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To: Fred Butterfield, Designated Federal Officer, Clean Air Scientific Advisory Committee (CASAC)

Ted Russell, CASAC Ambient Air Monitoring and Methods (AAMM) Subcommittee Chair

From: Judith C. Chow, CASAC AAMM subcommittee member

Subject: Review of Ambient Monitoring Issues Related to Lead

This memo addresses the questions on which the Subcommittee members were asked to comment regarding Attachment 1 ("Options for Lead NAAQS Indicator: Monitoring Implications"), Attachment 2 ["Draft Federal Reference Method (FRM) and Federal Equivalent Method (FEM) Criteria for Lead in PM10 (Pb-PM10)"], Attachment 3 ("Lead NAAQS Ambient Air Monitoring Network: Network Design Options Under Consideration"), and Attachment 4 ("Lead NAAQS Ambient Air Monitoring Network: Sampling Frequency Options Under Consideration").

Questions on Attachment 1 (Options for Lead NAAQS Indicator: Monitoring Implications)

Question 1: Considering issues such as sampler performance, size cuts, operator maintenance, integration with other measurement systems, and usefulness as the measurement system for the indicator, please describe the advantages and disadvantages of sampling and analysis of Pb-TSP versus sampling and analysis of Pb-PM_{10}.

The lead (Pb) national ambient air quality standard (NAAQS) was established in 1978 (U.S.EPA, 1978), when measurement technology for integrated samplers was limited to total suspended particulates (TSP). EPA should move toward Pb-PM_{10}, which is inhalable and can travel longer distances from emission sources.

Disadvantages: The TSP size fraction was defined by the dimensions of the high-volume (HiVol) sampler as specified in the code of Federal Regulations (Federal Register, 1975). It is well known that HiVol TSP is non-size-specific, and EPA should consider phasing out this old technology (Chow, 1995). By the end of the 1970s, efforts using wind tunnels to characterize HiVol size-selection profiles showed that the 50% cut point of 30 – 50 µm depended on the orientation of the sampler with respect to the direction and velocity of the wind (Bruckman and Rubino, 1976; Chahal and Romano, 1976; Wedding et al., 1977; Blanchard and Romano, 1978; McFarland et al., 1980; Swinford, 1980). The large opening underneath the HiVol's peak roof inlet allows dust to blow onto the filter before and after sampling between the every-sixth-day filter change. Given the non-size-specific nature of the TSP samples and considering the question of how well Pb-TSP can represent human exposure, this 1950s technology should be discontinued.

Advantages: The only advantage of keeping Pb-TSP is that a large body of Pb-TSP concentrations have been obtained since 1980 (U.S.EPA, 2007) and the highest levels of Pb are found near smelters and tailing piles (U.S.EPA, 2003). As shown in Figure 1, two areas in the U.S. are designated as non-attainment for the Pb NAAQS due to recorded high Pb concentrations (U.S.EPA, 2007). TSP data might be useful for long-term trend analysis and to keep continuity with historical data, but given the large reductions already seen, and the leveling of concentrations at most locations, this seems unnecessary.

The low-volume (16.7 L/min) PM_{10} inlet is wind-tunnel tested with specified collocated precision over a wide range of wind speeds and directions (Watson and Chow, 1993; 2001). Low volume PM_{10c} FRMs (Appendix O to Part 50) provide more flow control, low background Teflon-membrane filters, and more precise mass determination. It is also similar to $PM_{2.5}$ FRM (using the same PM_{10} impactor inlet with the addition of WINS or sharp-cut cyclone inlets). The low-volume PM_{10c} FRM sampler is consistent with the EPA current proposed difference method for $PM_{10-2.5}$, which is similar (e.g., filter medium, sample collection, gravimetric analysis, quality assurance [QA]/quality control [QC]) to new or existing PM data set(s). Since low-volume PM_{10} samplers have been widely deployed in many urban networks, they are commercially available and network

operators are familiar with them, the cost for additional sampling and analysis should be reasonable. There is no need for a separate Pb-PM_{10} network. The integrated air monitoring strategy (U.S.EPA, 2005) should be considered for Pb-PM_{10} monitoring (Scheffe et al., 2007)

Figure 1. Non-attainment areas for lead (from http://www.epa.gov/oar/oaqps/greenbk/maplead.html).

Question 2: Is it appropriate to monitor for Pb-PM_{10} near Pb sources? And if so, under what conditions?

Yes, Pb-PM_{10} should be monitored near Pb sources, including roadways, mines (containing lead ore), smelters, and tailing piles. The current ~200 Pb-TSP sites are mostly located in urban areas, which may not represent near-source exposure. Since Pb additions to gasoline were decreased in the early 1970s (Kitman, 2000), Pb-TSP content has decreased drastically, especially at urban sampling sites near freeways (U.S.EPA, 2007). Exposure to Pb comes from multiple sources, including ingestion and inhalation, so important point sources such as Pb smelters or areas with suspendable Pb tailings need to be considered. Pb is still found in road dust, and decomposition of tire wheel weights has

been suggested as a potential source (Root, 2000). In addition to blood level Pb, the relationship between air Pb and human exposure are critical (Bachmann, 2007). An evaluation of Pb emitters in the NEI (Attachment 3) is a good start. PM_{10} levels near Pb sources should be monitored under a variety of meteorological conditions and for extended periods, especially at downwind locations where the concentrations are expected to be the highest.

Question 3: One indicator option suggests using scaling Pb-PM_{10} monitoring data up to an equivalent Pb-TSP level in lieu of Pb-TSP monitoring data. Under what circumstances would it be appropriate to scale data (e.g., non-source oriented sites, low concentration sites) and when would it not be appropriate to scale data?

Even though the analysis for measurements between 1993 and 2006 shows good correlations between Pb-TSP and PM_{10} for 33 non-source-oriented sites, 40% of the Pb-TSP concentrations were underestimated using linear regression. As noted earlier, and well-documented in the scientific literature, the TSP fraction is ill-defined, not sampled consistently, has a large fraction that deposits near the source, and is not as amenable to Pb analysis as PM_{10}. A better question is: "What is the purpose for scaling Pb-PM_{10} to an equivalent Pb-TSP level?" Such scaling is rarely applicable to all situations. Without adequate collocation under different meteorological conditions, scaling data always includes unaccountable uncertainties. This exercise may be acceptable if the PM_{10} data can be used to set up new Pb-PM_{10} NAAQS. The U.S. EPA should acquire Pb-PM_{10} and analyze archived PM_{10} low-volume FRM samples to fill the gaps in the existing database.

Scaling data for source-oriented sites is even more difficult, since meteorological phenomena may result in disproportional particle resuspension for TSP as compared to PM_{10} and it is more difficult to establish Pb-PM_{10} and Pb-TSP relationships under high wind speeds.

Question 4: We have limited data collocated Pb-PM_{10} and Pb-TSP monitoring data. What types and "scaling factors" are appropriate to create using this data (e.g., non-source oriented, source oriented) ? What levels are appropriate for the types of scaling factors identified in the white paper?

At the very least, different statistical methods (e.g., weighted least squares, effective variance least squares, distribution of differences; (Watson and Chow, 2002; Mathai et al., 1984) should be used to create the "scaling factor." Data should be aggregated by season and segregated by wind sectors and wind speed to relate Pb-TSP to Pb-PM_{10} or vice-versa. It would be important to add a ± uncertainty to the scaling. Again, what is the purpose of scaling?

Questions on Attachment 2 [Draft Federal Reference Method (FRM) and Federal Equivalent Method (FEM) Criteria for Lead in PM10 (Pb-PM10)]

Question 1: Is it appropriate to use the low-volume PM_{10c} FRM sampler as the Pb-PM_{10} FRM sampler?

Yes, as stated in the response to Question 1 of Attachment 1. A low-volume PM_{10c} FRM sampler as the Pb-PM_{10} FRM sampler is the most cost-effective way. There shouldn't be any difference in low-volume PM_{10c} samplers for PM_{10} mass or Pb.

Question 2: What other PM_{10} samplers should be considered as either FRM or FEM for the Pb-PM_{10} FRM?

Although there are medium-volume and HiVol PM_{10} FRM samplers (see Table 2 of Chow, 1995, reproduced below) that can be considered as alternatives, many of them use 8" × 10" quartz-fiber filters. Since Pb is a stable compound, retrospective Pb analysis can be done on these samples by inductively coupled plasma (ICP), atomic absorption spectroscopy (AAS), or XRF. Since many of the PM_{10} high- or medium-volume FRMs are not compatible with the existing $PM_{2.5}$ networks, it creates more variability in those networks and is not as useful as low-volume PM_{10c} FRM samples.

Table 2. U.S. EPA designated reference and equivalent methods for PM_{10}.

Reference/Equivalent Method[903] (Designation No.)	*Sampler Description*	*Federal Register Citation (Notice Date)*
1. Reference method (RFPS-1087-062)	Wedding & Associates PM_{10} Critical Flow High-Volume Sampler (using a cyclone-type inlet, critical flow device, and 20.3 cm x 25.4 cm filters).	Vol. 52, 37366 (10/06/87)
2. Reference method (RFPS-1287-063)	Sierra-Andersen (SA) or General Metal Works (GMW) Model 1200 PM_{10} High-Volume Air Sampler System (using a SA- or GMW-1200 PM_{10} impaction-type size-selective inlet and 20.3 cm x 25.4 cm filters).	Vol. 52, 45684 (12/01/87) Vol. 53, 1062 (01/15/88)
3. Reference method (RFPS-1287-064)	Sierra-Andersen or General Metal Works Model 321 B PM_{10} High-Volume Air Sampler System (using a SA- or GMW-321 B PM_{10} impaction-type size-selective inlet and 20.3 cm x 25.4 cm filters).	Vol. 52, 45684 (12/01/87) Vol. 53, 1062 (01/15/88)
4. Reference method (RFPS-1287-065)	Sierra-Andersen or General Metal Works Model 321 C PM_{10} High-Volume Air Sampler System (using a SA- or GMW-321 C PM_{10} impaction-type size-selective inlet and 20.3 cm x 25.4 cm filters).	Vol. 52, 45684 (12/01/87) Vol. 53, 1062 (01/15/88)
5. Reference method (RFPS-0389-071)	Oregon DEQ Medium-Volume Sequential Filter Sampler for PM_{10} (using a SA 254 impaction-type PM_{10} inlet and 47 mm Teflon-membrane and quartz-fiber filters. Samples are collected simultaneously onto two filter substrates, and device can be programmed for up to six days of unattended operation and allow automatic filter-sequencing as filter overloading occurs).	Vol. 54, 12273 (03/24/89)
6. Reference method (RFPS-0389-073)	Sierra-Andersen Models SA 241 and SA 241M or General Metal Works Models G 241 and GA 241M PM_{10} Low Volume Dichotomous Samplers (using a SA 246 B or G 246 impaction-type PM_{10} inlet, 2.5 µm virtual impactor assembly, and 37 mm $PM_{2.5}$ and coarse [PM_{10} minus $PM_{2.5}$] filter holders).	Vol. 54, 31247 (07/27/89)
7. Equivalent method (EQPM-0990-076)	Andersen Instruments Model FH621-N PM_{10} Beta Attenuation Monitor (using a SA 246 B impaction-type PM_{10} inlet and 40 mm filter tape).	Vol. 55, 38387 (09/18/90)
8. Equivalent method (EQPM-1090-079)	Rupprecht & Patashnik TEOM Series 1400 and Series 1400a PM_{10} Monitor (using an impaction-type PM_{10} inlet, internal tapered element oscillating microbalance, and 12.7 mm diameter filter).	Vol. 55, 43406 (10/29/90)
9. Equivalent method (EQPM-0391-081)	Wedding & Associates PM_{10} Beta Gauge Automated Particle Sampler (using a cyclone-type PM_{10} inlet and 32 mm filter tape).	Vol. 56, 9216 (03/05/91)
10. Reference method (RFPS-0694-098)	Rupprecht & Patashnik Partisol Model 2000 Air Sampler (using an impaction-type PM_{10} inlet and 47 mm diameter filter).	Vol. 59, 35338 (07/11/94)

From Chow, 1995

Question 3: Is XRF an appropriate Pb-PM_{10} FRM analysis method?

Yes, ringed Teflon-membrane filters are one of the best choices for XRF analysis of Pb, owing to the high X-ray energy of the Pb L-α lines (10.55 and 12.61 ev), penetration into the filter, and large-particle self-absorption aren't major issues. XRF is non-destructive, relatively inexpensive, and can obtain other elemental concentrations as a bonus. It usually has low blank levels for metals and is inert to adsorption of gases. The $PM_{2.5}$ FRM network uses Whatman (Hillsboro, OR) PTFE (poltytetra fluroethylene) Teflon-membrane filters, which are 60% thicker than those from Pall Sciences (R2PJ047, 25 µm thickness, Ann

Arbor, MI), but this should not effect the minimum detectable limits (MDLs) of heavy elements such as Pb. In the early 1990s, a batch of Teflon-membrane filters were contaminated with Pb, and that compromised study results, therefore acceptance testing of low-volume PM_{10} Teflon-membrane filters is essential before sampling (Chow, 1995). The acceptance test should be set as 3 × MDL or 7 – 8 ng/cm^2. Pb analysis by XRF is highly sensitive, without much spectral interference. It can achieve MDLs of 1.5 – 2 ng/cm^2 (Note that the MDL in Table 1 of Attachment 2 is 1.5 ng/cm^2 and page 7 of Appendix Q to Part 50 shows 2.0 ng/cm^2. 3 ng/cm^2 is probably more reasonable.)

Question 4: What other analysis methods should be considered for FRM or FEM for the Pb-PM_{10} FRM?

There are quite a few modern analytical methods that can be used to quantify Pb. It can be analyzed by XRF, proton-induced X-ray emission (PIXE), flame ionization or graphite furnace, AAS, ICP/atomic emission spectroscopy (ICP/AES), or ICP/mass spectrometry (ICP/MS) (Watson et al., 1999). Table 1 shows the difference in MDLs among the different methods. Switching from AAS to XRF is a good choice, since AAS is labor intensive, subject to contamination during extraction, can only acquire a single element for a given time, and requires lengthy acid extraction prior to chemical analysis.

Some XRF and PIXE instruments quantify elements with atomic numbers ranging from 11 (sodium) to 92 (uranium), although XRF usually acquires elements with lower MDLs as compared to PIXE. It is non-destructive and requires neither sample preparation nor extensive operator time after samples are loaded into the analyzer. To achieve the greatest benefit for the investment, EPA should consider acquiring all the elements listed in Table 1 using XRF (added costs will include acquiring a complete set of standards and to conduct spectral processing). If archived or other samples are acquired on quartz- or cellulose-fiber filters, other analytical technology such as AAS or ICP can be considered, though the equivalences needs to be achieved among different analytical methods.

Table 1. Minimum detectable limits (MDLs) among the different methods.

	Minimum Detectable Limit in ng/m^3 [a]						
	Flame[e,f]			Graphite Furnace[e,f]			
Species	**INAA[b,c]**	**XRF[b]**	**PIXE[b.d]**	**AAS[e,g]**	**AAS[e,g]**	**ICP[e,g]**	**ICP-MS[h]**
Ag	0.12	6	NA[i]	4	0.005	1	0.000090
Al	24	5	12	30	0.01	20	0.004098
As	0.2	0.8	1	100	0.2	50	0.000081
Au	NA	2	NA	21	0.1	2.1	0.010000
Ba	6	25	NA	8[f]	0.04	0.05	0.000261
Be	NA	NA	NA	2[f]	0.05	0.06	0.000400
Br	0.4	0.5	1	NA	NA	NA	NA
Ca	94	2	4	1[f]	0.05	0.04	0.012675
Cd	4	6	NA	1	0.003	0.4	0.000007
Ce	0.06	NA	NA	NA	NA	52	0.000003
Cl	5	5	8	NA	NA	NA	NA
Co	0.02	0.4	NA	6[f]	0.02	1	0.000006
Cr	0.2	1	2	2	0.01	2	0.003906
Cs	0.03	NA	NA	NA	NA	NA	0.000015
Cu	30	0.5	1	4	0.02	0.3	0.001061
Eu	0.006	NA	NA	21	NA	0.08	0.000004
Fe	4	0.7	2	4	0.02	0.5	0.015601
Ga	0.5	0.9	1	52	NA	42	0.000039
Hf	0.01	NA	NA	2,000	NA	16	0.000010
Hg	NA	1	NA	500	21	26	0.010000
I	1	NA	NA	NA	NA	NA	NA
In	0.006	6	NA	31	NA	63	0.000009
K	24	3	5	2[f]	0.02	NA	0.007467
La	0.05	30	NA	2,000	NA	10	0.000003
Mg	300	NA	20	0.3	0.004	0.02	0.001633
Mn	0.12	0.8	2	1	0.01	0.1	0.000102
Mo	NA	1	5	31	0.02	5	0.000190
Na	2	NA	60	0.2[f]	< 0.05	NA	0.008134
Ni	NA	0.4	1	5	0.1	2	0.000301
P	NA	3	8	100,000	40	50	NA
Pb	NA	1	3	10	0.05	10	0.000069
Pd	NA	5	NA	10	NA	42	0.000024
Rb	6	0.5	2	NA	NA	NA	0.000049
S	6,000	2	8	NA	NA	10	0.002621
Sb	0.06	9	NA	31	0.2	31	0.000080
Sc	0.001	NA	NA	50	NA	0.06	NA
Se	0.06	0.6	1	100	0.5	25	0.000151
Si	NA	3	9	85	0.1	3	NA
Sm	0.01	NA	NA	2,000	NA	52	0.000006
Sn	NA	8	NA	31	0.2	21	0.000076
Sr	18	0.5	2	4	0.2	0.03	0.000035

Table 1. Continued.

	Minimum Detection Limit in ng/m^3 [a]						
	Flame[e,f]			Graphite Furnace[e,f]			
Species	**INAA[b,c]**	**XRF[b]**	**PIXE[b.d]**	**AAS[e,g]**	**AAS[e,g]**	**ICP[e,g]**	**ICP-MS[j]**
Ta	0.02	NA	NA	2,000	NA	26	0.000576
Th	0.01	NA	NA	NA	NA	63	0.000004
Ti	65	2	3	95	NA	0.3	0.001016
Tl	NA	1	NA	21	0.1	42	0.000148
U	NA	1	NA	25,000	NA	21	0.000004
V	0.6	1	3	52	0.2	0.7	0.000030
W	0.2	NA	NA	1,000	NA	31	0.000187
Y	NA	0.6	NA	300	NA	0.1	0.000020
Zn	3	0.5	1	1	0.001	1	0.003051
Zr	NA	0.8	3	1,000	NA	0.6	0.000306

[a] Minimum detection limit is three times the standard deviation of the blank for a filter of 1 mg/cm^2 areal density.
ICP = Inductively Coupled Plasma Emission Spectroscopy.
ICP-MS = Inductively Coupled Plasma - Mass Spectrometry
AAS = Atomic Absorption Spectrophotometry.
PIXE = Proton Induced X-ray Emissions Analysis.
XRF = X-ray Fluorescence Analysis.
INAA = Instrumental Neutron Activation Analysis.

[b] Concentration is based on 13.8 cm^2 deposit area for a 47 mm filter substrate, with a nominal flow rate of 20 L/min for 24-hour samples.

[c] Olmez, 1989.

[d] Cahill, 1980.

[e] Concentration is based on the extraction of 1/2 of a 47mm filter in 15 ml of deionized-distilled water, with a nominal flow rate of 20 L/min for 24-hour samples.

[f] Fernandez, 1989.

[g] Harman, 1989.

[h] Concentration is based on the digestion of 1/2 of a 47mm filter in 50 ml of acid, with a nominal flow rate of 20 L/min for 24-hour samples.

[i] Not available.

Question 5: Have we selected appropriate precision, bias, and method detection limit requirements for FEM evaluation?

Precision, bias, and MDLs for a FEM should be no different from FRM for Pb analysis. Since FEMs are usually installed at non-urban areas, MDLs for FEMs should be lower than those of FRMs. MDLs of one tenth of NAAQS are recommended in Attachment 2. Why should different MDLs be accepted for FRMs and FEMs? Five percent analytical accuracy, 15% precision, and 20% maximum difference as stated in Attachment 2 appear to be reasonable. Pb and other heavy elements have been shown to be quantifiable on filter tape deposits from FEM beta attenuation monitors (Watson et al., 2007).

Questions on Attachment 3 (Lead NAAQS Ambient Air Monitoring Network: Network Design Options Under Consideration)

Question 1: What types of monitoring sites should be emphasized in the network design (e.g., source oriented monitors, population monitors, near roadway monitors)?

Different types of sampling sites represent different receptor zones of representation based on EPA's Guidance on Network Design Principles (Watson et al., 1997). Pb-PM_{10} monitoring should include both neighborhood-scale monitors (0.5 – 4 Km) for hot spots (e.g., smelters, tailing piles) and urban-scale (4 – 100 m) monitors for population exposure in an urban environment (Chow et al., 2002). If elevated PM_{10} appears to raise concerns about public health near a specific source or sources, special studies should be conducted (with more intense frequency at multiple locations) to assess the source zone of influences and to address the receptor zone of representation (Chow et al., 1999)

Question 2: We are considering proposing requirements for monitoring near sources exceeding an emissions threshold and discuss a number of options for determining this threshold in the white paper. What options should be considered in establishing an emissions threshold?

Assuming the worst-case shown in Figure 2 of Attachment 1, Pb-TSP is 2.2 times Pb-PM_{10} for Pb-PM_{10} NAAQS. This translates current 1.5 µg Pb-TSP NAAQS to 0.68 $\mu g/m^3$ of Pb-PM_{10}. This value corresponds to median and maximum values of 0.3 $\mu g/m^3$ and 0.7 $\mu g/m^3$ per tons per year (tpy) for Pb emissions, respectively. There are 271 facilities in the U.S. for a 1 tpy emission rate. As mentioned in Question 2 of Attachment 1, the NEI is a good starting point, as are the estimations shown in Table 5 of Attachment 3 (e.g., 379 sites for core-based statistical areas [CBSA] with populations > 100,000 people. Note that the second Table 5 is the number of CBSAs).

Question 3: We are considering proposing requirements for non-source oriented monitoring in large urban areas to provide additional information on ambient air concentrations in urban areas. Considering other monitoring priorities and a potential requirement for Pb

monitoring near sources, what size of a non-source oriented Pb network is appropriate?

The relationship between estimated emissions and observed ambient concentrations should be established to determine an emissions threshold. The multi-layered network design for the Pb surveillance network is a good start. EPA should correlate locations of current Pb-TSP monitors (Figure 1 of Attachment 3) with those of Pb sources in NEI (Figure 2 of Attachment 3). For example, Figure 1 of Attachment 3 shows that there are no Pb monitoring sites in Arizona, where Figure 2 of Attachment 3 shows large (> 5 – 15 tpy) sources. Maybe the sources have been closed since the 2002 Inventory, but comparing existing point sources to monitoring sites provides good knowledge for network design.

According to the U.S. EPA (2007; see Figure 1 above), only Jefferson County, MO and East Helena Area (Lewis & Clark County), MT are designated as non-attainment areas for Pb, but Figure 1 of Attachment 3 doesn't show Pb-TSP monitoring near these sites. This type of discrepancy should be resolved. Statistical analyses based on existing data should also be considered before sites are chosen.

Question 4: What factors should we base non-source oriented monitoring requirements on (e.g., population, design value) ?

Non-source oriented monitoring intends to represent human exposure in an urban scale (4 – 100 Km) or neighborhood scale (0.5 – 4 Km). CBSA is a good start for the basic number of sampling sites. Even though Pb is a primary pollutant, and it may be localized, downwind transport from large point sources needs to be considered at the regional scale (100 – 1,000 Km)

Question 5: We are considering proposing requirements for Pb monitoring near roadways and interstates. Is it appropriate to include separate monitoring requirements for near roadway monitoring, or should near roadway monitors be a part of the non-source oriented monitoring requirement?

As less Pb was added to gasoline between 1978 and 1986, Pb emissions decreased substantially

(Bachmann, 2007). Even though mobile sources may contribute Pb from wheel weights (i.e., ground up as road dust), brake wear, petro-fuels (traceable amounts) and lube oil, Table 7 of Attachment 3 showed that maximum monthly Pb concentrations are below 0.05 $\mu g/m^3$; it is not clear how close the five selected sites are to roadways or other Pb emitters. Unless EPA is considering a Pb-PM_{10} NAAQS of $\leq$0.1 $\mu g/m^3$, roadside measurements may not be a priority. Some roadside (hot spot) monitors should be part of the normal PM_{10} and $PM_{2.5}$ networks, but it should not be necessary to perform these measurements in every city, although special studies can be conducted at busy intersections to address the spatial and temporal variations of Pb-PM_{10} along with ultrafine particles ($d_p < 0.1$ μm) measurements to address the issue of human exposure and potential health impacts (Biswas and Wu, 2005; Chow et al., 2005).

Question 6: Under what conditions would it be appropriate to waive the monitoring requirements for either source or non-source oriented monitors?

This is a decision of EPA and should be consistent with decisions for other criteria pollutants.

Questions on Attachment 4 (Lead NAAQS Ambient Air Monitoring Network: Sampling Frequency Options Under Consideration)

Question 1: What sampling frequency would be appropriate if the Pb NAAQS is based on a monthly average?

The original proposal from EPA during the mid-1970s considered monthly average Pb-TSP. Industry expressed a concern that the monthly maximum form of NAAQS would require longer-term average Pb-TSP as low as 0.41 $\mu g/m^3$ to keep the maximum monthly below 1.5 $\mu g/m^3$. The one-in-six day sampling schedule is not adequate to determine the monthly average (Supplemental Table 7 of Bachmann, 2007). If a monthly average is to be used, EPA would need to have a minimum of every third day sampling (i.e., ten samples/month).

Question 2: Is it appropriate to relax the sampling frequency in areas of low Pb concentration?

If so, at what percent of the Pb NAAQS?

It is reasonable to consider every sixth day sampling for areas with low Pb concentrations. The 30% Pb NAAQS proposed in Attachment 4 seems reasonable.

Question 3: Is it appropriate to relax the sampling frequency in areas considerably higher than the NAAQS? lf so, at what percent of the Pb NAAQS?

No. Areas with high Pb concentrations should keep at least an every third day sampling schedule, and possibly a more frequent schedule. If facilities emit high concentrations of Pb sporadically, daily sampling may be considered. Since suspended toxic dust might be a large source, sampling and analysis should be more frequent during activities or meteorological conditions that enhance dust suspension.

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