given SO_2 standard level, a 99th percentile form is appreciably more effective at limiting 5-minute peak SO_2 concentrations than a 98th percentile form (REA, section 10.5.3 and REA, Figures 7–27 and 7–28).
- Analyses in the REA indicating that over the last 10 years and for the vast majority of the sites examined, there appears to be little difference in 98th and 99th percentile design value stability (REA, section 10.5.3).
- The REA conclusion that taken together, the evidence and air quality information indicate that consideration should be given primarily to a 1-hour daily maximum standard with a 99th percentile or 4th highest daily maximum form (REA, section 10.5.3.3).
- CASAC indications that: "there is adequate information to justify the use of a concentration-based form averaged over 3 years" (Samet 2009, p. 16).
- CASAC recommendations that when evaluating 98th vs. 99th percentile forms, EPA should consider the number of days per year 98th vs. 99th percentile forms would allow SO_2 concentrations to exceed the selected standard level. Similarly, CASAC recommendations to consider the number of exceedences of 5-minute benchmarks given 98th vs. 99th percentile forms at a given standard level (Samet 2009).

b. Comments on Form

Most all State organizations and agencies (*e.g.,* NAACA, NESCAUM and agencies in FL, NM, PA, SC, TX, VT) supported a 99th percentile or 4th highest form. Similarly, public health (*e.g.,* ALA, ATS) and environmental organizations (*e.g.,* CBD, WEACT for Environmental Justice) and the Alexandria Department of Transportation and Environmental Services preferred either a 99th percentile or a more stringent form (*e.g.,* no exceedence) to further limit the occurrence of SO_2 concentrations that exceed the standard level in locations that attain the standard. In contrast, many industry groups (*e.g.,* UARG, NAM, LEC, RRI Energy, AirQuality Research & Logistics (AQRL)), and the SD DENR conditionally supported a

[15] As noted above, such a standard also satisfactorily addresses the issue raised by the reviewing court in the litigation that followed the last review of the SO_2 NAAQS: Why was no protection afforded in the standard for a susceptible subpopulation known to experience repeated adverse effects from exposure to 5–10 minute SO_2 bursts. American Lung Ass'n, 134 F. 3d at 392–93.

98th percentile form if EPA were to set a 1-hour standard.[16] EPA responses to specific comments on the form of the standard can be found below and in the RTC document (EPA 2010).

As mentioned above, a number of industry groups and the SD DENR preferred a 98th percentile form. In general, their preference for a 98th percentile form was based on their conclusion that a form based on the 98th percentile would be more stable than a form based on the 99th percentile, and that a 98th percentile form is consistent with the forms selected in recent NAAQS reviews (*i.e.* $PM_{2.5}$ and NO_2). For example AQRL stated: "The Administrator should reconsider her proposal and choose instead the 98th percentile (or equivalent nth highest value) *form* of the standard for the added reliability and stability it offers in determining compliance or progress towards attainment. This approach has been promulgated for recent revisions of the $PM_{2.5}$ and NO_2 standards and this consistency should be maintained with SO_2."

We agree with the commenters that it is important that a 1-hour standard have a form that is reasonably stable, but we disagree that a 98th percentile form is significantly more stable than a 99th percentile form. We note that the REA discussed analyses (also briefly described in the proposal; *see* section II.F.3, 74 FR at 64834) comparing trends in 98th and 99th percentile design values from 54 sites located in the 40 counties selected for the detailed air quality analysis (REA section 10.5.3 and Thompson, 2009). These results suggested that at the vast majority of sites, there would have been similar changes in 98th and 99th percentile design values over the last ten years (*i.e.* based on evaluating overlapping three year intervals over the last ten years; *see* REA, Figure 10–1 and Thompson, 2009). As part of this analysis, all of the design values over this ten year period for all 54 sites were aggregated and the standard deviation calculated (REA, Figure 10–2 and Thompson, 2009). Results demonstrated similar standard deviations—*i.e.* similar stability—based on aggregated 98th or aggregated 99th percentile design values over the ten year period (*see* REA, Figure 10–2 and Thompson 2009). Thus, we believe that in most locations, there will not be a substantial difference in stability between 98th and 99th percentile forms.

We also disagree with the commenters that the forms of NAAQS standards should be consistent across different NAAQS pollutants. This is almost like advocating consistent levels or averaging times for different NAAQS pollutants. Each pollutant is manifestly different from another, and the decision as to an appropriate standard for each, and appropriate elements (including form) of each standard and the interaction of these elements, necessarily is fact-specific. Cf. *Sierra Club* v. *EPA,* 353 F. 3d 976, 986 (DC Cir. 2004) ("This court has adopted an 'every tub on its own bottom' approach to EPA's setting of standards pursuant to the CAA, under which the adequacy of the underlying justification offered by the agency is the pertinent factor—not what the agency did on a different record concerning a different industry") (Roberts J.). There is thus no basis to say *a priori* that any element of one NAAQS should be consistent with another, although if all other things are equal, selecting stable forms for each NAAQS is a legitimate objective.

A 99th percentile form, rather than a 98th percentile form, is also needed for the standard to provide requisite public health protection. In this review of the primary SO_2 NAAQS, we considered information in the ISA suggesting that adverse respiratory effects are more likely to occur at the upper end of the distribution of ambient SO_2 concentrations. That is, the ISA described a few studies that reported an increase in SO_2-related respiratory health effects at the upper end of the distribution of SO_2 concentrations (*i.e.,* above 90th percentile SO_2 concentrations; ISA, section 5.3, p. 5–9). Moreover, we considered the extent to which different percentile forms, given the same standard level, limit 5-minute concentrations of SO_2 above benchmark levels. As noted above in section II.F.3.a, and in more detail in the proposal (*see* section II.F.3.a, 74 FR at 64834), air quality analyses presented in the REA suggested that at a given SO_2 standard level, a 99th percentile form is appreciably more effective at limiting 5-minute peak SO_2 concentrations than a 98th percentile form (REA, section 10.5.3, and REA, Figures 7–27 and 7–28). Taken together with the analyses suggesting that 98th and 99th percentile forms have similar stabilities, we reasonably concluded that a 99th percentile form was most appropriate for a 1-hour SO_2 standard.

As mentioned above, a number of health and environmental groups supported a 99th percentile form, but expressed that they would prefer a more restrictive form, such as a no-exceedence based form. In addition, the Alexandria Department of Transportation and Environmental Services only recommended a no, or one exceedence based form. In general, these groups concluded that a more restrictive form would further limit the: (1) Number of days an area could exceed the standard level and still attain the standard; and (2) the occurrence of 5-minute peaks of SO_2 above benchmark levels.

It is important that the particular form selected for a 1-hour daily maximum standard reflect the nature of the health risks posed by increasing SO_2 concentrations. The REA and proposal (*see* section II.F.3, 74 FR at 64833) noted that the form of the standard should reflect results from controlled human exposure studies demonstrating that the percentage of asthmatics affected, and the severity of the respiratory response (*i.e.* decrements in lung function, respiratory symptoms) increases as SO_2 concentrations increase. Taking this into consideration, EPA staff concluded that a concentration-based form, averaged over three years, is more appropriate than an exceedance-based form (REA, section 10.5.3). This is because a concentration-based form averaged over three years gives proportionally greater weight to years when 1-hour daily maximum SO_2 concentrations are well above the level of the standard, as it gives to years when 1-hour daily maximum SO_2 concentrations are just above the level of the standard. In contrast, an expected exceedance form gives the same weight to years when 1-hour daily maximum SO_2 concentrations are just above the level of the standard as it gives to years when 1-hour daily maximum SO_2 concentrations are well above the level of the standard. Therefore, we concluded that a concentration-based form, averaged over three years (which also increases the stability of the standard) better reflects the continuum of health risks posed by increasing SO_2 concentrations (*i.e.* the percentage of asthmatics affected and the severity of the response increases with increasing SO_2 concentrations; REA, section 10.5.3). Moreover, we note that analyses in the REA indicate that in most locations analyzed, a 99th percentile form would correspond to the 4th highest daily maximum concentration in a year, and that the 99th percentile, combined with the standard level

[16] EPA did not propose or seek comment on a 98th percentile form or a more restrictive form (*e.g.,* an exceedence based form). EPA also considered a 4th highest form, which is generally equivalent to the 99th percentile. However, a percentile based form is preferred since it results in a sampling from the same part of the annual distribution of 1-hour daily maximum SO_2 concentrations regardless of the number of 1-hour daily maximum concentrations reported in a given year for a particular location.

selected, will substantially limit 5-minute peaks of SO_2 above the 200 ppb and higher benchmark levels (*see* below, section II.F.4). Finally, we note that a concentration based form is in agreement with CASAC advice that: "there is adequate information to justify the use of a concentration-based form averaged over 3 years" (Samet 2009, p. 16).

c. Conclusions on Form

The Administrator agrees that the form of the standard should reflect the health evidence presented in the ISA indicating that the percentage of asthmatics affected and the severity of the response increases with increasing SO_2 concentrations. The Administrator also agrees that it is reasonable to consider the standard's stability as part of consideration of the form of the standard. Thus, the Administrator agrees that the standard should use a concentration-based form averaged over three years in order to give due weight to years when 1-hour SO_2 concentrations are well above the level of the standard, than to years when 1-hour SO_2 concentrations are just above the level of the standard. She also notes that a concentration-based form averaged over 3 years would likely be appreciably more stable than a no-exceedence based form.

In selecting a specific concentration based form, the Administrator first notes that a few epidemiologic studies described in the ISA reported an increase in SO_2-related respiratory health effects at the upper end of the distribution of ambient SO_2 concentrations (*i.e.,* above 90th percentile SO_2 concentrations; *see* ISA, section 5.3, p. 5–9). The Administrator notes further that numerous controlled human exposure studies have reported decrements in lung function and/or respiratory symptoms in exercising asthmatics exposed to peak 5–10 minute SO_2 concentrations. The Administrator therefore concludes that the form of a new 1-hour standard should be especially focused on limiting the upper end of the distribution of ambient SO_2 concentrations (*i.e.,* above 90th percentile SO_2 concentrations) in order to provide protection with an adequate margin of safety against effects reported in both epidemiologic and controlled human exposure studies.

In further considering specific concentration based forms, the Administrator notes as outlined above in section II.F.3.b, and discussed in more detail in the REA (REA, section 10.5.3) and proposal (*see* section II.F.3, 74 FR at 64834), that a 99th percentile form is likely to be appreciably more effective at limiting 5-minute benchmark exposures of concern compared to a 98th percentile form. Taken together with the considerations just discussed above, the Administrator has selected a 99th percentile form, averaged over 3 years. The Administrator concludes that a 99th percentile form, given the level selected (*see* section II.F.4 immediately below), will limit both the upper end of the distribution of ambient SO_2 concentrations reported in some epidemiologic studies to be associated with increased risk of SO_2-related respiratory morbidity effects (*e.g.,* emergency department visits), as well as 5-minute peak SO_2 concentrations resulting in decrements in lung function and/or respiratory symptoms in exercising asthmatics participating in controlled human exposure studies.

4. Level

As discussed below and in more detail in the proposal (section II.F.4, 74 FR at 64834), the Administrator proposed to set a 1-hour standard with a 99th percentile form (averaged over three years), with a level in the range of 50 to 100 ppb. The Administrator also solicited comment on standard levels greater than 100 ppb up to 150 ppb. This section summarizes the rationale for the Administrator's proposed range of standard levels (II.F.3.a), discusses comments related to the range of standard levels (II.F.3.b), and presents the Administrator's final conclusions regarding the level of a new 1-hour SO_2 standard (II.F.3.c).

a. Rationale for Proposed Decision

In assessing the level of a 1-hour standard with a 99th percentile form (averaged over three years), the Administrator considered the broad range of scientific evidence assessed in the ISA, including the epidemiologic studies and controlled human exposure studies, as well as the results of air quality, exposure, and risk analyses presented in the REA. In light of this body of evidence and analyses, the Administrator found it is necessary to provide increased public health protection for at-risk populations against an array of adverse respiratory health effects related to short-term (*i.e.,* 5 minutes to 24 hours) exposures to ambient SO_2. In considering the most appropriate way to provide this protection, the Administrator was mindful of the extent to which the available evidence and analyses could inform a decision on the level of a standard. The Administrator's proposed decisions on level, as discussed in detail in the proposal (*see* section II.F.4.e), are outlined below.

Given the above considerations, the Administrator proposed to set a level for a new 99th percentile 1-hour daily maximum primary SO_2 standard within the range from 50 to 100 ppb and took comment on levels above 100 ppb, up to 150 ppb. In reaching this proposed decision, the Administrator considered: (1) The evidence-based considerations from the final ISA and the final REA; (2) the results of the air quality, exposure, and risk assessments discussed above and in the final REA; (3) CASAC advice and recommendations on both the ISA and REA discussed above and provided in CASAC's letters to the Administrator; and (4) public comments received on the first and second drafts of the ISA and REA. In considering what level of a 1-hour SO_2 standard is requisite to protect public health with an adequate margin of safety, the Administrator was mindful that this choice requires judgments based on an interpretation of the evidence and other information that neither overstates nor understates the strength and limitations of that evidence and information.

As noted above, the Administrator selected an upper end of a range of levels to propose at 100 ppb. The selection of this level focused on the results of the controlled human exposure studies and is primarily based on the results of the air quality and exposure analyses which suggest that a 1-hour standard should be at or below 100 ppb to appreciably limit 5-minute SO_2 benchmark concentrations $\geq$ 200 ppb (*see* proposal Tables 2–4, and proposal sections II.F.4.a and II.F.4.b). That is, as described in the proposal (*see* section II.F.4.e), the 40-county air quality analysis estimates that a 100 ppb 1-hour standard would allow at most 2 days per year on average when estimated 5-minute daily maximum SO_2 concentrations exceed the 400 ppb benchmark, and at most 13 days per year on average when 5-minute daily maximum SO_2 concentrations exceed the 200 ppb benchmark (*see* proposal Table 2). Furthermore, given a simulated 1-hour 100 ppb standard level, most counties in the air quality analysis were estimated to experience 0 days per year on average when 5-minute daily maximum SO_2 concentrations exceed the 400 ppb benchmark and $\leq$ 3 days per year on average when 5-minute daily maximum SO_2 concentrations were estimated to exceed the 200 ppb benchmark (*see* REA, Tables 7–14 and 7–12). The Administrator also noted that the St. Louis exposure analysis indicated that a 1-hour standard at

100 ppb would still be estimated to protect > 99% of asthmatic children at moderate or greater exertion from experiencing at least one 5-minute SO_2 exposure ≥ 400 ppb per year, and about 97% of these children from exposures ≥ 200 ppb. In contrast, as described in the proposal (*see* section II.F.4.b), the St. Louis exposure analysis estimated that a 1-hour standard at 150 ppb would likely only protect about 88% of asthmatic children at moderate or greater exertion from experiencing at least one 5-minute SO_2 exposure ≥ 200 ppb per year.

As noted above and described in detail in the proposal (*see* section II.F.4.e), the Administrator selected 50 ppb as the lower end of a range of levels to propose, which is consistent with CASAC's advice. The selection of this level focused in part on the U.S. epidemiologic evidence described in detail in the proposal (*see* sections II.B.2, II.F.4.a, and II.F.4.e). With respect to these epidemiologic studies, seven of ten U.S. emergency department visit and hospital admission studies reporting generally positive associations with ambient SO_2 were conducted in locations where 99th percentile 1-hour daily maximum SO_2 levels were about 75–150 ppb, and three of these studies observed statistically significant positive associations between ambient SO_2 and respiratory-related emergency department visits and hospitalizations in multi-pollutant models with PM (NYDOH (2006), Ito *et al.,* (2007), and Schwartz et. al, (1995)). Thus, the Administrator noted that a 99th percentile 1-hour daily maximum standard set at a level of 50 ppb is well below the 99th percentile 1-hour daily maximum SO_2 concentrations reported in locations where these three studies were conducted (*i.e.* well below 99th percentile 1-hour daily maximum SO_2 levels of 78–150 ppb seen in NYDOH (2006), Ito *et al.,* (2007), and Schwartz et. al, (1995)). Finally, the Administrator noted that two epidemiologic studies reported generally positive associations between ambient SO_2 and emergency department visits in cities when 99th percentile 1-hour daily maximum SO_2 concentrations were approximately 50 ppb, but did not consider that evidence strong enough to propose setting a standard level lower than 50 ppb.

In considering the results of the air quality and exposure analyses, the Administrator also noted that the 40-county air quality analysis estimates that a 99th percentile 1-hour daily maximum standard set at a level of 50 ppb would result in zero days per year when estimated 5-minute SO_2 concentrations exceed the 400 ppb 5-minute benchmark level and at most 2 days per year when modeled 5-minute SO_2 concentrations exceed the 200 ppb 5-minute benchmark level (*see* proposal section II.F.4.b and proposal Table 2). In addition, the St. Louis exposure analysis estimates that a 99th percentile 1-hour daily maximum standard set at a level of 50 ppb would likely protect > 99% of asthmatic children at moderate or greater exertion from experiencing at least one 5-minute exposure both ≥ 400 and > 200 ppb per year (*see* proposal section II.F.4.b and Table 3). In addition, although not directly analyzed in the REA, the proposal (section II.F.4.b) noted that a 1-hour daily maximum standard at a level of 75 ppb would be bound by the exposure estimates from air quality adjusted to just meet 99th percentile 1-hour daily maximum standards at 50 and 100 ppb. Thus, a 1-hour daily maximum standard at a level of 75 ppb would be estimated to protect > 99% of asthmatic children at moderate or greater exertion in St. Louis from experiencing at least one exposure ≥ 400 ppb per year, and about 97% to > 99% of these children from experiencing at least one exposure ≥ 200 ppb per year.

The Administrator thus proposed to set the level of a new 1-hour standard that would protect public health with an adequate margin of safety between 50 ppb and 100 ppb. In so doing, the Administrator relied on reported findings from both epidemiologic and controlled human exposure studies, as well as the results of air quality and exposure analyses. The Administrator noted that the lower end of the proposed range was consistent with CASAC advice that there is clearly sufficient evidence for consideration of standard levels starting at 50 ppb (Samet 2009, p. 16). With respect to the upper end of the proposed range, the Administrator noted that CASAC concluded that standards up to 150 ppb "could be justified under some interpretations of weight of evidence, uncertainties, and policy choices regarding margin of safety" (*id.*), although the letter did not provide any indication of what interpretations, uncertainties, or policy choices might support selection of a level as high as 150 ppb.

In light of the range of levels included in CASAC's advice, the Administrator also solicited comment on setting a standard level above 100 ppb and up to 150 ppb. In so doing, the Administrator recognized that there are uncertainties with the scientific evidence, such as attributing effects reported in epidemiologic studies specifically to SO_2 given the presence of co-occurring pollutants, especially PM, and the uncertainties associated with using ambient SO_2 concentrations as a surrogate for exposure. However, the Administrator noted that compared to the proposed range of 50–100 ppb, a standard level as high as 150 ppb would not comparably limit 5-minute SO_2 exposures ≥ 200 ppb. That is, she noted that the St. Louis exposure analysis estimated that a 150 ppb standard would protect approximately 88% of asthmatic children at moderate or greater exertion from experiencing at least one SO_2 exposure ≥ 200 ppb per year (compared to > 99% and approximately 97% given standards at 50 and 100 ppb respectively; *see* proposal Table 3 at 74FR at 64841).

b. Comments on Level

Most State and local agencies and organizations that commented on this issue expressed support for setting the level of a 1-hour SO_2 standard somewhere within the proposed range of 50 to 100 ppb. More specifically, State environmental organizations (*i.e.,* NACAA and NESCAUM); State environmental agencies (*e.g.,* such agencies in DE, IL, MI, NY, NM, PA, VT), the Fond du Lac Tribe, and local groups (*e.g.,* NYDOH, City of Houston, New York City, Houston-Galveston Area Council) supported a level of a 1-hour SO_2 standard in the range of 50 to 100 ppb. In addition, State environmental agencies in IA and TX specifically supported a standard level of 100 ppb. In general, these groups cited the conclusions of CASAC and the Administrator's rationale as stated in the proposal as a basis for their recommendations, though State environmental agencies in IA and TX generally recommended placing more weight on the controlled human exposure evidence rather than on the epidemiology.

A number of environmental and medical/public health organizations (*e.g.,* ALA, ATS, EDF, Sierra Club, WEACT for Environmental Justice, NRDC, CBD) and some local organizations (*e.g.,* Alexandria Department of Transportation and Environmental Services, and Harris County (TX) Public Health & Environmental Services) supported setting a standard level at or near 50 ppb. This recommendation was typically based on the commenters' interpretation of the controlled human exposure and epidemiologic evidence, as described below.

With regard to the controlled human exposure evidence, health and environmental groups generally concluded that a 1-hour SO_2 standard

no higher than 50 ppb is needed to protect against 5-minute SO_2 benchmark exposures as low as 100 ppb identified from mouthpiece exposure studies, rather than the 200 ppb 5-minute SO_2 benchmark identified from "free breathing" controlled human exposure studies. More specifically, ALA *et al.,* stated:

> In its analysis of data from chamber studies in the ISA and in the REA, EPA focuses on studies of "free breathing" exposure. In doing so, EPA improperly and arbitrarily downplays important evidence that reported increased airway resistance, a measure of bronchoconstriction, in subjects with mild asthma at concentrations of 100 ppb. Regrettably, EPA does not rely on the mouthpiece studies in formulating its proposed standards * * * In downplaying the mouthpiece studies, EPA ignores the large segment of people who rely on oral or oronasal breathing some or all of the time.

The Administrator disagrees with the assertion that results from mouthpiece studies were improperly downplayed. These studies are discussed in the ISA, REA, and proposed rule as demonstrating respiratory effects of SO_2 at concentrations of 100 ppb, the lowest concentration tested using a mouthpiece exposure system. Nonetheless, these mouthpiece studies are not a reasonable proxy for actual exposure. In these studies, SO_2 is delivered directly through the mouth, typically in conjunction with nasal occlusion. This allows a greater fraction of the inhaled SO_2 to reach the tracheobronchial airways. Although we agree with commenters that some individuals do breathe oronasally both while at rest and during exercise, nasal ventilation still constitutes a significant percentage of total ventilation. The consequence is that individuals exposed to SO_2 through a mouthpiece are likely to experience greater respiratory effects from a given SO_2 exposure than they would in real life. Thus, as noted in the REA (REA, section 6.2) and in the proposal preamble (*see* section II.B.1.b), these mouthpiece studies only provide very limited evidence of decrements in lung function following exposure to 100 ppb SO_2. Therefore, the Administrator did not place great weight on these mouthpiece studies when considering the appropriate level of a 1-hour SO_2 standard.

In addition to their interpretation of the controlled human exposure evidence, health and environmental groups (*e.g.,* ALA, ATS, EDF, NRDC, Sierra Club, CBD) and the Alexandria Department of Transportation and Environmental Services generally concluded that the epidemiologic evidence indicates that a standard no higher than 50 ppb is required to protect public health. For example, it its comments the CBD stated:

> Epidemiologic studies referenced in the Proposed Rule showed positive, and in many cases statistically significant, relationships between ambient SO_2 concentrations and hospital admissions where 99th percentile 1-hour concentrations ranged from 50–460 ppb. Of these studies, two showed positive and sometimes statistically significant relationships in single-pollutant models at 50 ppb, and three studies showed statistically significant correlations at 78–150 ppb in multi-pollutant models. These three multipollutant studies, moreover, "lend[] strong support * * * to the conclusion that SO_2 effects are generally independent" of those of co-pollutants like particulate matter. Giving these studies their proper weight, and allowing for an adequate margin of safety, EPA should set a one-hour NAAQS at a level no higher than the lowest concentration at which positive, adverse relationships have been demonstrated: 50 ppb (note that footnotes were omitted).

The Administrator agrees that the epidemiologic studies referenced in the proposal need to be considered in judging the appropriate level for a new 99th percentile 1-hour SO_2 standard. However, she disagrees that when considered in total, these studies strongly support an SO_2 standard no higher than 50 ppb. The Administrator notes that selecting a standard level of 50 ppb would place considerable weight on the two U.S. emergency department visit studies conducted in locations where 99th percentile 1-hour SO_2 concentrations were approximately 50 ppb (*i.e.,* Wilson *et al.,* (2005) in Portland, ME and Jaffe *et al.,* (2003) in Columbus, OH). However, the Administrator does not find this appropriate given that, importantly, neither of these studies evaluated the potential for confounding by co-pollutants through the use of multipollutant models and thus, left unaddressed the issue of whether the effects seen in the studies were partially or totally attributable to exposure to sulfate PM. In addition, the Administrator notes that the overall results reported in these studies are mixed. It is important to note that mixed results do not automatically disqualify studies from being used as part of the evidence base for setting levels in NAAQS reviews. However, in this review the Administrator judges that the lack of mutipollutant model evaluation for potential confounding by PM in two locations with the lowest SO_2 levels combined with the presence of mixed emergency department visit results renders these two studies inappropriate to serve as the primary basis for the selection of the level of the SO_2 NAAQS. As an additional matter, the suggestion in some of the comments that EPA should necessarily base the level of a NAAQS on the lowest level seen in epidemiologic studies has been rejected repeatedly. *See, e.g. American Petroleum Inst.* v. *EPA,* 665 F. 2d at 1187 ("In so arguing NRDC essentially ignores the mixed results of the medical studies evident in the record, choosing instead to rely only on the studies that favor its position. The Administrator, however, was required to take into account all the relevant studies revealed in the record. Because he did so in a rational manner, we will not overrule his judgment as to the margin of safety.") Thus, although the Administrator finds that these two studies provide limited evidence of emergency department visits in cities where 99th percentile 1-hour daily maximum SO_2 concentrations are approximately 50 ppb, she also concludes that these studies do not provide enough evidence to warrant a standard at this level.

As discussed above in section, II.E.2, a number of industry groups (*e.g.,* ACC, UARG) did not support setting a new 1-hour SO_2 standard. However, several of these groups (*e.g.,* UARG, API) and the SC Chamber of Commerce concluded that, if EPA does choose to set a new 1-hour standard, the level of that standard should be ≥ 150 ppb. In addition, State environmental agencies in SD (SD DENR) and OH recommended standard levels at 150 ppb. As a basis for this recommendation, these groups generally emphasized uncertainties in the scientific evidence. Specifically, as discussed in more detail above (section II.E.2.a), these commenters typically concluded that the available epidemiologic studies do not support the conclusion that SO_2 causes the reported health effects. This was based on their assertion that the presence of co-pollutants in the ambient air precludes the identification of a specific SO_2 contribution to reported effects. Thus, these groups generally concluded that weight should not be placed on the cluster of three epidemiologic studies reporting statistically significant effects in multipollutant models with PM (*i.e.,* NYDOH 2006; Ito 2007; and Schwartz 1995). That is, these groups contend that these studies do not demonstrate an independent effect of SO_2. In addition, as noted in section II.E.2.b, many of these groups also disagreed with the Agency's judgment that adverse respiratory effects occur following 5-minute exposures to SO_2 concentrations as low as 200 ppb. These comments and EPA's responses are discussed below

and in section II of the RTC document (EPA 2010).

As described in more detail in section II.E.2.a, we agree that the interpretation of SO_2 epidemiologic studies is complicated by the fact that SO_2 is but one component of a complex mixture of pollutants present in the ambient air. However, the ISA concluded that when U.S. and international epidemiologic literature is evaluated as a whole, SO_2 effect estimates generally remained positive and relatively unchanged in multi-pollutant models with gaseous or particulate co-pollutants. Thus, although recognizing the uncertainties associated with separating the effects of SO_2 from those of co-occurring pollutants, the ISA concluded that the limited available evidence from studies employing multi-pollutant models indicates that the effect of SO_2 on respiratory health outcomes appears to be generally robust and independent of the effects of gaseous co-pollutants, including NO_2 and O_3, as well as particulate co-pollutants, particularly $PM_{2.5}$ (ISA, section 5.2; p. 5–9).

In addition, as described in detail above in section II.E.2.a, the ISA emphasized that controlled human exposure studies provide support for the plausibility of the associations reported in epidemiologic studies. The ISA noted that the results of controlled human exposure and epidemiologic studies form a plausible and coherent data set that supports a causal relationship between short-term (5-minutes to 24-hours) SO_2 exposures and adverse respiratory effects, and that the epidemiologic evidence (buttressed by the clinical evidence) indicates that the effects seen in the epidemiologic studies are attributable to exposure to SO_2 (ISA, section 5.2). The ISA in fact made the strongest finding possible regarding causality: "[e]valuation of the health evidence, with consideration of issues related to atmospheric sciences, exposure assessment, and dosimetry, led to the conclusion that there is *a causal relationship between respiratory morbidity and short-term exposure to* SO_2. This conclusion is supported by the consistency, coherence, and plausibility of findings observed in the human clinical, epidemiologic, and animal toxicological studies." ISA p. 5–2 (emphasis original).

As mentioned above, many groups dispute the ISA conclusion that taken together, results from U.S. and international epidemiologic studies employing multipollutant models indicate that SO_2 has an independent effect on the respiratory health outcomes reported in these studies. Thus, these groups contend that the Administrator should not place weight on epidemiologic studies and their associated air quality information in general, and more specifically, the Administrator should not place weight on air quality information from the three U.S. epidemiologic studies reporting statistically significant effects in multipollutant models with PM (*i.e.,* NYDOH 2006; Ito 2007; and Schwartz 1995). Specific comments on these three epidemiologic studies reporting statistically significant effects in multi-pollutant models with PM, and EPA responses are presented below and in the RTC document (EPA 2010).

Industry groups (*e.g.,* API) had several comments with respect to the study conducted by the NYDOH (NYDOH, 2006). First, these groups generally concluded that the results of this study are mixed. That is, while SO_2 effect estimates were positive and statistically significant even in multipollutant models with $PM_{2.5}$ or NO_2 in the Bronx, SO_2 effect estimates were actually negative in Manhattan in both single and multipollutant models. These groups also contend that this report was not peer-reviewed and that the authors of this study indicated that high correlations among pollutants in the Bronx made it difficult to confidently identify which pollutants are actually increasing risks. For these reasons, industry groups generally concluded that this study should not be relied upon by the Administrator.

We acknowledge that the results of the NYDOH analysis are mixed when comparing the Bronx and Manhattan study areas. However, we disagree that the presence of mixed results renders this study unreliable. We note that the mixed results reported in this study are likely to reflect greater statistical power for identifying effects in the Bronx, where the average daily emergency department visits differed substantially from those in Manhattan. Specifically, daily asthma emergency department visits were six times higher in the Bronx study area (43 per day) than in the Manhattan study area (7.2 per day). Thus, the more prominent effects in the Bronx likely at least partially reflect greater statistical power for identifying effects there. To put these numbers in perspective, the crude daily rates of asthma emergency department visits can be estimated by dividing the daily asthma counts by the population. The mean daily crude rates of asthma emergency department visits were over eight-fold higher in the Bronx study area (16.9 per 100,000 persons) than in the Manhattan area (2.02 per 100,000 persons). Population age structures were quite different in the two communities, with larger proportions of younger persons in the Bronx versus Manhattan. There are likely additional differences in population structures of the two communities, including differences in SES, race/ethnicity, and access to primary asthma care. These differences in the two communities may explain the differences in the results, and do not prevent EPA from legitimately relying on this study.

As mentioned above, these groups also contend that the NYDOH epidemiologic study should not be relied upon because it was not peer-reviewed. We disagree with this assertion. The NYDOH study was subject to multiple peer-review processes. This included reviews by the Agency for Toxic Substances and Disease Registry (ATSDR), EPA, and CASAC.

Finally, as also mentioned above, these groups contend that the NYDOH epidemiologic study is unreliable because the study authors indicated that high correlations among pollutants in the Bronx make it difficult to confidently identify which pollutants are actually increasing risks. In response, we note that high correlations among ambient air pollutant concentrations are not specific to the NYDOH study, and may contribute to uncertainty in the interpretation of many epidemiologic studies of air pollution. The approach most commonly utilized to disentangle the effects of correlated pollutants in air pollution epidemiology is the copollutant model. The NYDOH uses copollutant models and finds that the results for SO_2 remain significant in models considering the simultaneous effects of NO_2, O_3, and $PM_{2.5}$. This indicates an independent effect of SO_2 on the asthma emergency department visits reported in this study.

With respect to Ito *et al.,* (2007), industry groups generally commented that since the SO_2 effect estimate did not remain statistically significant in multipollutant models with NO_2, this study does not indicate an independent effect of SO_2 on emergency department visits in the NYC study area. API specifically commented:

> The RR for an increase of 6 ppb SO_2 was statistically significant (1.20; 95% CI: 1.13, 1.28) and remained so when $PM_{2.5}$, O_3, or CO was included in the model, but became nonsignificant when NO_2 was included in the model (RR not provided, 95% CI: 0.9, 1.1). Because associations with SO_2 could be attributable to NO_2, this study cannot be used to assess the effects of SO_2 on health effects with small incremental increases in exposure.

We disagree with the commenters. We believe that this study does demonstrate an independent effect of SO_2 on emergency department visits in NYC. We note that evidence from controlled human exposure studies has demonstrated effects of NO_2 (EPA, 2008b) and SO_2 independently on respiratory morbidity. Since each of these criteria pollutants has an independent effect on the respiratory system, it is logical that each may be responsible for an increase in emergency department visits for asthma in epidemiologic studies. In addition, the authors note that the attenuation of the SO_2 effect estimate when NO_2 is included in the model is "consistent with the result of monitor-to-monitor correlations, suggesting that NO_2 has less exposure error than CO or SO_2 in this data set." Thus, it appears as though the high spatial heterogeneity of SO_2 compared to NO_2, leading to increased exposure error, may be causing the attenuation of the SO_2 effect estimate when NO_2 is included in the model in this study—not that the effects seen in the study are attributable to NO_2. Overall, the results from this study are consistent with the SO_2 effect on respiratory emergency department visits and hospital admissions across studies and are coherent with the respiratory effects observed in controlled human exposure studies. This study thus provides persuasive evidence of an independent effect of short-term SO_2 exposure on respiratory morbidity.

With respect to Schwartz *et al.,* (1995), industry groups generally commented that the results of this study are mixed, and therefore should not be considered by the Administrator. More specifically, these commenters noted that although the results in New Haven remained statistically significant in the presence of PM_{10}, the SO_2 effect estimate in Tacoma was reduced and no longer statistically significant in the presence of PM_{10}. Commenters also noted that in both cities, the SO_2 effect estimate was reduced and no longer statistically significant in the presence of O_3.

We disagree that the results of this study of hospital admissions should not be considered by the Administrator. As noted by the commenters, this study was conducted in two cities, New Haven, CT and Tacoma, WA. These cities were chosen because they differ in several important aspects and the author expected the results from the two cities to be different due to the inherent nature of the study design and study locations. "New Haven has almost twice the mean SO_2 concentration of Tacoma, almost two and a half times the SO_2 concentration in the peak winter season, and a much larger summer ozone peak than Tacoma (Schwartz 1995)." Since the study was designed to examine the differences in these two cities, the fact that the results differed in the two cities does not invalidate those results. In addition, EPA considers the SO_2 effect to be robust to inclusion of O_3 in New Haven. The central effect estimate for SO_2 changed from 1.03 to 1.02 after the addition of O_3 as a copollutant and likely lost statistical significance due to a greater than 40% reduction in the number of days included because O_3 was only measured during the warm months. This reduction likely led to model instability and a loss of statistical significance. To be consistent with how results of other studies were interpreted in the ISA, and as supported by the CASAC, the effect of SO_2 is considered robust to the inclusion of O_3 in New Haven.

In addition to generally concluding that the epidemiology is too uncertain to demonstrate that SO_2 has an independent effect on the respiratory effects reported in those studies, many industry groups (*e.g.,* API, ACC, Progress Energy, EEI, CIBO) also commented that adverse health effects do not occur following 5–10 minute SO_2 exposures < 400 ppb in controlled human exposure studies (an issue also discussed above in section II.E.2.b). Thus, these groups generally maintained that the level of a 1-hour standard should not take into account limiting 5-minute peaks as low as 200 ppb. From this argument, many of these groups further maintained that 1-hour standard levels ≥ 150 ppb are requisite to protect public health with an adequate margin of safety.

As first discussed in section II.E.2.b above, we disagree with the commenters that adverse respiratory effects do not occur following 5-minute SO_2 exposures as low as 200 ppb. The ISA reported that exposure to SO_2 concentrations as low as 200–300 ppb for 5–10 minutes results in approximately 5–30% of exercising asthmatics experiencing moderate or greater decrements in lung function (defined in terms of a ≥ 15% decline in FEV_1 or 100% increase in sRaw; ISA, Table 3–1). Considering the 2000 ATS guidelines described in section II.E.2.b, we determined that these results could reasonably indicate an SO_2-induced shift in these lung function measurements for this sub-population. Under this scenario, an appreciable percentage of exercising asthmatics exposed to SO_2 concentrations as low as 200 ppb would likely have diminished reserve lung function and thus would likely be at greater risk if affected by another respiratory agent (*e.g.,* viral infection). Importantly, diminished reserve lung function in a population that is attributable to air pollution is considered an adverse effect under ATS guidance.[17] Also noted in section II.E.2.b, we were mindful of CASAC's pointed comments. The second draft ISA placed relatively little weight on health effects associated with SO_2 exposures at 200–300 ppb. CASAC strongly disagreed with this characterization of the health evidence. Their consensus letter following the second draft ISA states:

> Our major concern is the conclusions in the ISA regarding the weight of the evidence for health effects for short-term exposure to low levels of SO_2. Although the ISA presents evidence from both clinical and epidemiological studies that indicate health effects occur at 0.2 ppm or lower, the final chapter emphasizes health effects at 0.4 ppm and above * * * CASAC believes the clinical and epidemiological evidence warrants stronger conclusions in the ISA regarding the available evidence of health effects at 0.2 ppm or lower concentrations of SO_2. The selection of a lower bound concentration for health effects is very important because the ISA sets the stage for EPA's risk assessment decisions. In its draft Risk and Exposure Assessment (REA) to Support the Review of the SO_2 Primary National Ambient Air Quality Standards (July 2008), EPA chose a range of 0.4 ppm—0.6 ppm SO_2 concentrations for its benchmark analysis. As CASAC will emphasize in a forthcoming letter on the REA, we recommend that a lower bound be set at least as low as 0.2 ppm (Henderson 2008a).

Similarly, we were also mindful of CASAC comments on the first draft of the REA. The consensus CASAC letter following the 1st draft REA states:

> The CASAC believes strongly that the weight of clinical and epidemiology evidence indicates there are detectable clinically relevant health effects in sensitive subpopulations down to a level at least as low as 0.2 ppm SO_2. These sensitive subpopulations represent a substantial segment of the at-risk population (Henderson 2008b).

As noted in section II.E.2.b, we were also mindful of: (1) Previous CASAC recommendations (Henderson 2006) and NAAQS review conclusions (EPA 2006, EPA 2007d) indicating that moderate decrements in lung function can be clinically significant in some asthmatics (*see* section II.E.2.b for more detail) and

[17] *See Coalition of Battery Recyclers Association* v. *EPA,* No. 09–1011 (DC Cir., May 14, 2010), slip opinion at 9, holding that it was reasonable for EPA to conclude that a two IQ point mean population loss is an adverse effect based in part on consideration of comments from the American Academy of Pediatrics that such a loss should be prevented.

(2) controlled human exposure studies not including severe asthmatics and thus, that it is reasonable to assume that persons with more severe asthma than the study participants would have a more serious health effect from short-term exposure to 200 ppb SO_2. CASAC echoed this concern in its comments on the policy assessment chapter of the REA:

> Chapter 10 should better address uncertainty in identifying alternative NAAQS for SO_2. In particular, the uncertainties discussed in the health risk characterization should be considered in specifying a NAAQS that provides adequate margin of safety. One particular source of uncertainty needing acknowledgment is the characteristics of persons included in the clinical studies. The draft REA acknowledges that clinical studies are unlikely to have included severe asthmatics that are likely to be potentially at greater risk than those persons included in the clinical studies (Samet 2009; p. 15).

Taken together, the Administrator concluded that exposure to SO_2 concentrations as low as 200 ppb can result in adverse health effects in asthmatics. Consequently the Administrator also concluded that a 1-hour standard of 150 ppb is not requisite to protect public health with an adequate margin of safety, even with a 99th percentile form. This conclusion takes into account the St. Louis exposure analysis estimating that only 88% of asthmatic children at moderate or greater exertion would be protected from at least one 5-minute SO_2 exposure ≥ 200 ppb per year at a 1-hour standard level of 150 ppb, and appropriate weight placed on the epidemiologic evidence (*see* section II.F.4.c for a discussion of the epidemiologic evidence with respect to level).

c. Conclusions on Standard Level

Having carefully considered the public comments on the appropriate level for a 1-hour SO_2 standard, as discussed above, the Administrator believes the fundamental conclusions reached in the ISA and REA remain valid. In considering the level at which the 1-hour primary SO_2 standard should be set, the Administrator continues to place primary emphasis on the body of controlled human exposure and epidemiologic evidence assessed in the ISA, as summarized above in section II.B. In addition, the Administrator continues to view the results of exposure and risk analyses, discussed above in section II.C, as providing supporting information for her decision.

In considering the level of a 1-hour SO_2 standard, the Administrator notes that there is no bright line clearly mandating the choice of level within the reasonable range proposed. Rather, the choice of what is appropriate within this reasonable range is a public health policy judgment entrusted to the Administrator. This judgment must include consideration of the strengths and limitations of the evidence and the appropriate inferences to be drawn from the evidence and the exposure and risk assessments. These considerations and the Administrator's final decision with regard to the level of a new 1-hour SO_2 standard are discussed below.

In considering the controlled human exposure studies, the Administrator notes that these studies provide the most direct evidence of respiratory effects from exposure to SO_2. These studies exposed groups of exercising asthmatics to defined concentrations of SO_2 for 5–10 minutes and found adverse respiratory effects. As noted above (*see* section II.C), SO_2 exposure levels which resulted in respiratory effects in these studies were considered 5-minute benchmark exposures of potential concern in the analyses found in the REA. With respect to this evidence, the Administrator notes the following key points:

- Exposure of exercising asthmatics to 5–10 minute SO_2 concentrations ≥ 400 ppb results in moderate or greater decrements in lung function (in terms of FEV_1 or sRaw) in 20–60% of tested individuals in these studies. Moreover, these decrements in lung function are often statistically significant at the group mean level and are frequently accompanied by respiratory symptoms.[18] Based on ATS guidelines, exposure to SO_2 concentrations ≥ 400 ppb clearly result in adverse respiratory effects (*i.e.,* decrements in lung function in the presence of respiratory symptoms). Therefore, the Administrator has concluded it appropriate to place weight on the 400 ppb 5-minute SO_2 benchmark concentration of concern.
- Exposure of exercising asthmatics to 5–10 minute SO_2 concentrations at 200–300 ppb results in moderate or greater decrements in lung function in 5–30% of the tested individuals in these studies. The Administrator notes that although these decrements in lung function have not been shown to be statistically significant at the group mean level, or to be frequently accompanied by respiratory symptoms, she considers effects associated with exposures as low as 200 ppb to be adverse in light of CASAC advice, similar conclusions in prior NAAQS reviews, and the ATS guidelines described in detail above (*see* section II.E.2.b and II.F.4.b). Therefore, she has concluded it appropriate to place weight on the 200 ppb 5-minute benchmark concentration.
- There is very limited evidence from two mouthpiece exposure studies suggesting respiratory effects in exercising asthmatics following SO_2 exposures at 100 ppb. However, given the uncertainties and potential unrepresentativeness associated with mouthpiece studies (*see* section II.F.4.b above), the Administrator found it appropriate not to place weight on this 5-minute SO_2 benchmark concentration.

The Administrator also considered the results of the air quality, exposure, and risk analyses, as they serve to estimate the extent to which a given 1-hour standard limits the 5-minute benchmark concentrations of concern identified from controlled human exposure studies (*see* REA chapters 7–9, proposal section II.F.4.b, and proposal Tables 2–4). In considering these results as they relate to limiting 5-minute SO_2 benchmark concentrations ≥ 200 and 400 ppb, the Administrator notes the following key points:

- The 40-county air quality analysis estimates that a 100 ppb 1-hour daily maximum standard would allow at most 2 days per year on average in any county when estimated 5-minute daily maximum SO_2 concentrations exceed the 400 ppb benchmark, and at most 13 days per year on average when 5-minute daily maximum SO_2 concentrations exceed the 200 ppb benchmark (*see* proposal, Table 2, 74 FR at 64840). Furthermore, given a simulated 1-hour 100 ppb standard level, most of the counties in that air quality analysis were estimated to experience 0 days per year on average when 5-minute daily maximum SO_2 concentrations exceed the 400 ppb benchmark and ≤ 3 days per year on average when 5-minute daily maximum SO_2 concentrations were estimated to exceed the 200 ppb benchmark (*see* REA, Tables 7–14 and 7–12).
- The St. Louis exposure analysis estimates that a 99th percentile 1-hour daily maximum standard at a level of 100 ppb would likely protect > 99% of asthmatic children in that city at moderate or greater exertion from experiencing at least one 5-minute exposure ≥ 400 ppb per year, and

[18] The ISA concluded that collective evidence from key controlled human exposure studies considered in the previous review, along with a limited number of new controlled human exposure studies, consistently indicates that with elevated ventilation rates a large percentage of asthmatic individuals tested in a given chamber study (up to 60%, depending on the study) experience moderate or greater decrements in lung function, frequently accompanied by respiratory symptoms, following peak exposures to SO_2 at concentrations of 0.4–0.6 ppm. (ISA, p. 3–9).

approximately 97% of those asthmatic children at moderate or greater exertion from experiencing at least one exposure ≥ 200 ppb per year (*see* proposal, section II.F.4.b).

• The St. Louis risk assessment estimates that a 99th percentile 1-hour standard level at 100 ppb would likely protect about 97–98% of exposed asthmatic children in that city at moderate or greater exertion from experiencing at least one moderate or greater lung function response (defined as a ≥ 100% increase in sRaw; *see* proposal, section II.F.4.b).

Given the above considerations, the Administrator concludes that a 1-hour standard at a level of 100 ppb would appropriately limit 5-minute SO_2 benchmark concentrations ≥ 200 or 400 ppb. Moreover, although the Administrator acknowledges that the air quality and exposure analyses mentioned above suggest that a 50 ppb standard may somewhat further limit 5-minute SO_2 concentrations/exposures in excess of the 200 ppb benchmark (*see* proposal section II.F.4.b), she does not believe this information alone warrants a standard level lower than 100 ppb. More specifically, although she considers the health effects resulting from 5-minute SO_2 exposures as low as 200 ppb to be adverse, she also recognizes that such effects are appreciably less severe than those at SO_2 concentrations ≥ 400 ppb. Thus, she concludes that there is little difference in limiting 5-minute concentrations/exposures ≥ 400 ppb given 1-hour standard levels in the range of 50 to 100 ppb.

In considering the epidemiologic evidence with regard to level, the Administrator notes that there have been more than 50 peer reviewed epidemiologic studies published worldwide evaluating SO_2 (ISA, Tables 5–4 and 5–5). These studies have generally reported positive, although not always statistically significant associations between more serious health outcomes (*i.e.* respiratory-related emergency department visits and hospitalizations) and ambient SO_2 concentrations and have generally included populations potentially at increased risk for SO_2-related respiratory effects (e.g, children, older adults, and those with pre-existing respiratory disease). The Administrator finds that in assessing the extent to which these studies and their associated air quality information can inform the level of a new 99th percentile 1-hour daily maximum standard for the U.S., air quality information from the U.S. and Canada is most relevant since these areas have similar monitor network designs and patterns of air quality. However, as described in proposal section II.F.4.a, SO_2 concentrations reported for Canadian studies were not directly comparable to those reported for U.S. studies due to use of different monitoring protocols in those studies. Thus, the Administrator focused on 99th percentile air quality information from U.S. studies for informing potential 1-hour standard levels. She concludes that this information provides evidence of associations between ambient SO_2 and emergency department visits and hospital admissions in U.S. cities with particular 99th percentile 1-hour SO_2 levels, and thus provides information that is particularly relevant for setting the level of a 1-hour SO_2 standard. With regard to these studies she notes the following key points:

• Ten studies (some conducted in multiple locations) reported mostly positive, and sometimes statistically significant, associations between ambient SO_2 concentrations and emergency department visit and hospital admissions in locations where 99th percentile 1-hour daily maximum SO_2 levels ranged from approximately 50–460 ppb.

• Within this broader range of SO_2 concentrations, there is a cluster of three epidemiologic studies between 78–150 ppb (for the 99th percentile of the 1-hour SO_2 concentrations) where the SO_2 effect estimate remained positive and statistically significant in multi-pollutant models with PM (NYDOH (2006), Ito *et al.,* (2007), and Schwartz *et al.,* (1995)). Notably, although statistical significance in multi-pollutant models is an important consideration, it is not the only consideration when relying on such epidemiologic evidence.[19] However, as noted earlier, there is special sensitivity in this review in disentangling PM-related effects (especially sulfate PM) from SO_2-related effects in interpreting the epidemiologic studies; thus, these studies are of particular relevance here, lending strong support both to the conclusion that SO_2 effects are generally independent of PM (ISA, section 5.2) and that these independent adverse effects of SO_2 have occurred in cities with 1-hour daily maximum, 99th percentile concentrations in the range of 78–150 ppb. Nor did EPA find the comments criticizing these studies persuasive, as explained above in section II.F.4.b and in the RTC document (EPA 2010). The Administrator therefore judges it appropriate to place substantial weight on this cluster of three U.S. epidemiologic studies in selecting a standard level, as they are a group of studies that reported positive and statistically significant associations between ambient SO_2 and emergency department visits or hospital admissions even when potential confounding by PM was considered.

• The Administrator agrees with the finding in the ISA that the controlled human exposure evidence lends biological plausibility to the effects reported in epidemiologic studies (ISA, p. 5–9).

• There is limited evidence from two epidemiologic studies employing single pollutant models that found generally positive associations between ambient SO_2 and emergency department visits in locations where 99th percentile 1-hour SO_2 concentrations were approximately 50 ppb (*see* proposal, Figures 1 and 2). However, considering that the results of these studies were mixed, and importantly, that neither of these two studies evaluated the potential for confounding by co-pollutants through the use of multipollutant models (particularly with PM), the Administrator judges it appropriate to place limited weight on these studies.

• With regard to the cluster of three studies conducted in the Bronx (NYDOH 2006), NYC (Ito *et al.,* 2007), and New Haven (Scwartz *et al.,* 1995), there is a degree of uncertainty as to whether the 99th percentile 1-hour daily maximum SO_2 concentrations reported from monitors in these three study areas reflect the highest 99th percentile 1-hour daily maximum SO_2 concentration. Our limited qualitative analysis suggests that 99th percentile 1-hour daily maximum SO_2 concentrations reported by monitors in these study areas are reasonable approximations for the absolute highest 99th percentile 1-hour daily maximum SO_2 concentration that can occur across the entire area in these studies (including the areas where monitors were not located) (*see* Brode, 2010). However, although a reasonable approximation, it is still likely that these monitored concentrations are somewhat lower than the absolute highest 99th percentile 1-hour daily maximum SO_2 concentrations occurring across these epidemiologic study areas.

[19] For example, as noted in the proposal (proposal, section II.F.4, 74 FR at 64835) evidence of a pattern of results from a group of studies that find effect estimates similar in direction and magnitude would warrant consideration of and reliance on such studies even if the studies did not all report statistically significant associations in single- or multi-pollutant models. The SO_2 epidemiologic studies fit this pattern, and are buttressed further by the results of the clinical studies. ISA, section 5.2.

Weighing all of this evidence, the Administrator concludes that the epidemiologic studies provide strong support for setting a standard that limits the 99th percentile of the distribution of 1-hour daily maximum SO_2 concentrations to 75 ppb. This judgment takes into account the strong determinations in the ISA (and endorsed by CASAC), based on a much broader body of evidence, that there is a causal association between exposure to SO_2 and the types of respiratory morbidity effects reported in these studies. The Administrator further judges that it is not necessary based on existing epidemiologic evidence, to set a standard below 75 ppb. That is, the Administrator concludes that a standard level of 75 ppb is sufficiently below the SO_2 levels in three cities where epidemiologic studies found statistically significant effects in multipollutant models with PM (*i.e.,* 78, 82, and 150 ppb) to provide an adequate margin of safety given the uncertainty as to whether monitors in these study locations reflected the highest 1-hour daily maximum SO_2 concentration across the entire study area. Thus, a standard set at a level of 75 ppb is likely further below the 99th percentile 1-hour daily maximum concentrations in these three study areas than the bare comparison of levels would otherwise indicate. Finally, the Administrator again notes that epidemiologic evidence below 75 ppb is more uncertain because studies below 75 ppb did not evaluate potential confounding of results in multipollutant models, and because these studies reported mixed results.

Given the above considerations and the comments received on the proposal, the Administrator determines that the appropriate judgment, based on the entire body of evidence and information available in this review, and the related uncertainties, is a standard level of 75 ppb. She concludes that such a standard, with a 1-hour averaging time and 99th percentile form, will provide a significant increase in public health protection compared to the current standards and would be expected to protect against the respiratory effects that have been linked with SO_2 exposures in both controlled human exposure and epidemiologic studies. Specifically, she concludes that such a standard will limit 1-hour exposures at and above 75 ppb for those in susceptible populations that are at-risk of experiencing adverse health effects from short-term exposure to SO_2. Such a standard will also maintain SO_2 concentrations below those in locations where key U.S. epidemiologic studies have reported that ambient SO_2 is associated with clearly adverse respiratory health effects, as indicated by increased hospital admissions and emergency department visits. She also notes that a 1-hour standard at a level of 75 ppb is expected to substantially limit asthmatics' exposure to 5–10 minute SO_2 concentrations ≥ 200 ppb, thereby substantially limiting the adverse health effects associated with such exposures. Finally, the Administrator notes that a standard level of 75 ppb is consistent with the consensus recommendation of CASAC.

In setting the standard level at 75 ppb rather than at a lower level, the Administrator notes that a 1-hour standard with a level lower than 75 ppb would only result in significant further public health protection if, in fact, there is a continuum of serious, adverse health risks caused by exposure to SO_2 concentrations below 75 ppb. Based on the available evidence, the Administrator does not believe that such assumptions are warranted. Taking into account the uncertainties that remain in interpreting the evidence from available controlled human exposure and epidemiologic studies, the Administrator notes that the likelihood of obtaining benefits to public health with a standard set below 75 ppb decreases, while the likelihood of requiring reductions in ambient concentrations that go beyond those that are needed to protect public health increases.

Therefore, the Administrator judges that a 1-hour SO_2 standard at 75 ppb is sufficient to protect public health with an adequate margin of safety. This includes protection with an adequate margin of safety for susceptible populations at increased risk for adverse respiratory effects from short-term exposures to SO_2 for which the evidence supports a causal relationship with SO_2 exposures. The Administrator does not believe that a lower standard level is needed to provide this degree of protection. These conclusions by the Administrator appropriately consider the requirement for a standard that is neither more nor less stringent than necessary for this purpose and recognizes that the CAA does not require that primary NAAQS be set at a zero-risk level or to protect the most susceptible individual, but rather at a level that reduces risk sufficiently so as to protect the public health with an adequate margin of safety.

5. Retaining or Revoking the Current 24-Hour and Annual Standards

This section discusses considerations related to retaining or revoking the current 24-hour and annual SO_2 primary NAAQS. Specifically, this section summarizes the rationale for the Administrator's proposed decision regarding whether to retain or revoke the current standards (section II.F.5.a), discusses public comments related to whether to retain or revoke the current standards (II.F.5.b), and presents the Administrator's final conclusions regarding whether to retain or revoke the current standards (II.F.5.c).

a. Rationale for Proposed Decision

As noted in the proposal (*see* section II.F.5), the REA recognized that the particular level selected for a new 99th percentile 1-hour daily maximum standard would have implications for deciding whether to retain or revoke the current 24-hour and annual standards. That is, with respect to SO_2-induced respiratory morbidity, the lower the level selected for a 99th percentile 1-hour daily maximum standard, the less additional public health protection the current standards would be expected to provide. CASAC expressed a similar view following their review of the 2nd draft REA: "Assuming that EPA adopts a one hour standard in the range suggested, and if there is evidence showing that the short-term standard provides equivalent protection of public health in the long-term as the annual standard, the panel is supportive of the REA discussion of discontinuing the annual standard" (Samet 2009, p. 15). With regard to the current 24-hour standard, CASAC was generally supportive of using the air quality analyses in the REA as a means of determining whether the current 24-hour standard was needed in addition to a new 1-hour standard to protect public health. CASAC stated: "The evidence presented [in REA Table 10–3] was convincing that some of the alternative one-hour standards could also adequately protect against exceedances of the current 24-hour standard" (Samet 2009, p. 15).

In accordance with the REA findings and CASAC recommendations mentioned above, the Administrator noted that 1-hour standards in the range of 50–100 ppb would have the effect of maintaining 24-hour and annual SO_2 concentrations generally well below the levels of the current 24-hour and annual NAAQS (*see* REA Tables 10–3 and 10–4 and REA Appendix Tables D–3 to D–6). Thus, if a new 99th percentile 1-hour daily maximum standard was set in the proposed range of 50–100 ppb, then the Administrator proposed to revoke the current 24-hour and annual standards. However, as noted in the proposal, if a standard was set at a level >100 ppb and

up to 150 ppb, then the Administrator indicated that she would retain the existing 24-hour standard, recognizing that a 99th percentile 1-hour daily maximum standard at 150 ppb would not have the effect of maintaining 24-hour average SO_2 concentrations below the level of the current 24-hour standard in all locations analyzed (*see* REA Appendix Table D–4). Under this scenario, the Administrator would still revoke the current annual standard recognizing: (1) 99th percentile 1-hour daily maximum standards in the range of 50–150 ppb would maintain annual average SO_2 concentrations below the level of the current annual standard (*see* REA Table 10–4 and REA Appendix tables D–5 and D–6); and (2) the lack of sufficient evidence linking long-term SO_2 exposure to adverse health effects.

b. Comments on Retaining or Revoking the Current 24-Hour and Annual Standards

As noted above, most industry groups were opposed to the proposed revisions to the SO_2 NAAQS. However, some of these groups noted that if a 1-hour standard was adopted, then they would support revoking the current 24-hour and annual standards. State agencies generally supported revoking the current standards if a 1-hour standard was set in the proposed range, although NAACA, NESCAUM, and VT, while supportive of revoking the existing standards, also suggested that EPA explore setting a new 24-hour standard to minimize the potential that multiple hours within a day would exceed a 1-hour standard (*see* RTC document (EPA 2010), section IV). Groups which supported revoking the current 24-hour and annual standards (if a 1-hour standard was set in the proposed ranged) generally referenced the Administrator's rationale and CASAC advice described in the proposal (*see* section II.F.5).

Public health (*e.g.,* ALA, ATS) and environmental organizations (*e.g.,* CBD, WEACT for Environmental Justice) were generally opposed to revoking the current 24-hour and annual standards. These groups generally concluded that the 24-hour standard should be revised while the annual standard should be retained. In support of this position, ALA *et al.,* cited air quality information from the REA indicating that if air quality was simulated to just meet a 99th percentile 1-hour daily maximum standard in the proposed range of 50–100 ppb, then in some locations analyzed, 99th percentile 24-hour average SO_2 concentrations would be above concentrations (*i.e.,* above 99th percentile 24-hour average concentrations) in cities where U.S. emergency department visit and hospital admission studies reported positive associations with SO_2. In addition, many of these groups were opposed to revoking the current annual standard. In general, these groups concluded that given the uncertainties associated with SO_2 exposure and long-term health effects, EPA should err on the side of being health protective and retain the existing annual standard. EPA responses to comments on whether the current standards should be retained or revoked are presented below as well as in section IV of the RTC document (EPA 2010).

As stated in the REA and proposal, 99th percentile 24-hour average SO_2 concentrations in cities where U.S. emergency department visit and hospital admission studies (for all respiratory causes and asthma; identified from Table 5–5 of the ISA) were conducted ranged from 16 ppb to 115 ppb (Thompson and Stewart, 2009). Moreover, as stated in the REA and proposal (*see* section II.F.2), effect estimates that remained statistically significant in multi-pollutant models with PM were found in cities with 99th percentile 24-hour average SO_2 concentrations ranging from approximately 36 ppb to 64 ppb. In its comments, ALA *et al.,* stated (based on the air quality information in REA Appendix Table D–2) "with a 1-hour 50 ppb 99th percentile standard, 7 counties would experience a 99th percentile 24-hour concentration of 16 ppb or greater, the range found to be harmful in epidemiological studies. With an hourly standard of 100 ppb, 24 of 30 counties would have 99th percentile 24-hour concentrations above 16 ppb, with 1 county exceeding 36 ppb." Thus, these commenters generally maintained that a lowered 24-hour standard is needed to protect against these 24-hour SO_2 concentrations.

We disagree that a lowered 24-hour standard is needed to protect against 24-hour average SO_2 concentrations of concern identified from cities where U.S. emergency department visit and hospital admission studies were conducted. As noted in detail in the REA, there is uncertainty as to whether the health effects reported in epidemiologic studies using 24-hour average SO_2 concentrations are in fact due to 24-hour average SO_2 exposures (REA, section 10.5.2). That is, when describing epidemiologic studies observing positive associations between ambient SO_2 and respiratory symptoms, the ISA stated "that it is possible that these associations are determined in large part by peak exposures within a 24-hour period" (ISA, section 5.2 at p. 5–5). Similarly, the ISA stated that: "The effects of SO_2 on respiratory symptoms, lung function, and airway inflammation observed in the human clinical studies using peak exposures further provides a basis for a progression of respiratory morbidity resulting in increased emergency department visits and hospital admissions" and makes the associations observed in the epidemiologic studies "biologica[lly] plausib[le]" (*id.*). In contrast, evidence from controlled human exposure studies of 5–10 minutes and epidemiologic studies using 1-hour daily maximum SO_2 concentrations provided appreciably stronger evidence of respiratory morbidity effects following SO_2 exposures ≤ 1-hour.

Given that respiratory morbidity effects following SO_2 exposure may be most related to averaging times ≤1-hour, EPA found it most reasonable to consider the extent to which a 1-hour averaging time, given an appropriate form and level (which as discussed above, also substantially limits 5-minute benchmark exposures of concern; *see* sections II.F.2 and II.F.4), limited 99th percentile 24-hour average concentrations of SO_2 in locations where emergency department visit/hospitalization studies reported that the SO_2 effect estimate remained statistically significant in multi-pollutant models with PM (*i.e.,* locations with 99th percentile 24-hour average SO_2 concentrations ≥36 ppb). Considering this, we note that ALA *et al.,* identified only one county with 99th percentile 24-hour average SO_2 concentrations ≥36 ppb given a 99th percentile 1-hour daily maximum standard at 100 ppb, and no counties ≥36 ppb given a 99th percentile 1-hour daily maximum standard at 50 ppb. Thus, given a 99th percentile 1-hour daily maximum standard level at 75 ppb (*i.e.,* the form and level selected for a new 1-hour SO_2 standard), it is possible that no county in the ALA *et al.,* analysis would have had a 99th percentile 24-hour average SO_2 concentration ≥36 ppb.

With regard to the annual standard, we also disagree that this standard needs to be retained. First, the ISA found that "[t]he evidence linking short-term SO_2 exposure and cardiovascular effects, and morbidity and mortality with long-term exposures to SO_2 is inadequate to infer a causal relationship." ISA, p. 5–10. Thus, an annual standard is unnecessary to prevent long-term health effects. The remaining issue is whether such a standard provides further protection

against short-term effects, given the new one hour standard. We conclude that it does not. As noted in the proposal, our air quality information indicates that 1-hour standard levels in the range of 50–100 ppb are estimated to generally keep annual SO_2 concentrations well below the level of the current annual standard. CASAC agreed. The panel stated: "Assuming that EPA adopts a one hour standard in the range suggested, and if there is evidence showing that the short-term standard provides equivalent protection of public health in the long-term as the annual standard, the panel is supportive of the REA discussion of discontinuing the annual standard" (Samet 2009, p. 15). Taken together, this information indicates that retaining the annual standard would add no additional public health protection.

c. Administrator's Conclusions on Retaining or Revoking the Current 24-Hour and Annual Standards

In accordance with the REA findings and CASAC recommendations mentioned above, the Administrator concludes that a 1-hour standard at level of 75 ppb would have the effect of maintaining 24-hour and annual SO_2 concentrations generally well below the levels of the current 24-hour and annual NAAQS (*see* REA Tables 10–3 and 10–4 and REA Appendix Tables D–3 to D–6). She also concludes that, as noted above in section II.F.2, a 1-hour standard at 75 ppb will likely limit 99th percentile 24-hour SO_2 concentrations in U.S. locations where emergency department visit and hospital admission studies reported statistically significant associations in multi-pollutant models with PM. Finally, she notes the lack of sufficient health evidence to support an annual standard to protect against health effects associated with long-term SO_2 exposure. Taken together, the Administrator concludes it appropriate to revoke the current 24-hour and annual standards.

G. Summary of Decisions on the Primary Standards

For the reasons discussed above, and taking into account information and assessments presented in the ISA and REA as well as the advice and recommendations of CASAC, the Administrator concludes that the current 24-hour and annual primary standards are not requisite to protect public health with an adequate margin of safety. The Administrator also concludes that establishing a new 1-hour standard will appropriately protect public health with an adequate margin of safety, and specifically will afford requisite increased protection for asthmatics and other at-risk populations against an array of adverse respiratory health effects related to short-term (5 minutes to 24 hours) SO_2 exposure. These effects include decrements in lung function (defined in terms of sRaw and FEV_1), increases in respiratory symptoms, and related serious indicators of respiratory morbidity including emergency department visits and hospital admissions for respiratory causes.

Specifically, the Administrator is establishing a new short-term primary SO_2 standard with a 1-hour (daily maximum) averaging time and a form defined as the 3-year average of the 99th percentile of the yearly distribution of 1-hour daily maximum SO_2 concentrations, and a level of 75 ppb. In addition to setting a new 1-hour standard at 75 ppb, the Administrator is revoking the current 24-hour and annual standards recognizing that a 1-hour standard set at 75 ppb will have the effect of generally maintaining 24-hour and annual SO_2 concentrations well below the levels of the current 24-hour and annual standards.

III. Overview of the Approach for Monitoring and Implementation

We received several comments regarding the approaches discussed in the proposal for monitoring and modeling for comparison to the proposed new 1-hour SO_2 NAAQS, designations of areas as either attaining or not attaining the NAAQS, and implementation of the new NAAQS in State implementation plans (SIPs) that would ensure ultimate attainment of the new NAAQS in transitioning from the annual and 24-hour NAAQS in a timely manner. These comments raised fundamental questions regarding our contemplated approaches in all three areas, and caused us to re-examine them and review their consistency with past practice under the SO_2 NAAQS implementation program. After conducting that review, and in response to the public comments we are revising our general anticipated approach toward implementation of the new 1-hour NAAQS. This revised approach would better address: (1) The unique source-specific impacts of SO_2 emissions; (2) the special challenges SO_2 emissions present in terms of monitoring short-term SO_2 levels for comparison with the NAAQS in many situations; (3) the superior utility that modeling offers for assessing SO_2 concentrations; and (4) the most appropriate method for ensuring that areas attain and maintain the new 1-hour SO_2 NAAQS in a manner that is as expeditious as practicable, taking into account the potential for substantial SO_2 emissions reductions from forthcoming national and regional rules that are currently underway.

Below, we provide an overview of our revised approach to monitoring, and of our expected approaches to designations of areas, and implementation of the NAAQS. Due to the unique challenges presented by SO_2, we do not expect that the anticipated approaches discussed below would be necessarily transferable to other NAAQS pollutant situations. For NAAQS pollutants other than SO_2, air quality monitoring is more appropriate for determining whether all areas are attaining the NAAQS, and there is comparatively less dependence upon conducting refined modeling. Each of these subjects (*i.e.,* our revised approach to monitoring, and our expected approaches to designations of areas, and implementation of the NAAQS) is further addressed later in the preamble, in sections IV, V and VI, respectively. Where specific public comments on the proposal are addressed and responded to, further details of the specific revised approaches are explained. In many respects, both the overview discussion below and the subsequent more detailed discussions explain our expected and intended future action in implementing the new 1-hour NAAQS—in other words, they constitute guidance, rather than final agency action—and it is possible that our approaches may continue to evolve as we, States, and other stakeholders proceed with actual implementation. In other respects, such as in the final regulatory provisions regarding the promulgated monitoring network, we are explaining EPA's final conclusions regarding what is required by this rule. We expect to issue further guidance regarding implementation, particularly concerning issues that may arise regarding the application of refined dispersion modeling under this revised approach for monitoring and implementation, and issues that States and other stakeholders may also ask us to address as we proceed toward various stages of ensuring attainment. EPA intends to solicit public comment prior to finalizing this guidance.

The main necessary elements of implementing the new 1-hour NAAQS are: (1) An approach for assessing ambient concentrations to determine compliance with the NAAQS; (2) a process for using these assessments to designate areas relative to the new standard; and (3) the development of State plans that include control measures sufficient for ensuring the NAAQS is attained everywhere as expeditiously as possible, which we

believe should be no later than 2017. EPA's revised anticipated approach to determining compliance with the new SO_2 NAAQS is consistent with our historical approach to SO_2 designations and implementation through permits and emissions limitations, which involves the combined use of monitoring and modeling. The emphasis we would place on monitoring and modeling, compared with each other, under the revised expected approach is therefore significantly different than that in the approach discussed in the proposal, which was less in line with our historical practice for SO_2, as the public comments highlighted.

In the SO_2 NAAQS proposal, we recommended a monitoring-focused approach for comparison to the new NAAQS, featuring a two-pronged monitoring network design. This included monitors in certain CBSAs based on a combination of population and SO_2 emissions coupled with additional monitors within a State based on that State's contribution to national SO_2 emissions. The resulting proposed network would have required approximately 348 monitors nationwide to be sited at the locations of maximum concentration. Numerous State and local government commenters expressed concerns regarding the burdens of implementing the proposed monitoring network and the sufficiency of its scope for purposes of identifying violations. These commenters contended that our proposed monitoring network was too small and insufficient to cover the range of SO_2 sources, and yet too burdensome and expensive to expand to an adequate scale. Some of these commenters (the City of Alexandria, and the States of Delaware, North Carolina and Pennsylvania) suggested using modeling to determine the scope of monitoring requirements, or favored modeling over monitoring to determine compliance with the NAAQS.

Partly in response to these comments, and after reconsidering the proposal's monitoring-focused approach in light of EPA's historical approach to SO_2 NAAQS implementation and area designations decisions, we intend to use a hybrid analytic approach that would combine the use of monitoring and modeling to assess compliance with the new 1-hour SO_2 NAAQS. We believe that some type of hybrid approach is more consistent with our historical approach and longstanding guidance toward SO_2 than what we originally proposed. In addition, we believe that for a short-term 1-hour standard it is more technically appropriate, efficient, and effective to use modeling as the principle means of assessing compliance for medium to larger sources, and to rely more on monitoring for groups of smaller sources and sources not as conducive to modeling. We discuss the details of the final revised monitoring network requirements in section IV later in the preamble, but note here the relationship that the revised approach toward monitoring and modeling—taken partly in response to the public comments mentioned above—has to the other two general subject areas in implementation for which we are providing guidance, namely initial area designations and development of substantive implementation plans that ensure timely attainment and maintenance of the NAAQS. Our ultimate intention is to place greater emphasis on modeling than did the proposed rule as the most technically appropriate, efficient, and readily available method for assessing short-term ambient SO_2 concentrations in areas with large point sources. This projected change in approach would necessarily result in a lesser emphasis on the less appropriate, more expensive, and slower to establish monitoring tool than did the proposed rule. Therefore, the minimum requirements for the SO_2 monitoring network in this final rule are of a smaller scale than proposed, and we do not expect monitoring to become the primary method by which ambient concentrations are compared to the new 1-hour SO_2 NAAQS.

Instead, in areas without currently operating monitors but with sources that might have the potential to cause or contribute to violations of the NAAQS, we anticipate that the identification of NAAQS violations and compliance with the 1-hour SO_2 NAAQS would primarily be done through refined, source-oriented air quality dispersion modeling analyses, supplemented with a new, limited network of ambient air quality monitors. Historically, we have favored dispersion modeling to support SO_2 NAAQS compliance determinations for areas with sources that have the potential to cause an SO_2 NAAQS violation, and we have explained that for an area to be designated as "attainment," dispersion modeling regarding such sources needs to show the absence of violations even if monitoring does not show a violation. This has been our general position throughout the history of implementation of the SO_2 NAAQS program. *See, e.g.,* "Air Quality Control Regions, Criteria, and Control techniques; Attainment Status Designations," 43 FR 40412, 40415–16 (Sept. 11, 1978); "Air Quality Control Regions, Criteria, and Control Techniques," 43 FR 45993, 46000–02 (Oct. 5, 1978); "Air Quality Implementation Plans: State Implementation Plans; General Preamble," 57 FR 13498, 13545, 13547–48 (Apr. 16, 1992); "Approval and Promulgation of State Implementation Plans; Call for Sulfur Dioxide SIP Revisions for Billings/Laurel, MT," 58 FR 41430 (Aug. 4, 1993); "Designation of Areas for Air Quality Planning Purposes; Ohio," 59 FR 12886, 12887 (Mar. 18, 1994); "Ambient Air Quality Standards, National and Implementation Plans for Sulfur Oxides (Sulfur Dioxide)," 60 FR 12492, 12494–95 (Mar. 7, 1995); "Air Quality Implementation Plans; Approval and Promulgation: Various States: Montana," 67 FR 22167, 22170–71, 22183–887 (May 2, 2002).

Compared to other NAAQS pollutants, we would not consider ambient air quality monitoring alone to be the most appropriate means of determining whether all areas are attaining a short-term SO_2 NAAQS. Due to the generally localized impacts of SO_2, we have not historically considered monitoring alone to be an adequate, nor the most appropriate, tool to identify all maximum concentrations of SO_2. In the case of SO_2, we further believe that monitoring is not the most cost-efficient method for identifying all areas of maximum concentrations. However, for some situations monitoring is well suited, and we therefore will require it to some extent, as further explained in section IV of the preamble. For example, monitoring may appropriately be relied upon to assess compliance with the NAAQS by groups of smaller sources and sources that may not be as conducive to modeling as are larger SO_2 sources.

States will need to make any adjustments to the existing monitoring network to ensure that monitors meeting today's network design regulations for the new 1-hour NAAQS are sited and operational by January 1, 2013. We also expect to provide additional guidance regarding the application of refined dispersion modeling under this revised expected approach for implementation of the new SO_2 standard. Appendix A to the *Guideline on Air Quality Models* (Appendix W of 40 CFR part 51), Summaries of Preferred Air Quality Models, provides "key features of refined air quality models preferred for specific regulatory applications" (*see* Appendix A to Appendix W of Part 51 at A.0(1)). Refined dispersion modeling, following our current *Guideline on Air Quality Models* with appropriate flexibility for use in implementation, is anticipated to better reflect and account

for source-specific SO_2 impacts than the more limited monitoring-focused proposal. As noted above, EPA intends to solicit public comment prior to finalizing this guidance.

Based on a revised, hybrid approach, we expect to implement the new SO_2 standard in the following manner. In accordance with CAA section 107(d), EPA must designate areas as "attainment," "nonattainment" or "unclassifiable" for the new 1-hour SO_2 NAAQS by June 2012 (*i.e.,* two years following promulgation of the new NAAQS).[20] State Governors are required to submit their initial area designation recommendations to EPA no later than June 2011. We expect that EPA's final area designation decisions in 2012 would be based principally on data reported from SO_2 monitors currently in place today, and any refined modeling the State chooses to conduct specifically for initial area designations.[21] For these initial designations, we would expect to designate an area "nonattainment" if either monitoring data or appropriate refined modeling results show a violation. Any area that has monitoring and appropriate modeling data showing no violations we would expect to designate as "attainment."[22] All other areas, absent monitoring data and air quality modeling results showing no violations, we would expect to initially designate as "unclassifiable," as required by the Clean Air Act. The expected presumptive boundary for any area designated "nonattainment" would be the county boundary associated with the violation unless additional information provided to EPA demonstrates otherwise, as has been our general approach for other NAAQS pollutants. Any area initially designated "nonattainment" or "unclassifiable" could request redesignation to "attainment" after an assessment based on air quality modeling, conducted in accordance with the new guidance, and available monitoring data indicates that the standard has been met, as well as meeting all other requirements of the CAA for redesignation to attainment.

This anticipated approach toward initial area designations is a change from the approach discussed in the proposal, and logically follows from our general change in approach to the use and utility of monitoring versus modeling for determining short-term SO_2 ambient concentrations. As public commenters pointed out, establishment and implementation of the proposed monitoring network would have been both too limited and too late to inform initial area designations, and the expense and burden of accelerating it and expanding it would have been severe for State implementing agencies. Given the time needed to establish monitors, it is not realistic to expect either such an expanded monitoring network or even the more reasonable limited network of the final rule to be the chief tool for informing initial designations.

That means that some other approach is needed to inform initial designations of areas and other implementation decisions under the new SO_2 NAAQS. In addition to using any valid data generated by existing monitors, refined dispersion modeling may inform designation and implementation decisions regarding sources that may have the potential to cause or contribute to a NAAQS violation. In order for modeling to be done on the scale sufficient to identify all areas that might violate the new 1-hour standard, EPA anticipates issuing guidance that addresses a variety of issues, such as how to identify and appropriately assess the air quality impacts of small SO_2 sources (*e.g.,* those emitting less than 100 tons of SO_2 per year) that may potentially cause or contribute to a violation of the new SO_2 NAAQS. EPA expects that it will take more time for EPA to issue that guidance than is available in order to use it for the initial round of attainment designations. In addition to any smaller sources that might cause or contribute to NAAQS violations, States would need to model approximately 2000 larger sources across the country (*i.e.,* sources that emit greater than 100 tons per year and are collectively responsible for about 99% of all SO_2 emissions from point sources in the U.S.) to determine whether areas are attaining or not attaining the 1-hour standard. While these sources emitting 100 or more tons of SO_2 per year represent the significant fraction of the total emissions from point sources in the U.S., smaller sources also have the potential to violate the new SO_2 NAAQS.

After receiving EPA's forthcoming modeling guidance, States might initially focus modeling assessments on these larger sources that have been subject to permitting requirements and are generally better characterized than smaller sources. But even this effort would entail a substantial burden on States, under a compressed timeline following EPA's issuance of further modeling guidance. Consequently, EPA does not believe that for this new 1-hour SO_2 NAAQS it would be realistic or appropriate to expect States to complete such modeling and incorporate the results in initial designation recommendations, which under CAA section 107(d)(1)(A) must be submitted to EPA within 1 year of the promulgation of the 1-hour standard.

The remaining issue, then, is how to most appropriately use a modified hybrid approach, and its constituent modeling and monitoring tools, in the implementation plan development process in order to ensure expeditious attainment and maintenance of the NAAQS. Under the CAA, all States must develop and submit to EPA State implementation plans (SIPs) to attain and maintain the new 1-hour SO_2 NAAQS. CAA section 110(a)(1) requires States, regardless of designation status, to adopt SIPs that provide for implementation, maintenance and enforcement of each primary NAAQS. Traditionally, for areas that were designated "attainment" or "unclassifiable", we accepted State submissions of prevention of significant deterioration (PSD) permitting programs and other "infrastructure" SIP elements contained in CAA section 110(a)(2) as being sufficient to satisfy the section 110(a)(1) SIP submission requirement. However, due to our recognition here that monitoring is not generally the most appropriate or effective tool for assessing compliance with the new 1-hour SO_2 NAAQS, that additional guidance from EPA on conducting refined modeling for the new 1-hour NAAQS is anticipated to support our expected implementation approach, and that considerable time and resources may be needed to fully identify and properly characterize all SO_2 sources (including those emitting less than 100 tons of SO_2 per year) that may potentially cause or contribute to a violation of the new SO_2 NAAQS, we also had to assess how and when to best use modeling as the primary method in implementation.

[20] EPA is authorized by the Clean Air Act to take up to 3 years to complete the initial area designations in the event that insufficient information is available to complete the designations within 2 years.

[21] Since three complete years of data from any newly sited monitors meeting the new monitoring network design criteria are not expected to be obtained until the end of 2015, any newly sited monitors will not play a role in EPA's initial area designations.

[22] EPA anticipates making the determination of when monitoring alone is "appropriate" for a specific area on a case-by-case basis, informed by that area's factual record, as part of the designations process. EPA would expect to address this issue for such areas by examining the historic treatment of the area with respect to prior SO_2 designations as well as whether the area is one in which monitoring would be the more technically appropriate tool for determining compliance with the new SO_2 NAAQS. An example of a situation in which monitoring may be the more preferred approach is a shipping port (non-point source or "area" source) that is not in close proximity to other significant stationary SO_2 sources.

The approach that EPA expects to take, which is described in sections V and VI of the preamble, is consistent with the language of the Clean Air Act and would accommodate the time needed for an accurate assessment of ambient air quality levels for the 1-hour SO_2 standard. Section 107(d)(1) requires areas to be designated "attainment" if they meet the standard, "nonattainment" if they do not meet the standard or contribute to a nearby violation, or "unclassifiable" if they cannot be designated on the basis of available information. EPA's expected approach would enable us to make the appropriate designation decision required by the CAA, based on the record of information that will be before EPA regarding each area. Areas would be designated "nonattainment" if either available monitoring data or modeling shows that a violation exists, or "attainment" if both available monitoring data and modeling indicate the area is attaining. All other areas would be designated "unclassifiable," as required by section 107(d)(1)(A).

We currently anticipate that our projected post-designation implementation approach would look to robust CAA section 110(a)(1) SIPs, which have sometimes been previously referred to as "maintenance" or "infrastructure" SIPs but for the new SO_2 NAAQS would serve as substantive "attainment" SIPs. Our current thinking is that, to be approved by EPA, such plans would need to provide for attainment and maintenance of the new 1-hour SO_2 NAAQS as expeditiously as practicable, which we expect to be no later than five years after initial designation (or approximately August 2017) in all areas of the State, including any area initially designated "nonattainment," and also including any area designated "unclassifiable" that has SO_2 sources with the potential to cause or contribute to a violation of the NAAQS. The CAA establishes deadlines for States to submit these plans to EPA.[23] State plans that address areas designated as "nonattainment" (*i.e.,* "nonattainment area SIPs") are due within 18 months from the effective date of the designation, under CAA section 192. EPA anticipates that this deadline would be February 2014. State plans addressing all other areas (*i.e.,* "maintenance SIPs") are due within 3 years following the promulgation of the new NAAQS, or June 2013, under CAA section 110(a)(1).

Section 110(a)(1), unlike section 192, does not specify a maximum deadline by which States are required to show they have met the requirements to implement, maintain, and enforce a NAAQS. EPA believes, however, that August 2017 is the latest date by which areas should show they have achieved attainment and maintenance of the standard because this deadline is the same as would be required for areas designated nonattainment in June 2012. It is therefore presumptively reasonable as it is identical to the period Congress provided for nonattainment areas to reach attainment. Moreover, EPA notes that the maintenance SIPs will be due in June 2013, rather than in February 2014, giving States and sources at least as much time between SIP development and submission and the date by which attainment should be achieved as they would have had the area been designated nonattainment in 2012. These section 110(a)(1) SIPs would be able to rely on modeling reflecting any SO_2 reductions that we expect to result before the attainment date from compliance with the rules EPA expects to promulgate before 2013, (including technology-based standards under CAA section 112(d) for certain source categories emitting large amounts of SO_2 such as Electric Generating Units and industrial boilers, and revised rules establishing further limits on SO_2 emitted by sources in upwind States which contribute significantly to downstream States' inability to attain or maintain the $PM_{2.5}$ NAAS (the so-called Clean Air Interstate Replacement rule)). Thus, we intend that a State's section 110(a)(1) SIP may account for projected emissions reductions, including any from national and regional rules that are promulgated before these SIP submissions, provided that those reductions occur under a schedule that ensures attainment as expeditiously as practicable. We expect that date to be no later than 5 years from the date of initial designation or August 2017.

Under this anticipated approach, attainment SIPs for nonattainment areas would have to include enforceable emissions limitations, timetables for compliance, and appropriate testing/reporting to assure compliance, and demonstrate attainment through air quality modeling for all sources contributing to monitored and modeled violations, or that have the potential to cause or contribute to a violation of the NAAQS. The SIPs under section 110(a)(1) would need to demonstrate through refined air quality modeling that any source or group of sources that have the potential to cause or contribute to a violation of the NAAQS are, or will be, sufficiently controlled to ensure timely attainment and maintenance of the NAAQS. We would expect this to include any individual sources with the potential to emit 100 or more tons per year of SO_2, and other sources that may also cause or contribute to violations of the new SO_2 NAAQS. We expect to develop guidance for the States' use on how best to identify and assess the impact of sources that may have this potential. As mentioned previously, we intend to provide an opportunity for notice and comment on this guidance before finalizing it.

EPA again notes that it anticipates several forthcoming national and regional rules, such as the pending Industrial Boilers MACT standard under CAA section 112(d), that are likely to require significant reductions in SO_2 emissions over the next several years. A limited qualitative assessment based on the results of preliminary modeling of some sample facilities indicates that well controlled sources should meet the new SO_2 NAAQS (*see* Brode 2010b). Exceptions could include unique sources with specific characteristics that contribute to higher ambient impacts (short stack heights, complex terrain, *etc.*). These national and regional rules are expected to lead to SO_2 reductions that will help achieve compliance with the new SO_2 NAAQS prior to 2017. If, upon EPA review of submitted SIPs that rely upon those reductions or other local controls, it appears that States will nevertheless fail to attain the NAAQS as expeditiously as practicable (and no later than August 2017), the Clean Air Act provides authorities for EPA to solve such failure, including, as appropriate, disapproving submitted SIPs, re-designating unclassifiable areas to nonattainment, issuing SIP calls, and promulgating FIPs.

For the reasons discussed above, EPA has determined that it is appropriate and efficient to principally use modeling to assess compliance for medium to larger sources, and to rely more on monitoring for groups of smaller sources and sources not as conducive to modeling. EPA's revised monitoring network requirements have been developed to be consistent with this approach. However, EPA is still considering how monitoring and modeling data would be used together in specific situations to define attainment and nonattainment boundaries and under what circumstances it may be appropriate to rely on monitoring data alone to make attainment determinations. EPA intends

[23] The schedule for State plans addressing areas designated "nonattainment" is governed by CAA section 191. The schedule for State plans for all other areas, including areas designated "unclassifiable" and "attainment," is governed by CAA section 110(a)(1).

to address these issues as it develops implementation guidance.

In light of the new approach that EPA intends to take with respect to implementation of the SO_2 NAAQS, EPA intends to solicit public comment on guidance regarding modeling, and also solicit public comment on additional implementation planning guidance, including the content of the maintenance plans required under section 110(a)(1) of the Clean Air Act. EPA also notes that State monitoring plans and the SIP submissions that States will make will also be subject to public notice and comment.

IV. Amendments to Ambient Monitoring and Reporting Requirements

In this section of the preamble, we describe the proposal, the public comments that we received on the proposed monitoring and reporting requirements, and the final requirements for the SO_2 monitoring network. We are modifying our proposed approach to the amount of monitoring to require following consideration of public comments and a review of our historic practice in assessing compliance with the SO_2 NAAQS. As we explain above in section III, we will use a hybrid approach that combines monitoring and modeling, using each of these analytic tools where they are most appropriate and effective. This approach and its requirements are intended to support the revised SO_2 NAAQS, described in section II above. For a short-term 1-hour standard, dispersion modeling of stationary sources will generally be more technically appropriate, efficient, and effective because it takes into account fairly infrequent combinations of meteorological and source operating conditions that can contribute to peak ground-level concentrations of SO_2. Even an expansive monitoring network could fail to identify all such locations. Consequently, we have revised the scope of the monitoring network, reflecting a modified and expanded set of objectives. This section also describes and explains the final requirements for the new SO_2 Federal Reference Method (FRM), and the SO_2 network design, monitoring objectives, data reporting, and data quality objectives that support the revised primary SO_2 NAAQS.

A. Monitoring Methods

1. Requirements for SO_2 Federal Reference Method (FRM)

The proposal to promulgate an automated SO_2 FRM was based on a need to update the cumbersome existing manual wet-chemistry (pararosaniline) method to a continuous-type automated method that can readily provide 1-hour SO_2 measurement capability. *See* 74 FR at 64846–849. The following paragraphs provide background, rationale, and the final changes to the automated SO_2 Federal Reference Method (FRM) and to the associated performance specifications for automated SO_2 analyzers.

a. Proposed Ultraviolet Fluorescence SO_2 FRM and Its Implementation

FRMs, set forth in several appendices to 40 CFR Part 50, serve (1) To provide a specified methodology for definitively measuring concentrations of ambient air pollutants for comparison to the NAAQS in Part 50, and (2) to provide a standard of comparison for determining equivalency of alternative pollutant measurement methods that can be used in lieu of the FRM for such monitoring.

The FRM for measuring SO_2 in the ambient air was promulgated on April 30, 1971 in conjunction with the first primary SO_2 NAAQS (36 FR 8196). This SO_2 FRM is specified in Appendix A of Part 50 and identified as the pararosaniline manual method. *See* generally 74 FR at 64846. In the interim, EPA has designated many SO_2 methods as equivalent methods (FEMs), most of which are based on the ultraviolet fluorescence (UVF) measuring technique. *Id.* In fact, virtually all SO_2 monitoring data are now obtained with FEMs that use the UVF technique.

In light of this, EPA proposed to establish a new automated SO_2 FRM based on UVF—the same measurement technique employed by FEM analyzers now in widespread use by most State and local monitoring agencies and having the measurement capability needed to implement the proposed 1-hour SO_2 NAAQS. FRM analyzers using this UVF technique can provide the needed detection limits, precision, and accuracy and fulfill other purposes of an FRM, including use as an appropriate standard of reference for testing and designation of new FEM analyzers. At proposal, EPA specified the new method in performance-based form, describing a generic reference measurement principle and associated calibration procedure in a new Appendix A–1 to 40 CFR Part 50. Associated performance requirements applicable to candidate automated SO_2 analyzers (both FRMs and FEMs) were proposed in 40 CFR Part 53.

EPA also proposed retaining the existing manual pararosaniline FRM for SO_2. Although EPA recognized that the existing method is cumbersome for one-hour measurements, it is capable of making measurements of 1 hour or even 30 minute periods. 74 FR at 64846; *see also* Part 50 Appendix A at 1.1 ("[t]he method is applicable to the measurement of ambient SO_2 concentrations using sampling periods ranging from 30 minutes to 24 hours"). Supersession of the existing manual FRM, as defined in § 53.16, would require not only withdrawal of that existing FRM but also the cancellation of the designations of all existing SO_2 FEMs. Loss of the use of these FEM analyzers would leave State and local monitoring agencies with no approved SO_2 monitors until new FRM and FEM analyzers could be designated under the new FRM. The resulting costs and disruptions to monitoring agencies is unnecessary because the current SO_2 FEMs readily and accurately measure (and report) one-hour ambient measurements. *See* 74 FR at 64847. Accordingly, EPA concluded that supersession of the existing FRM was not warranted, given the costs and disruptions which would occur to State monitoring programs and the limited benefits from such an action given the suitability of the in-use FEMs. *Id.* at 68646; *see also* section 53.16(b)(1) stating that in exercising its discretion as to whether to proceed with supersession of an FRM, EPA will consider the benefits (in terms of requirements and purposes of the Act) from specifying a new reference method, potential economic consequences of such supersession for State and local monitoring agencies, and disruption to State and local air quality monitoring programs. Instead, EPA proposed to add the new UVF FRM while retaining the existing FRM for some period of time to support the continued approval of existing SO_2 FEM analyzers.

b. Public Comments on the Proposed FRM and Implementation

EPA received comments from State and local groups (*e.g.,* City of Houston, Houston-Galveston Area Council, KY, NC, NY, PA, SC, SD, and WI) and industry (*e.g.,* AirQuality Research and Logistics (AQRL), Consumers Energy, ExxonMobil, Montana Sulfur and Chemical Company, Inc. (MSCC), and the Utility Air Regulatory Group (UARG)), all generally supporting EPA's proposal to adopt the proposed automated UVF as an FRM. For example, South Dakota supported adding the UVF SO_2 method as an additional FRM and stated that this method is currently being used in the network and will reduce the cost of implementing the new monitoring

requirements for this rule. The UARG stated that the proposal to specify a different FRM to judge compliance is entirely reasonable, and UARG generally supported the proposed specifications for a new FRM but maintained that the current FRM could not be used along with a new FRM. ExxonMobil stated that it supports "* * * EPA allowing monitoring agencies to choose mobile monitoring that meets monitoring quality requirements." AQRL stated that "EPA is correct in choosing to designate [promulgate] a new (automated) FRM for measurement of SO_2."

EPA did not receive any public comments opposing the proposed automated UVF SO_2 FRM but did receive a few technical comments on specific provisions of the method. EPA proposed use of an inlet line particle filter as a requirement for new UVF SO_2 FRM analyzers, believing that use of a particle filter is advantageous to prevent interference, malfunction, or damage to the analyzer from particles in the sampled air. The State of Missouri questioned this requirement, noting that such a filter can sometimes cause problems and that filter requirements for other FRM and FEM analyzers have been analyzer-specific depending on the manufacturer's stipulation. EPA believes, however, that for new SO_2 FRM analyzers, the benefits and uniformity provided by a mandatory filter requirement outweigh possible disadvantages of such a filter.

Missouri also suggested that the language of proposed Sections 4.1.1 and 4.1.2 regarding calibration system flow rate requirements were somewhat confusing, and that the high (50–100 ppm) concentration requirement for the calibration standard specified in Section 4.1.6.1 is sometimes a problem. In response to these comments, the language of Sections 4.1.1 and 4.1.2 has been clarified, and the concentration of the standard specified in Section 4.1.6.1 has been reduced to 10 ppm.

EPA received a number of comments from States (*e.g.,* NC, NYSDEC, PA, SC, and SD) that supported the EPA proposed plan of temporary retention of the existing wet-chemistry pararosaniline FRM and for FEMs approved based on that method. For example, Pennsylvania stated "[t]his methodology should enable State and local agencies to continue using their existing monitoring equipment and [thereby] avoid large capital fund outlays for samplers and ultimately avoid any delays in collecting data that would be comparable to the proposed new primary sulfur dioxide NAAQS." North Carolina requested "* * * that the EPA maintain the current reference method for at least an additional 10 years." Wisconsin and the Center for Biological Diversity (CBD) suggested expeditiously phasing out the existing manual SO_2 FRM.

In contrast, however, EPA also received comments from industry that opposed the retention of the existing pararosaniline FRM while promulgating a new automated UVF FRM. In particular, UARG stated "* * * having two FRMs specified for a given NAAQS—is not viable," pointing out that there is only one FRM for each NAAQS under the present standards, a result UARG appears to believe is legally mandated.

EPA disagrees with this comment. First, there is nothing in the Act that mandates a single FRM for each NAAQS. Section 109 of the Act, in fact, does not address this issue at all. Second, as noted previously, there are sound policy reasons for not withdrawing the existing FRM at this time. Therefore, EPA sees no legal or other obstacle in adding a new automated UVF FRM while retaining the existing manual FRM.

UARG further maintained that EPA provided no support for its statement that the existing FEMs, which constitute the bulk of the existing SO_2 monitoring network, are adequate for the current and proposed new SO_2 NAAQS. UARG also stated that "although the FEMs may be adequate for many other purposes, they may only be used to judge compliance with the 1-hour NAAQS if they are shown to qualify as FRMs or FEMs under the new FRM definition."

EPA disagrees with this comment also. In answer to UARG's second point, it is not necessary that these existing FEMs be re-designated as FRMs pursuant to the new automated FRM to continue their approved use. There is no legal impediment to such continued use, since they are (and will continue to be) FEMs approved based on an FRM that adequately measures one-hour ambient SO_2 concentrations. Nor is there any technical impediment to the continued use of these FEMs, given that they are automated continuous monitoring methods capable of measuring SO_2 concentrations ranging from a few minutes to a 1-hour period. The existing FEMs in the network use the same UVF technology as the proposed (and now final) automated FRM and have been reporting 1-hour monitoring data for decades. These FRMs have been tested against the test and performance requirements of Part 53, which are designed specifically to test such continuous methods. Further, the proposed SO_2 method performance specifications for the standard measurement range were derived from data submitted in FEM applications for analyzers that were subsequently designated as FEMs. Therefore, these FEMs are technically and legally sound to judge compliance with the one-hour NAAQS.

EPA has clarified the regulatory text so that the rules state unambiguously that both SO_2 FRMs apply to the new one-hour standard (as well as to the 24-hour and annual standards so long as they are retained), as do all presently-designated FEMs.

c. Conclusions on Ultraviolet Fluorescence SO_2 FRM and Implementation

We are finalizing the proposed new automated SO_2 FRM, which is based on UVF technology, with the following minor technical changes: The language of Sections 4.1.1 and 4.1.2 has been clarified, and the minimum concentration of the calibration standard specified in Section 4.1.6.1 has been reduced to 10 ppm. The new FRM is codified as Appendix A–1 to 40 CFR Part 50 and titled "Reference Measurement Principle and Calibration Procedure for the Measurement of Sulfur Dioxide in the Atmosphere (Ultraviolet Fluorescence Method)." EPA is retaining the previously existing manual pararosaniline SO_2 FRM for the time being and re-codifying it as Appendix A–2 to 40 CFR Part 50. However, EPA plans to rescind this manual FRM at a future time when new SO_2 FRM analyzers have adequately permeated State monitoring networks.

2. Requirements for Automated SO_2 Methods

a. Performance Specifications for Automated Methods

In association with the proposal to adopt a new automated FRM, EPA proposed to update the performance-based designation requirements for FEM SO_2 analyzers currently specified in 40 CFR Part 53. As noted in the proposal preamble (74 at 64846), these requirements were established in the 1970's, based primarily on the wet-chemical measurement technology available at that time. Those initial requirements have become significantly outdated and need to be modified to match current technology, particularly because they would apply to new SO_2 FRM analyzers under the proposed new FRM. The better instrumental performance available with the proposed new UVF FRM technique allows the performance requirements in Part 53 to be made more stringent for

both FRM and FEM SO_2 analyzers. Updating these performance requirements is needed to ensure that, going forward, all new SO_2 monitors will have improved performance.

EPA solicited comments on the proposed new performance requirements for automated SO_2 methods that were included in Table B–1 (Performance Specifications for Automated Methods) of Part 53. We proposed revised performance specifications for noise, lower detectable limit, interference equivalent, zero drift, span drift, lag time, rise time, fall time, and precision. EPA proposed to reduce the allowable noise limit from 5 to 1 ppb, the lower detectable limit from 10 to 2 ppb, the interference equivalent limits from ±20 ppb to ±5 ppb for each interferent, and from 60 ppb to 20 ppb for the total of all interferents, the zero drift limit from ±20 to ±4 ppb, the lag time limit from 20 to 2 minutes, both rise and fall time limits from 15 to 2 minutes, and the precision limits from 15 ppb to 2 percent of the upper range limit. EPA further proposed to eliminate the requirements for span drift at 20% of the upper range limit. In addition, to address the need for more sensitive, lower measurement ranges for SO_2 analyzers, EPA proposed a separate set of performance requirements that would apply specifically to narrower measurement ranges, *i.e.* ranges extending from zero to concentrations less than 0.5 ppm. Other minor changes were proposed in the wording of a few sections of Part 53 Subparts A and B, including provision for alternate data recording devices in § 53.21 to supplement the older language relating specifically to strip chart recorders.

b. Public Comments

EPA received a number of comments from industry (AQRL and UARG) and from the multi-State organization NESCAUM regarding the proposed interferent limit requirements listed in Table B–1. UARG submitted comments supportive of all the proposed requirements for the new UVF SO_2 FRM, except for the proposed total interferent limits of 20 ppb. UARG acknowledged that EPA proposed to reduce the total interferent level substantially from 60 ppb to 20 ppb, but maintained that the proposed level of 20 ppb is still too high because it amounts to 20%–40% of the levels being considered for the NAAQS (50–150 ppb). AQRL recommended limiting "* * * each interferent to no more than ±3 ppb and total interference to no more than 12 ppb." NESCAUM recommended tightening the nitric oxide (NO) interference limit from 100:1 to 300:1 (*i.e.,* one third of the proposed value of ±5 ppb). NESCAUM states that the proposed interferent value of ±5 ppb results in substantial NO interference at sites with low SO_2 levels in urban areas.

EPA revisited the issue of the interferent equivalent limit for SO_2 analyzers in context of the above comments and reconsidered what is reasonably feasible with current technology. We reviewed the current instrument specifications and test data submitted for numerous SO_2 FEM applications. We also took into account that the test concentrations of most of these interferents are substantially higher than the concentrations normally observed in ambient air. EPA considered lowering the testing concentrations of these interferents, which would have correspondingly lowered the interferent equivalent for each analyte. However, EPA took a more conservative approach and retained the existing test concentrations for H_2S, NO_2, NO, O_3, m-xylene, and water vapor. Based on this review, we found that it is not feasible to further lower the limit requirement for these interferents below ±5 ppb. However, in response to the NESCAUM comment, EPA determined that the interferent equivalent limit requirement for NO interference could be reduced to ±3 ppb (166:1) for the new, lower measurement range to reduce possible NO interference at sites with low SO_2 levels in urban area.

In regard to the total limit for all interferent equivalents for SO_2 analyzers, EPA notes that many of the interferents for which testing is required (specified in Table B–3 of Part 53) would likely react with each other and would thus not co-exist in ambient air at the specified test concentrations. Therefore, EPA determined that the limit requirement for total interference equivalent can be eliminated, and Table B–1 now reflects this change.

EPA received comment from AQRL on the existing span drift requirement for SO_2 analyzers specified in Table B-1. AQRL recommended lowering the span drift requirement at 80% URL to 2.5%, stating that "ambient air monitors in the 21st century should be able to hold span drift to no more than ±2.5% under the conditions specified in EPA testing * * *." Based on information from FEM testing laboratories and manufacturers' data (EPA, 2009c), EPA largely agrees with this comment and concludes that the span drift requirement at 80% can be lowered to ±3%. Table B–1 has been changed to include this revised limit.

EPA received comment from the State of Wisconsin suggesting that the proposed revised provisions of section 53.21 (Test conditions) be further changed to more specifically recognize use of digital recorders for obtaining test results rather than maintaining the tie to analog strip chart recorder technology. EPA acknowledges that industry has moved away from strip chart recording technology to digital data recording. However, the proposed language of § 53.21 calls for a graphic representation of analyzer responses to test concentrations to facilitate visual examination of test results and allows any "alternative measurement data recording device" as long as it can provide such a graphic representation. Describing the analog strip chart recorder in this section provides an appropriate model to help define the type of graphic representation needed for the Part 53 tests. EPA believes that the proposed language of § 53.21 is adequately broad to permit digital or other types of data recording devices.

c. Conclusions for Performance Specifications for SO_2 Automated Methods

Based on typical performance capabilities of current UVF analyzers and manufacturers' actual testing data, we are keeping the limit for each interference equivalent for SO_2 analyzers at ±5 ppb. However, we are lowering the interference equivalent requirement for NO to ±3 ppb for the lower measurement range. A footnote denoting this specific requirement is being added to Table B–1. We are eliminating the total interference equivalent requirement for SO_2 analyzers, and Table B–1 is being revised to incorporate this change.

The 24-hour span drift at 80% of the upper range limit for SO_2 analyzers is being lowered to ±3% in Table B–1 to be in line with current technology. Also, unrelated to SO_2, a typographical error for the noise requirement for CO analyzers is being corrected to 0.5 ppm in Table B–1.

Finally, information on generation and verification of test concentrations for naphthalene was inadvertently omitted from Table B–2, Test Atmospheres, even though it was added as a required interferent test in our proposal. Therefore, we are adding that information for naphthalene. Also in Table B–2, we are correcting the verification information for nitric oxide.

B. Network Design

Ambient SO_2 monitoring data are collected by State, local, and Tribal monitoring agencies ("monitoring agencies") in accordance with the monitoring requirements contained in

40 CFR parts 50, 53, and 58. A monitoring network is generally designed to measure, report, and provide related information on air quality data as described in 40 CFR Part 58. To ensure that the data from the network is accurate and reliable, the monitors in the network must meet a number of requirements including the use of monitoring methods that EPA has approved as Federal Reference Methods (FRMs) or Federal Equivalent Methods (FEMs) (discussed in some detail above in section IV.A), focusing on particular monitoring objectives, and following specific siting criteria, data reporting, quality assurance and data handling rules or procedures.

With the revision to the SO_2 NAAQS, which establishes a new 1-hour averaging period intended to limit short-term exposures that may occur anywhere in an area, EPA evaluated the existing network to determine if it was adequate to support the revised SO_2 NAAQS. A significant fact for ambient SO_2 concentrations is that stationary sources are the predominant emission sources of SO_2 and the peak, maximum SO_2 concentrations that may occur are most likely to occur nearer the parent stationary source, as noted in the ISA (ISA, 2–1), section II.A.1 above, and in section IV.B.1 below. According to the 2005 National Emissions Inventory, there are 32,288 sources (facilities) emitting SO_2, of which 1,928 are emitting 100 tons per year (tpy) or more. In the proposal (74 FR 64851), EPA had anticipated requiring 348 source-oriented monitors in the network design based on a population and emissions metric and a State's emissions contribution to the National Emissions Inventory (NEI). In response to this proposal, EPA received numerous comments arguing that the required number of monitors in the network would be too small. Other commenters argued that expanding the monitoring to an adequate scale would impose a large burden and expense on the States. Some commenters referred to SO_2 modeling in their submissions as an addition or alternative to monitoring. Consequently, as part of developing a balanced response to these comments, we revisited how we had historically dealt with SO_2 for various purposes including designations and implementation through permitting and emissions limitations. As explained in section III, this has been realized through a combined monitoring and modeling approach. As set out below, and in sections III, VI, and VII, our ultimate intention is to utilize a combined monitoring and modeling approach, a hybrid analytic approach, to assess compliance with the revised SO_2 NAAQS.

As a result of this contemplated hybrid analytic approach, the minimum number of monitors required in the network through this rulemaking is reduced to approximately 163 monitors from the approximated 348 monitors that were proposed. This section of the preamble includes a discussion of the proposal, the comments received, and the details of and the rationale for the final changes to the SO_2 network design requirements.

1. Approach for Network Design

a. Proposed Approach for Network Design

To fully support the proposed revision to the SO_2 NAAQS, EPA indicated the need to identify where short-term, peak ground-level concentrations—*i.e.*, concentrations from 5 minutes to one hour (or potentially up to 24 hours)—may occur. Given that large stationary sources are the predominant source of emissions, monitoring short-term, peak ground-level concentrations would require monitors to be sited to assess impacts of individual or groups of sources and therefore be source-oriented in nature. As a result, under a monitoring-focused approach, EPA proposed a two-pronged monitoring network of all source-oriented monitors. However, due to the multiple variables that affect ground level SO_2 concentrations from individual or groups of sources, including stack heights, emission velocities, stack diameters, terrain, and meteorology, EPA could not specify a source specific threshold, algorithm, or metric by which to require monitoring. The design of the proposed network represented a primarily monitoring-focused approach to assess compliance with the primary SO_2 NAAQS.

In preparation for the SO_2 NAAQS proposal, EPA conducted an analysis of the approximately 488 SO_2 monitoring sites operating during calendar year 2008 (Watkins and Thompson, 2009). This analysis indicated that approximately ~ 35% of the monitoring network was addressing locations of maximum (highest) concentrations, likely linked to a specific source or group of sources. Meanwhile, just under half (~ 46%) of the sites were reported to be for the assessment of concentrations for general population exposure. These data allowed EPA to conclude that the network [24] was not properly focused to support the revised NAAQS (under the assumption that source-oriented monitoring data would be the primary tool for assessing compliance with the NAAQS). As a result, EPA proposed a two-pronged monitoring network (74 FR 64850), based on the premise of a monitoring-focused approach, with minimum requirements for: (1) Monitors in urban areas where there is a higher coincidence of population and emissions, utilizing a Population Weighted Emissions Index (PWEI), and (2) monitors in States based on each State's contributions to the national SO_2 emissions inventory. In addition, all the monitors in the network would be sited at locations of expected maximum hourly concentrations and therefore likely be source-oriented. This two-pronged network would have resulted in a minimum of approximately 348 monitors nationwide [25] providing data for comparison with the 1-hour standard and supporting its implementation.

Under the first prong of the network design, EPA proposed that the ambient SO_2 monitoring network account for SO_2 exposure by requiring monitors in locations where population and emissions may lead to higher potential for population exposure to peak hourly SO_2 concentrations. In order to do this, EPA developed a Population Weighted Emissions Index (PWEI) that uses population and emissions inventory data at the CBSA [26] level to assign required monitoring for a given CBSA (with population and emissions being obvious relevant factors in prioritizing numbers of required monitors). The PWEI for a particular CBSA was proposed to be calculated by multiplying the population (using the latest Census Bureau estimates) of a CBSA by the total amount of SO_2 emissions in that CBSA. The CBSA SO_2 emission value would be in tons per year, and calculated by aggregating the county level emissions for each county in a CBSA. We would then divide the resulting product of CBSA population and CBSA SO_2 emissions by 1,000,000 to provide a PWEI value, the units of

[24] Prior to this rulemaking there were no minimum monitoring requirements, except for those required at the multi-pollutant National Core (NCore) monitoring sites. The monitoring rule promulgated in 2006 (71 FR 61236) removed minimum monitoring requirements (except for those NCore stations). This change was largely driven by the fact that there was no longer an SO_2 nonattainment problem under the then-existing standards. However, this logic does not apply to the revised primary SO_2 NAAQS.

[25] Required monitor estimates were based on 2008 Census estimates and the 2005 National Emissions Inventory.

[26] CBSAs are defined by the U.S. Census Bureau, and are comprised of both Metropolitan Statistical Areas and Micropolitan Statistical Areas (*http://www.census.gov*).

which would be millions of people-tons per year.

We proposed that the first prong of the SO_2 network design require monitors in CBSAs, according to the following criteria. For any CBSA with a calculated PWEI value equal to or greater than 1,000,000, a minimum of three SO_2 monitors would be required within that CBSA. For any CBSA with a calculated PWEI value equal to or greater than 10,000, but less than 1,000,000, a minimum of two SO_2 monitors would be required within that CBSA. For any CBSA with a calculated PWEI value equal to or greater than 5,000, but less than 10,000, a minimum of one SO_2 monitor would be required within that CBSA. EPA estimated that the proposed criteria would have resulted in 231 required sites in 131 CBSAs.

Under the second prong of the network design, EPA proposed to require a monitor or monitors in each State, allocated by State-level SO_2 emissions. This prong of the network design was intended to allow a portion of the overall required monitors to be placed where needed, independent of the first prong of the network design, inside or outside of CBSAs. EPA proposed to require monitors, using State boundaries as the geographic unit for allocation purposes, in proportion to a State's SO_2 emissions, *i.e.,* a State with higher emissions would have been required to have a proportionally higher number of monitors. The proposed percent contribution of individual States would have been based on the most recent NEI, with SO_2 emissions being aggregated by State. The number of required monitors per State would correspond to every one percent (after rounding) of each State's contribution to the national SO_2 inventory. EPA also proposed that each State have at least one monitor required as part of this second prong, even if a particular State contributes less than 0.5% of the total anthropogenic national emissions inventory. As a result, the proposed second prong would have required approximately 117 monitoring sites based on State-level SO_2 emissions in the most recent NEI, which at the time of the proposal, was the 2005 NEI.

EPA also stated in the proposal that the multi-pollutant National Core (NCore) monitoring sites would not have counted towards meeting the proposed monitoring requirements. However, data from the NCore would be compared to the NAAQS even though NAAQS comparisons are not the sole objective of NCore monitors. The monitoring rule promulgated in 2006 (71 FR 61236) and codified at 40 CFR Part 58 and its Appendices established the NCore multi-pollutant network requirement to support integrated air quality management data needs. In particular, NCore sites are intended to provide long-term data for air quality trends analysis, model evaluation, and, for urban sites, tracking metropolitan air quality statistics. To do this, NCore sites are required to measure various pollutants, including SO_2, but they are not source oriented monitoring sites, and therefore are not likely to be the location of maximum expected concentration in an area. NCore sites are intended to provide data representing concentrations at the broader neighborhood and urban spatial scales. These reasons were the rationale justifying why SO_2 monitors at NCore stations would not have been part of the minimum monitors required under the proposed network.

b. Alternative Network Design

EPA also solicited comment on an alternative network design, including alternative methods to determine the minimum number of monitors per State (74 FR 64854). EPA requested comment on whether a screening approach for assessing the likelihood of a NAAQS exceedance could be developed and serve as a basis for determining the number and location of required monitors. In particular, EPA requested comment on whether it should utilize existing screening tools such as AERSCREEN or SCREEN3, which use parameters such as effective stack height and emissions levels to identify facilities with the potential to cause an exceedance of the proposed standard. For that set of sources, EPA could then require States to conduct more refined modeling (using the American Meteorological Society (AMS)/EPA Regulatory Model (AERMOD)) to determine locations where monitoring should be conducted. Any screening or refined modeling would likely be carried out by States by using EPA recommended models and techniques referenced by 40 CFR Part 51, Appendix W, which provides guidance on air quality modeling. Such screening or refined modeling uses facility emission tonnage, stack heights, stack diameters, emission temperatures, emission velocities, and accounts for local terrain and meteorology in determining where expected maximum hourly concentrations may occur. In using this approach, EPA would then require States to locate monitors at the point of maximum concentration around sources identified as likely causing NAAQS exceedances. EPA also noted that this alternative approach would not distinctly use population as a factor for where monitors should be placed.

c. Public Comments

EPA received many comments on the proposed network design and the alternative network design approaches. Based on comments that were clear enough on the issue, EPA believes the commenters' positions on the network design approach generally fell into one of three categories: (1) Those who supported the two-prong approach, but suggested some modification to it, (2) those who supported the alternative network design, and (3) those who suggested other concepts for the network instead of the two approaches EPA presented in the proposal.

The commenters who generally supported the two-prong network design, but suggested some modification included some State and local air agencies (*e.g.* NACAA and nine other State groups or agency commenters) and industry groups (*e.g.* AQRL, ACC, and eight other commenters). Of this group, some of the State and local air agencies specifically commented on how EPA should modify one or both of the prongs of the proposed network design. Some particular individual suggestions will be addressed here and those comments not addressed here will be addressed in the response to comment document. However, one recurring suggestion from the State and local agency commenters in this group was that the network design leads to some duplicative and/or unneeded monitoring, and therefore they requested that EPA include a provision to "waive" the monitoring network design requirements in situations where minimum monitoring requirements appear duplicative or unnecessary. In particular, NACAA stated that it "* * * is concerned that the two pronged approach in the proposed regulation will lead to duplicative monitoring in some areas and require monitors in areas where monitors are not needed. EPA recognizes the potential for duplicative monitoring, but the proposal does not permit the removal of duplicative monitors." This NACAA comment was echoed by some of the other States who commented on the proposed approach (*e.g.* AK, FL, IL, NC, SC, and WI). The industry commenters were also generally supportive of the two-prong approach, with some making general suggestions to modify the network design. For example, AQRL stated that the "* * * network design proposal seems to provide the flexibility for States and the EPA regions to work together to arrive at the adequate monitoring network." AQRL also

suggests that "a State/local area should have the option to shutdown or relocate any site mandated [by monitoring requirements] if measured design values at the site are less than 75% of the selected standard level." Multiple industry commenters (*e.g.* API, LEC, and RRI Energy) expressed concern that the proposed network design had no monitoring required specifically to measure background concentrations of SO_2. Dow Chemical suggested that EPA maintain some of the existing monitors that characterize population exposure and other non-source oriented sites for trends analysis.

Those commenters who did not support the proposed network design, and instead generally supported the concepts of the alternative network design, include public health and environmental groups (*e.g.* ALA, CBD, EDF, EJ, NRDC, and SC) and the States of Delaware and Iowa. In particular, ALA, EDF, NRDC, and SC stated "* * * the proposed 348 monitors are a grossly inadequate number to detect peak concentrations from the nearly 2,000 major sources that emit more than 100 tons per year of sulfur dioxide * * *" and that "it is most appropriate to use screening tools to site all the monitors in the areas of highest expected concentration * * *" The Center for Biological Diversity, with regard to the proposed network design, stated that "* * * a number of communities with very significant SO_2 emissions will not have any monitoring stations at all * * *" Further, the State of Iowa claimed that "the proposed design of the SO_2 ambient monitoring network provides insufficient assurances that the public is protected from the health effects of SO_2 exposure," and suggested that "* * * the final rule contain provisions that require monitors to be sited only at locations where dispersion modeling indicates that the NAAQS is violated."

Commenters also suggested other concepts for the monitoring network design in lieu of the approaches discussed in the proposal. NESCAUM, NYSDEC, and PADEP, all suggested using an emissions-only approach to trigger required monitoring instead of using the PWEI to require monitors in an area. For example, NYSDEC suggests that the proposed approach, using the PWEI, is "* * * not more predictive than using emissions data alone." NYSDEC went on to recommend that monitors be required in CBSAs with aggregated emissions of 50,000 tons per year or more and that ambient monitoring be considered for point sources with 20,000 tons per year. PADEP made several suggestions on network design, including monitoring in any CBSA "where there is a sulfur dioxide source or combination of sources within 50 miles emitting a total of at least 20,000 tons of SO_2 per year * * *"

Among all three groups of commenters discussed above, there was a subset of commenters who specifically mentioned using modeling in some form. Modeling was a component of the alternative network design, where monitors would be required based on screening models and possibly refined modeling of individual sources. EPA also expected that under the proposed approach, many States would use modeling as a quantitative analysis tool to site required monitors. Finally, source modeling is a critical element for PSD and facility permitting. In their comments, NESCAUM recommended that EPA allow modeling to be used in conjunction with monitoring data to better determine nonattainment areas. North Carolina advocated that EPA require SO_2 sources, without specifying a threshold size for sources, to perform modeling to demonstrate that fence-line (ambient) air does not exceed the NAAQS due to that particular source's emissions. North Carolina went on to suggest that if a source's modeling showed an exceedance of the NAAQS, the source could "then be required to reduce emissions from the stack, install continuous emissions monitoring (CEM) in the stack itself, or require a fence-line monitor at the target facility." North Carolina also stated, in the context of discussing its own PSD program, that "the costs for modeling are small compared to the costs for monitoring." Sierra Club stated that EPA should "* * * employ modern computer models to determine whether areas should be designated nonattainment because they do not meet the NAAQS in areas where there is no monitor." From these comments, EPA gathers that some public commenters find modeling a useful tool and support the use of modeling to ascertain ambient concentrations of SO_2.

2. Modeling Ambient SO_2 Concentrations

EPA considered the various and sometimes competing concerns raised by the commenters including duplicative monitoring, lack of adequate number of monitors, insufficient flexibility, the monitoring burden, and the modeling suggestions. EPA considered its historic practice and the analytic tools available to arrive at a balanced approach that took into account these concerns. In the past, EPA used a combination of modeling and monitoring for SO_2 during permitting, designations, and re-designations in recognition of the fact that a single monitoring site is generally not adequate to fully characterize ambient concentrations, including the maximum ground level concentrations, which exist around stationary SO_2 sources. With representative and appropriate meteorological and other input data, refined dispersion models are able to characterize air quality impacts from the modeled sources across the domain of interest on an hourly basis with a high degree of spatial resolution, overcoming the limitations of an approach based solely on monitoring. By simulating plume dispersion on an hourly basis across a grid of receptor locations, dispersion models are able to estimate the detailed spatial gradients of ambient concentrations resulting from SO_2 emission sources across a full range of meteorological and source operating conditions. The 1-hour NAAQS is intended to provide protection against short-term (5 minute to 24 hour) peak exposures, whether they result from typical meteorological conditions or not. Because ambient monitors are in fixed locations and a single monitor can only represent impacts which occur at the location of the monitor, a single monitor cannot identify all instances of peak ground-level concentrations if, for example, different wind directions on various days cause peak ground-level concentrations in different areas that do not overlap. The uncertainty associated with this limitation is much higher for an hourly standard than a long-term standard due to the higher degree of spatial and temporal variability associated with peak hourly impacts (discussed in ISA chapters 2.4 and 2.5). This limitation of ambient monitoring may be true even if the source-oriented ambient monitor was sited with the aid of modeling data, since the model is less reliable at predicting the precise location of maximum impacts than at predicting the distribution of impacts across the full modeling domain, and no single monitor can be sited in a way to always measure the peak ground-level SO_2 concentrations that may be occurring in the area around a source.

EPA's *Guideline on Air Quality Models,* Appendix W to 40 CFR Part 51, provides recommendations on modeling techniques and guidance for estimating pollutant concentrations in order to assess control strategies and determine emission limits. These recommendations were originally published in April 1978 and were incorporated by reference in the PSD regulations, 40 CFR sections 51.166 and

52.21 in June 1978 (43 FR 26382). The purpose of Appendix is to promote consistency in the use of modeling within the air quality management process. Appendix W is periodically revised to ensure that new model developments or expanded regulatory requirements are incorporated. The most recent revision to Appendix W was published on November 9, 2005 (70 FR 68218), wherein EPA adopted AERMOD as the preferred dispersion model for a wide range of regulatory applications in all types of terrain. AERMOD is a steady-state plume dispersion model that employs hourly sequential preprocessed meteorological data to simulate transport and dispersion from multiple point, area, or volume sources for averaging times from one hour to multiple years, based on an advanced characterization of the atmospheric boundary layer. AERMOD also accounts for building wake effects (*i.e.,* downwash) on plume dispersion. To support the promulgation of AERMOD as the preferred model for near-field dispersion (50 km or less), EPA evaluated the performance of the model across a total of 17 field study data bases (Perry, *et al.,* 2005; EPA, 2003), including several field studies based on model-to-monitor comparisons of SO_2 concentrations from operating power plants.

EPA anticipates that additional guidance for States may be needed to clarify how to conduct dispersion modeling under Appendix W to support the implementation of the new 1-hour SO_2 NAAQS. Although AERMOD is identified as the preferred model under Appendix W for a wide range of applications and will be appropriate for most modeling applications to support the new SO_2 NAAQS, Appendix W allows flexibility to consider the use of alternative models on a case-by-case basis when an adequate demonstration can be made that the alternative model performs better than, or is more appropriate than, the preferred model for a particular application.

In conclusion, EPA believes that a hybrid analytic approach that uses a combination of modeling and monitoring information addresses the varying and competing concerns expressed by the commenters. Modeling large emission sources, along with smaller sources with the potential to violate the NAAQS, deals effectively with the concern that the monitoring network is not large enough to account for all sources that could have high ambient SO_2 concentrations. EPA believes that more SO_2 sources will ultimately be directly addressed through modeling alone versus the number of sources which would have been monitored under the proposed network design (which proposed a minimum of 348 monitors). Because modeling provides a technically appropriate and efficient method to identify locations of maximum concentrations attributable to the major stationary SO_2 sources, in the final network design (discussed below in section IV.B.4), EPA is not requiring that monitors must be in locations of expected maximum concentration, and thus, typically source-oriented. Instead, monitors required under the final network design now can address multiple monitoring objectives (discussed in IV.B.3 below), with fewer number of monitors required overall than the number estimated in the proposal. The flexibility that States now have, where relatively fewer required monitors may be sited to meet multiple objectives, effectively addresses concerns about duplicative monitoring and the need for waivers, the need for measuring background concentrations, and that emissions data rather than the PWEI could be more predictive of high ambient SO_2 concentrations as a basis on which to require monitoring. The comments that suggested the use of modeling, along with an examination of past practice, resulted in the change to a hybrid approach where we use both modeling and monitoring to assess ambient SO_2 concentrations.

3. Monitoring Objectives

Because EPA contemplates an ultimate approach that combines both monitoring and modeling, the monitor objectives of the final network design are now broadened to include assessment of source impacts, highest concentration, population exposure, general background concentrations, SO_2 transport, and long-term trends. The following paragraphs provide background, rationale, and details for the final changes to monitoring objectives.

a. Proposed Monitoring Objectives

EPA proposed that all minimally required monitoring sites in the proposed two-prong network design be sited at locations of expected maximum 1-hour concentrations, which would also likely discern 5-minute peaks. EPA noted that in general, such locations would be close to larger emitting sources (in tons per year) and/or areas of relatively high emissions densities where multiple sources may be contributing to peak ground-level concentrations. As a result, the proposed monitoring network would have been comprised primarily of source-oriented monitors. EPA also proposed that when selecting monitoring sites from among a pool of candidate locations (which would be source-oriented under the proposed network design), States prioritize these sites based on where the maximum expected hourly concentrations would occur in greater proximity to populations. EPA solicited general comments on the role of population exposure in the site selection process.

b. Public Comments

Commenters discussed a variety of issues on the subject of monitoring objectives including the importance of considering population exposure, the need for flexibility in monitor placement, monitoring for background concentrations, monitoring for long term trends analysis, and characterizing potential long-range transport of SO_2.

EPA received many comments from States (*e.g.,* NACAA, DE, IL, IN, MO, SD, WI), the public health group ATS, and industry (*e.g.,* AQRL, Consumers Energy, Dominion, Dow, EPRI, ExxonMobil, Montana Sulfur and Chemical, NPRA, Portland Cement, Rio Tinto, and UARG) suggesting that required monitors account for, or be focused on, population exposure. EPA also received many comments from States (*e.g.,* NACAA, NESCAUM, FL, IL, IN, IA, MI, OH, SC, and WI) and industry (*e.g.,* API, Dow, and TxOGA) asking for more flexibility in (source-oriented) monitor placement with regard to both the target source and the physical location of a monitor relative to that source. For example NACAA stated that "for source oriented monitors, placement at the point of 1-hour maximum concentration must be realistic and flexible. EPA must allow agencies to determine the most scientifically defensible location, while taking into account potential exposures and access to locations with adequate siting." Wisconsin stated that "* * * monitor siting should be balanced toward population-based monitors with a preference toward maximum exposure." Wisconsin added that "* * * placing monitors at the maximum downwind location does not necessarily result in effective protection of public health."

EPA received a number of comments on background monitoring [27] from industry (API, LEC, and RRI Energy) and from the State of South Carolina. API stated that "because the monitors provide background concentrations

[27] Background monitoring can be considered to be representative of ambient concentrations upwind of (and therefore not typically influenced by) a geographic area such as an urban area, or of an individual or group of emission sources.

needed to model impacts of new sources or sources undergoing major modification in addition to providing data for judging compliance with the NAAQS, it is important that some monitors be sited in a manner suitable for assessing this background." API went on to state that "* * * EPA should encourage States to site an appropriate number of area-wide monitors for use in establishing ambient background levels of SO_2." South Carolina states that "to better support the monitoring objectives, in particular those improving our understanding and context for the source oriented monitoring data, the monitoring requirements must include the ability for States to address the needs for area and regional background concentration measurements."

A number of commenters, including States (*e.g.,* Missouri, NESCAUM, Ohio, and South Carolina), citizens (Valley Watch at the Atlanta public hearing), the CBD, and Dow, commented on SO_2 transport and related cross-boundary monitoring. Dow stated that "SO_2 distribution has long been known as an interstate issue with the vast majority of SO_2 sources being power plants and other fossil fuel combustion facilities. These facilities are more likely to impact distant areas than local areas and the resultant ground-level concentrations are often minimal." Ohio stated that, under the proposed approach, "* * * it is likely that OH, WV, KY, and IN will find sources along the Ohio River which could result in monitors being located across the river from each other." In such situations, Ohio asserts that "States are capable of working with our neighbors to determine which State would be in the best position to site and operate a monitor."

c. Conclusions on Monitoring Objectives

A hybrid analytical approach, as noted above in section III and IV.B.1 would ultimately make the most appropriate use of available tools such as modeling and monitoring. Thus, unlike under the proposal, the monitoring network will not have to be focused solely at locations of expected maximum concentration relative to an SO_2 source given the anticipated adoption of a hybrid analytical approach. The final network design is intended to be flexible to meet multiple monitoring objectives, most of which were identified in the public comments. Ambient monitoring networks are generally designed to meet three primary monitoring objectives, as listed in 40 CFR Part 58 Appendix D, Section 1, including: (1) Providing air pollution data to the general public in a timely manner, (2) support compliance with ambient air quality standards and emissions strategy development, and (3) support air pollution research studies (which includes health studies and research). In order to support these air quality management objectives, monitoring networks can have a variety of monitoring sites that can be sited, as necessary, to characterize (a) emission sources (*i.e.,* source-oriented monitoring), (b) the highest concentration in an area, (c) population exposure, (d) general background concentrations, (e) regional transport, and (f) welfare-based impact.

In light of the approach described in section III and further in IV.B.1 above, EPA is finalizing an SO_2 network design, with broadened objectives, which EPA believes will address the concerns noted in the public comments above, particularly those regarding siting flexibility, population exposure, cross-boundary impacts, and the need for the network to address multiple monitoring objectives. The final network design requires that any SO_2 monitors required in a particular CBSA as determined based on PWEI values, discussed below in section IV.B.4, shall satisfy the minimum monitoring requirements if they are sited at locations where they can meet any one or more of the following objectives (*see* Part 58 Appendix D section 4.4.2 as added by today's final rule):

(1) *Source-Oriented Monitoring:* This is accomplished with a monitor sited to determine the impact of significant sources or source categories on air quality. In some situations, such monitoring sites may also be classified as high concentration sites (discussed below). Examples of source-oriented monitors include those sited to capture or assess peak ground-level concentrations from one or more major SO_2 sources, or those sited in an area with multiple smaller sources with overlapping plumes.

(2) *Highest Concentration:* This is assessed by a monitor sited to measure the highest concentrations expected to occur in the area covered by the network. Such a location may, or may not, also be considered a source-oriented location (discussed above). Depending on the case, this location is representative of the highest concentration occurring across a relatively homogeneous area with spatial scales typically ranging from tens of meters up to four kilometers.[28]

(3) *Population Exposure:* This is assessed by a monitor sited to measure typical concentrations in areas of (relatively) high population density. Some examples are a monitor placed in an area of elevated or high SO_2 concentrations that also has a high population density, an area that might be included in public health studies, or in areas with vulnerable and susceptible populations.

(4) *General Background:* This is assessed by placing a monitor in an area to determine general background concentrations. Such locations might be considered to be representative of ambient concentrations upwind of (and therefore not typically influenced by) a geographic area such as an urban area, or of an individual or group of emission sources. EPA notes that although a required monitor is allowed to be sited to assess background concentrations, the required monitor is not allowed to be sited outside of the parent CBSA (whose PWEI value triggered required monitoring, discussed in section IV.B.4 and IV.B.5). If a State believes that there is a need to conduct background monitoring outside of CBSAs with required monitoring, EPA notes that States always have the prerogative to conduct monitoring above the minimum requirements in any location the State believes is appropriate.

(5) *Regional Transport:* This is assessed by placing a monitor in a location to determine the extent of regional pollutant transport. Such locations could be either upwind or downwind of urban areas, characterizing the entry or exit of the pollutant in a region, respectively. EPA notes that although a required monitor is allowed to be sited to assess regional transport, the required monitor is not allowed to be sited outside of the parent CBSA (whose PWEI value triggered required monitoring, discussed in section IV.B.4 and IV.B.5). If a State believes that there is a need to conduct background monitoring outside of CBSAs with required monitoring, EPA notes that States always have the prerogative to conduct monitoring above the minimum requirements in any location the State believes is appropriate.

In regard to the public comments expressing concerns on the issue of cross-boundary transport, *i.e.,* a source on one side of a political boundary contributes to peak ground-level concentrations on the other side of that boundary, EPA will allow a required monitor to be placed outside of the parent CBSA (whose PWEI value triggered monitoring, discussed in section IV.B.4 and IV.B.5) under one

[28] Spatial scales are defined in 40 CFR Part 58 Appendix D, section 1. Each scale is a description of the physical dimensions of an air parcel nearest a monitoring site throughout which pollutant concentrations are reasonably similar.

particular condition. A source-oriented monitor may be sited outside of the parent CBSA, whose PWEI value triggered required monitoring, if that monitor is characterizing the location of expected maximum concentration of a source inside that parent CBSA. If a State chooses to exercise this flexibility in source-oriented monitor siting, the State must provide clear rationale for their choice in their annual monitoring plan, which is subject to EPA regional approval. If the source-oriented monitor is to be placed in another State, such as the example provided by the State of Ohio in the public comments above, the two States are responsible for collaboration on the location and operation of that monitoring site.

Further, due to the broadened objectives of the final network design, EPA also is finalizing the provision that an NCore SO_2 monitor within a CBSA (where a CBSAs PWEI value triggered required monitoring) can be counted towards meeting the minimum monitoring requirements in this rulemaking (discussed in section IV.B.4) because they can meet some of the expanded objectives of the network. NCore sites are intended to provide long-term data for air quality trends analysis, model evaluation, and, for urban sites, tracking metropolitan air quality statistics, and therefore are appropriate to allow to count towards minimum monitoring requirements under the revised monitoring scheme.

Finally, EPA strongly encourages State and local air agencies to consider using required monitoring, as appropriate, to characterize those sources which are not as conducive to dispersion modeling and to assess population exposure. Sources that are not conducive to dispersion modeling include (1) sources classified as non-point sources (a.k.a. "area-sources") such as shipping ports, (2) a source situated in an area of complex terrain and/or situated in a complex meteorological regime, and (3) locations that have multiple, relatively small sources with overlapping plumes.

4. Final Monitoring Network Design

The use of a hybrid analytic approach (discussed above in section III and IV.B.1) makes it unnecessary for the final monitoring network design to be distinctly focused on monitoring locations of expected maximum concentration (and thus be primarily source-oriented), as discussed in section IV.B.3 above. Instead, with the dual use of modeling and monitoring for designations, the final monitoring network is designed to provide flexibility for required monitors to address the multiple monitoring objectives just discussed in the preceding section. This flexibility in monitoring objectives is in response, in part, to the many public comments received from States (*e.g.,* NACAA and six other States), industry (API, EPRI, UARG, and eight other groups), and from the American Thoracic Society (ATS), urging EPA to ensure that some or all of the required monitors be sited and suited to characterize population exposure and, from many of these same commenters, to allow flexibility in implementing the siting requirements for the monitors. Under a hybrid approach, and the different monitoring objectives resulting thereof, the final monitoring network design also does not need to be a two-prong approach like the one proposed. Therefore, EPA is adopting a modified version of the first prong of the proposed network design, which will use PWEI values to require monitors in certain CBSAs where there is increased coincidence of population and SO_2 emissions. There is no second prong in the final network design by which monitors are required based on a State's individual contribution to the national anthropogenic SO_2 inventory, as was proposed.

The final monitoring network design requires monitoring in CBSAs based on calculated PWEI values, where a PWEI shall be calculated (as discussed in section IV.B.5 below) for each CBSA. For any CBSA with a calculated PWEI value equal to or greater than 1,000,000, a minimum of three SO_2 monitors are required within that CBSA. This requirement remains the same as proposed. For any CBSA with a calculated PWEI value equal to or greater than 100,000, but less than 1,000,000, a minimum of two SO_2 monitors are required within that CBSA. For any CBSA with a calculated PWEI value equal to or greater than 5,000, but less than 100,000, a minimum of one SO_2 monitor is required within that CBSA. EPA has adjusted the thresholds for requiring one or two monitors in a CBSA and the rationale for this adjustment is explained more fully below in section IV.B.5. As just explained in section III.B.3, these monitors shall be sited to meet one or more of a number of monitoring site objectives, including the assessment of source impacts, highest concentrations, population exposure, general background, and regional transport. EPA believes that the monitors required within these PWEI breakpoints provide a reasonable minimum number of monitors in a CBSA, where there is a relatively increased coincidence of population and SO_2 emissions and therefore increased potential for exposures, because we are directly accounting for both population and emissions that exist in individual CBSAs.[29] EPA estimates that these minimum monitoring criteria (based on 2008 population and 2005 NEI data) require 163 monitors within 131 CBSAs. EPA also intends for SO_2 monitors at NCore stations to satisfy these minimum monitoring requirements. Based on analysis of proposed and approved NCore sites (as of April 2010), all of which are scheduled to be operational no later than January 1, 2011, EPA estimates that 52 of the total 80 SO_2 monitors at NCore stations are within the 131 CBSAs that have required monitors based on their PWEI values. As a result, EPA estimates that between these minimum monitoring requirements and the NCore network, there will be at least 191 SO_2 monitors operating across the country.

5. Population Weighted Emissions Index

In the proposal, EPA had introduced a metric based on population and emissions as a basis for locating monitors in the network. EPA anticipated that this metric would characterize the potential for exposure based on the proximity of source emissions to populations. The following paragraphs provide background, rationale, and details for the final changes of the calculation and use of the Population Weighted Emissions Index in determining minimum monitoring requirements.

a. Proposed Use of the Population Weighted Emissions Index

In the proposed network design approach, which utilized a two-prong network design, EPA created the Population Weighted Emissions Index (PWEI) in an attempt to focus monitoring resource where there was a higher proximity of population and SO_2 emissions. In effect, areas with higher PWEI values have higher potential for population exposure to short-term SO_2 emissions. EPA proposed that the PWEI be calculated using population and emissions inventory data at the Core Based Statistical Area (CBSA)[30] level to assign required monitoring for a given CBSA, with population and emissions being the relevant factors. To calculate the PWEI for a particular CBSA, using

[29] The rationale for finalizing the use of the PWEI and the number of monitors required through its application are discussed in section III.B.4.

[30] CBSAs are defined by the U.S. Census Bureau, and are comprised of both Metropolitan Statistical Areas and Micropolitan Statistical Areas (*http://www.census.gov*).

the latest Census Bureau estimates, the population of a CBSA must be multiplied by the total amount of SO_2 emissions in that CBSA. The CBSA emission value is in tons per year (using the latest available National Emissions Inventory [NEI] data), and is calculated by aggregating the county level emissions for each county in a CBSA. We then divide the resulting product of CBSA population and CBSA SO_2 emissions by 1,000,000 to provide a PWEI value in more manageable units of millions of people-tons per year.

With the change in the approach discussed in section III and section IV.B.1 above, and considering the final monitoring network design discussed in IV.B.4 above, the use of the PWEI from that which was proposed also changes. The following paragraphs discuss some of the public comments received on the general use and calculation of the PWEI; other comments that focused on the detailed application of the PWEI as proposed will be addressed in the response to comments document since our approach in applying the PWEI has changed.

b. Public Comments

EPA received a number of comments from State and local groups (*e.g.,* NACAA and eight others) and industry (*e.g.,* AQRL, ACC, and eight others) who generally agreed with the two-pronged network design concept which had the PWEI as a component. More specifically, some State commenters (*e.g.* NACAA, AK, FL, IL, NC, SC, and WI) expressed concern that the PWEI (along with the second prong of the proposed network design) created monitoring requirements that were "duplicative" and also called for monitors in areas where they were not needed. Even amongst some of the commenters who generally agreed with the PWEI concept, some provided examples of where the PWEI appeared to be duplicative in its proposed application. One example was provided by the State of Florida, "in the case of Homosassa Springs, the [proposed network design] requires two monitors [in that CBSA as a result of the proposed use of the PWEI]. The driving source is the Crystal River Power Plant, with emissions in 2008 of over 85,000 tons per year of SO_2. The next largest source in the CBSA has emissions of roughly two tons per year." EPA believes that Florida is asserting that the one large source disproportionately drove the PWEI too high for that particular CBSA and only one monitor was actually needed. EPA notes that these particular comments on duplicative monitoring were made under the premise that all proposed required monitors would be sited in locations of expected maximum concentration, and therefore would be source-oriented in nature. As a result, these commenters believed it was necessary that a waiver provision be included if they could show that the required number of monitors was too many, as in Florida's example.

As discussed in section IV.B.4 above, a hybrid approach results in a final network design with a reduced number of required monitors from the number proposed, a different application of the PWEI, and provides flexibility in meeting additional monitoring objectives for the required monitors, making the need for a waiver from the minimally required monitors unnecessary. If a CBSA is required to have multiple monitors now, those monitors are not specifically required to be located near sources where maximum concentrations of SO_2 are expected to occur. Instead, they can be sited at different locations to fulfill a variety of objectives, although, as noted in secion IV.B.3 above, EPA is strongly encouraging States to consider monitoring near sources not conducive to dispersion modeling and for characterization of population exposures.

EPA received comments from Michigan, South Carolina, and CBD requesting clarification on the logic behind the proposed PWEI thresholds, or breakpoints, by which three, two, one, or no monitors would be required in a given CBSA. In addition, some States (*e.g.,* MI, MO, SC, and WI) and industry (*e.g.,* LCA, LMOGA, and LPPA) suggested specific adjustments to the proposed application of the PWEI. For example, Michigan suggested that the required monitor breakpoint values be adjusted to the "natural breakpoints in the overall distribution". South Carolina suggested EPA identify a way to normalize the PWEI stating the PWEI would be more appropriate "* * * if it used a value that better addressed difference in area, population distribution, land use, number, types of sources, *etc.*"

In the proposed network design, EPA selected the PWEI values, or breakpoints, to require one or more monitors based on the overall distribution of PWEI values across all CBSAs. Based on U.S. Census Bureau data (*http://www.census.gov*), there are approximately 939 CBSAs in the country. EPA proposed and now requires that a PWEI value be calculated for each of these CBSAs to determine if monitoring is required in that CBSA. Based on 2008 census estimates and the 2005 NEI, the average CBSA PWEI value is 21,900 while the median value is only 121. This indicates that a relatively small number of CBSAs with high PWEI values are driving the very upper end of the PWEI distribution. The proposed breakpoint where one monitor was required in a CBSA was a PWEI value of 5,000. EPA estimated that 131 out of 939 CBSAs (~14%) have a PWEI value of 5,000 or more. Further, these 131 CBSAs occupy ~98% of the sum of PWEI values across all 939 CBSAs, where high PWEI values indicate increased coincidence in population and SO_2 emissions. Within this group of CBSAs with PWEI values of 5,000 or more, EPA considered the relative amounts of population, emissions, and general frequency of occurrence of relatively larger SO_2 sources (such as those that emit 100 tons per year or more) in selecting the breakpoints to require two and three monitors in a CBSA for the proposed network design. These considerations were made in an effort to apply a nationally applicable process by which to require a minimum number of monitors for an area, which all were to be sited in locations of expected maximum concentration, and therefore likely source-oriented monitors. In regard to the comments suggesting modification to the calculation or to normalize the PWEI, EPA believes that the proposed calculation, under a hybrid analytical approach, is still most appropriate. Under a hybrid analytical approach, States have the flexibility to move monitoring resources where needed within CBSAs that have a high coincidence of population and emissions instead of only being able to site monitors to characterize sources. States have the option to consider additional factors such as those listed in South Carolina's comments above in further identifying where required monitoring may be most appropriate in their areas with required monitoring.

Several States (*e.g.* NESCAUM, NYSDEC, and PADEP) suggested abandoning the PWEI concept altogether and instead using some form of emissions-only approach to require monitors. For example, NESCAUM, who generally supported a "hot-spot" monitoring approach, suggested that the PWEI be abandoned and EPA instead "* * * adopt an emissions-only approach, resulting in fewer CBSA monitors. We [NESCAUM] suggest a threshold of 50,000 tpy CBSA SO_2 emissions to trigger the first CBSA monitor and a second CBSA monitor required when emissions exceed 200,000 tpy." NESCAUM states that the proposed use of the PWEI "* * * can

result in multiple monitors in large cities that have relatively small CBSA SO_2 emissions, or no monitor in a CBSA with large emissions." NYSDEC suggests that the proposed approach, using the PWEI, is "* * * not more predictive than using emissions data alone." NYSDEC went on to suggest that monitors be required in CBSAs with aggregated emissions of 50,000 tons per year or more and that ambient monitoring be considered for point sources with 20,000 tons per year. PADEP made several suggestions on network design, with one that suggested monitoring in any CBSA "where there is a sulfur dioxide source or combination of sources within 50 miles emitting a total of at least 20,000 tons of SO_2 per year * * *"

EPA reviewed emissions and 2005 NEI data and compared the suggestions provided by NESCAUM and NYSDEC to the requirement of the final network design. Under NESCAUM's suggested design, EPA estimates there would be 75 required monitors in 65 CBSAs. Of these 65 CBSAs, 6 CBSAs that are not covered by the final network design would be included; however, 72 CBSAs that will have monitors under the final network design would otherwise not have monitors under NESCAUM's design. EPA believes that the exclusion of those 72 CBSAs would lead to too sparse a network to adequately meet the monitoring objectives of the network. Under NYSDEC's suggested network design, EPA estimates that there would be a minimum of 65 monitors in the same 65 CBSAs of the NESCAUM suggested design. Further, if States ensured that monitors were placed near all sources emitting 20,000 tons per year (as NYSDEC suggested should be "considered" for monitoring), there could be an additional 69 monitors.[31] EPA believes that the final network design as discussed above in section IV.B.4, with the increased flexibility for monitors to meet multiple monitoring objectives (discussed in IV.B.3 above) including, among others, characterization of source impacts or population exposure, is better served using PWEI values to require monitors because it explicitly accounts for population to require and distribute monitors as compared to an emissions-only approach. If there is reason for concern that other CBSAs or areas not included in the final network design, such as the six CBSAs that were included in the NESCAUM and NYSDEC suggested network designs noted above, warrant monitoring resources, States or the EPA Regional Administrator may take action to require monitoring in such areas. The authority of an EPA Regional Administrator to require additional monitoring above the minimum requirements is discussed in section IV.B.6 below.

EPA received a number of comments from States (*e.g.,* IA, NESCAUM, NC, NYSDEC, SC, and WI) and industry (*e.g.,* CE, Dominion, EEI, LCA, LMOGA, LPPA, and UARG) raising concern over the way the PWEI is calculated. Specifically, many commenters in this group indicated that they believed that the 2005 NEI would be used in an exclusive or permanent fashion to calculate the PWEI, and that updated NEI data would not be used. For example, NESCAUM states that "EPA should not require States to rely solely on EPA's inventories [for calculating the PWEI], such as the National Emissions Inventory (NEI), as they do not always have the updated information that is necessary for such regulatory decisions." Wisconsin "* * * believes that States should be allowed to use their own annual point source inventories instead of EPA's National Emissions Inventory (NEI) for evaluating emission sources. Wisconsin's point inventory is updated annually and has a reporting threshold of five tons per year for SO_2, making it more sensitive to changes in facility operations than the NEI, which is updated triennially." UARG stated that their "primary concern with this network design is its reliance on old emissions data. For electric utilities which report their SO_2 emissions to EPA annually, the use of more recent data would be appropriate."

EPA does not intend for relatively old emissions data to be used in calculating the PWEI values for individual CBSAs. As was detailed in the proposed regulatory text for 40 CFR Part 58 Appendix D (74 FR 64880), EPA stated that "The PWEI shall be calculated by multiplying the population of each CBSA, using the most current census data, by the total amount of SO_2 in tons per year emitted within the CBSA area, using an aggregate of the most recent county level emissions data available in the National Emissions Inventory for each county in each CBSA." Although commenters suggested that there may be other resources from which emissions data may be obtained, particularly at the individual State level, the NEI is comprised of emissions data which is collected by EPA from the States themselves. The Air Emissions Reporting Requirements (40 CFR Part 51), by which EPA sets out how States are to report their emission inventories, was recently revised in December of 2008. That rulemaking was intended to provide enhanced options to States for emissions data collection and exchange and unify reporting dates for various categories of inventories. EPA notes that the NEI is updated in full every three years and the 2008 NEI is scheduled to be available by January 2011. States will have submitted their data by May 31, 2010, before this rule is promulgated and published, and EPA will provide comment on these submittals during the summer of 2010. States will have an opportunity to revise their 2008 data submissions in the fall of 2010. In the triennial update, both point and nonpoint data are required to be submitted by States and are included in the inventory. Further, States are required to submit emissions data annually for all sources emitting 2,500 tons per year or more of SO_2 as well as for sources emitting other pollutants in excess of thresholds set for those pollutants. In all point source submittals to the NEI, States are also allowed to submit emissions data for sources of any emissions level, but are not required to do so. Starting with the 2009 NEI, the annual and triennial State NEI submittals will be due one year after the end of the emissions year. States have an additional opportunity to revise their submittals based on EPA comment in the spring of the following year, with EPA publishing the inventory no later than 6 months after the inventory submittal dates (18 months after the end of the emissions year). This approach and schedule is accelerated over past NEI schedules and has been designed as part of the development of the new Emission Inventory System (EIS). Rather than representing old emissions data, the NEI available through EIS represents a timely and appropriate source of emissions data.

EPA believes that the process by which the NEI will be updated (through use of the EIS) will be adjusted in a manner that will allow for more frequent insertion of State supplied emissions data, allowing for a more up-to-date inventory. EPA takes this opportunity to encourage States to supply all of their available emissions information to the NEI as soon as practicable. Therefore, EPA believes that the NEI is an appropriate and nationally representative source of emissions data by which PWEI calculations may be

[31] In simulating NYSDEC's suggested network design, EPA assumed that no CBSA would have more than one monitor. According to the 2005 NEI, there are 162 sources emitting 20,000 tpy or more a year. 93 of those sources are estimated to be inside CBSAs that have emissions of 50,000 tpy, leaving approximately 62 sources that would need a monitor to satisfy NYSDEC's suggested network design.

made. PWEI calculations for all CBSAs will use the same year of data at any given time, and States, local agencies, and Tribes will have uniform opportunity for revising their emissions data for this purpose. EPA again encourages States to view the NEI submittals as their opportunity to submit their best available SO_2 and other inventory data with the knowledge that it will be used for the purpose of PWEI values.

c. Conclusions on the Use of the Population Weighted Emissions Index

In the final network design, EPA has determined that it is appropriate to use PWEI values as the mechanism by which to require monitors in certain CBSAs, similar to its use in the first prong of the proposed two-prong network design. EPA believes that using the PWEI metric to inform where monitoring is required is more appropriate for the SO_2 network design than utilizing a population-only or emissions-only type of approach, because it takes into account not just one factor, *i.e.,* only population or only emissions, but instead takes into account the exposure from SO_2 emissions to groups of people who are in greater proximity to such emissions.

In the final rule, EPA is retaining the requirement to calculate the PWEI by multiplying the population of each CBSA, using the most current census data/estimates from the U.S. Census bureau, by the total amount of SO_2 in tons per year emitted within the CBSA area, using an aggregate of county level emissions data available in the most recent published version of the National Emissions Inventory for each county in each CBSA. The resulting product shall be divided by one million, providing a PWEI value, the units of which are million persons-tons per year. For any CBSA with a calculated PWEI value equal to or greater than 1,000,000, a minimum of three SO_2 monitors are required within that CBSA. For any CBSA with a calculated PWEI value equal to or greater than 100,000, but less than 1,000,000, a minimum of two SO_2 monitors are required within that CBSA. For any CBSA with a calculated PWEI value equal to or greater than 5,000, but less than 100,000, a minimum of one SO_2 monitor is required within that CBSA. EPA believes that the monitors required within these breakpoints provide a reasonable minimum number of monitors in a CBSA that considers the combination of population and emissions that exist in a CBSA. These criteria (based on 2008 population and 2005 NEI data) are estimated to require 163 monitors within 131 CBSAs.

EPA has changed the PWEI breakpoint in the final rule at which two monitors are required in a CBSA to 100,000 from the breakpoint of 10,000 in the proposed network design based on multiple considerations. First, EPA changed the breakpoint because of a hybrid analytic approach and attendant changes in monitoring objectives (*see* section IV.B.3), with the result being that the monitoring network is no longer intended to be comprised primarily of source-oriented monitors that are sited at locations of expected maximum concentration. This change in objective of the network design allows fewer monitors to provide the necessary amount of ambient monitoring data EPA to meet the multiple monitoring objectives. Second, the breakpoint of 100,000 occurs near a "natural" breakpoint in the PWEI distribution, a consideration that Michigan suggested, where the estimated 28 CBSAs with PWEI values of 100,000 or more occupy ~87% of the sum of PWEI values across all 939 CBSAs. Finally, EPA considered commenters' assertion that the first prong of the proposed network design created duplicative monitoring in certain CBSAs. This duplicative monitoring is especially recognized in some CBSAs with relatively small populations and somewhat large emissions which are dominated by a single source (such as the Homosassa Springs, FL example discussed above). Raising the second breakpoint helps to alleviate some of the duplicative monitoring that many of the State commenters noted.

EPA therefore is keeping the first and third breakpoints, which require one monitor in a CBSA having a PWEI value of 5,000 and three monitors in a CBSA having a PWEI value of 1,000,000. EPA believes maintaining these breakpoints along with the revised 100,000 PWEI breakpoint, will (1) ensure that highly populated areas will be monitored for ambient SO_2 concentrations even if the emissions in that area are moderate, which is appropriate given the fact that the greater population creates increased potential for exposure to those moderate emissions, and (2) that those areas with higher emissions or emission densities, with moderate or modest populations will be monitored because those increased emissions are likely to have a significant impact on nearby populations.

6. Regional Administrator Authority

The following paragraphs provide background, rationale, and details for the final changes to Regional Administrator authority to use discretion in requiring additional SO_2 monitors beyond the minimum network requirements.

a. Proposed Regional Administrator Authority

EPA proposed that the Regional Administrators will have discretion to require monitoring above the minimum requirements, as necessary, to address situations where the minimum monitoring requirements are not sufficient to meet monitoring objectives. EPA recognized that the minimum required monitors in the proposed two-pronged network design were based on indicators that may not have always provided spatial coverage for all the areas that have SO_2 sources. Although the network design and the objectives of the network design have changed from those that were proposed because of our contemplated use of a hybrid analytical approach, EPA believes it is still important for Regional Administrators to have the discretion, and authority, to require monitoring above the minimum requirements. Providing the RAs with this discretion will allow them to fill any identified gaps in meeting the monitoring objectives of the network.

b. Public Comments

Some commenters (*e.g.,* LCA, LMOGA, LPPA, and South Carolina) expressed concerns with the proposed provision authorizing the Regional Administrator to require additional monitoring above the minimum requirements. The LCA, LMOGA, and LPPA stated that "the EPA's proposal to allow the Regional Administrator discretion to require a State to add additional monitors is flawed in that it provides unfettered discretion. Criteria should be added * * * that limit such discretion and require the Regional Administrator to consider certain objective factors when determining whether to require any additional ambient SO_2 monitors to the network." South Carolina stated that "the Regional Administrators should not have the discretion to require monitoring above the requirements described in [the proposal for] Part 58 and its Appendices. State monitoring organizations must be given discretion to decide the appropriate use of resources to meet uniform monitoring requirements. Additional monitoring requirements should not be imposed without concurrence of the monitoring organization and additional funding that completely supports the additional costs."

c. Conclusions on Regional Administrator Authority

The authority of Regional Administrators to require additional monitoring above the minimum required is not unique to the SO_2 NAAQS. For example, Regional Administrators have the authority to use their discretion to require additional NO_2 or Pb monitors (40 CFR Part 58 Appendix D section 4.3.4 and 4.5, respectively) and to work with State and local air agencies in designing and/or maintaining an appropriate ozone monitoring network (40 CFR Part 58 Appendix D section 4.1). EPA believes that the nationally applicable final network design, although somewhat dictated by local factors (population and emissions), may not account for all locations where monitors should be sited, including where potentially high concentrations of SO_2 may be occurring. Examples include locations that have the potential to violate or contribute to violations of the NAAQS, areas that might have high concentrations of SO_2 that are not characterized by modeling or have sources that are not conducive to modeling, and locations with susceptible and vulnerable populations. As a result, EPA believes it is important for Regional Administrators to have the authority to address possible gaps in the minimally required monitoring network, especially near sources or areas that are not conducive to modeling by granting them authority to require monitoring above the minimum requirements. However, in response to public comments, EPA notes that Regional Administrators would use this authority in collaboration with State agencies to design and/or maintain the most appropriate SO_2 monitoring network to meet the needs of a given area. For all the situations where the Regional Administrators may require additional monitoring, it is expected that the Regional Administrators will work on a case-by-case basis with State or local air agencies. Further, any monitor required through the Regional Administrator and selected by the State agency, or any new monitor proposed by the State itself, is not done so with unfettered discretion, since any such action would be included in the Annual Monitoring Network Plan per § 58.10, which must be made available for public inspection or comment, and approval by the EPA Regional Administrator.

Therefore, EPA is finalizing the proposal that Regional Administrators may use their authority to require monitoring above the minimum requirements, as necessary, in any area, to address situations where the minimally required monitoring network is not sufficient to meet monitoring objectives. In all cases in which a Regional Administrator may consider the need for additional monitoring, it is expected that the Regional Administrators will work with the State or local air agencies to evaluate evidence or needs to determine if a particular area may warrant additional monitoring.

7. Monitoring Network Implementation

The following paragraphs provide background, rationale, and details for the final approach for the monitoring network implementation.

a. Proposed Monitoring Network Implementation

EPA proposed that State and, where appropriate, local air monitoring agencies submit a plan for deploying SO_2 monitors in accordance with the proposed requirements discussed above by July 1, 2011. EPA also proposed that the SO_2 network be physically established no later than January 1, 2013. EPA also proposed that the number of sites required to operate as a result of the Population Weighted Emissions Index (PWEI) values calculated for each CBSA be reviewed and revised for each CBSA through the 5-year network assessment cycle required in § 58.10.

b. Public Comments

EPA received comments from the ALA, EDF, NRDC, and SC that supported "* * * a more accelerated deployment of new monitoring than the 2013 target date proposed by EPA. The sooner monitors are in place, the sooner the public will experience the health benefits of the new standard." However, EPA received comment from States (*e.g.,* IA, MI, NC, SC and WI), industry (*e.g.,* LCA, LMOGA, and LPPA) and public health and environmental groups (*e.g.,* ALA, EDF, NRDC, and SC) expressing concern with the proposed deployment schedule of the proposed SO_2 network in that it was too fast or needed to be phased in. The States of Iowa, South Carolina, and Wisconsin suggested that EPA allow the proposed network to deploy on a phased schedule. For example, South Carolina recommended a "phased implementation with largest source/highest probability population exposure areas designated for implementation in 2013 (some proportion of the highest PWEI monitors) and establishment of the remaining PWEI and the State level emissions triggered monitoring required the following year." Meanwhile, the States of Michigan and North Carolina, along with the industry commenters LCA, LMOGA, and LPPA, suggested EPA reconsider implementation dates in light of the multiple rulemakings that impose mandates on States that have and will be occurring in the future. For example, North Carolina stated that "EPA must keep in mind that it is simultaneously revising numerous ambient standards and associated monitoring requirements. EPA seems to view each of these proposals as independent actions; but the State and local agencies must consider the cumulative impact of EPA's various regulatory actions on their ability to comply." North Carolina goes on to say that "EPA must allow States the flexibility to prioritize among the new requirements to get community based monitors in place first and to establish the others as funding and personnel resources allow."

EPA believes that with the use of a hybrid analytical approach, the concerns raised by States and industry commenters suggesting a phased or delayed implementation are addressed because the final network minimum design requirements result in fewer monitors being required than in the proposed network design. EPA's analysis of the existing network had indicated that a substantial number of monitors were not sited at locations of maximum concentrations. These monitors would have had to be re-located to count towards minimum monitoring requirements under the proposed monitoring-focused approach. Under a combined modeling and monitoring approach, the required monitors can be used to satisfy multiple monitoring objectives and therefore, many of the monitors in the existing network will satisfy the requirements in the final network design, eliminating any need for a phased or delayed network implementation. In regard to the suggestion by public health and environmental groups to speed up implementation, EPA notes that under a hybrid analytical approach much of the existing network will fulfill minimum monitoring requirements, and an accelerated schedule is not necessary; the network implementation date provides a balance between ensuring the minimally required network is fully in place in a reasonable amount of time and providing States adequate time to fulfill all the requirements in this rulemaking.[32]

EPA received comment on the frequency by which the minimally

[32] Moreover, as explained in section IV.A, the existing FEM monitors in operation may continue to be used to monitor compliance with the NAAQS.

required network will be reviewed and possibly adjusted based on updated population and emissions inventories. The State commenters listed above, and some others including NACAA, indicated that they believed that the proposal for reviewing the SO_2 network every five years was intended to be a separate review from the required 5-year network assessments required in § 58.10(d). NACAA stated "EPA proposes that the SO_2 monitoring network be evaluated every five years. This is an unnecessary duplication of effort in light of the current requirements for the annual network plan and five year network review." NACAA went on to say that "the current requirements [in § 58.10] should be regarded as the primary source of monitoring network information for all NAAQS pollutant monitoring, regardless of the pollutant."

EPA concurs with NACAA's statements that the existing requirements for network assessment are an appropriate primary source of monitoring network information. In the proposal, EPA did not intend for a required 5-year review of the SO_2 network to be an additional effort on top of the existing required network assessments but instead to be included as part of the 5-year assessment in § 58.10(d). EPA notes that CBSA populations and emissions inventories change over time, suggesting a need for periodic review of the monitoring network. At the same time, EPA recognizes the advantages of a stable monitoring network. However, after considering comments, EPA is not finalizing the proposed language for 40 CFR Part 58 Appendix D, section 4.4.3(2) which simply referenced back to § 58.10. This proposed text it is not needed and appears to simply cause confusion. EPA asserts that the existing requirements in § 58.10 provide a sufficient and appropriate mechanism for network updates and assessment.

c. Conclusions on Monitoring Network Implementation

Based on the public comments, and due to the contemplated use of a hybrid analytical approach, EPA is finalizing, as was proposed, that State and, where appropriate, local air monitoring agencies submit a plan for deploying SO_2 monitors in accordance with the proposed requirements presented below by July 1, 2011. Minimally required SO_2 monitors shall be physically established no later than January 1, 2013.

C. Data Reporting

The following paragraphs provide background, rationale, and details for monitor data reporting requirements.

a. Proposed Data Reporting

Controlled human exposure studies indicate that exposures to peaks of SO_2 on the order of 5 to 10 minutes result in moderate or greater decrements in lung function and/or respiratory symptoms in exercising asthmatics (section II.B.1 above, ISA section 5.2, REA section 7.2.3, and REA section 10.3.3.2). As a result, the 1-hour standard is intended to protect against short term exposures, including exposures on the order of 5 minutes up to 24 hours, as is discussed in section II.F.2 above. Therefore, in support of the revised NAAQS and its intent, EPA proposed that State and local agencies shall report to AQS the maximum 5-minute block average of the twelve 5-minute block averages of SO_2 for each hour. This 5-minute block reporting requirement is in addition to the existing requirement to report the 1-hour average. In addition, EPA solicited comment on the advantages and disadvantages (including associated resource burdens) of alternatively requiring State and local agencies to report all twelve 5-minute SO_2 values for each hour or the maximum 5-minute concentration in an hour based on a moving 5-minute averaging period rather than time block averaging.

EPA also proposed Data Quality Objectives (DQOs) for the SO_2 network. DQOs generally specify the tolerable levels for potential decision error used as a basis for establishing the quality and quantity of data needed to support the objectives of the monitors. EPA proposed the goal for acceptable measurement uncertainty for SO_2 methods to be defined as an upper 90 percent confidence limit for the coefficient of variation (CV) of 15 percent for precision and as an upper 95 percent confidence limit for the absolute bias of 15 percent for bias.

b. Public Comments

EPA received many comments on the reporting of 5-minute data values. The comments generally fell into one of the following categories: [33] (1) Those State, public health, and environmental groups who supported the proposed requirement to report the maximum 5-minute block average of the twelve 5-minute block averages of SO_2 for each hour (*e.g.,* Missouri, NESCAUM, North Carolina, ALA, EJ, EDF, NRDC, and SC), (2) those State, public health, and environmental groups who supported the reporting of all twelve 5-minute averages of each hour (*e.g.,* Kentucky, NYSDEC, AQRL, ALA, ATS, CBD, EJ, EDF, NRDC, and SC), (3) those State, public health, and environmental groups who supported reporting the maximum 5-minute concentration in an hour based on a moving 5-minute average (*e.g.,* South Dakota, ALA, CBD, EJ, EDF, NRDC, and SC), and (4) those State and industry groups who did not support the reporting of any 5-minute data (*e.g.,* Iowa, South Carolina, LEC, and RRI Energy).

Public health and environmental groups (*e.g.* ALA, CBD, EJ, EDF, NRDC, and SC) supported an approach where 5-minute data must be reported. However, these commenters were flexible in their position and supported multiple forms or types of 5-minute data reporting. The ALA, EJ, EDF, NRDC, and SC stated that "we support the proposed requirement for State and local monitoring agencies to report both hourly average and maximum 5-minute averages out of the twelve 5-minute block averages of SO_2 for each hour." They also expressed a preference for alternative 5-minute data reporting stating that they "strongly prefer that States be required to report the peak 5-minute concentrations of SO_2 based on a rolling average." Similarly, CBD stated that "* * * EPA should require that State and local agencies report all 12 five-minute SO_2 values for each hour in addition to 1-hour averages. Where possible, EPA also should require reporting of rolling five-minute averages rather than block data * * *"

Missouri generally supported the proposed requirement to report the maximum 5-minute average in the hour, saying "it is not a problem to report both the hourly average and the maximum 5-minute block average." Nevertheless, Missouri went on to note constraints, stating that "* * * [their] data logger and associated software do not have the capability to report all twelve 5-minute SO_2 values for each hour" and that they "* * * could not do this without software being developed for this purpose and it could be time intensive to validate this data."

Kentucky did not support the proposal to report the maximum 5-minute data block in the hour because of the limitations in their data acquisition systems. They explained that "the data acquisition system used by the [State] does not have the capability to automatically report the maximum 5-minute block of data from an hour concentration. [State] personnel would have to manually determine that

[33] *Note* that some commenters supported more than one form of reported 5-minute data.

value and then manually enter that data into AQS." Kentucky goes on to suggest that "the only feasible option for the [State] to submit 5-minute data to AQS would be to submit all twelve 5-minute blocks of data for each hour to AQS."

South Dakota stated that its "* * * preference would be to report the maximum 5-minute average for each hour calculated using a 5-minute rolling average." South Dakota goes on to state that "* * * while doubling the work required to validate data and load the data into AQS, the additional data should help determine if the selected standard concentration level has achieved the necessary reduction in high concentration 5-minute levels and provide the necessary data for further study of health impacts * * *"

South Carolina stated that it "* * * does not support mandatory reporting of 5-minute averages in addition to the 1-hour average required for comparison to the standard. The validation and reporting of 5-minute averages imposes a significant additional burden on the reporting organization and its Quality System." Iowa, who also did not support any form of 5-minute data reporting stated that "the five-minute data is not used to determine compliance with the NAAQS, and represents ancillary data," and that "validating and uploading the five-minute data will take at least as much staff time as generating the hourly data used for compliance." As a result, Iowa states that "if EPA determines that five-minute data is needed, we recommend that EPA require the maximum five-minute average in each hour, rather than all twelve five-minute averages, in order to reduce the burden associated with generation of the ancillary data set."

With regard to the proposed DQOs, EPA received comments from some States (*e.g.,* Kentucky, North Carolina, NYSDEC, and South Carolina) providing general support for the goals for acceptable measurement uncertainty for precision and bias. North Carolina stated that the "* * * precision and bias measurement uncertainty criteria should emulate those that have been established for other recent NAAQS and NCore pollutants." NYSDEC stated that "the proposal does not seem unreasonable, however these statistics are now expressed in terms of confidence limits: Precision—90% confidence of a CV of 15% and Bias—95% confidence of a CV of 15%." NYSDEC raises concern that "* * * the results are now dependent on the number of audits performed. This is highly variable because some agencies run automatic audits every night, [while] others use the old standard of once every 2 weeks."

In regard to comments on the proposed DQOs, EPA notes that the precision and bias estimation technique on which NYSDEC comments were focused were proposed and adopted in the monitoring rule promulgated on October 6, 2006 and EPA did not intend to reopen those requirements for comment. Moreover, SO_2 precision and bias estimates have been performed in this manner for the past four years and there have been no adverse effects on data quality at the minimum required level of performance checks every two weeks. The statistics for the precision and bias estimates and the DQO goals are based on the accumulation of the one-point precision checks aggregated at the frequencies required in CFR which is every two weeks. Any organization performing more frequent checks (such as every night) would accumulate more data for the precision and bias estimates, have higher confidence in the data, and would have less potential for outliers or higher than normal values effecting the precision and bias estimate. In addition, monitoring organizations running precision checks every 24 hours would be more able to control data quality to meet the DQO goals than organizations running the check every two weeks.

c. Conclusions on Data Reporting

EPA received a fairly diverse set of comments on the appropriateness of reporting 5-minute data and in what particular format it may be provided in. EPA has considered the comments by the States regarding validation of potentially 13 data values per hour (instead of 1 or 2) and some States' lack of data acquisition capacity or processing capability to report any particular type of 5-minute value. EPA believes that in light of these comments, adopting a requirement for continuous SO_2 analyzers to report all twelve 5-minute values or a rolling 5-minute value does not appear to provide enough added value for the potential increased burden on States, such as increased staff time dedicated to data processing and QA, or in improving or adjusting data acquisition capabilities. However, EPA also believes that obtaining some form of 5-minute data is appropriate because such data have been critical to this NAAQS review, and are anticipated to be of high value to inform future health studies and, subsequently, future SO_2 NAAQS reviews.[34] Indeed, as noted earlier, it was EPA's failure to adequately explain the absence of protection from elevated short-term (5- to 10-minute exposure) SO_2 concentrations for heavily breathing asthmatics that occasioned the remand of the 1996 SO_2 primary NAAQS (American Lung Association, 134 F.3d at 392). This belief is supported further by the expectation that a significant portion of the monitors operating to satisfy the final monitoring network design will likely be sited for population exposures, which have traditionally provided ambient data that is often utilized by epidemiologic health studies. Therefore, EPA is finalizing the requirement that State and local air agencies operating continuous SO_2 analyzers shall report the maximum 5-minute block average out of the twelve 5-minute block averages in each hour, for each hour of the day, and that State and local air agencies operating any type of SO_2 analyzer shall report the integrated 1-hour average value, as was proposed. EPA encourages States capable of reporting all twelve 5-minute data blocks in an hour to report such data to AQS. AQS is currently set-up to take the 5-minute maximum value in an hour under parameter code 42406 and can take all twelve 5-minute values under parameter code 42401 (with a duration code of H). EPA notes that if a State were to choose to submit all twelve 5-minute blocks in the hour, by default, they would be submitting the maximum 5-minute data block within that hour, although they have not singled out that particular value. Since the 5-minute data is not directly being used for comparison to the NAAQS, EPA believes that any State electing to submit all twelve 5-minute values is still satisfying the intent of having the maximum 5-minute value reported. Therefore, if a State chooses to submit all twelve 5-minute values in an hour, they will be considered to be satisfying the data reporting requirement of submitting the maximum 5-minute value in an hour, and they do not have to separately report the maximum 5-minute value from within that set of data values to AQS under parameter code 42406.

EPA proposed new regulation text for 40 CFR Part 58 Appendix C, which would have added section 2.1.2 that would have required any SO_2 FRM or

[34] The REA assessed exposure and risks associated with 5-minute SO_2 concentrations above 5-minute health effect benchmark levels derived from controlled human exposure studies. In the analyses, the REA noted that very few State and local agencies report ambient 5-minute SO_2 data (REA, section 10.3.3.2) and that the lack of 5-minute data necessitated the use of statistically estimated 5-minute SO_2 data in order to expand the geographic scope of the exposure and risk analyses (REA, section 7.2.3).

FEM used for making NAAQS decisions to be capable of providing both 1-hour and 5-minute averaged concentration data. EPA is not finalizing this proposed language, as the manual wet-chemistry pararosaniline reference method cannot provide 5-minute data. Therefore, the proposed language is inappropriate. However, both the UVF FEM and the new UVF FRM continuous methods are capable of providing 5-minute averaged data. As a result, the language in 58.12(g) and 58.16(g) requiring 5-minute SO_2 data has been adjusted to appropriately specify that only those States operating continuous FRM or FEMs are required to report the maximum 5-minute data value for each hour.

With regard to acceptable measurement uncertainties, EPA reviewed summary data for each Primary Quality Assurance Organization (PQAO) in the 2008 Data Quality Indicator Report on SO_2 data within the 2008 Criteria Pollutant Quality Indicator Summary Report for AQS Data (*http://www.epa.gov/ttn/amtic/qareport.html*). Of the 100 PQAOs in the report, none of those organizations had summary CV or bias values exceeding 10 percent. Thus, EPA believes that the SO_2 network can and does easily attain measurement uncertainty criteria more stringent than the finalized goal values and the monitoring required under the final network design should be able to maintain this level of performance. Therefore, in consideration of comments and existing quality assurance data, EPA is changing the final goals from those which were proposed for acceptable measurement uncertainty for SO_2 methods to be defined for precision as an upper 90 percent confidence limit for the coefficient of variation (CV) of 10 percent and for bias as an upper 95 percent confidence limit for the absolute bias of 10 percent.

V. Initial Designation of Areas for the 1-Hour SO_2 NAAQS

This section of the preamble further addresses the process under which EPA intends to identify whether areas of the country attain or do not attain or are "unclassifiable" regarding the new 1-hour SO_2 NAAQS. After EPA establishes a new NAAQS, the CAA directs States and EPA to take this first step, known as the "initial area designations," in ensuring that the NAAQS is ultimately attained.

We are revising our discussion of an expected approach toward issuing initial area designations in response to comments we received on the proposed rule's treatment of monitoring and modeling (both generally and in the specific context of designations), and to make the expected process more consistent with our historical approach to implementing the SO_2 NAAQS. A revised anticipated approach for issuing designations logically follows from our revised hybrid approach to monitoring and modeling as discussed above in sections III and IV. It would also affect a revised expected implementation approach that we later discuss in section VI. 1. Designations.

a. Clean Air Act Requirements

The CAA requires EPA and the States to take steps to ensure that the new NAAQS are met following promulgation. The first step is for EPA to identify whether areas of the country meet, do not meet, or cannot yet be classified as either meeting or not meeting the new NAAQS. Section 107(d)(1)(A) provides that, "By such date as the Administrator may reasonably require, but not later than 1 year after promulgation of a new or revised NAAQS for any pollutant under section 109, the Governor of each State shall * * * submit to the Administrator a list of all areas (or portions thereof) in the State" that should be designated as nonattainment, attainment, or unclassifiable for the new NAAQS. 42 U.S.C. 7407(d)(1)(A)(i)–(iii). Section 107(d)(1)(B)(i) further provides, "Upon promulgation or revision of a NAAQS, the Administrator shall promulgate the designations of all areas (or portions thereof) * * * as expeditiously as practicable, but in no case later than 2 years from the date of promulgation. Such period may be extended for up to one year in the event the Administrator has insufficient information to promulgate the designations within 2 years." 42 U.S.C. 7407(d)(1)(B)(i).

Under CAA section 107(d)(1)(B)(ii), no later than 120 days prior to promulgating designations, EPA is required to notify States of any intended modifications to their boundaries as EPA may deem necessary, and States will have an opportunity to comment on EPA's tentative decision. Whether or not a State provides a recommendation, the EPA must promulgate the designation that it deems appropriate. 42 U.S.C. 7407(d)(1)(B)(ii).

Accordingly, since the new 1-hour SO_2 NAAQS is being promulgated today, Governors should submit their initial SO_2 designation recommendations to EPA no later than June 2, 2011. If the Administrator intends to modify any State's boundary recommendation, the EPA will notify the Governor no later than 120 days prior to designations or, February 2012. States that believe the Administrator's modification is inappropriate will have an opportunity to demonstrate why they believe their recommendation is more appropriate before designations are finalized in June 2012.

For initial designations that will be finalized in June 2012, States should use monitoring data from the existing SO_2 network for the years 2008–2010, as well as any refined SO_2 dispersion modeling (*see* Appendix W to 40 CFR Part 51) for sources that may have the potential to cause or contribute to a NAAQS violation, provided that it is recent and available. EPA will then issue designations based on the record of information for that area. Under our anticipated approach, an area that has monitoring data or refined modeling results showing a violation of the NAAQS would be designated as "nonattainment." An area that has both monitoring data and appropriate modeling results showing no violations would be designated as "attainment." All other areas, including those with SO_2 monitors showing no violations but without modeling showing no violations, would be designated as "unclassifiable." Areas with no SO_2 monitors at all *i.e.,* "rest of State," would be designated as "unclassifiable" as well.

b. Approach Described in Proposal

In the proposed rule's preamble, we explained that we had proposed a new SO_2 ambient monitoring network, with new monitors expected to be deployed no later than January 2013. We also explained that we expected compliance with the new NAAQS to be determined based on 3 years of complete, quality assured, certified monitoring data. We further explained that we did not expect newly-cited monitors for the proposed network to generate sufficient monitoring data for us to use in determining whether areas complied with the new NAAQS by the statutory deadline to complete initial designations. Therefore, we explained, we intended to complete designations by June 2012 based on 3 years of complete, quality assured, certified air quality monitoring data as generated from the current monitoring network.

Consequently, we discussed our expectations to base initial designations on air quality data from the years 2008–2010 or 2009–2011, from SO_2 monitors operating at current locations, which we expected to continue through 2011. While those monitors are generally sited to measure 24-hour and annual average SO_2 concentrations, we noted that they all report hourly data, and we estimated that at least one third of those monitors might meet the proposed network

design requirements and not need to be moved. We explained that if any monitor in the current network indicated a violation of the new 1-hour NAAQS, we would intend to designate the area as "nonattainment." We further explained that if a monitor did not indicate a violation, our designation decision for the area would be made on a case-by-case basis, with one possibility being a designation of "unclassifiable."

We also explained that while the CAA section 107 designation provisions specifically address States, we intended to follow the same process for Tribes to the extent practicable, pursuant to CAA section 301(d), 42 U.S.C. 7601(d), and the Tribal Authority Rule, 40 CFR part 49.

c. Comments

Several commenters stated that the EPA did not provide nonattainment boundary guidance in the proposed rule and argued that guidance should be developed. Commenters also stated that EPA should consider boundaries that are less than the Core Based Statistical Area (CBSA), and perhaps even smaller than the county boundary (State of Michigan, Sierra Club).

In response, we note that the CAA requires that the EPA designate as "nonattainment" any area that does not meet (or contributes to an area that does not meet) the NAAQS. 42 U.S.C. 7407(d)(1)(A)(i). States with monitored or modeled SO_2 violations will need to recommend an appropriate nonattainment boundary that both includes sources contributing to that violation, as well as informs the public of the extent of the violation. For purposes of determining nonattainment boundaries, the EPA expects to consider the county line as the presumptive boundary for SO_2. This would be consistent with our approach under other NAAQS. States recommending less-than-countywide nonattainment boundaries should provide additional information along with their recommendation, demonstrating why a smaller area is more appropriate, as we have advised for other NAAQS. If States request it, EPA may develop additional guidance on the factors that States should consider when determining nonattainment boundaries.

In addition, as further discussed in section IV.B above, in the SO_2 NAAQS proposal, we proposed a monitoring-focused approach for comparison to the new NAAQS. The proposed network would have required approximately 348 monitors nationwide to be sited at the locations of maximum concentration. Numerous State and local government commenters expressed concerns regarding the perceived burdens of implementing the proposed monitoring network and the sufficiency of its scope for purposes of identifying violations. Some of these commenters (the City of Alexandria, and the States of Delaware, North Carolina and Pennsylvania) suggested using modeling to determine the scope of monitoring requirements, or favored modeling over monitoring to determine compliance with the NAAQS. Partly in response to these comments, and after reconsidering the proposal's monitoring-focused approach, specifically regarding how we have historically implemented SO_2 designations, we now anticipate taking a revised approach toward designations, using a hybrid analytic approach that combines the use of monitoring and available modeling to assess compliance with the new 1-hour SO_2 NAAQS. We discuss a revised expected approach toward designations below, and further discuss in section VI how we expect a hybrid approach to affect other implementation activities.

d. Expected Designations Process

As discussed in sections III and IV of this preamble, in response to the comments and after reviewing our historical SO_2 implementation practice, we intend to use a hybrid analytic approach for assessing compliance with the new 1-hour SO_2 NAAQS for initial designations. We also believe that a hybrid approach is more consistent with our historical approach and longstanding guidance toward SO_2 NAAQS designations and implementation than what we originally proposed. Technically, for a short-term 1-hour standard, it is more appropriate and efficient to principally use modeling to assess compliance for medium to larger sources, and to rely more on monitoring for groups of smaller sources and sources not as conducive to modeling.

In cases where there is complete air quality data from FRM and FEM SO_2 monitors, that data would be considered by EPA in designating areas as either "attainment" or "nonattainment" for the new SO_2 NAAQS. *See* Appendix T to Part 50 section 3b. In addition, in cases where a State submits air quality modeling data that are consistent with our current guidance or our expected revisions thereto, and which indicates that an area is attaining the standard or violating the standard, these data may support recommendations of "attainment" or "nonattainment." As explained in section IV above, we would not consider monitoring alone to be an adequate, nor the most accurate, tool to identify all areas of maximum concentrations of SO_2. In the case of SO_2, we further believe that monitoring is not the most cost-efficient method for identifying all areas of maximum concentrations.

Due to the necessarily limited spatial coverage provided by any monitoring regime, and the strong source-oriented nature of SO_2 ambient impacts, we recognize that using this more traditional approach in designations, would be more likely to identify a greater number of potential instances of nonattainment, if areas were to immediately conduct modeling of current source emissions, as compared to the approach we discussed in the proposed rule. As discussed in section III, forthcoming national and regional rules, such as the pending Industrial Boilers "Maximum Achievable Control Technology" (MACT) standard under CAA section 112(d), are likely to result in significant SO_2 emissions reductions in the next three to four years. A limited qualitative assessment of preliminary modeling of some sample facilities that would be covered by those rules indicates that well-controlled facilities should meet the new SO_2 NAAQS. However, there are some exceptions. These exceptions include unique sources with specific source characteristics that contribute to higher ambient impacts (short stack heights, complex terrain, *etc.*).

Again as described in section III, in order for States to conduct modeling on a large scale for the new 1-hour NAAQS, EPA expects additional guidance would be needed to clarify how to conduct dispersion modeling under Appendix W to support the implementation of the new 1-hour SO_2 NAAQS, and how to identify and appropriately assess the air quality impacts of sources that potentially may cause or contribute to violations of the NAAQS. Our anticipated modeling guidance will provide for refined modeling that will better reflect and account for source-specific impacts by following our current *Guideline on Air Quality Models,* Appendix W to 40 CFR Part 51, with appropriate flexibility for use in implementation. EPA intends to solicit public comment on this modeling guidance. We expect it will take some time for EPA to issue this guidance, and believe that given the timing and substantial burden of having to model several hundred sources, it would not be realistic or appropriate to expect States to complete such modeling and incorporate the results in designation recommendations for the new 1-hour SO_2 NAAQS that, under CAA section

107(d), are due to EPA within 1 year of the promulgation of the NAAQS.

Consequently, we expect that in most instances, Governors will submit designation recommendations of "unclassifiable" rather than conduct large-scale refined modeling of sources in advance of receiving our anticipated guidance. The absence of monitoring data showing violations for most areas, combined with the paucity of refined modeling of sources that have the potential to cause or contribute to violations of the NAAQS, will likely result in informational records that are insufficient to support initial designations of either "attainment" or "nonattainment." Under the Clean Air Act, in such a situation EPA is required to issue a designation for the area as "unclassifiable." However, we do not expect this result to delay expeditious attainment and maintenance of the new NAAQS, or to cause inappropriate, indefinite uncertainty regarding whether or not sources cause or contribute to NAAQS violations.

As described more fully in section III above and in section VI below, EPA's expected implementation approach would rely on the CAA section 110(a)(1) SIP obligation to ensure that all areas of the country attain and maintain the NAAQS on a timely basis even if they are designated "unclassifiable" initially. This SIP is due under CAA section 110(a)(1) within 3 years after promulgation of the new NAAQS, and does not depend upon EPA designating an area "nonattainment" based on recently monitored or modeled SO_2 levels. This period of time would allow States to use EPA's anticipated guidance on modeling for the new 1-hour SO_2 NAAQS, as well as account for SO_2 reduction levels at individual sources that are anticipated to result from promulgated national and regional rules to show attainment.

Once areas have both appropriate monitoring data (if required) and modeling data as appropriate, consistent with the new guidance, showing no violations of the SO_2 NAAQS, and have met other applicable requirements of CAA section 107(d)(3), the Agency would consider re-designating them from "unclassifiable" or "nonattainment" to "attainment" under CAA section 107(d)(3).

VI. Clean Air Act Implementation Requirements

This section of the preamble discusses the CAA requirements that States and emissions sources would need to address when implementing the new 1-hour SO_2 NAAQS based on the structure outlined in the CAA and existing rules. The EPA believes that existing guidance documents and regulations will be useful in helping States and sources to implement the new SO_2 NAAQS, but we also expect to develop additional guidance on modeling for the new one-hour standard and on developing SIPs under Section 110(a)(1) of the CAA.[35] In light of the new approach that EPA intends to take with respect to implementation of the SO_2 NAAQS, EPA intends to solicit public comment on guidance regarding modeling, and also solicit public comment on additional implementation planning guidance, including the content of the maintenance plans required under section 110(a)(1) of the Clean Air Act. EPA also notes that State monitoring plans and the SIP submissions that States will make will also be subject to public notice and comment."

In this section, we also further discuss how EPA's modified expected approaches toward monitoring and modeling and toward initial designations under the new SO_2 NAAQS (compared to how the proposed rule discussed addressing these issues) are anticipated to affect the types of SIP submissions States will need to provide to EPA and the timing of EPA's actions on those submissions leading up to attainment and maintenance of the new SO_2 NAAQS. In section IV above, we discuss the final amendments to the ambient monitoring and reporting requirements, and explain how in response to comments received on the proposal and after revisiting our historical practice in assessing compliance with prior SO_2 NAAQS, we have revised both the scope of the revised monitoring network and our expectations on how monitoring will be used in conjunction with modeling in assessing compliance and designating areas. In section V above, we discuss how we have revised our expected approach for issuing designations for the new 1-hour SO_2 NAAQS, and similarly explain how, in response to comments and after reviewing our historical approach, we have modified our expectations as discussed in the proposal for how and when monitoring and modeling will be used for designations. In this section VI, we describe in more detail how and when we expect States to demonstrate attainment, implementation, maintenance and enforcement of the new one-hour SO_2 NAAQS.

[35] *See* SO_2 Guideline Document, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, EPA–452/R–94–008, February 1994.

The CAA assigns important roles to EPA, States and Tribal governments to achieve the NAAQS. States have the primary responsibility for developing and implementing State implementation plans (SIPs) that contain State measures necessary to achieve the air quality standards in each area once EPA has established the NAAQS. EPA provides assistance to States and Tribes by providing technical tools, assistance, and guidance, including information on the potential control measures that may assist in helping areas attain the standards.

Under section 110 of the CAA, 42 U.S.C. 7410, and related provisions, States are directed to submit, for EPA approval, SIPs that provide for the attainment, implementation, maintenance, and enforcement of such standards through control programs directed at sources of SO_2 emissions. *See* CAA sections 110(a), and 191–192, 42 U.S.C. 7410(a) and 7514–7514a. If a State fails to adopt and implement the required SIPs by the time periods provided in the CAA, EPA has the responsibility under the CAA to adopt a Federal implementation plan (FIP) to ensure that areas attain the NAAQS in an expeditious manner. The States, in conjunction with EPA, also administer the prevention of significant deterioration (PSD) program for SO_2. *See* sections 160–169 of the CAA, 42 U.S.C. 7470–7479. In addition, Federal programs provide for nationwide reductions in emissions of SO_2 and other air pollutants under Title II of the Act, 42 U.S.C. 7521–7574. These programs involve limits on the sulfur content of the fuel used by automobiles, trucks, buses, motorcycles, non-road engines and equipment, marine vessels and locomotives. Emissions reductions for SO_2 are also obtained from implementation of the new source performance standards (NSPS) for stationary sources under sections 111 and 129 of the CAA, 42 U.S.C. 7411 and 7429; and the national emission standards for hazardous air pollutants (NESHAP) for stationary sources under section 112 of the CAA, 42 U.S.C. 7412 (such reductions resulting due to control of hazardous air pollutants (HAP) such as hydrogen chloride (HCl) under those rules). Title IV of the CAA, sections 402–416, 42 U.S.C. 7651a–7651o, specifically provides for major reductions in SO_2 emissions. EPA has also promulgated the Clean Air Interstate Rule (CAIR) to define additional SO_2 emission reductions needed in the Eastern United States to eliminate significant contribution of upwind States to downwind States'

nonattainment, or inability to maintain, the $PM_{2.5}$ NAAQS pursuant to CAA section 110(a)(2)(D), 42 U.S.C. 7410(a)(2)(D), a rule which EPA is reevaluating pursuant to court remand.

A. How This Rule Applies to Tribes

CAA section 301(d) authorizes EPA to treat eligible Indian Tribes in the same manner as States under the CAA and requires EPA to promulgate regulations specifying the provisions of the statute for which such treatment is appropriate. EPA has promulgated these regulations—known as the Tribal Authority Rule or TAR—at 40 CFR Part 49. *See* 63 FR 7254 (February 12, 1998). The TAR establishes the process for Indian Tribes to seek treatment-as-a-State eligibility and sets forth the CAA functions for which such treatment will be available. Under the TAR, eligible Tribes may seek approval for all CAA and regulatory purposes other than a small number of functions enumerated at section 49.4. Implementation plans under section 110 are included within the scope of CAA functions for which eligible Tribes may obtain approval. Section 110(o) also specifically describes Tribal roles in submitting implementation plans. Eligible Indian Tribes may thus submit implementation plans covering their reservations and other areas under their jurisdiction.

The CAA and TAR do not, however, direct Tribes to apply for treatment as a State or implement any CAA program. In promulgating the TAR EPA explicitly determined that it was not appropriate to treat Tribes similarly to States for purposes of, among other things, specific plan submittal and implementation deadlines for NAAQS-related requirements. 40 CFR 49.4(a). In addition, where Tribes do seek approval of CAA programs, including section 110 implementation plans, the TAR provides flexibility and allows them to submit partial program elements, so long as such elements are reasonably severable—*i.e.,* "not integrally related to program elements that are not included in the plan submittal, and are consistent with applicable statutory and regulatory requirements." 40 CFR 49.7.

To date, very few Tribes have sought treatment as a State for purposes of section 110 implementation plans. However, some Tribes may be interested in pursuing such plans to implement today's proposed standard, once it is promulgated.

1. Approach Described in the Proposal

In the proposed rule preamble, EPA described the various roles and requirements States would address in implementing the proposed NAAQS. Such references to States generally included eligible Indian Tribes to the extent consistent with the flexibility provided to Tribes under the TAR. Where Tribes do not seek treatment as a State for section 110 implementation plans, we explained that EPA under its discretionary authority will promulgate FIPs as "necessary or appropriate to protect air quality." 40 CFR 49.11(a). EPA also noted that some Tribes operate air quality monitoring networks in their areas. We explained that for such monitors to be used to measure attainment with the proposed revised primary NAAQS for SO_2, the criteria and procedures identified in the proposed rule would apply.

2. Current Approach

EPA did not receive any comments on this issue. However, as discussed elsewhere in this preamble, the final rule reflects in several respects modified expected approaches regarding the use of monitoring and modeling, the manner in which we expect to issue designations under the new SO_2 NAAQS, and the types of SIP submissions we expect would be needed to show attainment, implementation, maintenance and enforcement of the new NAAQS. Those changes in expected approach would, as appropriate, also apply to how we address data and any other submissions from Tribes for purposes of the new SO_2 NAAQS.

B. Nonattainment Area Attainment Dates

The latest date by which an area designated as nonattainment is required to attain the SO_2 NAAQS is determined from the effective date of the nonattainment designation for the affected area. For areas designated nonattainment for the revised SO_2 NAAQS, SIPs must provide for attainment of the NAAQS as expeditiously as practicable, but no later than 5 years from the effective date of the nonattainment designation for the area. *See* section 192(a) of the CAA, 42 U.S.C. 7651a(a). The EPA expects to determine whether an area has demonstrated attainment of the new SO_2 NAAQS by evaluating air quality monitoring and modeling data consistent with 40 CFR part 50, Appendix T and 40 CFR part 51, Appendix W. (*Note* that this differs from how we explained we would expect to make such determinations in the proposed rule, where we only mentioned monitoring as supplying the data we would evaluate. This expanded and changed discussion reflects the contemplated changes in our overall approaches to using monitoring and modeling, expectations for issuing designations, and expectations for reviewing SIP submissions showing attainment, implementation, maintenance, and enforcement of the new SO_2 NAAQS.)

1. Attaining the NAAQS

a. Approach Described in the Proposal

In the proposal preamble, we set forth the basic five conditions provided under section 107(d)(3)(E) of the CAA, 42 U.S.C. 7407(d)(3)(E) that a nonattainment area must meet in order to be redesignated as attainment:

- EPA must have determined that the area has met the SO_2 NAAQS;
- EPA has fully approved the State's implementation plan;
- The improvement in air quality in the affected area is due to permanent and enforceable reductions in emissions;
- EPA has fully approved a maintenance plan for the area; and
- The State(s) containing the area have met all applicable requirements under section 110 and part D.

b. Current Approach

EPA did not receive any comments on this aspect of the preamble of the proposal. However, in light of the fact that in the final rule, in response to other comments and consistent with historic practice, we are revising our proposed anticipated approaches to the overall use of monitoring and modeling and our expected approaches to issuing initial designations and reviewing SIP submissions, it follows that the way in which a nonattainment area seeks redesignation as an attainment area would also be affected by the final rule's overall changed approaches. For example, for EPA to determine that a nonattainment area has met the SO_2 NAAQS, we anticipate that the area would need to not only provide any monitoring data showing such compliance (and there would need to be an absence of monitoring data showing otherwise), but modeling where appropriate, consistent with modeling guidance that we plan to issue, would also need to show that the area is attaining and maintaining the NAAQS.

2. Consequences of a Nonattainment Area Failing To Attain by the Statutory Attainment Date

a. Approach Described in the Proposal

We explained in the proposal that any SO_2 nonattainment area that fails to attain by its statutory attainment date would be subject to the requirements of sections 179(c) and (d) of the CAA, 42

U.S.C. 7509(c) and (d). EPA is required to make a finding of failure to attain no later than 6 months after the specified attainment date and publish a notice in the **Federal Register**. The State would then need to submit an implementation plan revision no later than one year following the effective date of the **Federal Register** notice making the determination of the area's failure to attain. This submission must demonstrate that the standard will be attained as expeditiously as practicable, but no later than 5 years from the effective date of EPA's finding that the area failed to attain. In addition, section 179(d)(2) provides that the SIP revision must include any specific additional measures as may be reasonably prescribed by EPA, including "all measures that can be feasibly implemented in the area in light of technological achievability, costs, and any nonair quality and other air quality-related health and environmental impacts."

b. Current Approach

EPA did not receive any comments on this aspect of the discussion in the preamble to the proposal. However, due to the changes in the final rule's discussion of the overall expected approaches to monitoring and modeling, designations and EPA review of SIP submissions, it follows that the implementation of CAA sections 179(c) and (d) would also be affected by those changes. For example, under the anticipated approach, a nonattainment area's initial demonstration of attainment would need to show through modeling consistent with modeling guidance that we plan to issue, that the area attains and maintains the new SO_2 NAAQS. If the area fails to attain on time, any remedial implementation plan submission would also need to show, where appropriate, through modeling consistent with modeling guidance that we plan to issue, that the area attains and maintains the new SO_2 NAAQS.

C. Section 110(a)(1) and (2) NAAQS Maintenance/Infrastructure Requirements

We are significantly revising our expected approaches to the use of monitoring and modeling, expected issuance of initial designations, and EPA review of SIP submissions. This change in anticipated approach has particular relevance for how States would meet their statutory obligations under CAA section 110(a) to implement, maintain and enforce the new SO_2 NAAQS. In short, under such an approach, all areas, whether designated as attainment, nonattainment, or unclassifiable, would need to submit SIPs under CAA section 110(a) that show that they are attaining and maintaining the 1-hour SO_2 NAAQS as expeditiously as practicable through permanent and enforceable measures. In other words, the duty to show maintenance of the SO_2 NAAQS would not be limited to areas that are initially designated as nonattainment, but instead would apply regardless of designation. As has been expected historically, areas initially designated attainment for SO_2 are expected to submit to EPA the infrastructure elements of the 110(a) SIP, including the PSD program. Historically, EPA has determined this to be sufficient to demonstrate maintenance absent other available information to suggest the area would have difficulty maintaining the NAAQS.

As required by CAA section 192, nonattainment areas must demonstrate attainment as expeditiously as practicable, and no later than 5 years after designation (which would be August 2017). Under a hybrid approach as we have discussed earlier in sections III, IV, and V of this preamble, EPA believes that August 2017 would be the latest point that could be as expeditiously as practicable for attainment and unclassifiable areas as well, and EPA anticipates establishing this date through future rulemaking actions on individual SIPs.

As noted in earlier sections of this preamble, in the SO_2 NAAQS proposal, we recommended a monitoring-focused approach for comparison to the NAAQS. We received public comments that contended our proposed monitoring network was too small and insufficient to assess the hundreds of areas that might violate the new SO_2 NAAQS and yet too burdensome and expensive to expand to an adequate scale. Some commenters, especially State air agencies, recommended the use of modeling either to determine potential nonattainment areas or to identify areas subject to monitoring requirements. Because SO_2 is primarily a localized pollutant, modeling is the the most appropriate tool to accurately predict SO_2 impacts from large sources, EPA has used it in the past to determine SO_2 attainment status, and it can be performed more quickly and less costly than monitoring. Consequently, as part of developing a balanced response to the numerous comments we received on modeling and monitoring, we expect to use a hybrid analytic approach that combines the use of monitoring and modeling to assess compliance with respect to the new SO_2 NAAQS.

A hybrid analytic approach for assessing compliance with the new SO_2 NAAQS would make the most appropriate use of available tools and be more consistent with our historical approach than was what we originally proposed. For a short-term 1-hour standard, it is more accurate and efficient to use modeling to assess medium to larger sources and to rely on monitoring for groups of smaller sources and sources not as conducive to modeling.

We expect that States would initially focus performance of attainment demonstration modeling on larger sources (*e.g.,* those ≥ 100 tons per year (tpy) of SO_2), and that States would also identify and eventually conduct refined modeling of any other sources that may be anticipated to cause or contribute to a violation to determine compliance with the new SO_2 NAAQS. As discussed in Section III, EPA anticipates providing additional guidance to States to clarify how to conduct dispersion modeling under Appendix W to support the implementation of the new 1-hour SO_2 NAAQS. Prior to issuing this guidance, EPA intends to solicit public comment.

Since determining compliance with the SO_2 NAAQS will likely be a uniquely source-driven analysis, EPA explored options to ensure that the SO_2 designations process realistically accounts for anticipated SO_2 reductions at those sources that we expect will be achieved by current and pending national and regional rules. To ensure that all areas of the country attain the NAAQS on a timely basis, while accommodating modeling that is both informed by anticipated modeling guidance and accounts for those anticipated SO_2 reductions, EPA's intention is to emphasize the CAA section 110(a)(1) requirement that all States submit a SIP that shows implementation, maintenance and enforcement of the NAAQS. This SIP would be due under CAA section 110(a)(1) within 3 years after promulgation of the new NAAQS, and would not depend upon EPA designating an area nonattainment based on recently monitored or modeled SO_2 levels. In addition, like an attainment SIP required for a designated nonattainment area under CAA section 192, to show attainment this SIP can account for controlled SO_2 levels at individual sources that will be achieved after submission of the SIP but before the demonstrated attainment date. EPA intends to implement this approach in a way that ensures expeditious attainment of the NAAQS, under a schedule that we explain more fully below.

1. Section 110(a)(1)–(2) Submission

a. Approach Described in the Proposal

In the preamble to the proposal, we explained that section 110(a)(2) of the CAA directs all States to develop and maintain a solid air quality management infrastructure, including enforceable emission limitations, an ambient monitoring program, an enforcement program, air quality modeling capabilities, and adequate personnel, resources, and legal authority. Section 110(a)(2)(D) also requires State plans to prohibit emissions from within the State which contribute significantly to nonattainment or maintenance areas in any other State, or which interfere with programs under part C of the CAA to prevent significant deterioration of air quality or to achieve reasonable progress toward the national visibility goal for Federal class I areas (national parks and wilderness areas).

Under sections 110(a)(1) and (2) of the CAA, all States are directed to submit SIPs to EPA which demonstrate that basic program elements have been addressed within 3 years of the promulgation of any new or revised NAAQS. Subsections (A) through (M) of section 110(a)(2) set forth the elements that a State's program must contain in the SIP.[36] The proposed rule listed section 110(a)(2) NAAQS implementation requirements as the following:

- *Ambient air quality monitoring/data system:* Section 110(a)(2)(B) requires SIPs to provide for setting up and operating ambient air quality monitors, collecting and analyzing data and making these data available to EPA upon request.
- *Program for enforcement of control measures:* Section 110(a)(2)(C) requires SIPs to include a program providing for enforcement of SIP measures and the regulation and permitting of new/modified sources.
- *Interstate transport:* Section 110(a)(2)(D) requires SIPs to include provisions prohibiting any source or other type of emissions activity in the State from contributing significantly to nonattainment or interfering with maintenance of the NAAQS in another State, or from interfering with measures required to prevent significant deterioration of air quality or to protect visibility.
- *Adequate resources:* Section 110(a)(2)(E) directs States to provide assurances of adequate funding, personnel and legal authority to implement their SIPs.
- *Stationary source monitoring system:* Section 110(a)(2)(F) directs States to establish a system to monitor emissions from stationary sources and to submit periodic emissions reports to EPA.
- *Emergency power:* Section 110(a)(2)(G) directs States to include contingency plans, and adequate authority to implement them, for emergency episodes in their SIPs.
- *Provisions for SIP revision due to NAAQS changes or findings of inadequacies:* Section 110(a)(2)(H) directs States to provide for revisions of their SIPs in response to changes in the NAAQS, availability of improved methods for attaining the NAAQS, or in response to an EPA finding that the SIP is inadequate.
- *Consultation with local and Federal government officials:* Section 110(a)(2)(J) directs States to meet applicable local and Federal government consultation requirements when developing SIPs and reviewing preconstruction permits.
- *Public notification of NAAQS exceedances:* Section 110(a)(2)(J) directs States to adopt measures to notify the public of instances or areas in which a NAAQS is exceeded.
- *PSD and visibility protection:* Section 110(a)(2)(J) also directs States to adopt emissions imitations, and such other measures, as may be necessary to prevent significant deterioration of air quality in attainment areas and protect visibility in Federal Class I areas in accordance with the requirements of CAA Title I, part C.
- *Air quality modeling/data:* Section 110(a)(2)(K) requires that SIPs provide for performing air quality modeling for predicting effects on air quality of emissions of any NAAQS pollutant and submission of data to EPA upon request.
- *Permitting fees:* Section 110(a)(2)(L) requires the SIP to include requirements for each major stationary source to pay permitting fees to cover the cost of reviewing, approving, implementing and enforcing a permit.
- *Consultation/participation by affected local government:* Section 110(a)(2)(M) directs States to provide for consultation and participation by local political subdivisions affected by the SIP.

b. Final

EPA did not receive any comments on this aspect of the approached explained in the proposal preamble. However, in light of the modified approach discussed above, EPA is providing additional guidance concerning the CAA section 110(a)(1) maintenance plan requirement as a part of this discussion so that States will have sufficient information to meet this requirement with a SIP submittal three years after promulgation of the NAAQS. Section 110(a)(1) of the CAA states that each State, after reasonable notice and public hearing, is required to adopt and to submit to EPA, within 3 years after promulgation of any new or revised NAAQS for any pollutant, a SIP which provides for the implementation, maintenance, and enforcement of any new or revised NAAQS in each area of the State. As stated previously, in light of the new approach that EPA intends to take with respect to implementation of the SO_2 NAAQS, EPA intends to solicit public comment on guidance regarding modeling, and also solicit public comment on additional implementation planning guidance, including the content of the maintenance plans required under section 110(a)(1) of the Clean Air Act.

EPA expects that most areas of the country would be designated as unclassifiable for the 1-hour NAAQS for SO_2, due to a lack of both monitoring and modeling information concerning the attainment status of areas, in advance of States conducting further refined modeling according to our anticipated guidance. For areas that are designated unclassifiable, States are required to submit section 110(a)(1) plans to demonstrate implementation, maintenance and enforcement of the new SO_2 NAAQS. As previously explained in section III of the preamble, in order to meet the requirements of section 110(a)(1) and to ensure timely attainment of the NAAQS on a schedule that is as expeditious as would be required if an area had been designated nonattainment, EPA's current expectation is that States would submit SIPs which provide for attainment, implementation, maintenance, and enforcement of the 1-hour SO_2 NAAQS in all areas as expeditiously as practicable, which EPA believes in these cases would be no later than 5 years from the effective date of the area's designation. The section 110(a)(1) maintenance plan would also need to contain the following elements: (1) An

[36] In the proposed rule preamble, we explained that two elements identified in section 110(a)(2) were not listed in our summary because, as EPA interprets the CAA, SIPs incorporating any necessary local nonattainment area controls would not be due within 3 years, but rather are generally due at the time the nonattainment area planning requirements are due. *See* 74 FR 64860 at n. 39. These elements are: (1) Emission limits and other control measures, section 110(a)(2)(A), and (2) Provisions for meeting part D, section 110(a)(2)(I), which requires areas designated as nonattainment to meet the applicable nonattainment planning requirements of part D, title I of the CAA. To implement our revised intended approach in the final rule, however, it would be necessary for States to include, if relied upon to show attainment and maintenance of the new SO_2 NAAQS, any necessary emission limits and other control measures under section 110(a)(2)(A).

attainment emissions inventory, (2) a control strategy, as appropriate, (3) a maintenance demonstration, using an EPA approved air quality model as appropriate, (4) a contingency plan, and (5) a plan for verification of continued attainment of the standard. Attainment areas that appear to have difficulty maintaining attainment may also have to submit some of these elements. These elements are now explained in detail.

(1) Attainment Emissions Inventory

The State should develop an accurate attainment emissions inventory to identify the level of emissions in the area which is sufficient to attain the 1-hour SO_2 NAAQS. This inventory should be consistent with EPA's most recent guidance on emissions inventories currently available, and should include the emissions for the time period associated with the modeling and monitoring data showing attainment. Major source size thresholds for SO_2 are currently listed as 100 ton/yr, however, in cases where sources, individually, or collectively, that are below this level may potentially cause or contribute to a violation of the standard, these sources should also be included in the emissions inventory for the affected area. EPA notes that, unlike any monitoring or modeling data used in the initial designations context, which would be limited to current emissions levels, this estimate under a hybrid approach we expect to use for the new SO_2 NAAQS would be able to rely on modeled controlled emissions levels at sources achieved by enforceable national, regional or local rules that will be in place within the timeframe for demonstrating attainment. This is because demonstrations of attainment and maintenance of a NAAQS, unlike designations, are necessarily projections regarding future and continuing levels of ambient air pollution concentrations given that the statutory deadlines for their submission are in advance of the required achievement of attainment and maintenance. *See, e.g.,* CAA sections 191(a) and 192(a).

(2) Maintenance Demonstration

The key element of a section 110(a)(1) maintenance plan is a demonstration using, as appropriate, refined SO_2 dispersion modeling (*see* Appendix W to 40 CFR Part 51) which provides an indication of how the area will attain and maintain the 1-hour SO_2 NAAQS as expeditiously as practicable, which EPA believes would be within the 5 year period following the designation of the area. For SO_2 the State may generally demonstrate maintenance of the NAAQS by using refined dispersion modeling to show that the future mix of sources and emission rates in an area will not cause a violation of the 1-hour SO_2 NAAQS. As a result of applying the control strategy, EPA anticipates that additional guidance for States may be needed to clarify how to conduct dispersion modeling under Appendix W to support the implementation of the new 1-hour SO_2 NAAQS.

As explained above in IV.B, EPA believes that for SO_2 attainment and maintenance demonstrations, monitoring data alone is generally not adequate to characterize fully short-term ambient concentrations around major stationary sources of SO_2, and as a result may not capture the maximum SO_2 impacts. With representative and appropriate meteorological and other input data, refined dispersion models are able to characterize air quality impacts from the modeled sources across the domain of interest on an hourly basis with a high degree of spatial resolution, overcoming the limitations of an approach based solely on monitoring. By simulating plume dispersion on an hourly basis across a grid of receptor locations, dispersion models are able to estimate the detailed spatial gradients of ambient concentrations resulting from SO_2 emission sources across a full range of meteorological and source operating conditions. To capture such results on a monitor would normally require a prohibitively expansive air quality monitoring network. Further, as we have observed in prior actions (*see., e.g.,* 43 FR 45993, 45997, 46000–03 (Oct. 5, 1978)), monitoring data would not be adequate to demonstrate attainment if sources are using stacks with heights that are greater than good engineering practice (GEP), or other prohibited dispersion techniques, as section 123 prohibits credit in an attainment demonstration for any such practices.

Refined dispersion modeling for the section 110(a)(1) maintenance plan is expected to follow EPA's *Guideline on Air Quality Models,* Appendix W to 40 CFR Part 51, which provides recommendations on modeling techniques and guidance for estimating pollutant concentrations in order to assess control strategies and determine emission limits. These recommendations were originally published in April 1978 and were incorporated by reference in the PSD regulations, 40 CFR sections 51.166 and 52.21 in June 1978 (43 FR 26382–26388). The purpose of Appendix W is to promote consistency in the use of modeling within the air quality management process. Appendix W is periodically revised to ensure that new model developments or expanded regulatory requirements are incorporated. The most recent revision to Appendix W was published on November 9, 2005 (70 FR 68218), wherein EPA adopted AERMOD as the preferred dispersion model for a wide range of regulatory applications in all types of terrain. To support the promulgation of AERMOD as the preferred model, EPA evaluated the performance of the model across a total of 17 field study data bases (Perry, *et al.,* 2005; EPA, 2003), including several field studies based on model-to-monitor comparisons of SO_2 concentrations from operating power plants. AERMOD is a steady-state plume dispersion model that employs hourly sequential preprocessed meteorological data to simulate transport and dispersion from multiple point, area, or volume sources for averaging times from one hour to multiple years, based on an advanced characterization of the atmospheric boundary layer. AERMOD also accounts for building wake effects (*i.e.,* downwash) on plume dispersion.

As stated previously, EPA anticipates that additional guidance for States, Tribal, and local governments is needed to clarify how to conduct refined dispersion modeling under Appendix W to support the implementation of the new 1-hour SO_2 NAAQS. EPA intends to solicit public comment on guidance regarding modeling. Although AERMOD is identified as the preferred model under Appendix W for a wide range of applications and will be appropriate for most modeling applications to support the new SO_2 NAAQS, Appendix W allows flexibility to consider the use of alternative models on a case-by-case basis when an adequate demonstration can be made that the alternative model performs better than, or is more appropriate than, the preferred model for a particular application.

(3) Control Strategy

The EPA believes that in order to meet the implementation, maintenance and enforcement plan requirements of section 110(a)(1) for the new SO_2 NAAQS, States should consider all control measures that are reasonable to implement in light of the attainment and maintenance needs for the affected area(s). The EPA believes that where additional controls are necessary it would be appropriate for the level of controls in these areas to be similar to that required in areas that are designated as nonattainment for SO_2. These controls would provide for the attainment and maintenance of the SO_2 1-hour standard as expeditiously as

practicable. EPA believes that expeditious attainment in these areas will be within 5 years of the effective date of designation of an area. This approach would allow States to take into consideration emission reductions that we expect to be achieved from the implementation of future controls from national control measures as well as regional and local control measures that will be in place by the anticipated attainment date and are projected to help achieve attainment and maintenance of the standard. It would also reduce the risk of such areas failing to meet the NAAQS as expeditiously as nonattainment areas must meet it.

(4) Contingency Plan

The contingency plan is considered to be an enforceable part of the section 110(a)(1) plan and should ensure that there are appropriate contingency measures which can be implemented as expeditiously as practicable once they are triggered. The contingency plan should clearly identify the measures to be adopted, provide a schedule and procedures for adoption and implementation, and provide a specific time limit for actions by the State.

The EPA believes that in this case the contingency measures implemented under the contingency plan requirement for the section 110(a)(1) plan in unclassifiable areas under a revised approach for SO_2 should closely resemble the contingency measures required under section 172(c)(9) of the CAA. Section 172(c)(9) of the CAA defines contingency measures as measures in the SIP which are to be implemented in the event that an area fails to attain the NAAQS, or fails to meet the reasonable further progress (RFP) requirement, by the applicable attainment date for the area. Contingency measures become effective without further action by the State or EPA, upon determination by EPA that the area (1) failed to attain the NAAQS by the applicable attainment date, or (2) fail to meet RFP. These contingency measures should consist of other available control measures that are not included in the control strategy for the SIP.

The EPA interprets the contingency measure provision as primarily directed at general control programs which can be undertaken on an area-wide basis. Since SO_2 control measures are based on what is directly and quantifiably necessary to attain the SO_2 NAAQS, it would be unlikely for an area to implement the necessary emissions control yet fail to attain the NAAQS. Therefore, for SO_2 programs, EPA believes that State agencies should have a comprehensive program to identify sources of violations of the SO_2 NAAQS and undertake an aggressive follow-up for compliance and enforcement, including expedited procedures for establishing enforceable consent agreements pending the adoption of revised SIPs.

Such an approach toward minimum contingency measures for SO_2 would not preclude a State from requiring additional contingency measures that are enforceable and appropriate for a particular source or source category. A contingency measure for an SO_2 SIP might be a consent agreement between the State and EPA to reduce emissions from a source further in the event that the contingency measures are triggered. Alternatively, a source might adopt a contingency measure such as switching to low sulfur coal or reducing load until more permanent measures can be put into place to correct the problem. In either case, the contingency measure should be a fully adopted provision in the SIP in order for it to become effective at the time that EPA determines that the area either fails to attain the NAAQS or fails to meet RFP.

As a necessary part of the section 110(a)(1) plan, the State should also identify specific indicators, or triggers, which will be used to determine when the contingency measures need to be implemented. The identification of triggers would allow a State an opportunity to take early action to address potential violations of the NAAQS before they occur. By taking early action, States may be able to prevent any actual violations of the NAAQS, and therefore, reduce the need on the part of EPA to start the process to re-designate the areas as nonattainment. An example of a trigger would be monitored or modeled violations of the NAAQS. The EPA will review what constitutes an approvable contingency plan on a case-by-case basis.

(5) Verification of Continued Attainment

The submittal should provide an indication of how the State will track the progress of the section 110(a)(1) plan. This is necessary due to the fact that the emissions projections made for the attainment and maintenance demonstrations depend on assumptions of point, area, and mobile source growth. One option for tracking the progress of the attainment and maintenance demonstrations, provided here as an example, would be for the State to update periodically the emissions inventory. The attainment and maintenance demonstration should project maintenance during the five year period following the designations for the 1-hour SO_2 NAAQS, not simply that the area will be in attainment in the fifth year.

States should develop interim emission projection years to show a trend analysis for attainment and maintenance of the standard. These emission projections can also be used as triggers for implementing contingency measures. The EPA recognizes that it would be difficult and time consuming to develop projections for each year of the 5 year period. Therefore, the number of interim projection years should reflect whatever information exists regarding the potential for increases in emissions in the intervening years. For instance, if there is a high probability that emissions will increase to such an extent as to jeopardize continued maintenance of the standard even temporarily over the intervening years, the number of interim projection periods should be sufficient to document that such increases will not interfere with maintenance of the 1-hour SO_2 NAAQS.

When modeling for the attainment and maintenance demonstrations, one option for tracking progress would also be for the State to reevaluate periodically the modeling assumptions and data input. Such reevaluation, for example, could address any delays in source compliance with national, regional or local rules for which the State had previously modeled timely SO_2 reductions. In any event, the State should monitor the indicators for triggering the contingency measures on a regular basis.

EPA recognizes that the approach discussed above for SO_2 SIPs submitted under CAA section 110(a)(1)–(2) is significantly different from the one outlined in the proposal, and from what we have applied in the context of other criteria pollutants. However, EPA anticipates using a revised approach under section 110(a)(1)–(2) as part of an overall revised hybrid monitoring and modeling approach in response to comments on the proposed monitoring-focused approach to implementation of the new SO_2 NAAQS. We believe that such an approach would best account for the unique source-specific and localized impacts inherent to SO_2, and would be the most reasonable way to ensure that all areas of the United States timely attain and maintain the new NAAQS, while at the same time avoiding inappropriately requiring immediate refined modeling of all sources without appropriate EPA guidance. This would also allow attainment demonstrations to account

for expected substantial SO_2 reductions that will occur well in advance of the attainment deadline. Of course, for such a unique SO_2 approach to work, it would be imperative for all areas to timely submit, and for EPA to able to approve, adequate attainment, implementation, maintenance and enforcement SIPs that show attainment as expeditiously as practicable, and no later than 5 years following initial designations. Only by applying such a timeframe to the section 110(a)(1) SIP approach we are adopting for SO_2 could the approach be a reasonable one. To that end, EPA would not intend to approve SIPs that do not meet this schedule, and would take necessary and appropriate actions in response to any submission that would result in unacceptable delay of attainment. Such actions may include, but are not limited to, any combination of SIP disapproval, redesignation to nonattainment, and promulgation of a Federal implementation plan (FIP). Any future action establishing an attainment deadline will be completed through notice-and-comment rulemaking on individual SIP submissions.

The timeline below shows how we expect the several steps from promulgation of the new NAAQS through attainment should proceed, whether areas are designated nonattainment or unclassifiable, assuming timely action at each step:

- *June 2010:* EPA issues new SO_2 NAAQS, which starts periods within which CAA section 107 initial area designations must occur and CAA section 110(a)(1)–(2) SIPs must be submitted.
- *June 2011:* States submit initial area designations recommendations, based on available monitoring data, and on any refined modeling performed in advance of submitting CAA section 110(a)(1)–(2) SIPs.
- *June 2012:* EPA issues initial area designations. Any monitored or modeled violations would trigger nonattainment designations. (Per below, States designated nonattainment would submit nonattainment SIPs by February 2014, relying on refined modeling that demonstrates attainment by no later than August 2017.) States would be designated attainment if they submit both monitoring and modeling showing adequate evidence of no violations. All other cases would be initially designated as unclassifiable.
- *June 2013:* States submit CAA section 110(a)(1)–(2) SIPs. SIPs would rely on refined modeling and any required monitoring that demonstrates attainment and maintenance of the new SO_2 NAAQS as expeditiously as practicable, and no later than August 2017. For areas within the State designated attainment and unclassifiable, the section 110(a) SIP must contain any additional Federally enforceable control measures necessary to ensure attainment and maintenance of the NAAQS. (Control measures to be implemented in designated nonattainment areas are due later as part of the nonattainment SIP in February 2014.)
- *February 2014:* Any initially designated nonattainment areas submit CAA section 191–192 SIPs showing attainment no later than August 2017.
- *June 2014:* EPA approves or disapproves submitted CAA section 110(a)(1)–(2) SIPs. For attainment and unclassifiable areas, EPA's action would be based on adequacy of States' modeling (and any required monitoring) showing attainment as expeditiously as practicable, and no later than August 2017, in partial reliance on SO_2 reductions from national and regional standards that are achieved by the attainment date. EPA would also have discretion to re-designate areas based on these SIPs, including to nonattainment if SIPs are inadequate, as well as promulgate FIPs.
- *February 2015:* EPA approves or disapproves CAA section 191–192 attainment SIPs submitted by areas initially designated as nonattainment, with similar remedies as discussed above if SIPs are deficient.
- *June 2016:* CAA section 110(c) deadline by which EPA must issue a FIP for any area whose section 110(a)(1) SIP is disapproved in June 2014.
- *February 2017:* CAA section 110(c) deadline by which EPA must issue a FIP for a nonattainment area whose section 192 SIP is disapproved in February 2015.

August 2017: Expected date by which all areas, regardless of classification, achieve attainment, implementation, maintenance and enforcement of the new SO_2 NAAQS.

D. Attainment Planning Requirements

1. SO_2 Nonattainment Area SIP Requirements

a. Approach Described in the Proposal

We explained in the preamble to the proposal that any State containing an area designated as nonattainment with respect to the SO_2 NAAQS would need to develop for submission to EPA a SIP meeting the requirements of part D, Title I, of the CAA, providing for attainment by the applicable statutory attainment date. *See* sections 191(a) and 192(a) of the CAA. As indicated in section 191(a), all components of the SO_2 part D SIP must be submitted within 18 months of the effective date of an area's designation as nonattainment.

Section 172 of the CAA addresses the general requirements for areas designated as nonattainment. Section 172(c) directs States with nonattainment areas to submit a SIP which contains an attainment demonstration showing that the affected area will attain the standard by the applicable statutory attainment date. The SIP must show that the area will attain the standard as expeditiously as practicable, and must "provide for the implementation of all Reasonably Available Control Measures (RACM) as expeditiously as practicable (including such reductions in emissions from existing sources in the area as may be obtained through the adoption, at a minimum, of Reasonably Available Control Technology (RACT))."

SIPs required under Part D of the CAA must also provide for reasonable further progress (RFP). *See* section 172(c)(2) of the CAA. The CAA defines RFP as "such annual incremental reductions in emissions of the relevant air pollution as are required by part D, or may reasonably be required by the Administrator for the purpose of ensuring attainment of the applicable NAAQS by the applicable attainment date." *See* section 171 of the CAA. Historically, for some pollutants, RFP has been met by showing annual incremental emission reductions sufficient to maintain generally linear progress toward attainment by the applicable attainment date.

All SO_2 nonattainment area SIPs must include contingency measures which must be implemented in the event that an area fails to meet RFP or fails to attain the standards by its attainment date. *See* section 172(c)(9) of the CAA. These contingency measures must be fully adopted rules or control measures that take effect without further action by the State or the Administrator. The EPA interprets this requirement to mean that the contingency measures must be implemented with only minimal further action by the State or the affected sources with no additional rulemaking actions such as public hearings or legislative review.

Emission inventories are also critical for the efforts of State, local, and Federal agencies to attain and maintain the NAAQS that EPA has established for criteria pollutants including SO_2. Section 191(a) in conjunction with section 172(c) requires that areas designated as nonattainment for SO_2 submit an emission inventory to EPA no later than 18 months after designation as nonattainment. In the case of SO_2,

sections 191(a) and 172(c) also direct States to submit periodic emission inventories for nonattainment areas. The periodic inventory must include emissions of SO_2 for point, nonpoint, mobile, and area sources.

b. Current Approach

EPA did not receive any comments on this issue. Thus, EPA has no changes to make to this discussion.

2. New Source Review and Prevention of Significant Deterioration Requirements

a. Approach Described in the Proposal

We provided a discussion of the new source review and prevention of significant deterioration programs in the preamble to the proposed rule. The Prevention of Significant Deterioration (PSD) and nonattainment New Source Review (NSR) programs contained in parts C and D of Title I of the CAA govern preconstruction review of any new or modified major stationary sources of air pollutants regulated under the CAA as well as any precursors to the formation of that pollutant when identified for regulation by the Administrator.[37] The EPA rules addressing these programs can be found at 40 CFR 51.165, 51.166, 52.21, 52.24, and Part 51, appendix S.

The PSD program applies when a major source located in an area that is designated as attainment or unclassifiable for any criteria pollutant is constructed or undergoes a major modification.[38] The nonattainment NSR program applies on a pollutant-specific basis when a major source constructs or modifies in an area that is designated as nonattainment for that pollutant. The minor NSR program addresses major and minor sources that undergo construction or modification activities that do not qualify as major, and it applies, as necessary to assure attainment, regardless of the designation of the area in which a source is located.

The PSD requirements include but are not limited to the following:

- Installation of Best Available Control Technology (BACT);
- Air quality monitoring and modeling analyses to ensure that a project's emissions will not cause or contribute to a violation of any NAAQS or maximum allowable pollutant increase (PSD increment);
- Notification of Federal Land Manager of nearby Class I areas; and public comment on the permit.

To the extent necessary to address these PSD requirements for the new 1-hour SO_2 NAAQS, SIPs are due no later than 3 years after the promulgation date. Generally, however, the owner or operator of any major stationary source or major modification obtaining a final PSD permit on or after the effective date of the new 1-hour SO_2 NAAQS will be required, as a prerequisite for the PSD permit, to demonstrate that the emissions increases from the new or modified source will not cause or contribute to a violation of that new NAAQS. The EPA anticipates that individual sources will be able to complete this demonstration under the PSD regulations based on current guidance in EPA's Guideline on Air Quality Models, Appendix W of 40 CFR Part 51.

The owner or operator of a new or modified source will still be required to demonstrate compliance with the annual and 24-hour SO_2 increments, even when their counterpart NAAQS are revoked. The annual and 24-hour increments are established in the CAA and will need to remain in the PSD regulations because EPA does not interpret the CAA to authorize EPA to remove them. It appears necessary for Congress to amend the CAA to make appropriate changes to the statutory SO_2 increments. In 1990, the CAA was amended to accommodate PM_{10} increments in lieu of the statutory TSP increments.

In association with the requirement to demonstrate compliance with the NAAQS and increments, the owner or operator of a new or modified source must submit for review and approval a source impact analysis and an air quality analysis. The source impact analysis, primarily a modeling analysis, must demonstrate that allowable emissions increases from the proposed source or modification, in conjunction with emissions from other existing sources will not cause or contribute to either a NAAQS or increment violation. The air quality analysis must assess the ambient air quality in the area that the proposed source or modification would affect.

For the air quality analysis, the owner or operator must submit in its permit application air quality monitoring data that shall have been gathered over a period of one year and is representative of air quality in the area of the proposed project. If existing data representative of the area of the proposed project is not available, new data may need to be collected by the owner or operator of the source or modification. Where data is already available, it might be necessary to evaluate the location of the monitoring sites from which the SO_2 data were collected in comparison to any new siting requirements associated with the 1-hour SO_2 NAAQS. If existing sites are inappropriate for providing the necessary representative data, then new monitoring data will need to be collected by the owner or operator of the proposed project.

Historically, EPA has allowed the use of several screening tools to help facilitate the implementation of the new source review program by reducing the permit applicant's burden, and streamlining the permitting process for de minimis circumstances. These screening tools include a significant emissions rate (SER), significant impact levels (SILs), and a significant monitoring concentration (SMC). The SER, as defined in tons per year for each regulated pollutant, is used to determine whether any proposed source or modification will emit sufficient amounts of a particular pollutant to require the review of that pollutant under the NSR permit program. EPA will consider whether to evaluate the existing SER for SO_2 to see if it would change substantially based on the NAAQS levels for the 1-hour averaging period. Historically, for purposes of defining the SER, we have defined a de minimis pollutant impact as one that results in a modeled ambient impact of less than approximately 4% of the short-term NAAQS. The current SER for SO_2 (40 tpy) is based on the impact on the 24-hour SO_2 NAAQS. *See* 45 FR 52676, 52707 (August 7, 1980). We have typically used the most sensitive averaging period to calculate the SER, and we may want to evaluate the new 1-hour period for SO_2 because it is likely to represent the most sensitive averaging period for SO_2.

The SIL, expressed as an ambient pollutant concentration (ug/m3), is used to determine whether the impact of a particular pollutant is significant enough to warrant a complete air quality impact analysis for any applicable NAAQS and increments. EPA has promulgated regulations under 40 CFR 51.165(b) which include SILs for SO_2 to determine whether a source's impact would be considered to cause or contribute to a NAAQS violation for the 3-hour (the secondary NAAQS), 24-hour or annual averaging periods. These SILs were originally developed in 1978 to limit the application of air quality dispersion models to a downwind

[37] The terms "major" and "minor" define the size of a stationary source, for applicability purposes, in terms of an annual emissions rate (tons per year, tpy) for a pollutant. Generally, a minor source is any source that is not "major." "Major" is defined by the applicable regulations—PSD or nonattainment NSR.

[38] In addition, the PSD program applies to non-criteria pollutants subject to regulation under the Act, except those pollutants regulated under section 112 and pollutants subject to regulation only under section 211(o).

distance of no more than 50 kilometers or to "insignificant levels." *See* 43 FR 26398, June 19, 1978. Through guidance, EPA has also allowed the use of SILs to determine whether or not it is necessary for a source to carry out a comprehensive source impact analysis and to determine the extent of the impact area in which the analysis will be carried out. The existing SILs for SO_2 were not developed on the basis of specific SO_2 NAAQS levels, so there may be no need to revise the existing SILs. Even upon revocation of the annual and 24-hour NAAQS, the corresponding SIL should still be useful for increment assessment. A SIL for the 1-hour averaging period does not exist, and would need to be developed for use with modeling for 1-hour SO_2 NAAQS and any 1-hour increments.

Finally, the SMC, also measured as an ambient pollutant concentration ($\mu g/m^3$), is used to determine whether it may be appropriate to exempt a proposed project from the requirement to collect ambient monitoring data for a particular pollutant as part of a complete permit application. EPA first defined SMCs for regulated pollutants under the PSD program in 1980. *See* 45 FR 52676, 52709–10 (August 7, 1980). The existing SMC for SO_2, based on a 24-hour averaging period, may need to be re-evaluated to consider the effect of basing the SMC on the 1-hour averaging period, especially in light of revocation of the NAAQS for the 24-hour averaging period. Third, even if the 1-hour averaging period does not indicate the need for a revised SMC for SO_2, the fact that the original SMC for SO_2 is based on 1980 monitoring data (Lowest Detectable Level, correction factor of "5"), could be a basis for revising the existing value. More up-to-date monitoring data and statistical analyses of monitoring accuracy may yield a different—possibly lower—correction factor today. The new 1-hour NAAQS will not necessarily cause this result, but may provide a "window of opportunity" to re-evaluate the SMC for SO_2.

States which have areas designated as nonattainment for the SO_2 NAAQS are directed to submit, as a part of the SIP due 18 months after an area is designated as nonattainment, provisions requiring permits for the construction and operation of new or modified stationary sources anywhere in the nonattainment area. Prior to adoption of the SIP revision addressing major source nonattainment NSR for SO_2 nonattainment areas, the requirements of 40 CFR part 51, appendix S will apply. Nonattainment NSR requirements include but are not limited to:

- Installation of Lowest Achievable Emissions Rate (LAER) control technology;
- Offsetting new emissions with creditable emissions reductions;
- A certification that all major sources owned and operated in the State by the same owner are in compliance with all applicable requirements under the CAA;
- An alternatives and siting analysis demonstrating that the benefits of a proposed source significantly outweigh the environmental and social costs imposed as a result of its location, construction, or modification; and
- Public comment on the permit.

Minor NSR programs must meet the statutory requirements in section 110(a)(2)(C) of the CAA which requires "* * * regulation of the modification and construction of any stationary source * * * as necessary to assure that the [NAAQS] are achieved." These programs must be established in each State within 3 years of the promulgation of a new or revised NAAQS.

b. Comments and Responses

Several commenters stated that in order to avoid confusion and lag time as it relates to PSD/NSR and permitting activities, which must be taken by States following the promulgation of the revised NAAQS, EPA must provide guidance as soon as possible related to these issues. Commenters also stated that EPA must develop guidance as soon as possible to address the screening tools for PSD/NSR such as SILs, SERs, SMCs, and the development of increments. Several commenters also stated that guidance should be provided as it relates to the use of AERMOD to address PSD issues.

The EPA acknowledges that a decision to promulgate a new short-term SO_2 NAAQS will have implications for the air permitting process. The full extent of how a new short-term SO_2 NAAQS will affect the NSR process will need to be carefully evaluated. First, major new and modified sources applying for NSR/PSD permits will initially be required to demonstrate that their proposed emissions increases of SO_2 will not cause or contribute to a violation of any NAAQS or PSD increments for SO_2, including the new 1-hour SO_2 NAAQS. In addition, we believe that section 166(c) of the CAA authorizes EPA to consider the need to promulgate a new 1-hour increment. Historically, EPA has developed increments for each applicable averaging period for which a NAAQS has been promulgated. However, increments for a particular pollutant do not necessarily need to match the averaging periods that have been established for NAAQS for the same pollutant. *Environmental Defense Fund, Inc.* v. *EPA,* 898 F.2d 183, 189–190 (DC Cir. 1990) ("* * * the 'goals and purposes' of the PSD program, set forth in § 160, are not identical to the criteria on which the ambient standards are based.") Thus, we would need to evaluate the need for a new 1-hour SO_2 increment in association with the goals and purposes of the statutory PSD program requirements.

We agree with the commenters that there may be a need for EPA to provide additional screening tools or to revise existing screening tools that are frequently used under the NSR/PSD program for reducing the burden of completing SO_2 ambient air impact analyses. These screening tools include the SILs, as mentioned by the commenter, but also include the SER for emissions of SO_2 and the SMC for SO_2. The existing sceening tools apply to the averaging periods used to define the existing NAAQS for SO_2, including the annual, 24-hour, and 3-hour averaging periods. EPA intends to evaluate the need for possible changes or additions to each of these useful screening tools for SO_2 due to the revision of the SO_2 NAAQS to provide for a 1-hour standard. We believe it is highly likely that in order to be most useful for implementing the new 1-hour averaging period for NSR purposes, new 1-hour screening values will be appropriate.

Finally, in response to the comment concerning the need for additional guidance as it relates to the use of AERMOD to address PSD issues, EPA anticipates providing additional technical guidance on modeling and analysis as a part of the SIP demonstration process. As stated previously, EPA intends to solicit public comment on guidance regarding modeling, and also solicit public comment on additional implementation planning guidance. However, EPA believes that the air quality models currently required for NSR/PSD permitting as provided in the EPA's *Guideline on Air Quality Models,* Appendix W of CFR 40 Part 51 would be appropriate for demonstrating compliance with the revised SO_2 NAAQS under these programs. At this time, EPA is not considering modifying the AERMOD dispersion model and its underlying science for predicting SO_2 concentrations to accommodate the revised NAAQS for SO_2.

c. Current Approach

In the preamble to the proposed regulation, EPA noted that "PSD permit requirements are effective on the promulgation date of a new or revised standard." However, this statement did not reflect an important distinction that needs to be clarified here. Under section 51.166(b)(49)(i) and 52.21(b)(50)(i) of EPA's regulations, a pollutant that has not been regulated previously would become a "regulated NSR pollutant" upon promulgation of a NAAQS. *See,* 75 FR 17004, 17018–19. However, in the case of pollutants that are already "regulated NSR pollutants," at the time a new NAAQS is promulgated or an existing NAAQS is revised, EPA interprets the CAA and EPA regulations to require implementation of the new or revised standard in the Federal PSD permitting process upon the effective date of any new or revised standards. Section 165(a)(3) of the CAA and section 52.21(k) of EPA's regulations require that a permit applicant demonstrate that it will not cause or contribute to a violation of "any" NAAQS. *See,* Memorandum from Stephen D. Page, Director of EPA Office of Air Quality Planning and Standards, "Applicability of the Federal Prevention of Significant Deterioration Permit Requirements to New and Revised National Ambient Air Quality Standards" (April 1, 2010).

Amendments to the existing PSD requirements set forth in EPA regulations concerning SILs, SERs and SMCs may involve notice and comment rulemaking which could take at least one year to complete. For $PM_{2.5}$, EPA developed SERs under the initial NSR implementation requirements for $PM_{2.5}$. *See* 73 FR 28321, May 16, 2008. The SILs and SMC for $PM_{2.5}$ are being developed under a subsequent rulemaking simultaneously with the promulgation of $PM_{2.5}$ increments, pursuant to a CAA schedule that allows EPA 2 years from the promulgation of new and revised NAAQS to promulgate increments. Under such an approach, SILs and SMC are not available until the increments are promulgated. States and industry have criticized that approach because it has left State permitting authorities without an EPA-approved de minimis value that could be used in determining the level of analysis that individual PSD sources must undergo, and could result in more detailed analyses for sources that will have only have de miminis impacts on the NAAQS.

To address this concern, we believe it is appropriate to proceed with development of the PSD screening tools in advance of an increment rulemaking to hasten their availability. In addition, we are assessing the possibility of developing interim screening tools that can be used by States prior to the completion of the SIP-development process if the States establish an appropriate record for individual permitting actions based on the supporting technical information provided by EPA. It is our expectation, that if such interim screening tools are appropriate, we would make the interim SIL and the supporting record for EPA's assessment available before the effective date of the new 1-hour SO_2 NAAQS to facilitate more efficient PSD permit reviews once the new standard becomes effective.

3. General Conformity

a. Approach Described in the Proposal

Section 176(c) of the CAA requires that all Federal actions conform to an applicable implementation plan developed pursuant to section 110 and part D of the CAA. The EPA rules developed under section 176(c) prescribe the criteria and procedures for demonstrating and assuring conformity of Federal actions to a SIP. Each Federal agency must determine that any actions covered by the general conformity rule conform to the applicable SIP before the action is taken. The criteria and procedures for conformity apply only in nonattainment areas and those nonattainment areas redesignated to attainment since 1990 ("maintenance areas") with respect to the criteria pollutants under the CAA: [39] carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O3), particulate matter ($PM_{2.5}$ and PM_{10}), and sulfur dioxide (SO_2). The general conformity rules apply one year following the effective date of designations for any new or revised NAAQS.[40]

The general conformity determination examines the impacts of direct and indirect emissions related to Federal actions. The general conformity rule provides several options to satisfy air quality criteria, such as modeling or offsets, and requires the Federal action to also meet any applicable SIP requirements and emissions milestones. The general conformity rule also requires that notices of draft and final general conformity determinations be provided directly to air quality regulatory agencies and to the public by publication in a local newspaper.

b. Current Approach

EPA did not receive any comments on this aspect of the discussion in the proposal and expects to follow that approach.

E. Transition From the Existing SO_2 NAAQS to a Revised SO_2 NAAQS

a. Proposal

In addition to proposing a short-term 1-hour SO_2 NAAQS, EPA proposed to revoke the annual and 24-hour standards (annual 0.03 ppm and 24-hour 0.14 ppm). Specifically, EPA proposed that the level for the 1-hour standard for SO_2 be a range between 50–100 ppb, and took comment on setting the level of the standard up to 150 ppb. We explained that if the Administrator sets the 1-hour standard at 100 ppb or lower, EPA proposed to revoke the 24-hour standard. If the Administrator set the level of the 1-hour standard between a range of 100–150 ppb, then EPA proposed to retain the 24-hour standard.

We explained that if EPA revised the SO_2 NAAQS and revoked either the annual or 24-hour standard, EPA would need to promulgate adequate anti-backsliding provisions. The CAA establishes anti-backsliding requirements where EPA relaxes a NAAQS. Here, in EPA replacing the annual and 24-hour standards with a short term 1-hour standard, EPA must address the section 172(e) anti-backsliding provision of the CAA and determine whether it applies on its face or by analogy, and what provisions are appropriate to provide for transition to the new standard. States will need to insure that the health protection provided under the prior SO_2 NAAQS continues to be achieved as well as maintained as States begin to implement the new NAAQS. This means that States are directed to continue implementing attainment and maintenance SIPs associated with the prior SO_2 NAAQS until such time as they are subsumed by any new planning and control requirements associated with the new NAAQS.

Whether or not section 172(e) directly applies to EPA's final action on the SO_2 NAAQS, EPA has previously looked to other provisions of the CAA to determine how to address anti-

[39] Criteria pollutants are those pollutants for which EPA has established a NAAQS under section 109 of the CAA.

[40] Transportation conformity is required under CAA section 176(c) (42 U.S.C. 7506(c) to ensure that Federally supported highway and transit project activities are consistent with ("conform to") the purpose of the SIP. Transportation conformity applies to areas that are designated nonattainment, and those areas redesignated to attainment after 1990 ("maintenance areas" with plans developed under CAA section 175A) for transportation-related criteria pollutants. Due to the relatively small amounts of sulfur in gasoline and on-road diesel fuel, transportation conformity does not apply to the SO_2 NAAQS. 40 CFR 93.102(b)(1).

backsliding. The CAA contains a number of provisions that indicate Congress's intent to not allow provisions from implementation plans to be altered or removed if the plan revision would jeopardize the air quality protection being provided by the existing plan when EPA revises a NAAQS to make it more stringent. For example, section 110(l) provides that EPA may not approve a SIP revision if it interferes with any applicable requirement concerning attainment and RFP, or any other applicable requirement under the CAA. In addition, section 193 of the CAA prohibits the modification of a control, or a control requirement, in effect or required to be adopted as of November 15, 1990 (*i.e.,* prior to the promulgation of the Clean Air Act Amendments of 1990), unless such a modification would ensure equivalent or greater emissions reductions. Further, section 172(e) of the CAA specifies that if EPA revises a NAAQS to make it less stringent than a previous NAAQS, control obligations no less stringent than those that apply in nonattainment area SIPs may not be relaxed, and adopting those controls that have not yet been adopted as needed may not be avoided. The intent of Congress, concerning the aforementioned sections of the CAA, was confirmed in a recent DC Circuit Court opinion on the Phase I ozone implementation rule. *See South Coast Air Quality Management Dist.* v. *EPA,* 472 F.3d 882 (DC Cir. 2006).

To ensure that the anti-backsliding provisions and principles of section 172(e) are met and applied upon EPA revocation of the annual and 24-hour standards, EPA is providing that those SO_2 NAAQS will remain in effect for one year following the effective date of the initial designations under section 107(d)(1) for the new SO_2 NAAQS before the current NAAQS are revoked in most attainment areas. However, any existing SIP provisions under CAA sections 110, 191 and 192 associated with the annual and 24-hour SO_2 NAAQS will remain in effect, including all currently implemented planning and emissions control obligations, including both those in the State's SIP and that have been promulgated by EPA in FIPs. This will ensure that both the new nonattainment NSR requirements and the general conformity requirements for a revised standard are in place so that there will be no gap in the public health protections provided by these two programs. It will also ensure that all nonattainment areas under the annual and/or 24-hour NAAQS and all areas for which SIP calls have been issued will continue to be protected by currently required control measures.

EPA is also providing that the annual and 24-hour NAAQS remain in place for any current nonattainment area, or any area for which a State has not fulfilled the requirements of a SIP call, until the affected area submits, and EPA approves, a SIP with an attainment, implementation, maintenance and enforcement SIP which fully addresses the attainment and maintenance requirements of the new SO_2 NAAQS. This, in combination with the CAA mechanisms provided in sections 110(l), 193, and 172(e) will help to ensure that continued progress is made toward timely attainment of the SO_2 NAAQS. Also, in light of the nature of the new SO_2 NAAQS, the lack of classifications (and mandatory controls associated with such classifications pursuant to the CAA), and the small number of current nonattainment areas, and areas subject to SIP calls, EPA believes that retaining the current standard for a limited period of time until attainment and maintenance SIPs are approved for the new standard in current nonattainment areas and SIP call areas, and one year after designations in other areas, will adequately serve the anti-backsliding requirements and goals of the CAA.[41]

b. Comments and Responses

Several commenters stated that they support EPA's proposal stating that the annual and 24-hour SO_2 NAAQS EPA would remain in effect for one year following the effective date of the initial designations under section 107(d)(1) for the revised SO_2 NAAQS before the current NAAQS are revoked in most attainment areas. The commenters also support EPA's proposal that any existing SIP provisions under CAA sections 110, 191 and 192 associated with the annual and 24-hour SO_2 NAAQS would remain in effect, including all currently implemented planning and emissions control obligations, including both those in the State's SIP and that have been promulgated by EPA in FIPs. Several commenters also stated that they support EPA's proposal that an area's nonattainment designation and the subsequent CAA requirements under the current SO_2 NAAQS will remain in effect until the affected State submits, and EPA approves a SIP which meets all of the relevant CAA requirements for the affected nonattainment area. EPA appreciates the support of the commenters on its strategy for addressing the anti-backsliding requirements related to the current and revised SO_2 standard, pursuant to section 172(e) of the CAA.

One commenter, however, stated that while they support EPA's proposal to address the anti-backsliding provisions of section 172(e) of the CAA, they believe that EPA's proposal is deficient in several respects. The commenter stated that EPA's proposal to not terminate the annual and 24-hour standards for SO_2 in any nonattainment area, or any area for which a State has not fulfilled the requirements of a SIP call, until after the affected area submits and EPA approves a SIP with an attainment demonstration which fully "addresses" the attainment requirements of the revised SO_2 NAAQS is flawed. The commenter states that EPA's use of the term "addresses" is impermissibly and arbitrarily ambiguous and that the agency needs to clarify that "fully addressing" the attainment requirements of the revised NAAQS actually means providing for timely attainment of the NAAQS, and the submittal of a SIP that fully meets all of the requirements of section 110 and part D of Title I of the CAA, including sections 172, 173, and 191–193 of the CAA.

Another commenter stated that the 24-hour SO_2 standard should not be revoked in attainment areas until EPA approves section 110(a)(2) "infrastructure" SIPs under the new 1-hour standard for such areas, in order to avoid delays in between attainment designation and such SIP approvals resulting in leaving the public unprotected or creating inter-state conflict that triggers section 126 petitions. This commenter further stated that the annual SO_2 standard should not be revoked until EPA approves SIPs in attainment areas under the future SO_2 secondary standard, which may also be based on an annual averaging time.

EPA agrees with the comment made by the commenter regarding the need to approve SIPs in nonattainment areas (and in SIP call areas) before revoking the 24-hour and annual NAAQS for such areas. EPA clarifies that for those areas designated as nonattainment for the current NAAQS, or areas which have not met the requirements of a SIP call, that the State must submit a SIP that meets all of the applicable CAA requirements as they relate to section 110 and part D of Title I of the CAA, including sections 110(a), 172, 173, and 191–193 of the CAA. In addition to the

[41] The areas that are currently designated as nonattainment for the pre-existing SO_2 primary NAAQS are Hayden, AZ; Armstrong, PA; Laurel, MT; Piti, GU; and Tanguisson, GU. The areas that are designated nonattainment for both the primary and the secondary standards are East Helena, MT, Salt Lake Co, MT, Toole Co, UT, and Warren Co, NJ. (*See http://www.epa.gov/oar/oaqps/greenbk/lnc.html*). The Billings/Laurel, MT, area is the only area currently subject to a SIP call.

submittal of the SIP related to these requirements, EPA must approve the submittal for the area before the current standard can be revoked for the affected area.

EPA disagrees with the comment. This rulemaking concerns only the primary standards for SO_2. 74 FR at 64812 n. 2. The annual SO_2 standard is a primary standard, not a secondary standard. *See* 40 CFR section 50.4 (a). The exclusive secondary standard for SO_2 is the 3-hour standard codified in 40 CFR section 50.5. EPA is not determining the adequacy of this secondary standard in this review or this rulemaking, as just noted. The commenter's request to retain the annual primary standard until SIPs reflecting a new secondary standard are approved is effectively a request to amend the present secondary standard, and is therefore inappropriate given the scope of this review. In any case, in the event that any substantive responsive to this comment is required, air quality information indicates that a 1-hour standard of 75 ppb is estimated to generally keep annual SO_2 concentrations well below the level of the current annual standard. 74 FR at 64845. Thus, there would be no loss of protection to public welfare due to revocation of the annual primary standard.

EPA further disagrees with the commenter's request that we not revoke the 24-hour standard in attainment areas before section 110(a)(2) "infrastructure" SIPs are approved under the new 1-hour SO_2 standard. An area that has shown it has attained the 24-hour standard and that is not the subject of a SIP call, even after revocation of the 24-hour standard, will still have in its SIP its prior "infrastucture" SIP elements. There is no need to delay revocation when that will not cause the area to become subject to a new SIP under the new 1-hour NAAQS any faster than the statute already requires (*i.e.,* three years from the date of promulgation of the new NAAQS). Furthermore, as we have explained in sections III, IV, V and VI of this preamble, all areas are required by section 110(a)(1) of the Clean Air Act to submit such SIPs by June 2013, and we expect that to be approved they will all need to show attainment, implementation, maintenance and enforcement of the new NAAQS as expeditiously as practicable, which we believe is no later than August 2017. EPA believes this anticipated approach would more than sufficiently address the backsliding concerns raised by the commenter.

c. Final

EPA is making no changes to the proposed rule's discussion of the transition strategy discussion for SO_2 with the exception of the clarifications noted above.

VII. Appendix T—Interpretation of the Primary NAAQS for Oxides of Sulfur and Revisions to the Exceptional Events Rule

EPA proposed to add Appendix T, Interpretation of the Primary National Ambient Air Quality Standards for Oxides of Sulfur, to 40 CFR Part 50 in order to provide monitoring data handling procedures for the proposed SO_2 1-hour primary standard. The proposed section 50.17 which sets the averaging period, level, indicator, and form of the NAAQS referred to this Appendix T. The proposed Appendix T detailed the computations necessary for determining when the proposed 1-hour primary SO_2 NAAQS is met based on data from ambient monitoring and also addressed monitoring data reporting, data completeness considerations, and rounding conventions.

EPA proposed two versions of Appendix T. The first applied to a 1-hour primary standard based on the annual 4th high value form, while the second applied to a 1-hour primary standard based on the 99th percentile daily value form. The final version of the Appendix reflects our choice to adopt the 99th percentile daily form (*see* section II. E.3 above).

For the 1-hour primary standard, EPA proposed monitoring data handling procedures, a cross-reference to the Exceptional Events Rule, a grant of discretion for the Administrator to consider otherwise incomplete monitoring data to be complete, and a provision addressing the possibility of there being multiple SO_2 monitors at one site. EPA is finalizing these proposals, with one change from the proposal with regard to the multiple monitor provision.

EPA is also making certain drafting changes to the proposed regulatory text to clarify certain points and to assure that the regulatory text conforms with EPA's intentions as stated in the preamble. Specifically, EPA has slightly edited the text of the rule from that proposed by adding the phrase "at an ambient air monitoring site" to section 50.17 (b) and to section 1.1 of Appendix T to part 50, and also by adding a section 50.17 (c) stating that the level of the standard is to be measured by an FRM found in Appendix A or A–1 to Part 50, or by a properly designated FEM. Both of these provisions are being added to conform the text of the new 1-hour standard to the language of other NAAQS. *See. e.g.* the text of the 8-hour primary standard for ozone in section 50.10 (a) and (b). The reference to "at an ambient monitoring site" makes clear that the regulatory text refers to situations where compliance with a NAAQS is measured by means of monitoring. This text does not restrict or otherwise address approaches which EPA or States may use to implement the new 1-hour NAAQS, which may include, for example, use of modeling (*see* sections III—VI above). *See* CAA sections 107 (d) (3) (A) (any "air quality data" may be used for redesignations); 110 (a) (1) (which does not address the issue of the types of data States may use in devising plans for implementation, maintenance, and enforcement of a primary NAAQS); 192 (a) (which does not specify the types of data that may support a demonstration that a non-attainment area has attained a NAAQS). Similarly, EPA notes that Appendix T applies when ambient monitoring data is gathered and utilized in support of the new 1-hour SO_2 NAAQS. As noted in sections III, IV, V, and VI above, there are circumstances when EPA is considering use of modeling in the SO_2 NAAQS implementation effort, and other considerations would apply if and to the extent modeling is utilized.

The EPA is also making SO_2-specific changes to the deadlines in 40 CFR 50.14, by which States must flag ambient air data that they believe have been affected by exceptional events and submit initial descriptions of those events, and to the deadlines by which States must submit detailed justifications to support the exclusion of those data from EPA monitoring-based determinations of attainment or nonattainment with the NAAQS.

A. Interpretation of the Primary NAAQS for Oxides of Sulfur

The purpose of a monitoring data interpretation rule for the SO_2 NAAQS is to give effect to the form, level, averaging time, and indicator specified in the regulatory text at 40 CFR 50.17, anticipating and resolving in advance various future ambiguities that could otherwise occur regarding use of ambient monitoring data. The new Appendix T provides definitions and requirements that apply to the new 1-hour primary standard for SO_2. The requirements concern how ambient monitoring data are to be reported, what ambient monitoring data are to be considered (including the issue of which of multiple monitors' data sets will be used when more than one monitor has operated at a site), and the

applicability of the Exceptional Events Rule to the primary SO_2 NAAQS.

1. Proposed Interpretation of the Standard Based on Data From Ambient Monitoring

With regard to monitoring data completeness for the proposed 1-hour primary standard, the proposed Appendix T followed past EPA practice for other NAAQS pollutants by requiring that in general at least 75% of the monitoring data that should have resulted from following the planned monitoring schedule in a period must be available for the key air quality statistic from that period to be considered valid. For the 1-hour primary SO_2 NAAQS, the key air quality statistics are the daily maximum 1-hour concentrations in three successive years. It is important that sampling within a day encompass the period when concentrations are likely to be highest and that all seasons of the year are well represented. Hence, the 75% requirement was proposed to be applied at the daily and quarterly levels.

Recognizing that there may be years with incomplete data, the proposed Appendix T for the 99th percentile form provided that a design value derived from incomplete monitoring data will nevertheless be considered valid if the relevant one of two diagnostic substitution tests validated such a design value as being either above the NAAQS level or equal to or below the NAAQS level.

The first proposed diagnostic data substitution test, relevant when the design value derived from incomplete data was equal to or below the NAAQS level, was intended to identify those cases with incomplete monitoring data in which it nevertheless is very likely, if not virtually certain, that the daily 1-hour design value would have been observed to be less than or equal to the level of the NAAQS if monitoring data had been minimally complete. This test involved the substitution of a high historical concentration for any missing data. The second proposed diagnostic data substitution test, relevant when the design value derived from incomplete data was above the NAAQS level, was intended to identify those cases with incomplete monitoring data in which it nevertheless is very likely, if not virtually certain, that the daily 1-hour design value would have been observed to be above the level of the NAAQS if monitoring data had been minimally complete. This test involved the substitution of a low historical concentration for any missing data.

It should be noted that one possible outcome of applying the relevant proposed substitution test is that a 3-year period with incomplete monitoring data may nevertheless be determined to not have a valid design value and thus to be unusable in making 1-hour primary NAAQS compliance determinations based on monitoring for that 3-year period.

Also, we proposed that the Administrator have general discretion to use incomplete monitoring data based on case specific factors, either at the request of a State or at her own initiative. Similar provisions existed already for some other NAAQS.

The 99th percentile version of the proposed Appendix T provided a table for determining which day's maximum 1-hour concentration will be used as the 99th percentile concentration for the year. The proposed table is similar to one used now for the 24-hour $PM_{2.5}$ NAAQS and the new 1-hour NO_2 NAAQS, which are both based on a 98th percentile form, but adjusted to reflect a 99th percentile form for the 1-hour primary SO_2 standard. The proposed Appendix T also provided instructions for rounding (not truncating) the average of three annual 99th percentile hourly concentrations before comparison to the level of the primary NAAQS.

2. Comments on Interpretation of the Standard

Several commenters expressed support for EPA's proposed 75% completeness requirement for daily and quarterly monitoring data. A comment was received that the substitution test should not be used to make attainment or non-attainment designations. This commenter also said that the same completeness requirement as used for nonattainment should be used for attainment. Another commenter agreed that there should be completeness criteria, but thought that monitoring data should be substituted to make the set only 75% complete. We received one comment that the computation of design values where multiple monitors are present at a site should be averaged and not taken from a designated primary monitor. We received no comment on the provision which would afford the Administrator (or her delegee) discretion to use incomplete monitoring data based on specified factors and accordingly are adopting that provision as proposed.

3. Conclusions on Interpretation of the Standard

Consistent with the Administrator's decision to adopt a 99th percentile form for the 1-hour NAAQS, the final version of Appendix T is based on that form.

We agree with the three comments expressing the view that the requirement for 75% monitoring data completeness per quarter should apply with respect to the 1-hour standard. The final rule includes this requirement.

We agree that nonattainment based on data from ambient monitoring should not be declared without a very high confidence that actual air quality did not meet the NAAQS, but we believe the proposed (and final) substitution test provides this irrefutable proof. In the relevant substitution test (Appendix T section 3.c.iii), the lowest daily maximum concentration observed in the same calendar quarter within the 3-year period is the value used in the substitution. Moreover, to guard against the possibility that even this lowest observed value is unrepresentative because only a small number of days that happened to have had poor air quality have valid monitoring data, substitution is permitted only if there are at least 200 days across the three matching quarters of the three years under consideration for which 75 percent of the hours in the day have reported concentrations. (If less than 200 days are available, the outcome is that no conclusion can be reached based on data from monitoring as to whether the NAAQS is met, an outcome which satisfies the concern expressed by the commenter.) While it is conceivable that the actual daily maximum concentration on the day(s) without sufficiently complete data could have been even lower than the value selected as the substitute value, the value that is selected for substitution will be quite low, and therefore it is extremely unlikely to be a candidate for selection as the annual 99th percentile daily maximum concentration. The actual effect of the data substitution, if any, is to change which of the actually observed and ranked daily maximum concentrations during the year is identified as the 99th percentile; the direction of the change, if any, will always be towards a lower design value. For example, if the substitution test of section 3.c.iii is used because there is one quarter of 92 days is missing 70 of its 92 daily maximum concentration values; causing there to be only 295 days with valid daily values for the whole year, it would be necessary to substitute 47 values to make that quarter 75 percent complete. This would result in 343 days of actual or substituted monitoring data for the year. The increase from 292 days to 342 days would cause the annual 99th percentile value to shift from the 3rd highest value to the 4th highest. Since a low

concentration is being used for the substitution, it is impossible for the 4th highest value to itself be a substituted value. If this shift results in the 3-year design value remaining above the NAAQS, the failure to meet the NAAQS is confirmed. If this shift results in the 3-year design value changing to be equal to or below the NAAQS, under the terms of the substitution test the outcome is that no conclusion could be reached based on this ambient monitoring data as to whether the NAAQS is met. Since either the same or a lower ranking actually measured concentration will always be identified, it is impossible for the outcome of the substitution test of section 3.c.iii to be that an area truly meeting the NAAQS based on ambient monitoring data is determined to not meet it based on ambient monitoring data.

The commenter who said that the same completeness requirement should be used for nonattainment as for attainment appears to have been referring to a particular feature of the proposed diagnostic substitution test rather than to the basic completeness requirement of 75%, which in both the proposal and the final rule applies equally to both attainment and nonattainment situations. This particular feature is discussed in the next paragraph.

The commenter who said that it is appropriate to substitute data to make the set only 75% complete appears to have taken note that in the proposed substitution test relevant in the case of an incomplete design value equal to or below the NAAQS (section 3.c.ii), data are substituted until 100% completeness is reached for the affected quarter, while in the test relevant in the case of an incomplete design value above the NAAQS (section 3.c.iii) data are substituted only until 75% completeness is reached. EPA believes this distinction is appropriate, and we have retained the 100% substitution limit in the final rule. In the case of an incomplete design value that is equal to or below the NAAQS, the concern is that the actual concentrations on the days without a valid daily maximum 1-hour concentration may have been quite high such that the concentration on one of those days would have been selected as the annual 99th percentile value. To be selected as the annual 99th percentile value, a daily maximum must be ranked no lower than the 4th highest daily value for the year. If substitution stopped when 75% of the days in a quarter had an actual or substituted value, there could be a situation in which only one, two, or three historical high values would need to be substituted to reach the 75% limit. It would therefore be possible for one of the actually measured concentrations (for the same or another quarter) to be identified as the annual 99th percentile value even if the substitution value is higher than any value actually measured, defeating the very purpose of the diagnostic test for an incomplete design value below the NAAQS, which is to essentially rule out the possibility of not meeting the NAAQS (when making monitoring-based determinations). The simplest way to ensure that at least four values are substituted (when there are at least four missing daily values) is to require substitution up to the 100% limit.

With regard to situations with multiple monitors operating at one site, we note that there are few cases of this situation for SO_2 monitoring. Of over 500 SO_2 monitoring sites in operation any time during 2007–2009, for example, only seven stations reported 1-hour data to the Air Quality System under two or more distinct Pollutant Occurrence Codes (POC). In the same period, collocated monitors reported data to AQS under distinct POCs for only one of over 400 nitrogen dioxide sites, for only two of almost 400 carbon monoxide sites, and for only eight of almost 1300 ozone sites. Even so, we believe is it important to have a well defined monitor data handling procedure for such situations. Also, there is a practical advantage in implementation if the same or similar procedure is used across NAAQS pollutants especially for these four gaseous pollutants that are measured on a 1-hour basis. A procedure that is simple to implement also has advantages in implementation. Finally, the procedure should not introduce any upward or downward bias in the determination of the design value for the monitoring site.[42]

The proposed procedure for multiple SO_2 monitors was the same as EPA recently proposed and finalized for the new 1-hour NAAQS for nitrogen dioxide, where there were no adverse comments received on the proposal (75 FR 6474, February 9, 2010). It is also the same as recently proposed in the reconsideration of the 8-hour ozone NAAQS (75 FR 2938, January 19, 2010). In the proposed procedure, in general, data from two monitors would never be mixed within a year but data from different monitors in different years could be used to calculate the 3-year design value. As noted above, one commenter on the SO_2 proposal suggested that instead of designating a primary monitor when there are two monitors at a site, the measurements for an hour from multiple monitors should be averaged instead. EPA has also received at least one comment disagreeing with the recent proposal regarding multiple ozone monitors. The comment in the ozone rulemaking favored hour-by-hour substitution of data from a secondary monitor when the designated primary monitor has not given a value measurement, as opposed to the proposed restriction against mixing data within a year. These comments have caused us to rethink the direction set in the final NO_2 rule and in the proposals for SO_2 and ozone. We now believe that substitution of monitoring data hour-by-hour is an acceptable and in some ways superior approach to the other possible approaches, while averaging hour-by-hour would be unduly complex. Also, averaging hour-by-hour might not be transparent depending on whether the averaging is done at the monitoring agency before submission to EPA or by EPA as part of calculating a design value. However, in light of the rarity of collocated monitors, it would be an unwarranted demand on limited EPA resources to develop and maintain software for hour-by-hour data substitution. Also, an hour-by-hour data substitution approach depends on the advance designation of a primary monitor, which itself could introduce confusion and would require software changes to EPA's data system. Therefore, EPA believes that the most practical, and still a technically valid approach, is to allow monitoring agencies the option of hour-by-hour substitution between secondary and primary monitors before submission of data to EPA, and for EPA to select for use in calculating design values the one monitoring data record which has the highest degree of completeness for a given year. The final rule is based on this approach. EPA will also consider this approach when finalizing the ozone NAAQS reconsideration rule, and when proposing data interpretation provisions for a planned rulemaking to review the carbon monoxide NAAQS. The already finalized procedures for nitrogen dioxide data interpretation will be

[42] Selecting the maximum or minimum observed concentration for an hour, the maximum or minimum annual 99th percentile, or the maximum or minimum three-year design value would introduce such a bias. Averaging multiple 1-hour measurements when available, designating one monitor as primary and using a second monitor's measurement only when the primary monitor fails to give a valid measurement, or simply choosing to use the data record from only one of the monitors (on some basis that is independent of the concentration values obtained) would not introduce such a bias.

implemented as promulgated, but will affect only an extremely small number of collocated SO_2 monitoring situations.

Finally, as proposed, the final version of Appendix T has a cross reference to the Exceptional Events Rule (40 CFR 50.14) with regard to the exclusion of monitoring data affected by exceptional events. In addition, the specific steps for including such data in completeness calculations while excluding such data from actual design value calculations is clarified in Appendix T.

B. Exceptional Events Information Submission Schedule

The Exceptional Events Rule at 40 CFR 50.14 contains generic deadlines for a State to submit to EPA specified information about exceptional events and associated air pollutant concentration data. A State must initially notify EPA that data have been affected by an event by July 1 of the calendar year following the year in which the event occurred; this is done by flagging the data in AQS and providing an initial event description. The State must also, after notice and opportunity for public comment, submit a demonstration to justify any claim within 3 years after the quarter in which the data were collected. However, if a regulatory decision based on the data (for example, a designation action) is anticipated, the schedule to flag data in AQS and submit complete documentation to EPA for review is shortened, and all information must be submitted to EPA no later than one year before the decision is to be made.

These generic deadlines are suitable for the period after initial designations have been made under a NAAQS, when the decision that may depend on data exclusion is a redesignation from attainment to nonattainment or from nonattainment to attainment. However, these deadlines present problems with respect to initial designations under a newly revised NAAQS. One problem is that some of the deadlines, especially the deadlines for flagging some relevant data, may have already passed by the time the revised NAAQS is promulgated. Until the level and form of the NAAQS have been promulgated a State does not know whether the criteria for excluding data (which are tied to the level and form of the NAAQS) were met on a given day. Another problem is that it may not be feasible for information on some exceptional events that may affect final designations to be collected and submitted to EPA at least one year in advance of the final designation decision. This could have the unintended consequence of EPA designating an area nonattainment because of uncontrollable natural or other qualified exceptional events.

The Exceptional Events Rule at section 50.14(c)(2)(v) indicates "when EPA sets a NAAQS for a new pollutant, or revises the NAAQS for an existing pollutant, it may revise or set a new schedule for flagging data for initial designation of areas for those NAAQS."

For the specific case of SO_2, the signature date for the revised SO_2 NAAQS is June 2, 2010. State/Tribal area designations recommendations will be due by June 2, 2011, and EPA will make initial area designations under the revised NAAQS by June 1, 2012 (since June 2, 2012 would be on a Saturday) and will be informed by air quality data from the years 2008–2010 or 2009–2011 if there is sufficient data for these data years and by any refined modeling that is conducted. (*See* Sections III, V and VI above for more detailed discussions of the designation schedule and what data EPA expects to use.) Because final designations would be made by June 1, 2012, all events to be considered during the designations process would have to be flagged and fully documented by States one year prior to designations, by June 1, 2011. A State would not be able to flag and submit documentation regarding events that occurred between June to December 2011 by one year before designations are made in June 2012.

EPA is adopting revisions to 40 CFR 50.14 only to change submission dates for information supporting claimed exceptional events affecting SO_2 data. The rule text at the end of this notice shows the changes that will apply to the new 1-hour SO_2 NAAQS. For air quality data collected in 2008, we are extending the generic July 1, 2009 deadline for flagging data (and providing a brief initial description of the event) to October 1, 2010. EPA believes this extension will provide adequate time for States to review the impact of exceptional events from 2008 on the revised standard and notify EPA by flagging the relevant data in AQS. EPA is not changing the foreshortened deadline of June 1, 2011 for submitting documentation to justify an SO_2-related exceptional event from 2008. We believe the generic deadline provides adequate time for States to develop and submit proper documentation.

For data collected in 2009, EPA is extending the generic deadline of July 1, 2010 for flagging data and providing initial event descriptions to October 1, 2010. EPA is retaining the deadline of June 1, 2011 for States to submit documentation to justify an SO_2-related exceptional event from 2009. For data collected in 2010, EPA is promulgating a deadline of June 1, 2011 for flagging data and providing initial event descriptions and for submitting documentation to justify exclusion of the flagged data. EPA believes that this deadline provides States with adequate time to review and identify potential exceptional events that occur in calendar year 2010, even for those events that might occur late in the year. EPA believes these deadlines will be feasible because experience suggests that exceptional events affecting SO_2 data are few in number and easily assessed, so no State is likely to have a large workload.

If a State intends 2011 data to be considered in SO_2 designations, 2011 data must be flagged and detailed event documentation submitted 60 days after the end of the calendar quarter in which the event occurred or by March 31, 2012, whichever date occurs first. Again, EPA believes these deadlines will be feasible because experience suggest that exceptional events affecting SO_2 data are few in number and easily assessed, so no State is likely to have a large workload.

Table 1 summarizes the designation deadlines discussed in this section and provides designation schedule information from recent, pending or prior NAAQS revisions for other pollutants. EPA is revising the final SO_2 exceptional event flagging and documentation submission deadlines accordingly to provide States with reasonably adequate opportunity to review, identify, and document exceptional events that may affect an area designation under a revised NAAQS.

TABLE 1—SCHEDULE FOR EXCEPTIONAL EVENT FLAGGING AND DOCUMENTATION SUBMISSION FOR DATA TO BE USED IN DESIGNATIONS DECISIONS FOR NEW OR REVISED NAAQS

NAAQS pollutant/standard/(level)/promulgation date	Air quality data collected for calendar year	Event flagging & initial description deadline	Detailed documentation submission deadline
$PM_{2.5}$/24-Hr Standard (35 μg/m^3) Promulgated October 17, 2006.	2004–2006	October 1, 2007 [a]	April 15, 2008 [a].
Ozone/8-Hr Standard (0.075 ppm) Promulgated March 12, 2008.	2005–2007	June 18, 2009 [a]	June 18, 2009 [a].
	2008	June 18, 2009 [a]	June 18, 2009 [a].
	2009	60 Days after the end of the calendar quarter in which the event occurred or February 5, 2010, whichever date occurs first [b].	60 Days after the end of the calendar quarter in which the event occurred or February 5, 2010, whichever date occurs first [b].
NO_2/1-Hour Standard (80–100 PPB, final level TBD).	2008	July 1, 2010 [a]	January 22, 2011 [a].
	2009	July 1, 2010 [a]	January 22, 2011 [a].
	2010	April 1, 2011 [a]	July 1, 2011 [a].
SO_2/1-Hour Standard (50–100 PPB, final level TBD).	2008	October 1, 2010 [b]	June 1, 2011 [b].
	2009	October 1, 2010 [b]	June 1, 2011 [b].
	2010	June 1, 2011 [b]	June 1, 2011 [b].
	2011	60 Days after the end of the calendar quarter in which the event occurred or March 31, 2012, whichever date occurs first [b].	60 Days after the end of the calendar quarter in which the event occurred or March 31, 2012, whichever date occurs first [b].

[a] These dates are unchanged from those published in the original rulemaking, and are shown in this table for informational purposes—the Agency is not opening these dates for comment under this rulemaking.
[b] Indicates change from general schedule in 40 CFR 50.14.
Note: EPA notes that the table of revised deadlines *only* applies to data EPA will use to establish the final initial designations for new or revised NAAQS. The general schedule applies for all other purposes, most notably, for data used by EPA for redesignations to attainment.

Note further that EPA is reprinting portions of this Table in section 5014 but, with respect to the pollutants other than SO_2, is doing so only for readers' convenience and is not reopening or otherwise reconsidering any aspect of the rules related to these other pollutants.

VIII. Communication of Public Health Information

Information on the public health implications of ambient concentrations of criteria pollutants is currently made available primarily through EPA's Air Quality Index (AQI) program. The current AQI has been in use since its inception in 1999 (64 FR 42530). It provides accurate, timely, and easily understandable information about daily levels of pollution (40 CFR 58.50). The AQI establishes a nationally uniform system of indexing pollution levels for nitrogen dioxide, carbon monoxide, ozone, particulate matter and SO_2. The AQI converts pollutant concentrations in a community's air to a number on a scale from 0 to 500. Reported AQI values enable the public to know whether air pollution levels in a particular location are characterized as good (0–50), moderate (51–100), unhealthy for sensitive groups (101–150), unhealthy (151–200), very unhealthy (201–300), or hazardous (300–500). The AQI index value of 100 typically corresponds to the level of the short-term primary NAAQS for each pollutant. An AQI value greater than 100 means that a pollutant is in one of the unhealthy categories (*i.e.,* unhealthy for sensitive groups, unhealthy, very unhealthy, or hazardous) on a given day; an AQI value at or below 100 means that a pollutant concentration is in one of the satisfactory categories (*i.e.,* moderate or good). Decisions about the pollutant concentrations at which to set the various AQI breakpoints, that delineate the various AQI categories, draw directly from the underlying health information that supports the review of the primary NAAQS.

The Agency recognizes the importance of revising the AQI in a timely manner to be consistent with any revisions to the primary NAAQS. Therefore, EPA proposed to finalize conforming changes to the AQI in connection with the Agency's final decision on the SO_2 NAAQS. Conforming changes that were proposed include setting the 100 level of the AQI at the same level as the revised primary SO_2 standard if a short-term primary standard was promulgated, and revising the other AQI breakpoints at the lower end of the AQI scale (*i.e.,* AQI values of 50 and 150). EPA did not propose to change breakpoints at the higher end of the AQI scale (from 200 to 500), which would apply to State contingency plans or the Significant Harm Level (40 CFR 51.16), because the information from this review does not inform decisions about breakpoints at those higher levels.

With regard to an AQI value of 50, the breakpoint between the good and moderate categories, historically this value is set at the level of the annual NAAQS, if there is one, or one-half the level of the short-term NAAQS in the absence of an annual NAAQS (63 FR 67823, Dec. 12, 1998). Taking into consideration this practice, EPA proposed to set the AQI value of 50 to be between 25 and 50 ppb SO_2, 1-hour average; stating that concentrations toward the lower end of this range would be appropriate if the standard was set at the lower end of the range of proposed standard levels, while concentrations toward the higher end of this range would be more appropriate if the standard was set at the higher end of the range of proposed standard levels. EPA solicited comments on this range for an AQI value of 50 and the appropriate basis for selecting an AQI value of 50.

With regard to an AQI value of 150, the breakpoint between the unhealthy for sensitive groups and unhealthy categories, historically values between the short-term standard and an AQI value of 500 are set at levels that are approximately equidistant between the AQI values of 100 and 500 unless there is health evidence that suggests a specific level would be appropriate (63 FR 67829, Dec. 12, 1998). For an AQI value of 150, EPA proposed to set the breakpoint within the range from 175 to 200 ppb SO_2, 1-hour average, since it represents the midpoint between the proposed range for the short-term

standard and the level of an AQI value of 200 (300 ppb SO_2, 1-hour average).

EPA received few comments on the proposed breakpoints. Consistent with the level of the short-term primary SO_2 standard promulgated in this rule, EPA is setting the AQI value of 100, the breakpoint between the moderate and unhealthy for sensitive groups category, at 75 ppb, 1-hour average. EPA is setting the AQI value of 50, the breakpoint between the good and moderate categories, at 35 ppb SO_2, 1-hour average, which is approximately one-half the level of the new short-term standard, since the annual SO_2 standard is being revoked. EPA is setting the AQI value of 150, the breakpoint between the unhealthy for sensitive groups and unhealthy categories, at 185 ppb SO_2, 1-hour average, which represents the approximate midpoint between the level of the new short-term standard (75 ppb SO_2, 1-hour average) and the level of an AQI value of 200 (300 ppb SO_2, 1-hour average).

EPA received comments from several State environmental organizations and organizations of State and local air agencies about forecasting and reporting the AQI for SO_2. These commenters expressed the view that forecasting hourly SO_2 concentrations would be difficult. One commenter requested that EPA delay the forecasting requirement for one year and other agencies requested that EPA provide assistance in developing a forecast model. Another commenter expressed the view that it is impractical to incorporate SO_2 into its forecasting and public health notification program because SO_2 does not behave like a regional pollutant, and that exceedances may occur with little or no warning and for two hours or less. This commenter requested EPA consider the resources necessary for public communications at the State and local levels, particularly in areas where other air quality exceedances are relatively rare.

EPA recommends and encourages air quality forecasting but it is not required (64 FR 42548; August 4, 1999). We agree that there will be new challenges associated with creating and communicating an SO_2 forecast, and will work with State and local agencies that want to develop an SO_2 forecasting program on issues including, but not limited to, forecasting air quality for short time periods. We plan to work with State and local air agencies to figure out the best way to present this information to the public using the AQI.

With respect to the comment that it is impractical to incorporate SO_2 into a forecasting and public health notification program because SO_2 does not behave like a regional pollutant, this final rule departs from the proposed rule in that it allows for a combined monitoring and modeling approach. Because of this, the monitoring network is not required to be wholly source-oriented in nature. States have flexibility to allow required monitoring sites to serve multiple monitoring objectives including characterizing source impacts, highest concentrations, population exposure, background, and regional transport. Further, EPA expects that much of the existing network will be retained by States to satisfy the minimum monitoring requirements. This means that it is unlikely that AQI reporting and forecasting will be heavily driven by source-oriented monitors. Rather, many of the existing monitors (a majority of which are community-wide monitors) will remain in place, which prevents the need for new geographic regions to be delineated. With respect to concerns expressed about the resources required to report the AQI in areas were exceedances of the standard are very rare, Appendix G to Part 58 specifies that if the index value for a particular pollutant remains below 50 for a season or year, then a State or local agency may exclude the pollutant from the calculation of the AQI.

IX. Statutory and Executive Order Reviews

A. Executive Order 12866: Regulatory Planning and Review

Under section 3(f)(1) of Executive Order 12866 (58 FR 51735, October 4, 1993), this action is an "economically significant regulatory action" because it is likely to have an annual effect on the economy of $100 million or more. Accordingly, EPA submitted this action to the Office of Management and Budget (OMB) for review under EO 12866 and any changes made in response to OMB recommendations have been documented in the docket for this action. In addition, EPA prepared a Regulatory Impact Analysis (RIA) of the potential costs and benefits associated with this action. However, the CAA and judicial decisions make clear that the economic and technical feasibility of attaining the national ambient standards cannot be considered in setting or revising NAAQS, although such factors may be considered in the development of State implementation plans to implement the standards. Accordingly, although an RIA has been prepared, the results of the RIA have not been considered by EPA in developing this final rule.

When estimating the SO_2- and $PM_{2.5}$-related human health benefits and compliance costs in Table 2 below, EPA applied methods and assumptions consistent with the state-of-the-science for human health impact assessment, economics and air quality analysis. EPA applied its best professional judgment in performing this analysis and believes that these estimates provide a reasonable indication of the expected benefits and costs to the nation of the selected SO_2 standard and alternatives considered by the Agency. The Regulatory Impacts Analysis (RIA) available in the docket describes in detail the empirical basis for EPA's assumptions and characterizes the various sources of uncertainties affecting the estimates below.

EPA's 2009 Integrated Science Assessment for Particulate Matter concluded, based on the scientific literature, that a no-threshold log-linear model most adequately portrays the PM-mortality concentration-response relationship. Nonetheless, consistent with historical practice and our commitment to characterizing the uncertainty in our benefits estimates, EPA has included a sensitivity analysis with an assumed threshold in the PM-mortality health impact function in the RIA. EPA has included a sensitivity analysis in the RIA to help inform our understanding of the health benefits which can be achieved at lower air quality concentration levels. While the primary estimate and the sensitivity analysis are not directly comparable, due to differences in population data and use of different analysis years, as well as the difference in the assumption of a threshold in the sensitivity analysis, comparison of the two results provide a rough sense of the proportion of the health benefits that occur at lower $PM_{2.5}$ air quality levels. Using a threshold of 10 $\mu g/m^3$ is an arbitrary choice (EPA could have assumed 6, 8, or 12 $\mu g/m^3$ for the sensitivity analysis). Assuming a threshold of 10 $\mu g/m^3$, the sensitivity analysis shows that roughly one-third of the benefits occur at air quality levels below that threshold. Because the primary estimates reflect EPA's current methods and data, EPA notes that caution should be exercised when comparing the results of the primary and sensitivity analyses. EPA appreciates the value of sensitivity analyses in highlighting the uncertainty in the benefits estimates and will continue to work to refine these analyses, particularly in those instances in which air quality modeling data are available.

Table 2 shows the results of the cost and benefits analysis for each standard alternative. As indicated above, implementation of the SO_2 control

measures identified from AirControlNET and other sources does not result in attainment with the all target NAAQS levels in several areas. In these areas, additional unspecified emission reductions might be necessary to reach some alternative standard levels. The first part of the table, labeled *Partial attainment (identified controls),* shows only those benefits and costs from control measures we were able to identify. The second part of the table, labeled *Unidentified Controls,* shows only additional benefits and costs resulting from unidentified controls. The third part of the table, labeled *Full attainment,* shows total benefits and costs resulting from both identified and unidentified controls. It is important to emphasize that we were able to identify control measures for a significant portion of attainment for many of those counties that would not fully attain the target NAAQS level with identified controls. Note also that in addition to separating full and partial attainment, the table also separates the portion of benefits associated with reduced SO_2 exposure (*i.e.,* SO_2 benefits) from the additional benefits associated with reducing SO_2 emissions, which are precursors to $PM_{2.5}$ formation—(*i.e.,* the $PM_{2.5}$ co-benefits). For instance, for the selected standard of 75 ppb, $2.2 million in benefits are associated with reduced SO_2 exposure while $15 billion to $37 billion are associated with reduced $PM_{2.5}$ exposure.

TABLE 2—MONETIZED BENEFITS AND COSTS TO ATTAIN ALTERNATE STANDARD LEVELS IN 2020

[Millions of 2006$] [a]

	Number of counties fully controlled	Discount rate (percent)	Monetized SO_2 benefits	Monetized $PM_{2.5}$ co-benefits,[c,d]	Costs	Net benefits
Partial Attainment (identified controls)						
50 ppb	40	3	[b]	$30,000 to $74,000	$2,600	$27,000 to $71,000.
		7		$28,000 to $67,000		$25,000 to $64,000.
75 ppb	20	3	[b]	$14,000 to $35,000	$960	$13,000 to $34,000.
		7		$13,000 to $31,000		$12,000 to $30,000.
100 ppb	6	3	[b]	$6,900 to $17,000	$470	$6,400 to $17,000.
		7		$6,200 to $15,000		$5,700 to $15,000.
Unidentified Controls						
50 ppb	16	3	[b]	$4,000 to $9,000	$1,800	$2,200 to $7,200.
		7		$3,000 to $8,000		$1,200 to $6,200.
75 ppb	4	3	[b]	$1,000 to $3,000	$500	$500 to $1,500.
		7		$1,000 to $3,000		$500 to $2,500.
100 ppb	3	3	[b]	$500 to $1,000	$260	$240 to $740.
		7		$500 to $1,000		$240 to $740.
Full Attainment						
50 ppb	56	3	$8.50	$34,000 to $83,000	$4,400	$30,000 to $79,000.
		7		$31,000 to $75,000		$27,000 to $71,000.
75 ppb	24	3	$2.20	$15,000 to $37,000	$1,500	$14,000 to $36,000
		7		$14,000 to $34,000		$13,000 to $33,000.
100 ppb	9	3	$0.60	$7,400 to $18,000	$730	$6,700 to $17,000.
		7		$6,700 to $16,000		$6,000 to $15,000.

[a] Estimates have been rounded to two significant figures and therefore summation may not match table estimates.

[b] The approach used to simulate air quality changes for SO_2 did not provide the data needed to distinguish partial attainment benefits from full attainment benefits from reduced SO_2 exposure. Therefore, a portion of the SO_2 benefits is attributable to the known controls and a portion of the SO_2 benefits are attributable to the unidentified controls. Because all SO_2-related benefits are short-term effects, the results are identical for all discount rates.

[c] Benefits are shown as a range from Pope *et al.* (2002) to Laden *et al.* (2006). Monetized benefits do not include unquantified benefits, such as other health effects, reduced sulfur deposition, or improvements in visibility.

[d] These models assume that all fine particles, regardless of their chemical composition, are equally potent in causing premature mortality because there is no clear scientific evidence that would support the development of differential effects estimates by particle type. Reductions in SO_2 emissions from multiple sectors to meet the SO_2 NAAQS would primarily reduce the sulfate fraction of $PM_{2.5}$. Because this rule targets a specific particle precursor (*i.e.,* SO_2), this introduces some uncertainty into the results of the analysis.

B. Paperwork Reduction Act

The information collection requirements in this final rule have been submitted for approval to the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.* The Information Collection Request (ICR) document prepared by EPA for these revisions to part 58 has been assigned EPA ICR number 2370.02. The information collected under 40 CFR part 53 (*e.g.,* test results, monitoring records, instruction manual, and other associated information) is needed to determine whether a candidate method intended for use in determining attainment of the NAAQS in 40 CFR part 50 will meet the design, performance, and/or comparability requirements for designation as a Federal reference method (FRM) or Federal equivalent method (FEM). We do not expect the number of FRM or FEM determinations to increase over the number that is currently used to estimate burden associated with SO_2 FRM/FEM determinations provided in the current ICR for 40 CFR part 53 (EPA ICR numbers 2370.01). As such, no change in the burden estimate for 40 CFR part 53 has been made as part of this rulemaking.

The information collected and reported under 40 CFR part 58 is needed to determine compliance with the NAAQS, to characterize air quality and

associated health impacts, to develop emissions control strategies, and to measure progress for the air pollution program. The amendments would revise the technical requirements for SO_2 monitoring sites, require the siting and operation of additional SO_2 ambient air monitors, and the reporting of the collected ambient SO_2 monitoring data to EPA's Air Quality System (AQS). The ICR is estimated to involve 102 respondents for a total approximate cost of $15,203,762 (total capital, and labor and non-labor operation and maintenance) and a total burden of 207,662 hours. The labor costs associated with these hours is $11,130,409. Included in the $15,203,762 total are other costs of other non-labor operations and maintenance of $1,104,377 and equipment and contract costs of $2,968,975. In addition to the costs at the State and local air quality management agencies, there is a burden to EPA for a total of 14,749 hours and $1,060,621. Burden is defined at 5 CFR 1320.3(b). State, local, and Tribal entities are eligible for State assistance grants provided by the Federal government under the CAA which can be used for monitors and related activities. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations in 40 CFR are listed in 40 CFR part 9.

C. Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impacts of this rule on small entities, small entity is defined as: (1) A small business that is a small industrial entity as defined by the Small Business Administration's (SBA) regulations at 13 CFR 121.201; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.

After considering the economic impacts of this final rule on small entities, I certify that this action will not have a significant economic impact on a substantial number of small entities. This final rule will not impose any requirements on small entities. Rather, this rule establishes national standards for allowable concentrations of SO_2 in ambient air as required by section 109 of the CAA. *American Trucking Ass'ns* v. *EPA,* 175 F.3d 1027, 1044–45 (DC Cir. 1999) (NAAQS do not have significant impacts upon small entities because NAAQS themselves impose no regulations upon small entities). Similarly, the amendments to 40 CFR Part 58 address the requirements for States to collect information and report compliance with the NAAQS and will not impose any requirements on small entities.

D. Unfunded Mandates Reform Act

This action is not subject to the requirements of sections 202 and 205 of the UMRA. EPA has determined that this final rule does not contain a Federal mandate that may result in expenditures of $100 million or more for State, local, and Tribal governments, in the aggregate, or the private sector in any one year. The revisions to the SO_2 NAAQS impose no enforceable duty on any State, local or Tribal governments or the private sector. The expected costs associated with the monitoring requirements are described in EPA's ICR document, but those costs are not expected to exceed $100 million in the aggregate for any year. Furthermore, as indicated previously, in setting a NAAQS, EPA cannot consider the economic or technological feasibility of attaining ambient air quality standards. Because the CAA prohibits EPA from considering the types of estimates and assessments described in section 202 when setting the NAAQS, the UMRA does not require EPA to prepare a written statement under section 202 for the revisions to the SO_2 NAAQS.

With regard to implementation guidance, the CAA imposes the obligation for States to submit SIPs to implement the SO_2 NAAQS. In this final rule, EPA is merely providing an interpretation of those requirements. However, even if this rule did establish an independent obligation for States to submit SIPs, it is questionable whether an obligation to submit a SIP revision would constitute a Federal mandate in any case. The obligation for a State to submit a SIP that arises out of section 110 and section 191 of the CAA is not legally enforceable by a court of law, and at most is a condition for continued receipt of highway funds. Therefore, it is possible to view an action requiring such a submittal as not creating any enforceable duty within the meaning of U.S.C. 658 for purposes of the UMRA. Even if it did, the duty could be viewed as falling within the exception for a condition of Federal assistance under U.S.C. 658.

EPA has determined that this final rule contains no regulatory requirements that might significantly or uniquely affect small governments because it imposes no enforceable duty on any small governments. Therefore, this rule is not subject to the requirements of section 203 of the UMRA.

E. Executive Order 13132: Federalism

This final rule does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. The rule does not alter the relationship between the Federal government and the States regarding the establishment and implementation of air quality improvement programs as codified in the CAA. Under section 109 of the CAA, EPA is mandated to establish NAAQS; however, CAA section 116 preserves the rights of States to establish more stringent requirements if deemed necessary by a State. Furthermore, this rule does not impact CAA section 107 which establishes that the States have primary responsibility for implementation of the NAAQS. Finally, as noted in section E (above) on UMRA, this rule does not impose significant costs on State, local, or Tribal governments or the private sector. Thus, Executive Order 13132 does not apply to this rule.

F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments

Executive Order 13175, entitled "Consultation and Coordination with Indian Tribal Governments" (65 FR 67249, November 9, 2000), requires EPA to develop an accountable process to ensure "meaningful and timely input by Tribal officials in the development of regulatory policies that have Tribal implications." This final rule does not have Tribal implications, as specified in Executive Order 13175. It does not have a substantial direct effect on one or more Indian Tribes, on the relationship between the Federal government and Indian Tribes, or on the distribution of power and responsibilities between the

Federal government and Tribes. The rule does not alter the relationship between the Federal government and Tribes as established in the CAA and the TAR. Under section 109 of the CAA, EPA is mandated to establish NAAQS; however, this rule does not infringe existing Tribal authorities to regulate air quality under their own programs or under programs submitted to EPA for approval. Furthermore, this rule does not affect the flexibility afforded to Tribes in seeking to implement CAA programs consistent with the TAR, nor does it impose any new obligation on Tribes to adopt or implement any NAAQS. Finally, as noted in section E (above) on UMRA, this rule does not impose significant costs on Tribal governments. Thus, Executive Order 13175 does not apply to this rule.

G. Executive Order 13045: Protection of Children From Environmental Health and Safety Risks

This action is subject to Executive Order (62 FR 19885, April 23, 1997) because it is an economically significant regulatory action as defined by Executive Order 12866, and we believe that the environmental health risk addressed by this action has a disproportionate effect on children. The final rule will establish uniform national ambient air quality standards for SO_2; these standards are designed to protect public health with an adequate margin of safety, as required by CAA section 109. The protection offered by these standards may be especially important for asthmatics, including asthmatic children, because respiratory effects in asthmatics are among the most sensitive health endpoints for SO_2 exposure. Because asthmatic children are considered a sensitive population, we have evaluated the potential health effects of exposure to SO_2 pollution among asthmatic children. These effects and the size of the population affected are discussed in chapters 3 and 4 of the ISA; chapters 3, 4, 7, 8, 9 of the REA, and sections II.A through II.E of this preamble.

H. Executive Order 13211: Actions That Significantly Affect Energy Supply, Distribution or Use

This rule is not a "significant energy action" as defined in Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use" (66 FR 28355; May 22, 2001) because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. The purpose of this rule is to establish revised NAAQS for SO_2. The rule does not prescribe specific control strategies by which these ambient standards will be met. Such strategies will be developed by States on a case-by-case basis, and EPA cannot predict whether the control options selected by States will include regulations on energy suppliers, distributors, or users. Thus, EPA concludes that this rule is not likely to have any adverse energy effects.

I. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (NTTAA), Public Law 104–113, section 12(d) (15 U.S.C. 27) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (*e.g.,* materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This final rulemaking involves technical standards with regard to ambient monitoring of SO_2. The use of this voluntary consensus standard would be impractical because the analysis method does not provide for the method detection limits necessary to adequately characterize ambient SO_2 concentrations for the purpose of determining compliance with the final revisions to the SO_2 NAAQS.

J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 12898 (59 FR 7629; Feb. 16, 1994) establishes Federal executive policy on environmental justice. Its main provision directs Federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States.

EPA has determined that this final rule will not have disproportionately high and adverse human health or environmental effects on minority or low-income populations because it increases the level of environmental protection for all affected populations without having any disproportionately high and adverse human health effects on any population, including any minority or low-income population. The final rule will establish uniform national standards for SO_2 in ambient air.

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List of Subjects

40 CFR Part 50

Environmental protection, Air pollution control, Carbon monoxide, Lead, Nitrogen dioxide, Ozone, Particulate matter, Sulfur oxides.

40 CFR Part 53

Environmental protection, Administrative practice and procedure, Air pollution control, Intergovernmental

relations, Reporting and recordkeeping requirements.

40 CFR Part 58

Environmental protection, Administrative practice and procedure, Air pollution control, Intergovernmental relations, Reporting and recordkeeping requirements.

Dated: June 2, 2010.

Lisa P. Jackson,

Administrator.

■ For the reasons stated in the preamble, title 40, chapter I of the Code of Federal Regulations is amended as follows:

PART 50—NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

■ 1. The authority citation for part 50 continues to read as follows:

Authority: 42 U.S.C. 7401, *et seq.*

■ 2. Section 50.4 is amended by adding paragraph (e) to read as follows:

§ 50.4 National primary ambient air quality standards for sulfur oxides (sulfur dioxide).

* * * * *

(e) The standards set forth in this section will remain applicable to all areas notwithstanding the promulgation of SO_2 national ambient air quality standards (NAAQS) in § 50.17. The SO_2 NAAQS set forth in this section will no longer apply to an area one year after the effective date of the designation of that area, pursuant to section 107 of the Clean Air Act, for the SO_2 NAAQS set forth in § 50. 17; except that for areas designated nonattainment for the SO_2 NAAQS set forth in this section as of the effective date of § 50. 17, and areas not meeting the requirements of a SIP call with respect to requirements for the SO_2 NAAQS set forth in this section, the SO_2 NAAQS set forth in this section will apply until that area submits, pursuant to section 191 of the Clean Air Act, and EPA approves, an implementation plan providing for attainment of the SO_2 NAAQS set forth in § 50.17.

■ 3. Section 50.14 is amended by revising paragraph (c)(2)(vi) to read as follows:

§ 50.14 Treatment of air quality monitoring data influenced by exceptional events.

* * * * *

(c) * * *

(2) * * *

(vi) When EPA sets a NAAQS for a new pollutant or revises the NAAQS for an existing pollutant, it may revise or set a new schedule for flagging exceptional event data, providing initial data descriptions and providing detailed data documentation in AQS for the initial designations of areas for those NAAQS. Table 1 provides the schedule for submission of flags with initial descriptions in AQS and detailed documentation. These schedules shall apply for those data which will or may influence the initial designation of areas for those NAAQS. EPA anticipates revising Table 1 as necessary to accommodate revised data submission schedules for new or revised NAAQS.

TABLE 1—SCHEDULE OF EXCEPTIONAL EVENT FLAGGING AND DOCUMENTATION SUBMISSION FOR DATA TO BE USED IN DESIGNATIONS DECISIONS FOR NEW OR REVISED NAAQS

NAAQS Pollutant/standard/(level)/promulgation date	Air quality data collected for calendar year	Event flagging & initial description deadline	Detailed documentation submission deadline
$PM_{2.5}$/24-Hr Standard (35 μg/m3) Promulgated October 17, 2006.	2004–2006	October 1, 2007 [a]	April 15, 2008. [a]
Ozone/8-Hr Standard (0.075 ppm) Promulgated March 12, 2008.	2005–2007 2008 2009	June 18, 2009 [a] June 18, 2009 [a] 60 days after the end of the calendar quarter in which the event occurred or February 5, 2010, whichever date occurs first [b].	June 18, 2009 [a] June 18, 2009 [1] 60 days after the end of the calendar quarter in which the event occurred or February 5, 2010, whichever date occurs first. [b]
NO_2/1-Hour Standard (80–100 PPB, final level TBD).	2008 2009 2010	July 1, 2010 [a] July 1, 2010 [a] April 1, 2011 [a]	January 22, 2011. [a] January 22, 2011. [a] July 1, 2010. [a]
SO_2/1-Hour Standard (50–100 PPB, final level TBD).	2008 2009 2010 2011	October 1, 2010 [b] October 1, 2010 [b] June 1, 2011. [b] 60 days after the end of the calendar quarter in which the event occurred or March 31, 2012, whichever date occurs first [b].	June 1, 2011. [b] June 1, 2011. [b] June 1, 2011. [b] 60 days after the end of the calendar quarter in which the event occurred or March 31, 2012, whichever date occurs first. [b]

[a] These dates are unchanged from those published in the original rulemaking, or are being proposed elsewhere and are shown in this table for informational purposes—the Agency is not opening these dates for comment under this rulemaking.

[b] Indicates change from general schedule in 40 CFR 50.14.

Note: EPA notes that the table of revised deadlines *only* applies to data EPA will use to establish the final initial designations for new or revised NAAQS. The general schedule applies for all other purposes, most notably, for data used by EPA for redesignations to attainment.

* * * * *

■ 4. A new 50.17 is added to read as follows:

§ 50.17 National primary ambient air quality standards for sulfur oxides (sulfur dioxide).

(a) The level of the national primary 1-hour annual ambient air quality standard for oxides of sulfur is 75 parts per billion (ppb, which is 1 part in 1,000,000,000), measured in the ambient air as sulfur dioxide (SO_2).

(b) The 1-hour primary standard is met at an ambient air quality monitoring site when the three-year average of the annual (99th percentile) of the daily maximum 1-hour average concentrations is less than or equal to 75 ppb, as determined in accordance with Appendix T of this part.

(c) The level of the standard shall be measured by a reference method based on Appendix A or A–1 of this part, or by a Federal Equivalent Method (FEM)

designated in accordance with part 53 of this chapter.

■ 5. Add Appendix A–1 to Part 50 to read as follows:

Appendix A–1 to Part 50—Reference Measurement Principle and Calibration Procedure for the Measurement of Sulfur Dioxide in the Atmosphere (Ultraviolet Fluorescence Method)

1.0 Applicability

1.1 This ultraviolet fluorescence (UVF) method provides a measurement of the concentration of sulfur dioxide (SO_2) in ambient air for determining compliance with the national primary and secondary ambient air quality standards for sulfur oxides (sulfur dioxide) as specified in § 50.4, § 50.5, and § 50.17 of this chapter. The method is applicable to the measurement of ambient SO_2 concentrations using continuous (real-time) sampling. Additional quality assurance procedures and guidance are provided in part 58, Appendix A, of this chapter and in Reference 3.

2.0 Principle

2.1 This reference method is based on automated measurement of the intensity of the characteristic fluorescence released by SO_2 in an ambient air sample contained in a measurement cell of an analyzer when the air sample is irradiated by ultraviolet (UV) light passed through the cell. The fluorescent light released by the SO_2 is also in the ultraviolet region, but at longer wavelengths than the excitation light. Typically, optimum instrumental measurement of SO_2 concentrations is obtained with an excitation wavelength in a band between approximately 190 to 230 nm, and measurement of the SO_2 fluorescence in a broad band around 320 nm, but these wavelengths are not necessarily constraints of this reference method. Generally, the measurement system (analyzer) also requires means to reduce the effects of aromatic hydrocarbon species, and possibly other compounds, in the air sample to control measurement interferences from these compounds, which may be present in the ambient air. References 1 and 2 describe UVF method.

2.2 The measurement system is calibrated by referencing the instrumental fluorescence measurements to SO_2 standard concentrations traceable to a National Institute of Standards and Technology (NIST) primary standard for SO_2 (*see* Calibration Procedure below).

2.3 An analyzer implementing this measurement principle is shown schematically in Figure 1. Designs should include a measurement cell, a UV light source of appropriate wavelength, a UV detector system with appropriate wave length sensitivity, a pump and flow control system for sampling the ambient air and moving it into the measurement cell, sample air conditioning components as necessary to minimize measurement interferences, suitable control and measurement processing capability, and other apparatus as may be necessary. The analyzer must be designed to provide accurate, repeatable, and continuous measurements of SO_2 concentrations in ambient air, with measurement performance as specified in Subpart B of Part 53 of this chapter.

2.4 *Sampling considerations:* The use of a particle filter on the sample inlet line of a UVF SO_2 analyzer is required to prevent interference, malfunction, or damage due to particles in the sampled air.

3.0 Interferences

3.1 The effects of the principal potential interferences may need to be mitigated to meet the interference equivalent requirements of part 53 of this chapter. Aromatic hydrocarbons such as xylene and naphthalene can fluoresce and act as strong positive interferences. These gases can be removed by using a permeation type scrubber (hydrocarbon "kicker"). Nitrogen oxide (NO) in high concentrations can also fluoresce and cause positive interference. Optical filtering can be employed to improve the rejection of interference from high NO. Ozone can absorb UV light given off by the SO_2 molecule and cause a measurement offset. This effect can be reduced by minimizing the measurement path length between the area where SO_2 fluorescence occurs and the photomultiplier tube detector (*e.g.* <5 cm). A hydrocarbon scrubber, optical filter and appropriate distancing of the measurement path length may be required method components to reduce interference.

4.0 Calibration Procedure

Atmospheres containing accurately known concentrations of sulfur dioxide are prepared using a compressed gas transfer standard diluted with accurately metered clean air flow rates.

4.1 *Apparatus:* Figure 2 shows a typical generic system suitable for diluting a SO_2 gas cylinder concentration standard with clean air through a mixing chamber to produce the desired calibration concentration standards. A valve may be used to conveniently divert the SO_2 from the sampling manifold to provide clean zero air at the output manifold for zero adjustment. The system may be made up using common laboratory components, or it may be a commercially manufactured system. In either case, the principle components are as follows:

4.1.1 SO_2 standard gas flow control and measurement devices (or a combined device) capable of regulating and maintaining the standard gas flow rate constant to within ±2 percent and measuring the gas flow rate accurate to within ±2, properly calibrated to a NIST-traceable standard.

4.1.2 Dilution air flow control and measurement devices (or a combined device) capable of regulating and maintaining the air flow rate constant to within ±2 percent and measuring the air flow rate accurate to within ±2, properly calibrated to a NIST-traceable standard.

4.1.3 Mixing chamber, of an inert material such as glass and of proper design to provide thorough mixing of pollutant gas and diluent air streams.

4.1.4 Sampling manifold, constructed of glass, polytetrafluoroethylene (PTFE Teflon™), or other suitably inert material and of sufficient diameter to insure a minimum pressure drop at the analyzer connection, with a vent designed to insure a minimum over-pressure (relative to ambient air pressure) at the analyzer connection and to prevent ambient air from entering the manifold.

4.1.5 Standard gas pressure regulator, of clean stainless steel with a stainless steel diaphragm, suitable for use with a high pressure SO_2 gas cylinder.

4.1.6 Reagents

4.1.6.1 SO_2 gas concentration transfer standard having a certified SO_2 concentration of not less than 10 ppm, in N_2, traceable to a NIST Standard Reference Material (SRM).

4.1.6.2 Clean zero air, free of contaminants that could cause a detectable response or a change in sensitivity of the analyzer. Since ultraviolet fluorescence analyzers may be sensitive to aromatic hydrocarbons and O_2-to-N_2 ratios, it is important that the clean zero air contains less than 0.1 ppm aromatic hydrocarbons and O_2 and N_2 percentages approximately the same as in ambient air. A procedure for generating zero air is given in reference 1.

4.2 Procedure

4.2.1 Obtain a suitable calibration apparatus, such as the one shown schematically in Figure 1, and verify that all materials in contact with the pollutant are of glass, Teflon™, or other suitably inert material and completely clean.

4.2.2 Purge the SO_2 standard gas lines and pressure regulator to remove any residual air.

4.2.3 Ensure that there are no leaks in the system and that the flow measuring devices are properly and accurately calibrated under the conditions of use against a reliable volume or flow rate standard such as a soap-bubble meter or a wet-test meter traceable to a NIST standard. All volumetric flow rates should be corrected to the same reference temperature and pressure by using the formula below:

$$F_c = F_m \frac{298.15 P_m}{760\left(T_m + 273.15\right)}$$

Where:

F_c = corrected flow rate (L/min at 25 °C and 760 mm Hg),
F_m = measured flow rate, (at temperature, T_m and pressure, P_m),
P_m = measured pressure in mm Hg, (absolute), and
T_m = measured temperature in degrees Celsius.

4.2.4 Allow the SO_2 analyzer under calibration to sample zero air until a stable response is obtained, then make the proper zero adjustment.

4.2.5 Adjust the airflow to provide an SO_2 concentration of approximately 80 percent of the upper measurement range limit of the SO_2 instrument and verify that the total air flow of the calibration system exceeds the demand of all analyzers sampling from the output manifold (with the excess vented).

4.2.6 Calculate the actual SO_2 calibration concentration standard as:

$$[SO_2] = C\frac{F_p}{F_t}$$

Where:

C = the concentration of the SO_2 gas standard
F_p = the flow rate of SO_2 gas standard
F_t = the total air flow rate of pollutant and diluent gases

4.2.7 When the analyzer response has stabilized, adjust the SO_2 span control to obtain the desired response equivalent to the calculated standard concentration. If substantial adjustment of the span control is needed, it may be necessary to re-check the zero and span adjustments by repeating steps 4.2.4 through 4.2.7 until no further adjustments are needed.

4.2.8 Adjust the flow rate(s) to provide several other SO_2 calibration concentrations over the analyzer's measurement range. At least five different concentrations evenly spaced throughout the analyzer's range are suggested.

4.2.9 Plot the analyzer response (vertical or Y-axis) versus SO_2 concentration (horizontal or X-axis). Compute the linear regression slope and intercept and plot the regression line to verify that no point deviates from this line by more than 2 percent of the maximum concentration tested.

Note: Additional information on calibration and pollutant standards is provided in Section 12 of Reference 3.

5.0 Frequency of Calibration

The frequency of calibration, as well as the number of points necessary to establish the calibration curve and the frequency of other performance checking will vary by analyzer; however, the minimum frequency, acceptance criteria, and subsequent actions are specified in Reference 3, Appendix D: Measurement Quality Objectives and Validation Template for SO_2 (page 9 of 30). The user's quality control program should provide guidelines for initial establishment of these variables and for subsequent alteration as operational experience is accumulated. Manufacturers of analyzers should include in their instruction/operation manuals information and guidance as to these variables and on other matters of operation, calibration, routine maintenance, and quality control.

6.0 References for SO_2 Method

1. H. Okabe, P. L. Splitstone, and J. J. Ball, "Ambient and Source SO_2 Detector Based on a Fluorescence Method", *Journal of the Air Control Pollution Association,* vol. 23, p. 514–516 (1973).
2. F. P. Schwarz, H. Okabe, and J. K. Whittaker, "Fluorescence Detection of Sulfur Dioxide in Air at the Parts per Billion Level," *Analytical Chemistry,* vol. 46, pp. 1024–1028 (1974).
3. *QA Handbook for Air Pollution Measurement Systems—Volume II. Ambient Air Quality Monitoring Programs.* U.S. EPA. EPA–454/B–08–003 (2008).

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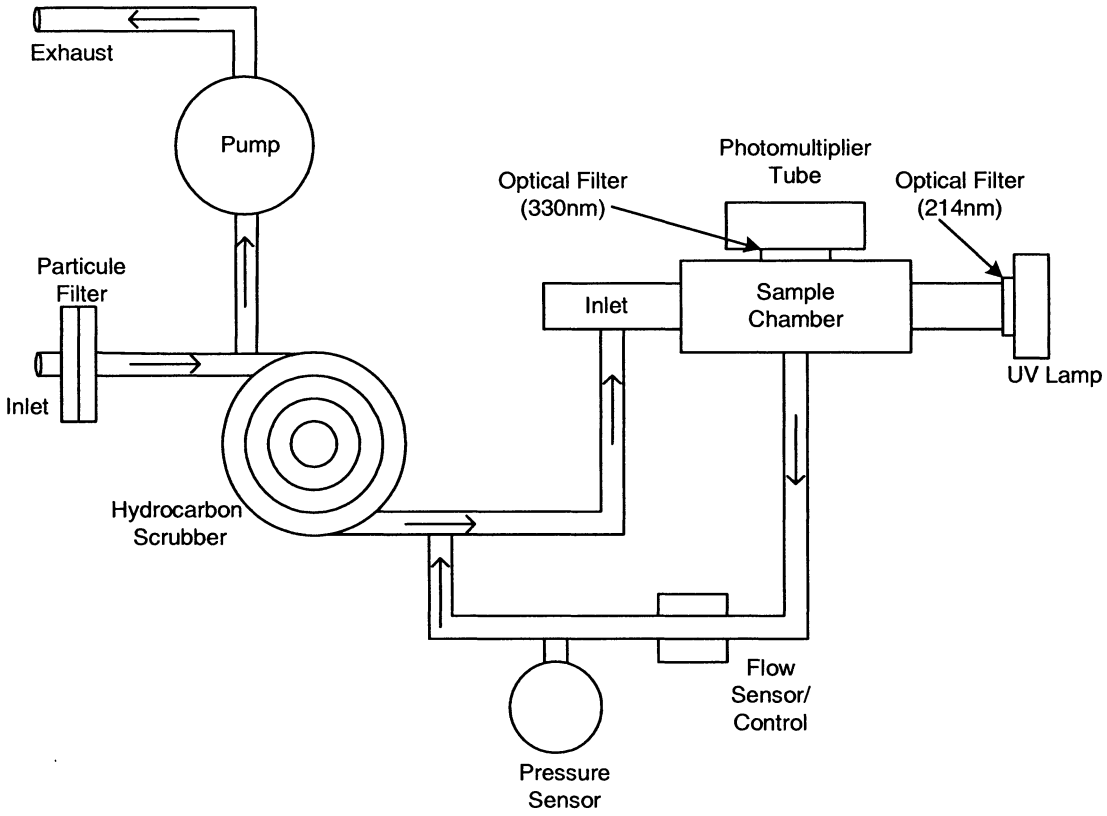

Figure 1. UVF SO_2 analyzer schematic diagram.

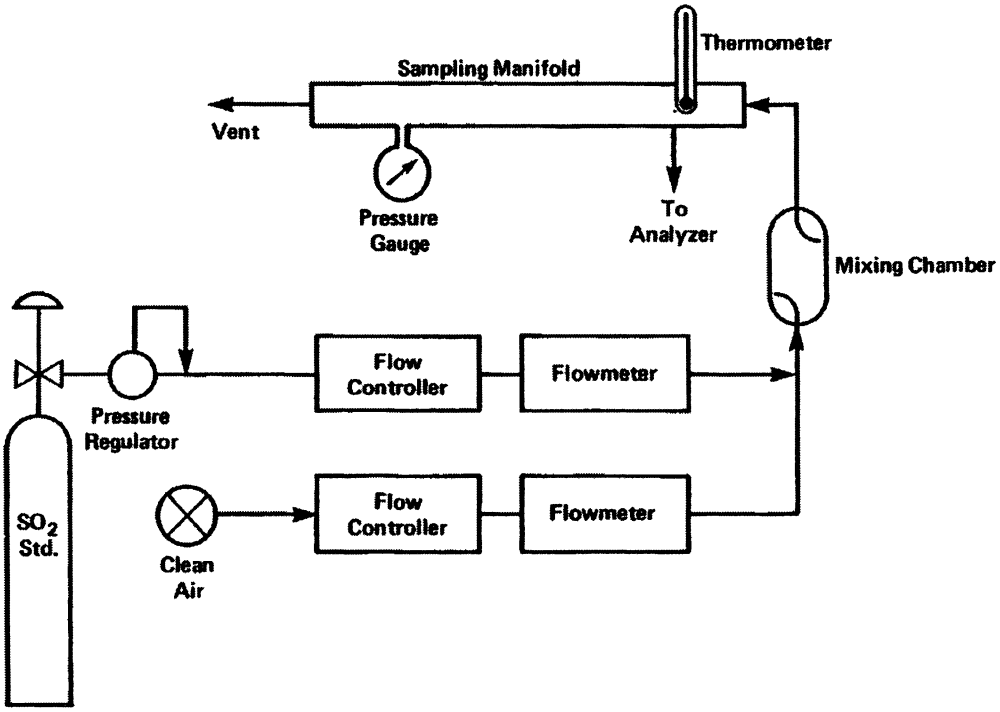

Figure 2. Calibration system using a compressed gas standard.

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■ 6. Appendix A to Part 50 is redesignated as Appendix A–2 to Part 50.

■ 7. Appendix T to Part 50 is added to read as follows:

Appendix T to Part 50—Interpretation of the Primary National Ambient Air Quality Standards for Oxides of Sulfur (Sulfur Dioxide)

1. General

(a) This appendix explains the data handling conventions and computations necessary for determining when the primary national ambient air quality standards for Oxides of Sulfur as measured by Sulfur Dioxide ("SO_2 NAAQS") specified in § 50.17 are met at an ambient air quality monitoring site. Sulfur Dioxide (SO_2) is measured in the ambient air by a Federal reference method (FRM) based on appendix A or A–1 to this part or by a Federal equivalent method (FEM) designated in accordance with part 53 of this chapter. Data handling and computation procedures to be used in making comparisons between reported SO_2 concentrations and the levels of the SO_2 NAAQS are specified in the following sections.

(b) Decisions to exclude, retain, or make adjustments to the data affected by exceptional events, including natural events, are made according to the requirements and process deadlines specified in §§ 50.1, 50.14 and 51.930 of this chapter.

(c) The terms used in this appendix are defined as follows:

Daily maximum 1-hour values for SO_2 refers to the maximum 1-hour SO_2 concentration values measured from midnight to midnight (local standard time) that are used in NAAQS computations.

Design values are the metrics (*i.e.,* statistics) that are compared to the NAAQS levels to determine compliance, calculated as specified in section 5 of this appendix. The design value for the primary 1-hour NAAQS is the 3-year average of annual 99th percentile daily maximum 1-hour values for a monitoring site (referred to as the "1-hour primary standard design value").

99th percentile daily maximum 1-hour value is the value below which nominally 99 percent of all daily maximum 1-hour concentration values fall, using the ranking and selection method specified in section 5 of this appendix.

Pollutant Occurrence Code (POC) refers to a numerical code (1, 2, 3, *etc.*) used to distinguish the data from two or more monitors for the same parameter at a single monitoring site.

Quarter refers to a calendar quarter.

Year refers to a calendar year.

2. Requirements for Data Used for Comparisons With the SO_2 NAAQS and Data Reporting Considerations

(a) All valid FRM/FEM SO_2 hourly data required to be submitted to EPA's Air Quality System (AQS), or otherwise available to EPA, meeting the requirements of part 58 of this chapter including appendices A, C, and E shall be used in design value calculations. Multi-hour average concentration values collected by wet chemistry methods shall not be used.

(b) Data from two or more monitors from the same year at the same site reported to EPA under distinct Pollutant Occurrence Codes shall not be combined in an attempt to meet data completeness requirements. The Administrator will combine annual 99th percentile daily maximum concentration values from different monitors in different years, selected as described here, for the purpose of developing a valid 1-hour primary standard design value. If more than one of the monitors meets the completeness requirement for all four quarters of a year, the steps specified in section 5(a) of this appendix shall be applied to the data from the monitor with the highest average of the four quarterly completeness values to derive a valid annual 99th percentile daily maximum concentration. If no monitor is complete for all four quarters in a year, the steps specified in section 3(c) and 5(a) of this appendix shall be applied to the data from the monitor with the highest average of the four quarterly completeness values in an attempt to derive a valid annual 99th percentile daily maximum concentration. This paragraph does not prohibit a monitoring agency from making a local designation of one physical monitor as the primary monitor for a Pollutant Occurrence Code and substituting the 1-hour data from a second physical monitor whenever a valid concentration value is not obtained from the primary monitor; if a monitoring agency substitutes data in this manner, each substituted value must be accompanied by an

AQS qualifier code indicating that substitution with a value from a second physical monitor has taken place.

(c) Hourly SO_2 measurement data shall be reported to AQS in units of parts per billion (ppb), to at most one place after the decimal, with additional digits to the right being truncated with no further rounding.

3. Comparisons With the 1-Hour Primary SO_2 NAAQS

(a) The 1-hour primary SO_2 NAAQS is met at an ambient air quality monitoring site when the valid 1-hour primary standard design value is less than or equal to 75 parts per billion (ppb).

(b) An SO_2 1-hour primary standard design value is valid if it encompasses three consecutive calendar years of complete data. A year meets data completeness requirements when all 4 quarters are complete. A quarter is complete when at least 75 percent of the sampling days for each quarter have complete data. A sampling day has complete data if 75 percent of the hourly concentration values, including State-flagged data affected by exceptional events which have been approved for exclusion by the Administrator, are reported.

(c) In the case of one, two, or three years that do not meet the completeness requirements of section 3(b) of this appendix and thus would normally not be useable for the calculation of a valid 3-year 1-hour primary standard design value, the 3-year 1-hour primary standard design value shall nevertheless be considered valid if one of the following conditions is true.

(i) At least 75 percent of the days in each quarter of each of three consecutive years have at least one reported hourly value, and the design value calculated according to the procedures specified in section 5 is above the level of the primary 1-hour standard.

(ii) (A) A 1-hour primary standard design value that is equal to or below the level of the NAAQS can be validated if the substitution test in section 3(c)(ii)(B) results in a "test design value" that is below the level of the NAAQS. The test substitutes actual "high" reported daily maximum 1-hour values from the same site at about the same time of the year (specifically, in the same calendar quarter) for unknown values that were not successfully measured. *Note* that the test is merely diagnostic in nature, intended to confirm that there is a very high likelihood that the original design value (the one with less than 75 percent data capture of hours by day and of days by quarter) reflects the true under-NAAQS-level status for that 3-year period; the result of this data substitution test (the "test design value", as defined in section 3(c)(ii)(B)) is not considered the actual design value. For this test, substitution is permitted only if there are at least 200 days across the three matching quarters of the three years under consideration (which is about 75 percent of all possible daily values in those three quarters) for which 75 percent of the hours in the day, including State-flagged data affected by exceptional events which have been approved for exclusion by the Administrator, have reported concentrations. However, maximum 1-hour values from days with less than 75 percent of the hours reported shall also be considered in identifying the high value to be used for substitution.

(B) The substitution test is as follows: Data substitution will be performed in all quarter periods that have less than 75 percent data capture but at least 50 percent data capture, including State-flagged data affected by exceptional events which have been approved for exclusion by the Administrator; if any quarter has less than 50 percent data capture then this substitution test cannot be used. Identify for each quarter (*e.g.,* January–March) the highest reported daily maximum 1-hour value for that quarter, excluding State-flagged data affected by exceptional events which have been approved for exclusion by the Administrator, looking across those three months of all three years under consideration. All daily maximum 1-hour values from all days in the quarter period shall be considered when identifying this highest value, including days with less than 75 percent data capture. If after substituting the highest reported daily maximum 1-hour value for a quarter for as much of the missing daily data in the matching deficient quarter(s) as is needed to make them 100 percent complete, the procedure in section 5 yields a recalculated 3-year 1-hour standard "test design value" less than or equal to the level of the standard, then the 1-hour primary standard design value is deemed to have passed the diagnostic test and is valid, and the level of the standard is deemed to have been met in that 3-year period. As noted in section 3(c)(i), in such a case, the 3-year design value based on the data actually reported, not the "test design value", shall be used as the valid design value.

(iii) (A) A 1-hour primary standard design value that is above the level of the NAAQS can be validated if the substitution test in section 3(c)(iii)(B) results in a "test design value" that is above the level of the NAAQS. The test substitutes actual "low" reported daily maximum 1-hour values from the same site at about the same time of the year (specifically, in the same three months of the calendar) for unknown hourly values that were not successfully measured. Note that the test is merely diagnostic in nature, intended to confirm that there is a very high likelihood that the original design value (the one with less than 75 percent data capture of hours by day and of days by quarter) reflects the true above-NAAQS-level status for that 3-year period; the result of this data substitution test (the "test design value", as defined in section 3(c)(iii)(B)) is not considered the actual design value. For this test, substitution is permitted only if there are a minimum number of available daily data points from which to identify the low quarter-specific daily maximum 1-hour values, specifically if there are at least 200 days across the three matching quarters of the three years under consideration (which is about 75 percent of all possible daily values in those three quarters) for which 75 percent of the hours in the day have reported concentrations. Only days with at least 75 percent of the hours reported shall be considered in identifying the low value to be used for substitution.

(B) The substitution test is as follows: Data substitution will be performed in all quarter periods that have less than 75 percent data capture. Identify for each quarter (*e.g.,* January–March) the lowest reported daily maximum 1-hour value for that quarter, looking across those three months of all three years under consideration. All daily maximum 1-hour values from all days with at least 75 percent capture in the quarter period shall be considered when identifying this lowest value. If after substituting the lowest reported daily maximum 1-hour value for a quarter for as much of the missing daily data in the matching deficient quarter(s) as is needed to make them 75 percent complete, the procedure in section 5 yields a recalculated 3-year 1-hour standard "test design value" above the level of the standard, then the 1-hour primary standard design value is deemed to have passed the diagnostic test and is valid, and the level of the standard is deemed to have been exceeded in that 3-year period. As noted in section 3(c)(i), in such a case, the 3-year design value based on the data actually reported, not the "test design value", shall be used as the valid design value.

(d) A 1-hour primary standard design value based on data that do not meet the completeness criteria stated in 3(b) and also do not satisfy section 3(c), may also be considered valid with the approval of, or at the initiative of, the Administrator, who may consider factors such as monitoring site closures/moves, monitoring diligence, the consistency and levels of the valid concentration measurements that are available, and nearby concentrations in determining whether to use such data.

(e) The procedures for calculating the 1-hour primary standard design values are given in section 5 of this appendix.

4. Rounding Conventions for the 1-Hour Primary SO_2 NAAQS

(a) Hourly SO_2 measurement data shall be reported to AQS in units of parts per billion (ppb), to at most one place after the decimal, with additional digits to the right being truncated with no further rounding.

(b) Daily maximum 1-hour values and therefore the annual 99th percentile of those daily values are not rounded.

(c) The 1-hour primary standard design value is calculated pursuant to section 5 and then rounded to the nearest whole number or 1 ppb (decimals 0.5 and greater are rounded up to the nearest whole number, and any decimal lower than 0.5 is rounded down to the nearest whole number).

5. Calculation Procedures for the 1-Hour Primary SO_2 NAAQS

(a) *Procedure for identifying annual 99th percentile values.* When the data for a particular ambient air quality monitoring site and year meet the data completeness requirements in section 3(b), or if one of the conditions of section 3(c) is met, or if the Administrator exercises the discretionary authority in section 3(d), identification of annual 99th percentile value is accomplished as follows.

(i) The annual 99th percentile value for a year is the higher of the two values resulting from the following two procedures.

(1) *Procedure 1.* For the year, determine the number of days with at least 75 percent of the hourly values reported.

(A) For the year, determine the number of days with at least 75 percent of the hourly values reported including State-flagged data affected by exceptional events which have been approved for exclusion by the Administrator.

(B) For the year, from only the days with at least 75 percent of the hourly values reported, select from each day the maximum hourly value excluding State-flagged data affected by exceptional events which have been approved for exclusion by the Administrator.

(C) Sort all these daily maximum hourly values from a particular site and year by descending value. (For example: (x[1], x[2], x[3], * * *, x[n]). In this case, x[1] is the largest number and x[n] is the smallest value.) The 99th percentile is determined from this sorted series of daily values which is ordered from the highest to the lowest number. Using the left column of Table 1, determine the appropriate range (*i.e.,* row) for the annual number of days with valid data for year y (cn_y). The corresponding "n" value in the right column identifies the rank of the annual 99th percentile value in the descending sorted list of daily site values for year y. Thus, $P_{0.99, y}$ = the nth largest value.

(2) *Procedure 2.* For the year, determine the number of days with at least one hourly value reported.

(A) For the year, determine the number of days with at least one hourly value reported including State-flagged data affected by exceptional events which have been approved for exclusion by the Administrator.

(B) For the year, from all the days with at least one hourly value reported, select from each day the maximum hourly value excluding State-flagged data affected by exceptional events which have been approved for exclusion by the Administrator.

(C) Sort all these daily maximum values from a particular site and year by descending value. (For example: (x[1], x[2], x[3], * * *, x[n]). In this case, x[1] is the largest number and x[n] is the smallest value.) The 99th percentile is determined from this sorted series of daily values which is ordered from the highest to the lowest number. Using the left column of Table 1, determine the appropriate range (*i.e.,* row) for the annual number of days with valid data for year y (cn_y). The corresponding "n" value in the right column identifies the rank of the annual 99th percentile value in the descending sorted list of daily site values for year y. Thus, $P_{0.99,y}$ = the nth largest value.

(b) The 1-hour primary standard design value for an ambient air quality monitoring site is mean of the three annual 99th percentile values, rounded according to the conventions in section 4.

TABLE 1

Annual number of days with valid data for year "y" (cn_y)	$P_{0.99,y}$ is the nth maximum value of the year, where n is the listed number
1–100	1
101–200	2
201–300	3
301–366	4

PART 53–AMBIENT AIR MONITORING REFERENCE AND EQUIVALENT METHODS

■ 8. The authority citation for part 53 continues to read as follows:

Authority: Sec. 301(a) of the Clean Air Act (42 U.S.C. sec. 1857g(a)), as amended by sec. 15(c)(2) of Pub. L. 91–604, 84 Stat. 1713, unless otherwise noted.

Subpart A—[Amended]

■ 9. Section 53.2 is amended by revising paragraphs (a)(1) and (b) to read as follows:

§ 53.2 General requirements for a reference method determination.

* * * * *

(a) *Manual methods*—(1) *Sulfur dioxide (SO_2)* and Lead. For measuring SO_2 and lead, appendixes A–2 and G of part 50 of this chapter specify unique manual FRM for measuring those pollutants. Except as provided in § 53.16, other manual methods for lead will not be considered for a reference method determination under this part.

* * * * *

(b) *Automated methods.* An automated FRM for measuring SO_2, CO, O_3, or NO_2 must utilize the measurement principle and calibration procedure specified in the appropriate appendix to part 50 of this chapter (appendix A–1 only for SO_2 methods) and must have been shown in accordance with this part to meet the requirements specified in this subpart A and subpart B of this part.

■ 10. Section 53.8 is amended by revising paragraph (c) to read as follows:

§ 53.8 Designation of reference and equivalent methods.

* * * * *

(c) The Administrator will maintain a current list of methods designated as FRM or FEM in accordance with this part and will send a copy of the list to any person or group upon request. A copy of the list will be available via the Internet and may be available from other sources.

■ 11. Table A–1 to Subpart A is revised to read as follows:

TABLE A–1 TO SUBPART A OF PART 53—SUMMARY OF APPLICABLE REQUIREMENTS FOR REFERENCE AND EQUIVALENT METHODS FOR AIR MONITORING OF CRITERIA POLLUTANTS

Pollutant	Reference or equivalent	Manual or automated	Applicable part 50 appendix	Applicable subparts of part 53					
				A	B	C	D	E	F
SO_2	Reference	Manual	A–2						
		Automated	A–1	✓	✓				
	Equivalent	Manual	A–1	✓		✓			
		Automated	A–1	✓	✓	✓			
CO	Reference	Automated	C	✓	✓				
	Equivalent	Manual	C	✓		✓			
		Automated	C	✓	✓	✓			
O_3	Reference	Automated	D	✓	✓				
	Equivalent	Manual	D	✓		✓			
		Automated	D	✓	✓	✓			
NO_2	Reference	Automated	F	✓	✓				
	Equivalent	Manual	F	✓		✓			
		Automated	F	✓	✓	✓			
Pb	Reference	Manual	G						
	Equivalent	Manual	G	✓		✓			
		Automated	G	✓		✓			
PM_{10}-Pb	Reference	Manual	Q						
	Equivalent	Manual	Q	✓		✓			

TABLE A–1 TO SUBPART A OF PART 53—SUMMARY OF APPLICABLE REQUIREMENTS FOR REFERENCE AND EQUIVALENT METHODS FOR AIR MONITORING OF CRITERIA POLLUTANTS—Continued

Pollutant	Reference or equivalent	Manual or automated	Applicable part 50 appendix	Applicable subparts of part 53					
				A	B	C	D	E	F
		Automated	Q	✓		✓			
PM_{10}	Reference	Manual	J	✓			✓		
	Equivalent	Manual	J	✓		✓	✓		
		Automated	J	✓		✓	✓		
$PM_{2.5}$	Reference	Manual	L	✓				✓	
	Equivalent Class I	Manual	L	✓		✓		✓	
	Equivalent Class II	Manual	L[1]	✓		✓[2]		✓	✓[1 2]
	Equivalent Class III	Automated	L[1]	✓		✓		✓	✓[1]
$PM_{10-2.5}$	Reference	Manual	L, O	✓				✓	
	Equivalent Class I	Manual	L, O	✓		✓		✓	
	Equivalent Class II	Manual	L, O	✓		✓[2]		✓	✓[1 2]
	Equivalent Class III	Automated	L[1], O[1]	✓		✓		✓	✓[1]

1. Some requirements may apply, based on the nature of each particular candidate method, as determined by the Administrator.
2. Alternative Class III requirements may be substituted.

Subpart B—[Amended]

■ 12. Section 53.20 is amended by revising paragraph (b) and Table B–1 in paragraph (c) to read as follows:

§ 53.20 General provisions.

* * * * *

(b) For a candidate method having more than one selectable measurement range, one range must be that specified in table B–1 (standard range for SO_2), and a test analyzer representative of the method must pass the tests required by this subpart while operated in that range. The tests may be repeated for one or more broader ranges (*i.e.,* ones extending to higher concentrations) than the range specified in table B–1, provided that the range does not extend to concentrations more than four times the upper range limit specified in table B–1. For broader ranges, only the tests for range (calibration), noise at 80% of the upper range limit, and lag, rise and fall time are required to be repeated. The tests may be repeated for one or more narrower ranges (ones extending to lower concentrations) than that specified in table B–1. For SO_2 methods, table B–1 specifies special performance requirements for narrower (lower) ranges. For methods other than SO_2, only the tests for range (calibration), noise at 0% of the measurement range, and lower detectable limit are required to be repeated. If the tests are conducted or passed only for the specified range (standard range for SO_2), any FRM or FEM method determination with respect to the method will be limited to that range. If the tests are passed for both the specified range and one or more broader ranges, any such determination will include the additional range(s) as well as the specified range, provided that the tests required by subpart C of this part (if applicable) are met for the broader range(s). If the tests are passed for both the specified range and one or more narrower ranges, any FRM or FEM method determination for the method will include the narrower range(s) as well as the specified range. Appropriate test data shall be submitted for each range sought to be included in a FRM or FEM method determination under this paragraph (b).

(c) * * *

TABLE B–1—PERFORMANCE SPECIFICATIONS FOR AUTOMATED METHODS

Performance parameter	Units[1]	SO_2		O_3	CO	NO_2	Definitions and test procedures
		Std. range[3]	Lower range[2 3]				
1. Range	ppm	0–0.5	<0.5	0–0.5	0–50	0–0.5	Sec. 53.23(a).
2. Noise	ppm	0.001	0.0005	0.005	0.5	0.005	Sec. 53.23(b).
3. Lower detectable limit	ppm	0.002	0.001	0.010	1.0	0.010	Sec. 53.23(c).
4. Interference equivalent							
Each interferent	ppm	±0.005	[4]±0.005	±0.02	±1.0	±0.02	Sec. 53.23(d).
Total, all interferents	ppm	—	—	0.06	1.5	0.04	Sec. 53.23(d).
5. Zero drift, 12 and 24 hour	ppm	±0.004	±0.002	±0.02	±1.0	±0.02	Sec. 53.23(e).
6. Span drift, 24 hour							
20% of upper range limit	Percent	—	—	±20.0	±10.0	±20.0	Sec. 53.23(e).
80% of upper range limit	Percent	±3.0	±3.0	±5.0	±2.5	±5.0	Sec. 53.23(e).
7. Lag time	Minutes	2	2	20	10	20	Sec. 53.23(e).
8. Rise time	Minutes	2	2	15	5	15	Sec. 53.23(e).
9. Fall time	Minutes	2	2	15	5	15	Sec. 53.23(e).
10. Precision							
20% of upper range limit	ppm	—	—	0.010	0.5	0.020	Sec. 53.23(e).
	Percent	2	2	.....	.....	.....	Sec. 53.23(e).
80% of upper range limit	ppm	—	—	0.010	0.5	0.030	Sec. 53.23(e).
	Percent	2	2	—	—	—	Sec. 53.23(e).

1. To convert from parts per million (ppm) to $\mu g/m^3$ at 25 °C and 760 mm Hg, multiply by M/0.02447, where M is the molecular weight of the gas. Percent means percent of the upper range limit.
2. Tests for interference equivalent and lag time do not need to be repeated for any lower SO_2 range provided the test for the standard range shows that the lower range specification is met for each of these test parameters.

3. For candidate analyzers having automatic or adaptive time constants or smoothing filters, describe their functional nature, and describe and conduct suitable tests to demonstrate their function aspects and verify that performances for calibration, noise, lag, rise, fall times, and precision are within specifications under all applicable conditions. For candidate analyzers with operator-selectable time constants or smoothing filters, conduct calibration, noise, lag, rise, fall times, and precision tests at the highest and lowest settings that are to be included in the FRM or FEM designation.

4. For nitric oxide interference for the SO_2 UVF method, interference equivalent is ±0.003 ppm for the lower range.

* * * * *

■ 13. Section 53.21 is amended by revising paragraph (a) to read as follows:

§ 53.21 Test conditions.

(a) *Set-up and start-up* of the test analyzer shall be in strict accordance with the operating instructions specified in the manual referred to in § 53.4(b)(3). Allow adequate warm-up or stabilization time as indicated in the operating instructions before beginning the tests. The test procedures assume that the test analyzer has an analog measurement signal output that is connected to a suitable strip chart recorder of the servo, null-balance type. This recorder shall have a chart width of a least 25 centimeters, chart speeds up to 10 cm per hour, a response time of 1 second or less, a deadband of not more than 0.25 percent of full scale, and capability either of reading measurements at least 5 percent below zero or of offsetting the zero by at least 5 percent. If the test analyzer does not have an analog signal output, or if other types of measurement data output are used, an alternative measurement data recording device (or devices) may be used for the tests, provided it is reasonably suited to the nature and purposes of the tests and an analog representation of the analyzer measurements for each test can be plotted or otherwise generated that is reasonably similar to the analog measurement recordings that would be produced by a conventional chart recorder.

* * * * *

■ 14. Section 53.22(d) is amended by revising Table B–2 to read as follows:

§ 53.22 Generation of test atmospheres.

* * * * *

(d) * * *

TABLE B–2—TEST ATMOSPHERES

Test gas	Generation	Verification
Ammonia	Permeation device. Similar to system described in references 1 and 2.	Indophenol method, reference 3.
Carbon dioxide	Cylinder of zero air or nitrogen containing CO_2 as required to obtain the concentration specified in Table B–3.	Use NIST-certified standards whenever possible. If NIST standards are not available, obtain 2 standards from independent sources which agree within 2 percent, or obtain one standard and submit it to an independent laboratory for analysis, which must agree within 2 percent of the supplier's nominal analysis.
Carbon monoxide	Cylinder of zero air or nitrogen containing CO as required to obtain the concentration specified in Table B–3.	Use a FRM CO analyzer as described in reference 8.
Ethane	Cylinder of zero air or nitrogen containing ethane as required to obtain the concentration specified in Table B–3.	Gas chromatography, ASTM D2820, reference 10. Use NIST-traceable gaseous methane or propane standards for calibration.
Ethylene	Cylinder of pre-purified nitrogen containing ethylene as required to obtain the concentration specified in Table B–3.	Do.
Hydrogen chloride	Cylinder[1] of pre-purified nitrogen containing approximately 100 ppm of gaseous HCL. Dilute with zero air to concentration specified in Table B–3.	Collect samples in bubbler containing distilled water and analyze by the mercuric thiocyante method, ASTM (D612), p. 29, reference 4.
Hydrogen sulfide	Permeation device system described in references 1 and 2.	Tentative method of analysis for H_2S content of the atmosphere, p. 426, reference 5.
Methane	Cylinder of zero air containing methane as required to obtain the concentration specified in Table B–3.	Gas chromatography ASTM D2820, reference 10. Use NIST-traceable methane standards for calibration.
Naphthalene	1. Permeation device as described in references 1 and 2 .. 2. Cylinder of pre-purified nitrogen containing 100 ppm naphthalene. Dilute with zero air to concentration specified in Table B–3.	Use NIST-certified standards whenever possible. If NIST standards are not available, obtain 2 standards from independent sources which agree within 2 percent, or obtain one standard and submit it to an independent laboratory for analysis, which must agree within 2 percent of the supplier's nominal analysis.
Nitric oxide	Cylinder[1] of pre-purified nitrogen containing approximately 100 ppm NO. Dilute with zero air to required concentration.	Use NIST-certified standards whenever possible. If NIST standards are not available, obtain 2 standards from independent sources which agree within 2 percent, or obtain one standard and submit it to an independent laboratory for analysis, which must agree within 2 percent of the supplier's nominal analysis.
Nitrogen dioxide	1. Gas phase titration as described in reference 6 ..... 2. Permeation device, similar to system described in reference 6.	1. Use an FRM NO_2 analyzer calibrated with a gravimetrically calibrated permeation device. 2. Use an FRM NO_2 analyzer calibrated by gas-phase titration as described in reference 6.
Ozone	Calibrated ozone generator as described in reference 9	Use an FEM ozone analyzer calibrated as described in reference 9.
Sulfur dioxide	1. Permeation device as described in references 1 and 2 .. 2. Dynamic dilution of a cylinder containing approximately 100 ppm SO_2 as described in Reference 7.	Use an SO_2 FRM or FEM analyzer as described in reference 7.

TABLE B–2—TEST ATMOSPHERES—Continued

Test gas	Generation	Verification
Water	Pass zero air through distilled water at a fixed known temperature between 20° and 30° C such that the air stream becomes saturated. Dilute with zero air to concentration specified in Table B–3.	Measure relative humidity by means of a dew-point indicator, calibrated electrolytic or piezo electric hygrometer, or wet/dry bulb thermometer.
Xylene	Cylinder of pre-purified nitrogen containing 100 ppm xylene. Dilute with zero air to concentration specified in Table B–3.	Use NIST-certified standards whenever possible. If NIST standards are not available, obtain 2 standards from independent sources which agree within 2 percent, or obtain one standard and submit it to an independent laboratory for analysis, which must agree within 2 percent of the supplier's nominal analysis.
Zero air	1. Ambient air purified by appropriate scrubbers or other devices such that it is free of contaminants likely to cause a detectable response on the analyzer. 2. Cylinder of compressed zero air certified by the supplier or an independent laboratory to be free of contaminants likely to cause a detectable response on the analyzer.	

[1] Use stainless steel pressure regulator dedicated to the pollutant measured.

Reference 1. O'Keefe, A. E., and Ortaman, G. C. "Primary Standards for Trace Gas Analysis," *Anal. Chem.* 38, 760 (1966).
Reference 2. Scaringelli, F. P., A. E. Rosenberg, E., and Bell, J. P., "Primary Standards for Trace Gas Analysis." *Anal. Chem.* 42, 871 (1970).
Reference 3. "Tentative Method of Analysis for Ammonia in the Atmosphere (Indophenol Method)", *Health Lab Sciences,* vol. 10, No. 2, 115–118, April 1973.
Reference 4. 1973 Annual Book of ASTM Standards, American Society for Testing and Materials, 1916 Race St., Philadelphia, PA.
Reference 5. *Methods for Air Sampling and Analysis,* Intersociety Committee, 1972, American Public Health Association, 1015.
Reference 6. 40 CFR 50 Appendix F, "Measurement Principle and Calibration Principle for the Measurement of Nitrogen Dioxide in the Atmosphere (Gas Phase Chemiluminescence)."
Reference 7. 40 CFR 50 Appendix A–1, "Measurement Principle and Calibration Procedure for the Measurement of Sulfur Dioxide in the Atmosphere (Ultraviolet Fluorscence)."
Reference 8. 40 CFR 50 Appendix C, "Measurement Principle and Calibration Procedure for the Measurement of Carbon Monoxide in the Atmosphere" (Non-Dispersive Infrared Photometry)".
Reference 9. 40 CFR 50 Appendix D, "Measurement Principle and Calibration Procedure for the Measurement of Ozone in the Atmosphere".
Reference 10. "Standard Test Method for C, through C5 Hydrocarbons in the Atmosphere by Gas Chromatography", D 2820, 1987 Annual Book of Aston Standards, vol 11.03, American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103.

■ 15. Section 53.23(d) is amended by revising Table B–3 to read as follows:

§ 53.23 Test procedures.

(d) * * *

* * * * *

TABLE B–3—INTERFERENT TEST CONCENTRATION,[1] PARTS PER MILLION

Pollutant	Analyzer type	Hydrochloric acid	Ammonia	Hydrogen sulfide	Sulfur dioxide	Nitrogen dioxide	Nitric oxide	Carbon dioxide	Ethylene	Ozone	M-xylene	Water vapor	Carbon monoxide	Methane	Ethane	Naphthalene
SO_2	Ultraviolet fluorescence	.....	.....	[5]0.1	[4]0.14	0.5	0.5	.....	.....	0.5	0.2	20,000	.....	.....	.....	[6]0.05
SO_2	Flame photometric	.....	.....	0.01	[4]0.14	.....	.....	750	.....	.....	.....	[3]20,000	50	.....	.....	.....
SO_2	Gas chromatography	.....	.....	0.1	[4]0.14	.....	.....	750	.....	.....	.....	[3]20,000	50	.....	.....	.....
SO_2	Spectrophotometric-wet chemical (pararosanaline).	0.2	0.1	0.1	[4]0.14	0.5	.....	750	.....	0.5	.....	.....	.....	.....	.....	.....
SO_2	Electrochemical	0.2	0.1	0.1	[4]0.14	0.5	0.5	.....	0.2	0.5	.....	[3]20,000	.....	.....	.....	.....
SO_2	Conductivity	0.2	0.1	.....	[4]0.14	0.5	.....	750	.....	.....	.....	.....	.....	.....	.....	.....
SO_2	Spectrophotometric-gas phase, including DOAS.	.....	.....	.....	[4]0.14	0.5	.....	.....	.....	0.5	0.2	.....	.....	.....	.....	.....
O_3	Chemiluminescent	.....	.....	[3]0.1	.....	.....	.....	750	.....	[4]0.08	.....	[3]20,000	.....	.....	.....	.....
O_3	Electrochemical	.....	[3]0.1	.....	0.5	0.5	.....	.....	.....	[4]0.08	.....	.....	.....	.....	.....	.....
O_3	Spectrophotometric-wet chemical (potassium iodide).	.....	[3]0.1	.....	0.5	0.5	[3]0.5	.....	.....	[4]0.08	.....	.....	.....	.....	.....	.....
O_3	Spectrophotometric-gas phase, including ultraviolet absorption and DOAS.	.....	.....	.....	0.5	0.5	0.5	.....	.....	[4]0.08	0.02	20,000	.....	.....	.....	.....
CO	Infrared	.....	.....	.....	.....	.....	.....	750	.....	.....	.....	20,000	[4]10	.....	.....	.....
CO	Gas chromatography with flame ionization detector.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20,000	[4]10	.....	0.5	.....
CO	Electrochemical	.....	.....	.....	.....	.....	0.5	.....	0.2	.....	.....	20,000	[4]10	.....	.....	.....
CO	Catalytic combustion-thermal detection.	.....	0.1	.....	.....	.....	.....	750	0.2	.....	.....	20,000	[4]10	5.0	0.5	.....
CO	IR fluorescence	.....	.....	.....	.....	.....	.....	750	.....	.....	.....	20,000	[4]10	.....	0.5	.....
CO	Mercury replacement-UV photometric.	.....	.....	.....	.....	.....	.....	.....	0.2	.....	.....	.....	[4]10	.....	0.5	.....
NO_2	Chemiluminescent	.....	[3]0.1	.....	0.5	[4]0.1	0.5	.....	.....	.....	.....	20,000	.....	.....	.....	.....
NO_2	Spectrophotometric-wet chemical (azo-dye reaction).	.....	.....	.....	0.5	[4]0.1	0.5	750	.....	0.5	.....	.....	.....	.....	.....	.....
NO_2	Electrochemical	0.2	[3]0.1	.....	0.5	[4]0.1	0.5	750	.....	0.5	.....	20,000	50	.....	.....	.....
NO_2	Spectrophotometric-gas phase.	.....	[3]0.1	.....	0.5	[4]0.1	0.5	.....	.....	0.5	.....	20,000	50	.....	.....	.....

1. Concentrations of interferent listed must be prepared and controlled to ±10 percent of the stated value.
2. Analyzer types not listed will be considered by the Administrator as special cases.
3. Do not mix with the pollutant.

4. Concentration of pollutant used for test. These pollutant concentrations must be prepared to ±10 percent of the stated value.
5. If candidate method utilizes an elevated-temperature scrubber for removal of aromatic hydrocarbons, perform this interference test.
6. If naphthalene test concentration cannot be accurately quantified, remove the scrubber, use a test concentration that causes a full scale response, reattach the scrubber, and evaluate response for interference

* * * * *

Subpart C [Amended]

■ 16. Section 53.32 is amended by revising paragraph (e)(2) to read as follows:

§ 53.32 Test procedures for methods for SO_2, CO, O_3, and NO_2.

* * * * *

(e) * * *

(2) For a candidate method having more than one selectable range, one range must be that specified in table B–1 of subpart B of this part, and a test analyzer representative of the method must pass the tests required by this subpart while operated on that range. The tests may be repeated for one or more broader ranges (*i.e.,* ones extending to higher concentrations) than the one specified in table B–1 of subpart B of this part, provided that such a range does not extend to concentrations more than four times the upper range limit specified in table B–1 of subpart B of this part and that the test analyzer has passed the tests required by subpart B of this part (if applicable) for the broader range. If the tests required by this subpart are conducted or passed only for the range specified in table B–1 of subpart B of this part, any equivalent method determination with respect to the method will be limited to that range. If the tests are passed for both the specified range and a broader range (or ranges), any such determination will include the broader range(s) as well as the specified range. Appropriate test data shall be submitted for each range sought to be included in such a determination.

* * * * *

■ 17. Table C–1 to Subpart C is revised to read as follows:

TABLE C–1 TO SUBPART C OF PART 53—TEST CONCENTRATION RANGES, NUMBER OF MEASUREMENTS REQUIRED, AND MAXIMUM DISCREPANCY SPECIFICATIONS

Pollutant	Concentration range, parts per million (ppm)	Simultaneous measurements required				Maximum discrepancy specification, parts per million
		1-hour		24-hour		
		First set	Second set	First set	Second set	
Ozone	Low 0.06 to 0.10	5	6	.....	.....	0.02
	Med. 0.15 to 0.25	5	6	.....	.....	0.03
	High 0.35 to 0.46	4	6	.....	.....	0.04
	Total	14	18	.....	.....	.....
Carbon monoxide	Low 7 to 11	5	6	.....	.....	1.5
	Med. 20 to 30	5	6	.....	.....	2.0
	High 25 to 45	4	6	.....	.....	3.0
	Total	14	18	.....	.....	.....
Sulfur dioxide	Low 0.02 to 0.05	5	6	3	3	0.02
	Med. 0.10 to 0.15	5	6	2	3	0.03
	High 0.30 to 0.50	4	6	2	2	0.04
	Total	14	18	7	8	.....
Nitrogen dioxide	Low 0.02 to 0.08	.....	.....	3	3	0.02
	Med. 0.10 to 0.20	.....	.....	2	2	0.02
	High 0.25	.....	.....	2	2	0.03
	Total	.....	.....	7	8	.....

PART 58—AMBIENT AIR QUALITY SURVEILLANCE

■ The authority citation for part 58 continues to read as follows:

Authority: 42 U.S.C. 7403, 7410, 7601(a), 7611, and 7619.

Subpart B [AMENDED]

■ 19. Section 58.10, is amended by adding paragraph (a)(6) to read as follows:

§ 58.10 Annual monitoring network plan and periodic network assessment.

* * * * *

(a) * * *

(6) A plan for establishing SO_2 monitoring sites in accordance with the requirements of appendix D to this part shall be submitted to the EPA Regional Administrator by July 1, 2011 as part of the annual network plan required in paragraph (a) (1). The plan shall provide for all required SO_2 monitoring sites to be operational by January 1, 2013.

* * * * *

■ 20. Section 58.12 is amended by adding paragraph (g) to read as follows:

§ 58.12 Operating Schedules

* * * * *

(g) For continuous SO_2 analyzers, the maximum 5-minute block average concentration of the twelve 5-minute blocks in each hour must be collected except as noted in § 58.12 (a).

* * * * *

■ 21. Section 58.13 is amended by adding paragraph (d) to read as follows:

§ 58.13 Monitoring network completion.

* * * * *

(d) The network of SO_2 monitors must be physically established no later than January 1, 2013, and at that time, must be operating under all of the requirements of this part, including the

requirements of appendices A, C, D, and E to this part.

■ 22. Section 58.16 is amended by adding paragraph (g) to read as follows:

§ 58.16 Data submittal and archiving requirements.

* * * * *

(g) Any State or, where applicable, local agency operating a continuous SO_2 analyzer shall report the maximum 5-minute SO_2 block average of the twelve 5-minute block averages in each hour, in addition to the hourly SO_2 average.

■ 23. Appendix A to Part 58 is amended as by adding paragraph 2.3.1.6 to read as follows:

Appendix A to Part 58—Quality Assurance Requirements for SLAMS, SPMs and PSD Air Monitoring

* * * * *

2.3.1.6 *Measurement Uncertainty for SO_2.* The goal for acceptable measurement uncertainty for precision is defined as an upper 90 percent confidence limit for the coefficient of variation (CV) of 10 percent and for bias as an upper 95 percent confidence limit for the absolute bias of 10 percent.

* * * * *

■ 24. Appendix D to Part 58 is amended as by revising paragraph 4.4 to read as follows:

Appendix D to Part 58—Network Design Criteria for Ambient Air Quality Monitoring

* * * * *

4.4 Sulfur Dioxide (SO_2) Design Criteria.

4.4.1 *General Requirements.* (a) State and, where appropriate, local agencies must operate a minimum number of required SO_2 monitoring sites as described below.

4.4.2 *Requirement for Monitoring by the Population Weighted Emissions Index.* (a) The population weighted emissions index (PWEI) shall be calculated by States for each core based statistical area (CBSA) they contain or share with another State or States for use in the implementation of or adjustment to the SO_2 monitoring network. The PWEI shall be calculated by multiplying the population of each CBSA, using the most current census data or estimates, and the total amount of SO_2 in tons per year emitted within the CBSA area, using an aggregate of the most recent county level emissions data available in the National Emissions Inventory for each county in each CBSA. The resulting product shall be divided by one million, providing a PWEI value, the units of which are million persons-tons per year. For any CBSA with a calculated PWEI value equal to or greater than 1,000,000, a minimum of three SO_2 monitors are required within that CBSA. For any CBSA with a calculated PWEI value equal to or greater than 100,000, but less than 1,000,000, a minimum of two SO_2 monitors are required within that CBSA. For any CBSA with a calculated PWEI value equal to or greater than 5,000, but less than 100,000, a minimum of one SO_2 monitor is required within that CBSA.

(1) The SO_2 monitoring site(s) required as a result of the calculated PWEI in each CBSA shall satisfy minimum monitoring requirements if the monitor is sited within the boundaries of the parent CBSA and is one of the following site types (as defined in section 1.1.1 of this appendix): population exposure, highest concentration, source impacts, general background, or regional transport. SO_2 monitors at NCore stations may satisfy minimum monitoring requirements if that monitor is located within a CBSA with minimally required monitors under this part. Any monitor that is sited outside of a CBSA with minimum monitoring requirements to assess the highest concentration resulting from the impact of significant sources or source categories existing within that CBSA shall be allowed to count towards minimum monitoring requirements for that CBSA.

4.4.3 *Regional Administrator Required Monitoring.* (a) The Regional Administrator may require additional SO_2 monitoring stations above the minimum number of monitors required in 4.4.2 of this part, where the minimum monitoring requirements are not sufficient to meet monitoring objectives. The Regional Administrator may require, at his/her discretion, additional monitors in situations where an area has the potential to have concentrations that may violate or contribute to the violation of the NAAQS, in areas impacted by sources which are not conducive to modeling, or in locations with susceptible and vulnerable populations, which are not monitored under the minimum monitoring provisions described above. The Regional Administrator and the responsible State or local air monitoring agency shall work together to design and/or maintain the most appropriate SO_2 network to provide sufficient data to meet monitoring objectives.

4.4.4 SO_2 *Monitoring Spatial Scales.* (a) The appropriate spatial scales for SO_2 SLAMS monitors are the microscale, middle, neighborhood, and urban scales. Monitors sited at the microscale, middle, and neighborhood scales are suitable for determining maximum hourly concentrations for SO_2. Monitors sited at urban scales are useful for identifying SO_2 transport, trends, and, if sited upwind of local sources, background concentrations.

(1) *Microscale*—This scale would typify areas in close proximity to SO_2 point and area sources. Emissions from stationary point and area sources, and non-road sources may, under certain plume conditions, result in high ground level concentrations at the microscale. The microscale typically represents an area impacted by the plume with dimensions extending up to approximately 100 meters.

(2) *Middle scale*—This scale generally represents air quality levels in areas up to several city blocks in size with dimensions on the order of approximately 100 meters to 500 meters. The middle scale may include locations of expected maximum short-term concentrations due to proximity to major SO_2 point, area, and/or non-road sources.

(3) *Neighborhood scale*—The neighborhood scale would characterize air quality conditions throughout some relatively uniform land use areas with dimensions in the 0.5 to 4.0 kilometer range. Emissions from stationary point and area sources may, under certain plume conditions, result in high SO_2 concentrations at the neighborhood scale. Where a neighborhood site is located away from immediate SO_2 sources, the site may be useful in representing typical air quality values for a larger residential area, and therefore suitable for population exposure and trends analyses.

(4) *Urban scale*—Measurements in this scale would be used to estimate concentrations over large portions of an urban area with dimensions from 4 to 50 kilometers. Such measurements would be useful for assessing trends in area-wide air quality, and hence, the effectiveness of large scale air pollution control strategies. Urban scale sites may also support other monitoring objectives of the SO_2 monitoring network such as identifying trends, and when monitors are sited upwind of local sources, background concentrations.

4.4.5 *NCore Monitoring.* (a) SO_2 measurements are included within the NCore multipollutant site requirements as described in paragraph (3)(b) of this appendix. NCore-based SO_2 measurements are primarily used to characterize SO_2 trends and assist in understanding SO_2 transport across representative areas in urban or rural locations and are also used for comparison with the SO_2 NAAQS. SO_2 monitors at NCore sites that exist in CBSAs with minimum monitoring requirements per section 4.4.2 above shall be allowed to count towards those minimum monitoring requirements.

* * * * *

■ 25. Appendix G to Part 58 is amended as by revising Table 2 to read as follows:

Appendix G to Part 58—Uniform Air Quality Index (AQI) and Daily Reporting

* * * * *

TABLE 2—BREAKPOINTS FOR THE AQI

These breakpoints							Equal these AQI's	
O_3 (ppm) 8-hour	O_3 (ppm) 1-hour [1]	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	CO (ppm)	SO_2 (ppm) 1-hour	NO_2 (ppm) 1-hour	AQI	Category
0.000–0.059 ..		0.0–15.4	0–54	0.0–4.4	0–0.035	0–0.053	0–50	Good.
0.060–0.075 ..		15.5–40.4	55–154	4.5–9.4	0.036–0.075	0.054–0.100	51–100	Moderate.
0.076–0.095 ..	0.125–0.164	40.5–65.4	155–254	9.5–12.4	0.076–0.185	0.101–0.360	101–150	Unhealthy for Sensitive Groups.
0.096–0.115 ..	0.165–0.204	[3] 65.5–150.4	255–354	12.5–15.4	[4] 0.186–0.304	0.361–0.64	151–200	Unhealthy.
0.116–0.374 ..	0.205–0.404	[3] 150.5–250.4	355–424	15.5–30.4	[4] 0.305–0.604	0.65–1.24	201–300	Very Unhealthy.
([2])	0.405–0.504	[3] 250.5–350.4	425–504	30.5–40.4	[4] 0.605–0.804	1.25–1.64	301–400	
([2])	0.505–0.604	[3] 350.5–500.4	505–604	40.5–50.4	[4] 0.805–1.004	1.65–2.04	401–500	Hazardous.

[1] Areas are generally required to report the AQI based on 8-hour ozone values. However, there are a small number of areas where an AQI based on 1-hour ozone values would be more precautionary. In these cases, in addition to calculating the 8-hour ozone index value, the 1-hour ozone index value may be calculated, and the maximum of the two values reported.

[2] 8-hour O_3 values do not define higher AQI values (≥301). AQI values of 301 or greater are calculated with 1-hour O_3 concentrations.

[3] If a different SHL for $PM_{2.5}$ is promulgated, these numbers will change accordingly.

[4] 1-hr SO_2 values do not define higher AQI values (≥200). AQI values of 200 or greater are calculated with 24-hour SO_2 concentrations.

* * * * *

[FR Doc. 2010–13947 Filed 6–21–10; 8:45 am]

BILLING CODE 6560–50–P