Appendix B:

Recommendation for Representative Meteorological Data Set for Sikeston Power Station

MEMORANDUM

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TO: File

FROM: Stacy Allen

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SUBJECT: Recommendation for representative meteorological data set for Sikeston Power Station

The APCP is conducting analyses of meteorological data to select the most representative data to be used in air pollution modeling for specific sources in Missouri. The choice of a meteorological data set is to be used in State Implementation Plan (SIP) modeling evaluations, including but not limited to 2010 SO_2 NAAQS modeling. The following is an analysis of the data and recommendations for the Sikeston Power Station located in Scott County, Missouri.

Background: When states are required to complete air pollution modeling exercises to fulfill SIP obligations, various EPA regulatory guidance documents are consulted. When refined dispersion modeling is required, states choosing to use EPA's preferred model AERMOD must select surface and upper-air meteorological datasets for model input. Guidance on the choice of meteorological datasets comes from 40 CFR Part 51, Appendix W, the Guideline on Air Quality Models (November 2005), and various pollutant-specific documents like the SO_2 NAAQS Designations Modeling Technical Assistance Document.

There is no site-specific upper air dataset available for most locations because it is cost-prohibitive. Because upper air data does not depend on surface characteristics which change over short distances, the representativeness of upper air data extends over a broader region. The spacing of the readily-available National Weather Service (NWS) upper air network is several hundred kilometers to capture the larger upper air pattern, and the nearest station is generally chosen for the area to be modeled.

Surface meteorological data is highly dependent on the local surface conditions and terrain. Appendix W section 8.3 states that meteorological input data should be selected that is representative of the area of concern. Representativeness is dependent on (1) the proximity of the meteorological monitoring site to the area under consideration, (2) the complexity of the terrain, (3) the exposure of the meteorological monitoring site, and (4) the period of time during which data are collected. EPA's emphasis on these representativeness criteria is echoed in the draft SO2 NAAQS Designations Modeling Technical Assistance Document (May 2013), section 7, Meteorological Data. EPA's Modeling TAD discusses representativeness in depth, especially regarding the choice of off-site data to model the area of concern. The immediate area surrounding the meteorological collection site influences the low level

wind pattern and the depth of atmospheric mixing that can be expected. The variables that capture these characteristics are surface roughness, albedo, and Bowen ratio. Since these three variables are required inputs for the AERSURFACE meteorological data processor that is a required part of the AERMOD modeling, it is critical that any off-site surface weather data must be as closely representative of these variables as possible.

When site-specific surface weather data is not available, the most commonly used off site source of data is the NWS. These data sets are readily available, quality assured, and generally meet data completeness requirements. The most representative meteorological surface weather station, usually at an airport, must be chosen for the facility. Most airport meteorological data is collected via an Automated Surface Weather System (ASOS) station that will meet EPAs modeling requirements for complete data elements over the time period. In a few cases, meteorological monitoring data at nearby industrial facilities can be used if it is closer than the nearest NWS site and meets representativeness criteria. The meteorological inputs needed for EPA's model of choice, AERMOD, are evaluated using the AERMOD pre-processor AERSURFACE. AERSURFACE calculates surface roughness, albedo, and Bowen Ratio at the facility of interest because these local characteristics influence pollutant dispersion patterns. AERSURFACE is run for both the facility of interest and the meteorological surface weather station so that the results can be compared, and the most similar weather station is chosen to represent the facility of interest. Because EPA is not prescriptive on how states are to choose representative meteorology, the AERMOD Implementation Guide (last revised March 19, 2009, http://www.epa.gov/ttn/scram/7thconf/aermod/aermod_implmtn_guide_19March2009.pdf) is followed in the following documentation.

Technical Analysis:

The Sikeston Power Station has no on-site or nearby collected surface or upper air meteorological data. Offsite NWS data is evaluated for representativeness in the following discussion.

The National Land Cover Database (1992) is used to create a 1km radius circle around the center of the facility for surface roughness, and a 10 km square for reflectance (albedo) and convective instability (Bowen ratio). The 1 km and 10 km radii are the recommended values from the AERMOD Implementation Guide, section 3.1.2. There is no indication that surface characteristics at the facility of interest require further site-specific analysis because of significant terrain or land cover discontinuities just beyond the 1 km recommended area of interest. Using these land cover characteristics, AERSURFACE is run three times to account for possible wet, dry and average precipitation conditions when compared to actual meteorological station observations. The precipitation scheme affects the convective instability (Bowen ratio) by providing more or less moisture available for latent heat transfer due to vapor to liquid phase transitions. The AERSURFACE outputs are loaded to the "MetSiteSelection.xlsm" spreadsheet that allows comparison of the facility with meteorological stations. The spreadsheet tool has pre-loaded the AERSURFACE characteristics for Missouri surface weather stations, and displays them side-by-side with the facility characteristics. The tool also provides graphical

displays of surface cover information, and allows for satellite image comparisons. In general, meteorological stations within 200 km of the facility of interest are preferred as their prevailing weather conditions would be most similar to the facility. However, locations more than 200 km from the facility of interest can be considered when surface conditions of nearby meteorological stations are not deemed representative.

Sikeston:

For upper air data, the Springfield, MO upper air station is closest to Sikeston at 338 km and best represents the vertical atmospheric characteristics of the region surrounding Sikeston.

For surface data, the Cape Girardeau (39 km), Poplar Bluff (64 km), and Farmington (122 km) airports are the closest to the Sikeston facility.

Cape Girardeau: The surface roughness values compare favorably between Sikeston and this airport. Because the land cover characteristics are very similar, with 90% row crop/10% pasture at Cape Girardeau, and 66% row crop and 8% pasture at Sikeston, the surface roughness values within 1 km of each site are very similar (4-56% different by season). The 1992 Land Cover Data identifies 11% of the land cover near Sikeston as water. Changes at the facility shown in more recent satellite images indicate that the amount of water cover near the facility has dropped significantly since 1992, especially in the southeast quadrant. Current land cover in this quadrant is low grasses, which compares favorably with Cape Girardeau. The albedos agree within 5%. The Bowen ratios differ by 3-30% across all seasons.

Poplar Bluff: The surface roughness values compare favorably between Poplar Bluff and Sikeston. Land cover is 51% row crops, 9% pasture, and 16% low intensity residential for Poplar Bluff, compared to 66% row crop and 8% pasture for Sikeston. Surface roughness values differ by 40-98% between these locations by season. The albedos agree within 1%. The Bowen ratios differ by 6-22% across the seasons.

Farmington: The surface roughness values differ by 12-72% across all seasons between Farmington and Sikeston. The land cover categories are similar, with planted or grass cover at 75% for Farmington and 77% for Sikeston (includes pasture, row crop and recreational grasses). By individual land type, Farmington only has 14% row crop compared to 66% for Sikeston, accounting for most of the difference in winter and spring surface roughness. Albedo values agree within 7%. Bowen ratios are within 29% for all seasons and precipitation schemes.

The next closest airport within 200 km (St. Louis Downtown, 193km) offers no improvement to the comparison of combined surface roughness, albedo, or Bowen ratios than the three closest surface weather stations. The strong similarity in land cover between Cape Girardeau and Sikeston, along with similar albedo and Bowen ratios, make the closest NWS meteorological station at Cape Girardeau the most representative surface weather station.

Recommendation: The following meteorological data sets are recommended:

Facility of Interest	Upper Air Location	Surface Data Location
Sikeston	Springfield, MO	Cape Girardeau