Preliminary Comments on the REA from Dr. Delbert Eatough

(Received on 09-11-17)

Chapter 3

Charge Question 4. Does the Panel find the description of the three study areas and their key aspects (Section 3.3) to be clear and technically appropriate?

Selection of Study Areas

It seems appropriate to first discuss the choices made in selecting the three study areas included in the REA. In Section 1 of the REA The following were listed as the criteria used in considering individual study areas (I give them numbers to allow reference back to them in my discussion):

1. **Design value near the existing standard (75 ppb).** Design values ranging from 50 ppb 33 to 100 ppb were considered preferable to minimize the magnitude of the adjustment needed to generate air quality just meeting the existing standard and potentially minimizing the uncertainties in estimates of exposures associated with the adjustment approach. In considering areas with regard to this criterion, consecutive 3-year periods as far back as 2011-2013 were considered.
2. **One or more air quality monitors reporting 5-minute SO2 data for the 3-year study period.** In judging whether monitors provided such a 3-year record, completeness requirements (summarized in section 3.5) were applied for all three years to ensure the availability of adequate data for informing the ambient air concentrations used for exposure modeling.
3. **Availability of existing air quality modeling datasets**. There are many areas in the U.S. that have chosen to model air quality for regulatory purposes, i.e., in designating areas with regard to attainment of the existing standard. This criterion was not only considered important for efficiency purposes, but also to maintain consistency between our assessment approach and state-level modeling regarding the years selected, sources included, emission levels and profiles, and assumptions used to predict ambient concentrations.
4. **Population size greater than 100,000.**
5. **Significant and diverse emissions sources.** Preference was given to study areas with a diverse source mix, including EGUs, petroleum refineries, and secondary lead smelting (generally reflects battery recycling). A diverse source mix allows for capturing exposures to both large sources (e.g., emissions of 10,000-20,000 tons and small sources (e.g., emissions of hundreds of tons per year) distributed about a study area.

In addition, it was indicated that an attempt was made to select a variety of geographical regions and to minimize the inclusion of study areas near the ocean or large water bodies, such as the Great Lakes, given the potential for unusual atmospheric chemistry and associated transformation of SO_2 in those areas and limits in our ability to accurately model such events.

I have also taken into account the indication in Section 1 that the final REA will draw upon the final ISA and will reflect consideration of the Clean Air Scientific Advisory Committee's (CASAC) advice and public comments on this draft REA.

In our review of the draft ISA in March of this year we made one suggestion to EPA, which they indicated in the August 16, 2017 response from Administrator Pruitt they would address in the next draft of the ISA that are particularly important with respect to the REA:

"updates to information on sources and emissions of sulfur oxides, including contributions of emissions from smelters and integrated iron and steel mills, as well as updating information on spatial and temporal variation in sulfur dioxide concentrations."

The focus on smelters and integrated iron and steel mills reflects the importance of these sources with respect to exposure of the populations near the sources to elevated concentrations or SO_2 and the possible importance of inorganic S(IV) containing particulate materials from these sources as potential confounders of SO_2 asthma exacerbation. While the importance of the later item will be dependent on epidemiological evaluations to be conducted by EPA, the importance of integrated iron and steel mills is not.

The above observations are the basis of my comments which follow on the consideration of adding an additional study area to the revised REA.

I believe that the selection of Indianapolis, Indiana and Tulsa, Oklahoma as study sites are reasonable choices based on the above outlined criteria. However, it is somewhat of a stretch to characterize Indianapolis as representing the Ohio River Valley.

In contrast, the selection of Fall River, Massachusetts does not follow two of the criteria listed above, it has only a single source and it is on a large body of water (the Dynegy Brayton Point EGU being located directly on the Mt Hood Bay). I personally do not feel the later criteria is significant but EPA indicated this would be a consideration in their choice of study areas. I understand that EPA would not like to drop this study area because of the unique nature of the end analysis. I would like to point out that the high fraction of asthmatics exposed to the 100-ppb bench mark concentration, as compared to the other two study areas (Table 5.2) is not unexpected. The single EGU source in the study region is located only about 10 mi from the Fall River population centers, it has three sort stacks (107 m tall) which together emit just under 20,000 ton per year (e.g. Table B-5). In addition, the prevailing wind is often from the west blowing directly towards Fall River and essentially never the opposite direction (Figure A-9).

These features lead to the high exposures report in Table 5.2. In contrast, for example, the major point source in Indianapolis is the IP&L Harding Street EGU which emits just over 20,000 ton per year from two stacks which are also short (80 m) (e.g. Table B-20). The facility also emits about 800 ton per year from two units with scrubbers and 172 m stacks. However, the wind rose data indicate that major wind transport is from the southwest (Figure A-10) carrying emissions away from the monitor which provided SO_2 modeling data for Indianapolis.

I would suggest that a fourth study site is needed both to provide a site where high exposure, like that seen in Fall River, would be expected and to provide data which includes emission from integrated iron and steel mills. The first draft REA suggested two sites which would meet this criteria, Cleveland Ohio and Detroit Michigan. I would personally prefer the Detroit location

I suggest you consider including the Detroit, Wayne Co, MI study area. It would be useful to have a map of that study area like Figures 4-2 through 4-5 in the draft REA to further evaluate that possibility. If the data from the multiple monitors (6) in this potential study area could all be used in the APEX analysis this would be a strong point for including Detroit as a study area. The draft REA indicated that continuous 5 min SO_2 data are available. In addition, if the possibility of looking at the impact of emissions from the Zug island steel mill or the Trenton Channel Power Plant located near the steel mill or the closely located together DTE Belle River Power Plant and St. Clair Power Plant in the northeast part of Detroit existed this would further indicate it would be an excellent study area. The three mentioned EGUs do not have tall stacks and they may contribute to more local impacts. The last point could be determined by examination of the data from the six monitors in Detroit.

Finally, to put the sources chosen for study in perspective, I have created the following Table of major sources in each Study Area using data from Appendix B plus data from other sources. The emphasis on the importance of EGU emissions in the selected study areas is obvious.

Study Area	Source	Type	Stack Height	Annual 2011 Emissions	
Fall River	Brayton	EGU	107 m	18,600	
Indianapolis	IP&L Harding St.	EGU	80 m	16,600	
			172 m	2,600	Scrubbed
	Citizens Thermal	EGU	83 m	4,400	
	Quemetco	Pb Sec.	30 & 50 m	130	Battery
Tulsa	PSO Northeastern	EGU	185 m	17,900	
(not in REA**)**	OGE Muskogee	EGU	107 m	24,200	Year?
	Refinery West	Oil	~30 m	730	
	Refinery East	Oil	194 m	20	
	Sapulpa	Railway	~ 30 m	200	
Other	Conemaugh (Pa)	EGU	305 m	8,000	Scrubbed
	Cayuga (In)	EGU	170 m	86,000	2005 data
		EGU	170 m	3,400	Scrubbed
	Salt Lake City	Cu Smelter	370 m	800	Scrubbed
	Hayden	Cu Smelter	305 m	20,000	
	Detroit Zug Island	Steel Mill	20 to 60 m	2,900	

EGU units account for 98% if the total SO_2 emissions in the three study areas. The next most significant source is the Oil Refineries in Tulsa which account for 1.2% of the total emissions and 4% of the SO_2 emissions in Tulsa. I have outlined above the importance of considering emissions from integrated iron and steel mills. Addition of Detroit as a study area would include such a facility and this facility would have 4 times the SO_2 emissions of the two Oil Refineries in Tulsa. The Detroit Steel Mill would account for 8% of the total SO_2 in the study area, while the two EGU units in Detroit would account for 82% (Michigan Department of Environmental Equality, 2015). I strongly recommend EPA consider adding the Detroit area as a fourth study area to provide a somewhat better balance in the REA.

I would recommend adding Gila County in Arizona (site of both the Hayden and Globe copper smelters), but recognize this area would not meet the above criteria for population (53,000 total population). However, if the hypothesis that particulate inorganic S(IV) is a significant confounder to SO_2 exacerbation of asthma is shown to be correct, addition of Gila County as an additional study site should be addressed. The importance of addressing a site with emissions from an integrated iron and steel mill would also increase if this were the case. EPA is now examining older epidemiological data to test this hypothesis in their preparation of the next versions of the ISA.

Description of Study Areas

The first draft REA included useful maps describing the study areas, e.g. Figures 4.2 through 4.5 of that documents. These figures provided the following information which informed the reader about the study area:

- A readable map of the area.
- The location of the SO_2 monitors in the area, including an indication of whether the monitoring site provided 5 min data.
- The location and size of various SO_2 sources in the area.
- Relative equal distances from each of the sources.

I would recommend that similar figures be added to this version of the REA. In addition, addition of the identification of the type of each source, like that given in Figures 3.1 – 3.3 of this version would be valuable. This information would allow ready identification of the locations of monitors and sources for the various Tables given in Chapter 3.

I am confused by Table 3.1. It indicates there was no monitor with continuous 5-minute data in Indianapolis. How then was the study area modeled? Is the Table in error?

Charge Question 5. Does the Panel find the description of the air quality modeling done to estimate the spatial variation in 1-hour concentrations (section 3.2) to be technically sound and clearly communicated?

The steps required to provide needed input to AIRMOD are clearly laid out at the start of Chapter 3. I am not a modeler and will not attempt to evaluate the use of the model, only to give my impression of the methods used to provide data input to the model and seek input from other members of the panel with expertise in the areas related to those questions.

Ground meteorological data. Fall River is the only study area without an airport in the study area. EPA has used data from Providence to provide the wind data. Providence is 20 miles away and there is possible influence from the bays in the region. Do meteorologists in the panel feel comfortable with the use of the Providence data?

Upper air meteorological data. The Chatham site used to provide the upper air meteorological data at Fall River for AIRMOD is located at the point of Cape Cod and extends well out into the ocean. Do meteorologists in the panel feel data from this site will be characteristic of upper air data at Fall River?

Classification of Brayton as “rural” (Page 3-8, line 20). The stacks at Brayton were not “tall”, only 107 m high. Does the classification as “rural” in the model based on this assumption effect

the AIRMOD results? I have already commented on how the high emissions, low stack and wind rose data all point to an expected high impact at Fall River.

Charge Question 6. To simulate air quality just meeting the current standard, we have adjusted model predicted 1hour SO2 concentrations using a proportional approach focusing on the primary emissions source in each area to reduce the modeled concentrations at the highest air quality receptor to meet the current standard (section 3.4). Considering the goal of the analyses it to provide a characterization of air quality conditions that just meet the current standard and considering the associated uncertainties, what are the Panel's views on this approach?

I have no comments on this section.

Charge Question 7. A few approaches were used to extend the existing ambient air monitoring data to reflect temporal patterns in the study area (section 3.5). Does the Panel find the approaches used below to be technically sound and clearly communicated? a. Data substitution approach for missing 1-hour, 5-minute maximum, or 5-minute continuous ambient air monitor concentrations (section 3.5.1). b. Estimating pattern of within-hour 5-minute continuous concentrations where 1-hour average and 5-minute maximum are known (section 3.5.2). c. Combining pattern of continuous 5-minute concentrations within each hour from monitors in or near the study area with the modeled 1-hour concentrations (section 3.5.3).

Indianapolis: There were only maximum 5 min concentrations available at the single monitor at this study area. You chose Detroit data to represent the hourly pattern at Indianapolis and used data from one of the six monitors there. You have given no justification for the choice of the 1 of 6. A map for Detroit like those for Figures 4-8 through 4-11 in the previous draft would help us evaluate the wisdom of that choice. Please provide that to the panel. I consider the information presented on assumptions too incomplete to reach a conclusion on the results.

Fall River: Good coverage of 5-minute data for 2011 and 2012 lends credibility to the data for these two years and the tight statistics for these data in Table 3-10. I will leave it to modelers in the group to judge how well the 2013 results are consistent with the first two years results. However, the results for Fall River should be fairly solid based on the input data.

Tulsa: As indicated in Table 3-9, Tulsa had the most complete coverage of 5-minute data of any of the study sites, with continuous 5-minute data at three sites for all three years and continuous data at a fourth site added in 2013. However, there is not just a single EGU in the Tulsa area, but 5, 2 burning coal and 3 burning natural gas. (http://www.powerplantjobs.com/ppj.nsf/powerplants1?openform&cat=ok&Count=500, https://www.psoklahoma.com/global/utilities/lib/docs/info/facts/factsheets/PSO_Fact_Sheet_2015.pdf, https://www.google.com/maps/d/viewer?mid=1Yf43pX6guhAx8Y_XZ7sy-25CqUU&hl=en_US&ll=36.10870952767214%2C-96.17040100000003&z=9).

These include:

- Public Service Company of Oklahoma Northeastern Plant; 2 units with 856 MW capacity burning natural gas and 2 Units with 936 MW capacity burning coal. The stacks for the coal fired units are 185 m high and emit about 17,900 tons per year. The facility is located just south of Oologah, OK, about 30 mi NE of the Holly Refinery. The monitoring station M0078 in figure 6.2 is located between Tulsa and the facility, being closest to the facility.
- Public Service Company of Oklahoma Tulsa Plant; 2 units with 319 MW capacity burning natural gas. This facility is within Tulsa.
- Public Service Company of Oklahoma Riverside Plant; 2 units with 1059 MW capacity burning natural gas. This facility is in Jenks, OK, just south of Tulsa, with the Richard L. jones Jr. Airport being about halfway between this facility and the Holly Refinery.
- Green Country power plant: 3 units with 795 MW capacity burning natural gas. This facility is also located in Jenks, OK.
- OG&E Muskogee Generating Station, 3 units with 1716 MW capacity burning coal. The stacks for the coal fired units are 107 m high and emit about 22,409 tons per year. This facility is in Muskogee, about 50 mi SE of the Holly Refinery.

Exactly how the data available for Tulsa were used is not clear. Table 3-6 indicated that the Public Service Company of Oklahoma Northeastern Plant was included as a point source in the modeling domain for Tulsa. This EGU is also included in Figure A-5 which gives the location of point sources for Tulsa. However, it is also stated on line 13 of page 3-12 (Section 3.2.2.3) that monitor 401431127 was used as the background monitor. Furthermore, the EGU is not included in Figure C-5 which gives the Tulsa study area air quality modeling domain and includes M1127. Figure 3-3 giving air quality receptors in the Tulsa exposure modeling domain and design values calculated from modeled hourly concentrations adjusted to just meet the existing standard indicates that M1127 (which they state was used as a background monitor except when winds were from the north). M1127 is just south of the EGU included as one of the Tulsa area point sources but the EGU is not included in Figure 3-3. That does not make sense. The discussion of the assignment of monitors to model air quality receptors for Tulsa on page 3-30 indicate that M1127 was to represent air quality receptors not having a strong local source influence. You also state that you did not use data from this monitor when winds were from the north. This would be the times of impact by the EGU. You state throughout the results for Tulsa that the major source impacting the region in Figure 3-3 is the West Refinery (730 tons SO_2 per year) and appear to ignore the EGU (17,900 tons SO_2 per year). Do these assumptions account for the underprediction of SO_2 at high concentrations in Figures D-10 through D-12? Do all the above observations account for the modeled minimal impact in Tulsa? Finally, the OGE Muskogee EGU (24,200 tons SO_2 per year is also within the domain for Figure 3-3, is southeast of the refinery and the wind rose indicate the major air flow into Tulsa is from the south.

A map for Tulsa like that for Figures 4-8 through 4-11 in the previous draft giving us locations of the monitors and (all) the sources would certainly help to evaluate the results and the reasonableness of the conclusions. Please provide. One would expect the results for Tulsa to be the most accurate, based on the input data, as few assumptions are needed to reach the end results, but it is not at all clear that reasonable assumptions were made.

Figure 3-4. Ultimately the proof of the pudding for Section 3.5 is given in this Figure. It is not stated (or clear) for which site this comparison applies. I suspect it is 2011 and 2012, Fall River. If this is so what do the top two plots for 2013 look like where continuous 5-min data were not available? The statement is made on page 3-26 that comparisons for Indianapolis were "similar". Given the more indirect nature of the Indianapolis analysis, please show us a similar Figure for Indianapolis. Finally, there were continuous 5-minute data at all monitor sites for Tulsa, so estimation of 5-minute data for other considerations was not needed. What do the plots for Tulsa look like, particularly, how much is the scatter in the measured and predicted 5-minute data reduced? These key results would allow a more definite evaluation of that is done in Section 3.5.

Reference

Michigan Department of Environmental Quality 20 August 2015 "Proposed Sulfur Dioxide One-Hour National Ambient Air Quality Standard State Implementation Plan", http://www.deq.state.mi.us/aps/downloads/SIP/SO2SIP.pdf