Attachment A

Alternative Model Justification for Low Wind Speed Beta Options:

AERMET and AERMOD

Appendix W, Section 3.2.2 provides an approach for approval of an alternative model to determine whether it is more appropriate for this modeling application. The principle sources involve tall stack buoyant releases.

EPA indicates that for this purpose, an alternative refined model may be used provided that:

1. The model has received a scientific peer review;
2. The model can be demonstrated to be applicable to the problem on a theoretical basis;
3. The data bases which are necessary to perform the analysis are available and adequate;
4. Appropriate performance evaluations of the model have shown that the model is not biased toward underestimates; and
5. A protocol on methods and procedures to be followed has been established.

These five points are discussed below.

The model selected for this modeling application is the EPA-proposed updates to the AERMOD modeling system version 15181, including the AERMET ADJ_U* option, combined with the AERMOD LOWWIND3 option. EPA has indicated support for these changes in the Appendix W proposal and in the Roger Brode presentation made at the 11th Modeling Conference on August 12, 2015 (see presentation at http://www.epa.gov/ttn/scram/11thmodconf/presentations/1-5_Proposed_Updates_AERMOD_System.pdf).

1. The model has received a scientific peer review

The AERMET changes reference a Boundary-Layer Meteorology peer-reviewed paper[1] that is the source of the AERMET formulation for changes in the friction velocity computation for low wind speeds. The combination of the AERMET changes and the AERMOD changes (version 14134 LOWWIND2, similar to version 15181 LOWWIND3) has been evaluated and the study[2] has been published in the November, 2015 issue of the Journal of the Air & Waste Management Association (JAWMA). The manuscript associated with the JAWMA article is provided in Attachment B. A supplemental evaluation exercise with AERMET/AERMOD version 15181 is provided in Attachment C that shows consistent evaluation results (with a slight improvement) for the proposed AERMOD modeling application.

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[1] Qian, W., and A. Venkatram, 2011. Performance of Steady-State Dispersion Models Under Low Wind-Speed Conditions. *Boundary-Layer Meteorology*, 138:475–491.

[2] Paine, R., O. Samani, M. Kaplan, E. Knipping and N. Kumar, 2015. Evaluation of low wind modeling approaches for two tall-stack databases, *Journal of the Air & Waste Management Association*, 65:11, 1341-1353, DOI: 10.1080/10962247.2015.1085924.

2. **The model can be demonstrated to be applicable to the problem on a theoretical basis.**

   There is no theoretical limitation to the application of the AERMET and AERMOD low wind changes – they are generally applicable. The current default algorithm in AERMET has been demonstrated to be faulty and needs to be replaced by the ADJ_U* approach. The improvements due to the LOWWIND3 algorithm are demonstrated with the low wind model evaluations reported by the presentations[3] at the 11th EPA modeling conference and in Attachment C.

3. **The data bases which are necessary to perform the analysis are available and adequate.**

   Routine meteorological databases that are already available are sufficient for exercising this low wind options. There are no special database requirements for the use of these options.

4. **Appropriate performance evaluations of the model have shown that the model is not biased toward underestimates.**

   The studies cited above by EPA and AECOM provide this demonstration.

5. **A protocol on methods and procedures to be followed has been established.**

   The AECOM modeling documentation associated with the case-specific application (characterizing the SO_2 concentrations near the Labadie Energy Center) for this procedure is provided in Attachment D. Modeling files consistent with this document were separately provided to the MDNR.

   Compared to modeling previously conducted by the Missouri DNR, the modeling documented in Attachment D differed in the following ways, as noted[4] by the MDNR in their "Area Boundary Recommendations for the 2010 1-hour Sulfur Dioxide Standard – July 2016 Designations".

   - The most recent version of AERMOD, version 15181 (released by EPA in July 2015), was used. This version contains certain bug fixes and enhancements relative to AERMOD version 14134, which was used by the MDNR.
   - The AECOM analysis utilized the low wind options (ADJ_U* and LOWWIND3) that are proposed[5] by EPA for adoption as preferred AERMOD options.
   - AECOM merged the emission releases from units 3 and 4 at Labadie because they are flues in a common stack, consistent with the guidance provided by EPA Model Clearinghouse Memo 91-II-01. MDNR modeled these adjacent flues as individual release points.
   - AECOM also used a more representative (rural) site to characterize the unmodeled background concentrations in the region.
   - AECOM obtained hourly stack release parameters (temperature and flow rate) from Ameren that were not previously available to the MDNR.

   Each of these differences can be considered as a refinement to the approach used by the MDNR.

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[3] http://www.epa.gov/ttn/scram/11thmodconf/presentations/1-5_Proposed_Updates_AERMOD_System.pdf and http://www.epa.gov/ttn/scram/11thmodconf/presentations/2-3_Low_Wind_Speed_Evaluation_Study.pdf.

[4] Available at http://dnr.mo.gov/env/apcp/docs/adoption-september242015.pdf.

[5] 80 FR 45340. July 29, 2015.