A. AMEREN MISSOURI MERAMEC ENERGY CENTER

Ameren Missouri's Meramec Energy Center (Meramec) is a coal-fired electric generating facility located in St. Louis County, Missouri. Based on the air program's technical review of this facility, current conditions support a recommendation of attainment for a portion of St. Louis County.

A.1 Monitoring and Modeling Data

There are no ambient SO_2 monitors near Meramec that can be relied upon to characterize the air quality around the source. Instead, the air program performed extensive air dispersion modeling to characterize air quality for the area. The air program modeled Meramec using the most recent three years of actual emissions data (and new allowable emission rates) with concurrent representative meteorological data to approximate a monitored design value for the area. The following paragraphs summarize the modeling analysis performed specific to Meramec, and the modeling protocol in Appendix H contains more detail on general modeling procedures.

Emissions Data for Model Input

Further emissions information including interactive source evaluation is included in Section A.2. Meramec units 1 & 2 are limited to burning only natural gas as of April 16, 2016 in order to exempt them from the Mercury and Air Toxics Standard (MATs) rule. Meramec has requested to amend their Title V permit to make this natural gas limitation federally enforceable. Therefore, natural gas combustion emission rates for these units were used in the model in conjunction with recent actual variable emission rates for Meramec units 3 & 4.

The most recent three years (2013-2015) of hourly emissions (CEMS) data was obtained through EPA's Clean Air Markets Division program database (CAMD) and the downloaded SO_2 hourly mass emissions data was formatted for direct input into AERMOD. Meramec provided recorded hourly varying stack release parameters including exit temperature and exit flow rate that were evaluated and paired with the CAMD retrieved CEMS emissions.

Meteorological Data for Model Input

An air program staff meteorologist performed a technical evaluation to determine which surface and upper air stations are most representative of Meramec. Meramec has no on-site or nearby collected surface or upper air meteorological data. Offsite NWS data was evaluated for representativeness in the following discussion. 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.

For upper air data, the Lincoln, IL National Weather Service upper air station is closest to Meramec at 209 km and best represents the vertical atmospheric characteristics of the region.

For surface data, the Downtown St. Louis/Cahokia (24 km), Spirit of St. Louis (39 km), and Lambert (39 km) airports are closest to Meramec. There are eleven other NWS locations within 200 km of Meramec. Explicit criteria for each of the respective stations are compared below.

> Downtown/Cahokia: Land cover categories are similar between the Cahokia airport and Meramec. Both have a majority of herbaceous/planted land cover (53% Cahokia, 24% Meramec), with another significant portion as developed land (38% Cahokia, 14% Meramec). However, Meramec also has significant portions of land cover as water (23%), Wetlands (20%) and forest (17%). The surface roughness values at Cahokia show a strong duality between

smooth and rough surfaces (planted vs developed), as does Meramec (planted/water are smooth, wetland/forest/developed are rough). Though the specific land cover types are slightly different, the roughness values show similarity. Roughness values differ by 10-20% in summer and fall, and 20-30% in winter and spring. The albedos agree within 1%. The Bowen ratios differ by near 40% in all seasons for dry conditions, around 30% for average and wet conditions.

Spirit: Land cover at Spirit is 74% herbaceous/planted, with a small portion of forest (15%) and developed land (9%). Compared to the mixed cover types at Meramec (planted/water/wetland/forest/developed), Spirit has a more uniformly smooth surface. Surface roughness values are lower at Spirit, and are 50-60% lower than Meramec in winter and spring, but agree closer in summer and fall at under 5% different. The albedos agree within 1%. The Bowen ratios differ by 15-25% across the seasons in dry and average conditions, and 0 to 20% in wet conditions. Despite different land cover breakouts between Spirit and Meramec, the surface roughness, albedo and Bowen ratio don't show significant differences because the characteristics of the land cover are similar.

Lambert: Land cover near Lambert airport is 66% developed and 33% herbaceous/cultivated land. This is very different from the mix of herbaceous, water, wetland, forest and developed land at Meramec. The surface roughness values differ by around 40% in winter and spring and around 65% in summer and fall. Albedo values differ by up to 13%. Bowen ratios are 80% to 120% different across the seasons and precipitation schemes.

In this case, Cahokia has slightly better agreement with the Meramec surface roughness values, and it is the closest station at 24km. Though Spirit shows slightly better agreement in Bowen ratio throughout the year, the larger discrepancy in surface roughness in winter and spring and additional 15 km distance away from Meramec rule it out as the most representative surface meteorological dataset. The Downtown/Cahokia airport surface NWS site data is preferable to represent the surface meteorological conditions at Meramec.

The recommended representative meteorological stations used in this modeling analysis are shown in Table 1.

Table 1 – Meramec Energy Center Meteorological Datasets

Facility of Interest	Surface Data Location	Upper Air Location
Meramec Energy Center	Downtown/Cahokia, IL	Lincoln, IL

AERMOD, EPA's recommended dispersion model per Appendix W, contains an option to model a source under either rural or urban dispersive conditions. Section 7.2.3 describes that land use or population should be used to characterize the urban or rural surroundings of a source being modeled. Of the two methods, land use is the preferred method as it directly influences meteorological variables. The land classification method of Auer (Correlation of Land Use and Cover with Meteorological Anomalies, Journal of Applied Meteorology, May 1978) results in a 3 km radius surrounding Meramec with under 50% cover in the urban categories. The eastern half of the 3km circle contains the Mississippi river water surface and the remaining is virtually 100% agricultural river bottom farm land. The western half of the 3km circle contains mixed forested, wetland, and residential/commercial land use. Despite the land classification method determination of rural dispersive characteristics, additional consideration is given based on the AERMOD Implementation Guide (Aug 3, 2015), section 5 "Urban Applications." The guide states that users "should consider the potential for urban heat island influences across the full modeling domain." In the case of Meramec SO_2 modeling, the domain is much larger than the 3km domain examined for land use and urban/rural classification. The larger domain also captures the urbanized area of south St. Louis that experiences an urban heat island effect. Due to the larger regional nature of the urban heat island effect, Meramec was modeled with the urban option in AERMOD. To use

the urban option in AERMOD, a population must be specified for the area. For this analysis, the 2014 US Census estimated population for St. Louis County (where Meramec is located) of 1 million was used.

Much like the urban heat island effect that occurs on the regional scale, determining a representative regional background concentration must be given similar considerations for the entire modeled region. Since Meramec is nearby a large metropolitan area it likely experiences higher background concentrations than a more rural, isolated site would. The air program established an urban background concentration during recent nonattainment plan development. The established regional background concentration for urban areas of 13 ppb was determined reasonable for use in this analysis since Meramec is located near a large metropolitan area. The analysis focused on the JFK monitor in Kansas which is also near a large metropolitan area that experiences urban effects. The modeling protocol in Appendix H further details this analysis. There is an outstate monitor located in Mark Twain State park which has historically been used for background concentration purposes. This monitor has a recent design value of 8 ppb. However, the established urban concentration of 13 ppb was determined to be more representative of the area surrounding Meramec while also being more conservative. The chosen background concentration was added to model predicted concentrations to account for natural sources and sources not explicitly included in the modeling inventory. The maximum modeled concentration for the area was 165.9 $\mu g/m^3$ or 63.3 ppb. This demonstrates the area is currently in compliance with the 1-hour SO_2 standard of 75 ppb. A map including plotted output concentrations is shown below in Figure 1.

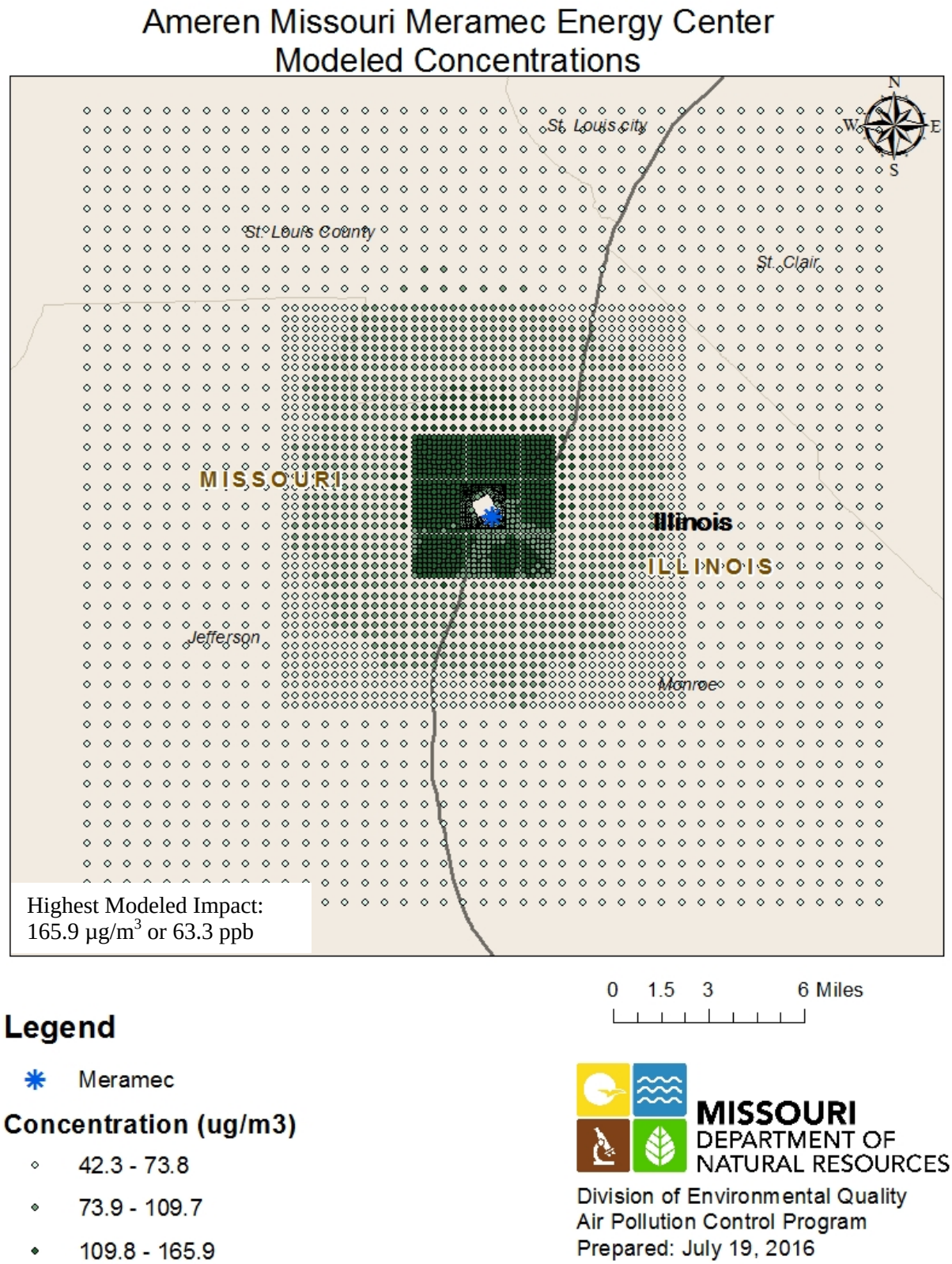

Figure 1 – Meramec Energy Center Modeled SO_2 Concentrations

A.2 Emissions Data

The emissions sources surrounding Meramec were evaluated to determine an interactive source inventory for the dispersion modeling analysis. Figure 2 displays a map of Meramec along with permitted SO_2 sources located within 20 km that were evaluated for inclusion in the modeling inventory. Table 2 lists all sources included on the map along with their 2013-2015 actual emissions.

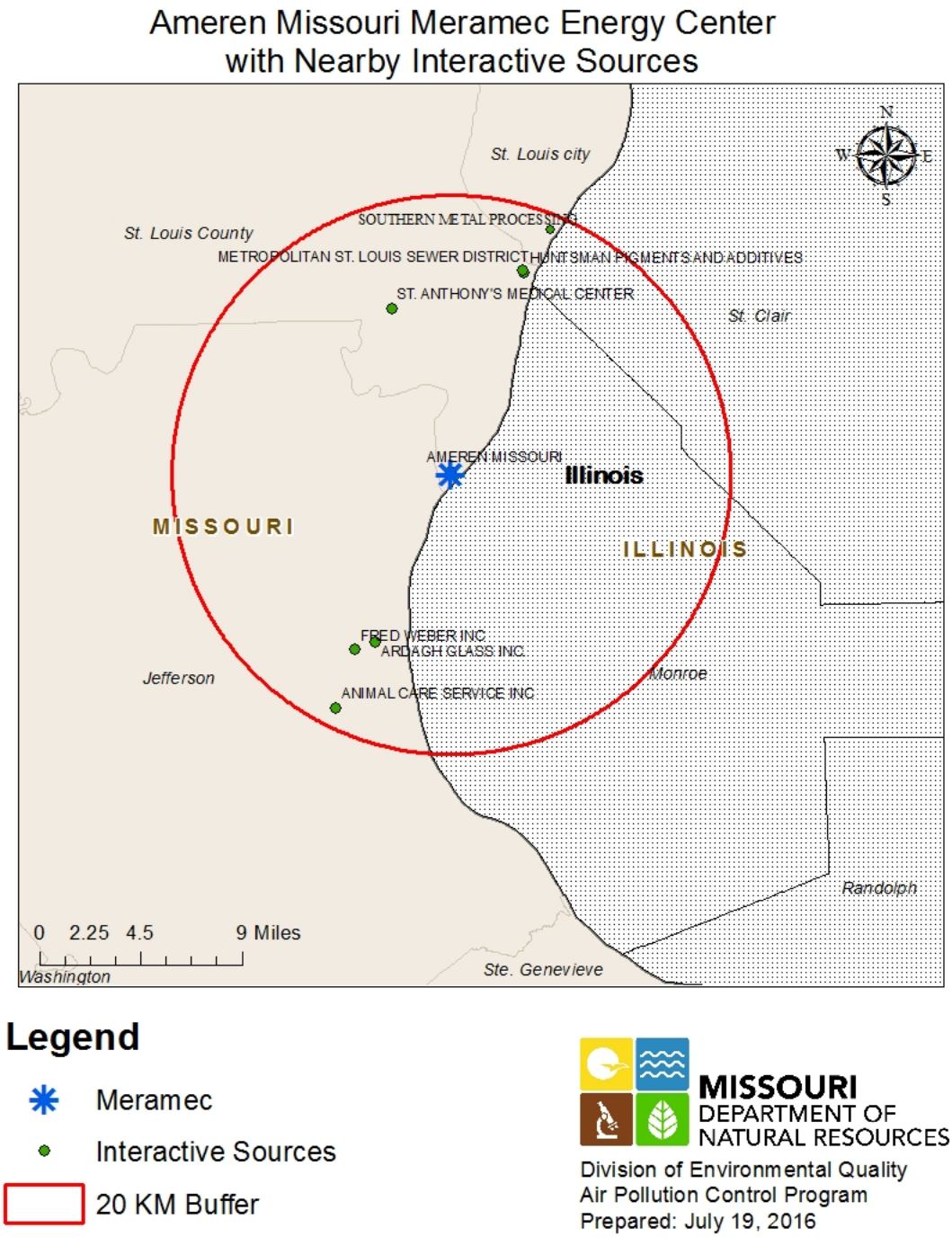

Figure 2 – Meramec Energy Center with Nearby Interactive Sources

Table 2 – Meramec Energy Center and Interactive Source 2013-2015 SO_2 Emissions

Source Name	2013 SO_2 Emissions (TPY)	2014 SO_2 Emissions (TPY)	2015 SO_2 Emissions (TPY)
Meramec Energy Center	5,962	11,702	5,245
Ardagh Glass Inc.	136.2	42.2	43.8
Animal Care Service Inc.	1.1	1.1	1.1
Huntsman Pigments and Additives	4.5	4.1	4.7
Fred Weber Trautman Asphalt	4.5	4.5	0
MSD Lemay WWTP	1.77	1.87	1.95
St. Anthony's Medical Center	2.2	2.2	2.2
Southern Metal Processing	7.2	7.2	7.2

A.2.1 Evaluation of Sources to Model

All sources included on the map in Figure 2 were evaluated for possible inclusion in the modeling inventory. The following bullets describe each of the sources listed in Table 2 along with a discussion about how each source will be characterized in the modeling analysis:

- Meramec Energy Center – Meramec (189-0010) includes two coal-fired and two natural gas-fired boilers that generate electricity that is supplied to the grid. The plant is owned by Ameren Missouri. The air program used actual SO_2 emissions data from the continuous emission monitoring system (CEMS) located at this facility in conjunction with new fuel combustion limitations. Meramec units 1 and 2 are limited to burning only natural gas as of April 16, 2016, in order to be exempt from the Mercury and Air Toxics standard (MATs). Meramec applied to amend their Title V permit to make this natural gas limitation federally enforceable. The modeled years include the most recent three years (2013 – 2015). The use of CEMS data in the model for this facility allows the model to act as a surrogate for monitoring data, which EPA guidance deems appropriate when developing boundary designation recommendations.

- Ardagh Glass Inc. (formerly St. Gobain Containers) – Ardagh Glass Inc. (099-0068) is a glass container manufacturing plant located in Jefferson County. Ardagh has two major SO_2 emission points, glass melting furnaces. These two units vent to one stack, EP40. Ardagh emitted approximately 42 tons of SO_2 in 2014. The single emission release point was modeled using stack release parameters as reported to MoEIS.

- Animal Care Service Incorporated – Animal Care Service Inc. (099-0150) is an animal care facility located in Jefferson County. The facility has eight SO_2 emitting units, multi-chamber incinerators that altogether emit approximately 1 ton of SO_2. All eight units have stack releases and were modeled with parameters as reported to MoEIS.

- Huntsman Pigments and Additives – Huntsman (189-0035) is a pigment manufacturing facility located in St. Louis County. Huntsman has six SO_2 emitting units. This facility has boilers and dryers fueled by both oil and natural gas. Huntsman emitted four tons of SO_2 in 2014. All six units have stack releases and were modeled with parameters as reported to MoEIS.

- Fred Weber – Fred Weber Trautman Asphalt plant (099-0098) is an asphalt plant located in Jefferson County. The facility has two SO_2 emitting units, an asphalt heater and a mixer. This plant reported 4.5 tons of SO_2 emissions in 2014. Both units have stack releases and were modeled with parameters as reported to MoEIS. This facility is no longer active as of company correspondence dated November 2015.

- Metropolitan St. Louis Sewer District (MSD) Lemay – MSD Lemay (189-0217) is a waste water treatment plant (WWTP) located in St. Louis County. Lemay has two SO_2 emission points, the incinerator stack and boiler stack. Lemay emitted 1.95 tons of SO_2 in 2014. Both emission points have stack releases and were modeled with parameters as reported to MoEIS.

- St. Anthony's Medical Center – St. Anthony's Medical Center (189-1155) is a medical facility located in St. Louis County. St. Anthony's has two SO_2 emitting processes, boilers used for heating and generators. St. Anthony's is located within 20 km from Meramec and emitted two tons of SO_2 in 2014. Both units have stack releases and were modeled with parameters as reported to MoEIS.

- Southern Metal Processing – Southern Metal Processing (510-1407) is a metal processing facility located in St. Louis City. The facility is located within 20 km of Meramec and emitted 7 tons of SO_2 in 2014. The only SO_2 emitting unit, a copper furnace, has a stack release and was modeled with parameters as reported to MoEIS.

Beyond these 8 included sources, an additional 27 sources within 20 km of Meramec were excluded from the model analysis due to emission levels below 1 ton. These 27 sources cumulatively emitted less than 2.5 tons of SO_2 in 2014. Possible impacts from these sources are accounted for through the use of a regional background concentration.

Table 3 details the emission release parameters used for boilers at Meramec, and Table 4 shows an excerpt from the hourly emissions file.

Table 3 – Meramec Energy Center Emission Release Parameters

Facility I.D.	Facility Name	Site Name	Emission Point I.D.	Model ID	Description	Release Type	Sulfur Limit [1] (lb/hour-24 Hour Block Average for Units 1-4)	Modeled Emission Rate (g/s)
189-0010	Ameren Missouri	Meramec Energy Center	001	MER1	Boiler #1 - 1566mmBTU/hr coal fired boiler w/Natural Gas for ignition, flame stablization, and supplemental load	POINT	1081.01	0.116*
189-0010	Ameren Missouri	Meramec Energy Center	002	MER2	Boiler #2 - 1566mmBTU/hr coal fired boiler w/Natural Gas for ignition, flame stablization, and supplemental load	POINT	1141.58	0.116*
189-0010	Ameren Missouri	Meramec Energy Center	003	MER3	Boiler #3 - 3172mmBTU/hr coal fired boiler w/Natural Gas for ignition, flame stablization, and supplemental load	POINT	2413.92	Used hourly emissions in lieu of static values (see Table 4)
189-0010	Ameren Missouri	Meramec Energy Center	004	MER4	Boiler #4 - 3782mmBTU/hr coal fired boiler w/Natural Gas for ignition, flame stablization, and supplemental load	POINT	2734.28	Used hourly emissions in lieu of static values (see Table 4)
189-0010	Ameren Missouri	Meramec Energy Center	005	EU5	Emergency Generator - 15.3 mmBTU/hr diesel engine	POINT	<500 ppmv SO_2	0.0000028
189-0010	Ameren Missouri	Meramec Energy Center	006	EU6	Combustion Turbine - 891 mmBTU/hr #2 Fuel Oil/Diesel	POINT	<500 ppmv SO_2	0.17008
189-0010	Ameren Missouri	Meramec Energy Center	006A/B	EU7	Combustion Turbine - 927 mmBTU/hr #2 Fuel Oil/Diesel	POINT	<500 ppmv SO_2	0.08838

[1] State Rulemaking, 10 CSR 10-6.261 contains limits on Meramec Units 1-4, compliance date January 1, 2017.

Model ID	**Easting** *Meters*	**Northing** *Meters*	**Base Elevation** *Meters*	**Actual Stack Height** *Meters*	**Stack Temperature** *Kelvin (From MoEIS)*	**Stack Exit Velocity** *Meters/Second (From MoEIS)*	**Stack Diameter** *Meters*	**Comments**
MER1	732714.14	4253776.27	127.47	76.20	419.71	30.98	3.35	*Emission Rate from reported MHDR and AP-42 Emission Factor for Natural Gas Combustion
MER2	732675.11	4253783.41	127.47	76.20	434.48	30.21	3.35	*Emission Rate from reported MHDR and AP-42 Emission Factor for Natural Gas Combustion
MER3	732626.15	4253790.07	127.96	106.68	Used hourly temperatures in lieu of static values (see Table 4)	Used hourly velocity values in lieu of static values (see Table 4)	4.27	
MER4	732582.63	4253799.56	128.13	106.68	Used hourly temperatures in lieu of static values (see Table 4)	Used hourly velocity values in lieu of static values (see Table 4)	4.88	
EU5	732735.46	4253533.21	128.13	12.19	612.04	11.61	0.30	
EU6	732424.8	4253983.9	128.13	9.76	838.71	31.64	3.66	
EU7	732398.49	4253978.74	128.13	8.99	838.71	20.79	4.75	

*Units 1 and 2 are modeled using natural gas combustion rates since these units are required to burn exclusively natural gas as of April 16, 2016, enforceable through the facility's Title V operating permit.

Table 4 – Excerpt from 2013-2015 Hourly CEMS Emission File for Meramec Energy Center (Units 3 & 4)

	Year	Month	Day	Hour	Unit ID	SO_2 ER (g/s)	Temp (K)	Velocity (m/s)
SO HOUREMIS	13	8	31	1	MER3	118.994	467	31.166
SO HOUREMIS	13	8	31	1	MER4	129.982	431.944	25.767
SO HOUREMIS	13	8	31	2	MER3	109.28	463.944	29.293
SO HOUREMIS	13	8	31	2	MER4	112.442	423.667	22.759
SO HOUREMIS	13	8	31	3	MER3	99.036	459.556	26.902
SO HOUREMIS	13	8	31	3	MER4	113.022	419	21.806
SO HOUREMIS	13	8	31	4	MER3	96.844	458.222	26.247
SO HOUREMIS	13	8	31	4	MER4	114.521	415.5	21.037

A.3 Meteorology and Topography

Meteorology and topography are interrelated as significant topographical features often cause localized meteorological effects. Due to this related nature, these two factors were evaluated together. Topography and surrounding land features can have a significant impact on the wind patterns and thus the dispersion of air pollutants from emission sources. There are no significant terrain features in the area around Meramec that would greatly impact dispersion, such as mountain ranges. However, the Mississippi river valley does form the Eastern county boundary which could cause some localized meteorological effects in the eastern portion of the modeling domain. The surrounding terrain and meteorological effects were represented in Meramec's modeling analysis to best simulate monitoring of the area's ambient air quality. Since no other significant terrain or meteorological features exist around Meramec, except the river valley which is used to set the Eastern boundary, topography and meteorology were not used to set the remainder of the recommended area boundary.

A.4 Jurisdictional Boundaries

Attainment area boundaries are typically defined by easily identifiable features such as county, municipal, or township boundaries. Large, immovable features such as rivers or highways can also be used. In this case, since Meramec's modeled impact attains the standard, the main considerations are that the boundary include the Meramec Energy Center and be easily identifiable.

The recommended attainment boundary for Meramec consists of highways, county and state lines, and the Mississippi river as defined below. Figure 3 displays a map with the recommended boundary.

Northern Boundary: Interstate 255 and 50

Eastern Boundary: Interstate 55 and County line between St. Louis and Jefferson Counties

Southern Boundary: County line between St. Louis and Jefferson Counties and Mississippi River

Western Boundary: Mississippi River and State line between Missouri and Illinois

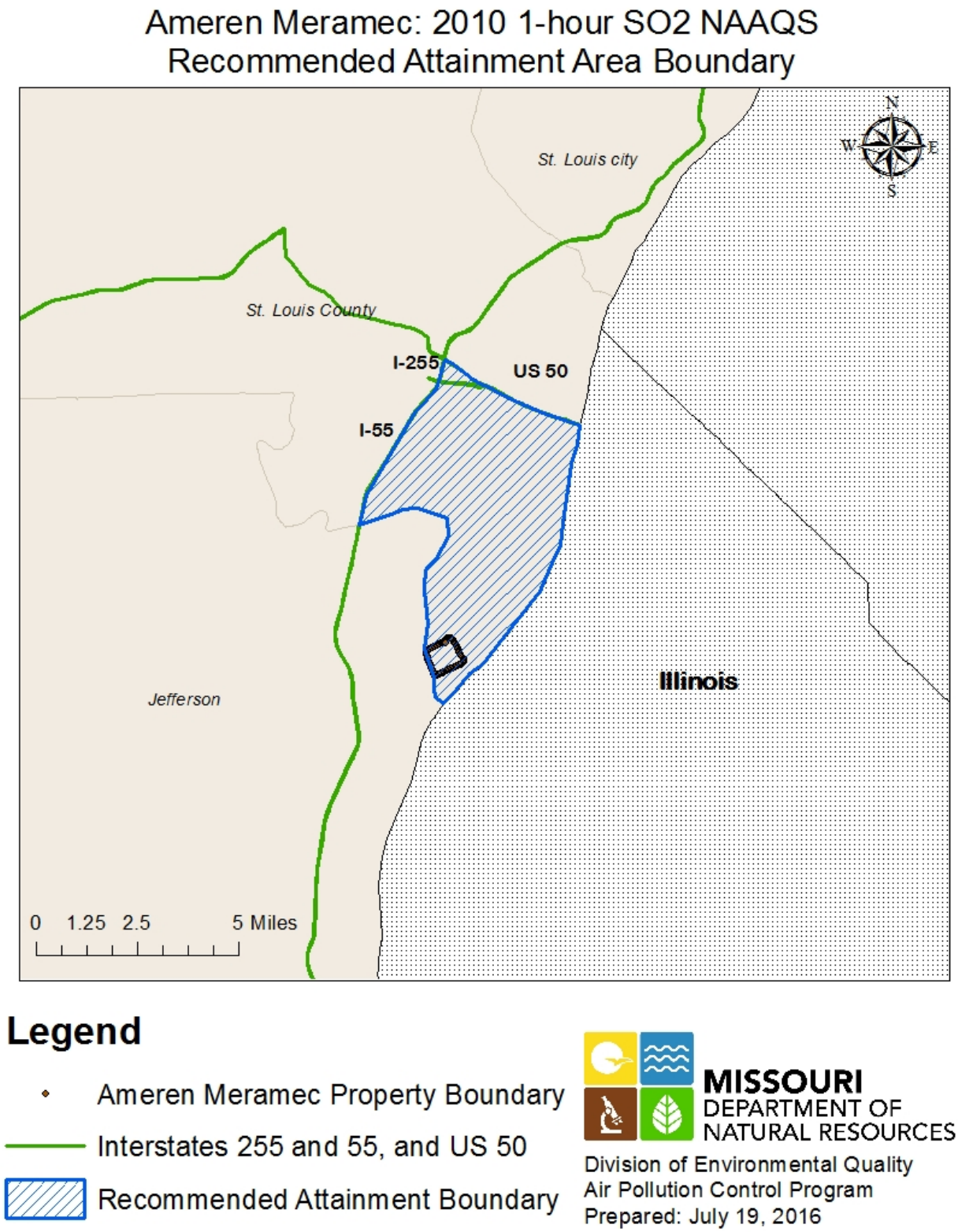

Figure 3 – Ameren Meramec Energy Center Recommended 2010 1-hour SO_2 NAAQS Attainment Area