Preliminary Comments from Dr. James Boylan on EPA's Integrated Science Assessment for Sulfur Oxides – Health Criteria (External Review Draft – November 2015) 1/26/2016

Comments on Chapter 2

Chapter 2 describes scientific information on sources, atmospheric chemistry, and measurement and modeling of ambient concentrations of gaseous sulfur oxides.

a. To what extent is the information presented regarding sources, chemistry, and measurement and modeling of ambient concentrations accurate, complete, and relevant to the review of the SO_2 NAAQS?

Page 2-3: Figure 2-1 needs to add the label for the y-axis. Also, many of the "Industrial" source category names have been cut-off which makes it difficult to distinguish them from each other.

Figures 2-2, 2-3, 2-4: The text on page 2-3 states "Counties that have not fully achieved the current air quality standard for SO_2, being partially or entirely out of attainment, are outlined in yellow in Figures 2-2, 2-3 and 2-4." However, the legend in the figures describes these areas as "Counties with ambient SO_2 1-hr concentrations that exceed 75 ppb" or "Counties with SO_2 concentrations above the NAAQS". The two are not identical because areas can exceed the NAAQS, but not be designated nonattainment. Also, the author should add which 3-year design value was used to determine if the county was nonattainment. Next, the author should explain why (A) industrial cement production and (B) industrial chemical and allied products manufacturing are included in Figure 2-3(A) and Figure 2-3(B) when it looks there are many other source categories with higher SO_2 emissions (see Figure 2-1).

Page 2-9: Figure 2-5 should include EPA SO_2 projections to 2017 or 2018. These are readily available as part of the modeling EPA did for the recently proposed Cross-State Air Pollution Rule (CSAPR).

b. Please comment on the extent to which available information on the spatial and temporal trends of ambient SO_2 concentrations at various scales has been adequately and accurately described. In particular, what is the extent to which the analyses of recently available 5-min SO_2 concentration data are informative in considering relationships between 5-min and 1-hr SO_2 concentrations?

Pages 2-24 to 2-84: Section 2.5 "Environmental Concentrations" is based on 2010-2012 data. However, 2013 has been available since May 1, 2014 and 2014 data has been available since May 1, 2015. By including this additional data, the number of data points will nearly double adding to the robustness of the analysis.

Pages 2-41 to 2-46: Figures 2-14, 2-15, 2-16, 2-17, 2-18, and 2-19 need to include the SO_2 emissions for each NEI Facility. This will help explain the spatial variability in the SO_2 concentrations at the monitors.

Page 2-68: In Figure 2-28, many sites with high SO_2 concentrations are classified as "Moderate Conc Sites" (e.g., Cleveland, Pittsburgh, and Payson/Phoenix) while other sites with much lower SO_2 concentrations are classified as "High Conc Sites" (e.g., New York City and St. Louis). It seems that the method for identifying the classification needs to be updated. In addition to only looking at SO_2 data from these six cities, the rest of the SO_2 data pairs should be analyses to support the author's conclusion on page 2-69 that "These results emphasize that 1-hour average concentrations at or below 75 ppb, for the most part, represent hourly 5-minute maximum values below 200 ppb." Specifically, the author should create a single scatter plot with all the SO_2 data pairs from all the SO_2 monitors in the country. Finally, there are a number of data points that are below the 1:1 line in Cleveland and St. Louis. By definition, the 5-minute maximum value can never be lower than the 1-hour average value if the 5-minute maximum value is extracted from the same hour of data. It is inappropriate to compare a 5-minute maximum value to a 1-hour average value if the 5-minute maximum value is extracted from a different hour.

Page 2-71 to 2-73: The time series plots in Figure 2-29, 2-30, and 2-31 should replace the red circles with a time series line so that the lower values can be distinguished from each other.

c. How informative is the analysis of correlations between SO_2 and co-occurring pollutant concentrations for interpretation of epidemiologic studies?

Page 2-82 to 2-83: The author states "The lower wintertime SO_2-O_3 correlation could be directly linked to relatively low O_3 concentrations during this time of year due to less photochemical O_3 production. At such low ambient levels that are presumably near the instrument detection limit, O_3 measurements may be subject to substantial measurement error, which may lead to poor correlations between O3 and other pollutants, including SO_2." I agree with the first sentence. However, I don't agree with the second sentence since no evidence has been presented to support this conclusion. In many areas of the country, winter ozone levels are well above instrument detection limit and hover around 30-40 ppb. A reason for the low SO_2-O_3 correlation in all seasons is likely due to the regional nature of ozone formation vs. the local nature of SO_2 plume hits. In the wintertime, there is higher SO_2 and less ozone due to the less oxidation of SO_2 and less formation of ozone due to decreased photochemistry.

Page 2-84: The author states "However, given that a small subset of monitors report relatively strong copollutant correlations, confounding may need to be considered on a study-by-study basis." The author should example the handful of data point that have a high correlation coefficient to help identify the reason (e.g., power plant plume hits). Then, these situations can be accounted for in exposure studies.

Comments on Section 2.6 – Atmospheric Modeling

Page 2-87: The author states "One limitation of the Gaussian approach is the assumption of steady conditions over a 1-hour modeling period and over the plume transport distance to the receptors." This is especially true for low winds which is when the SO_2 concentrations are the highest. For this reason, a Lagrangian model such as CALPUFF or SCICHEM is preferred.

Page 2-89: The author presents AERMOD model performance for multiple field-study databases. In these examples, the emissions characteristics and background concentrations were well known; meteorological data were available on site; and tracer concentrations were measured at multiple locations where high plume impacts were expected. In these cases, model was generally shown to be

acceptable. However, there are many application of AERMOD where the emissions are not know, the background concentrations are not known, and the meteorological data is not on site (typically from the nearest airport that can a considerable distance away from the emission source). In these cases, the model performance is usually very poor or not evaluated at all which can lead to large modeled uncertainties.