

14 February 2011

Subject: R10 Technical Staff AERMOD-COARE Information and Data Request;
First Request

A. Overview and Authority

Shell Oil Incorporated (Shell) is seeking EPA Region 10 (R10) approval under Section 3.0 in Appendix W of 40 CFR 51, to utilize an alternative technique to more accurately estimate concentration impacts in a marine environment. This technique is an over water meteorological preprocessor program that will replace the AERMET preprocessor program within the AERMOD modeling system which has been approved for regulatory application by the Agency. AERMET is approved for terrestrial applications but not for marine environment sited sources. The technique is described in Shell's "Evaluation of the COARE-AERMOD Alternative Modeling Approach Support of Simulation of Shell Exploratory Drilling Sources in the Beaufort and Chukchi Seas" (Evaluation) dated December, 2010.

Shell has selected Condition 3 in Subsection 3.2.2.b to demonstrate the technique is a better approach to estimate concentration impacts in a marine environment. The five elements that comprise this alternative technique demonstration are detailed in Subsection 3.2.2.e. They are:

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

B. Information/Data Request

1. COARE Defensibility.
 - a. Is COARE the most up-to-date science for marine boundary layer conditions? Please explain.
 - b. Is there anything from more recent field campaigns, such as VOCALS, that would improve the science? Please explain.

2. Appropriateness of COARE in Arctic conditions.

COARE was originally developed for tropical marine conditions. It is not entirely clear that the balance of radiation, sensible heat, and latent heat fluxes is representative of Arctic conditions. Additionally, it was developed most for light wind conditions. More recently, COARE has been modified for high wind conditions and stable boundary layers, and it has been applied outside the tropics. Region 10

needs to know if it has been applied to Arctic (or high latitude) marine conditions, and if so, how well it fared.

- a. What evidence does Shell have that COARE is an appropriate boundary layer scheme for Arctic conditions?
 - b. Can Shell point to examples of peer-reviewed literature in which the COARE algorithm was applied to cold, high-latitude marine environments?
3. AERMOD-COARE incorporates surface and vertical profile data appropriately.
 - a. Is the choice of critical Ri based solely on Gryning and Batchvarova (2003)?
 - b. Can Shell provide more scientific basis for the choice of critical Ri ? The journal they published this work in is not well-known and could potentially be of dubious quality.
4. The Evaluation dated December, 2010 did not include supporting documentation. Shell is requested to provide:
 - a. A user manual.
 - b. A model formulation document. (Account for all input data to AERMOD-COARE and all calculations that prepare the data for AERMOD-COARE [e.g., surface fluxes, convective mixing heights...etc.])
 - c. Any Fortran code written to support the execution of the technique.
 - d. Copies of scientific papers referenced and/or used.
 - e. Logic for selecting specific methods or procedures to select certain meteorological parameters.
 - f. Model input and output files, and data used with the evaluations. An explanation/diagram would be helpful in understanding the steps.
5. Discuss the minimal meteorological variables needed, and what options are available to use alternative methods to derive any missing variables.
6. Are standard tower and/or buoy measurements enough to drive to COARE? If not, what non standard measurements or calculations need to be performed?
7. Please identify the location in the support documentation in which Shell has satisfied the five conditions in Subsection 3.2.2.e.
8. After R10 accepts all your responses to the information and data requests, Shell is requested to bundle all documents, comments and responses into a single package. In addition, Shell is requested to generate a DVD that includes all model input and output files, meteorological data sets, Fortran codes, spreadsheets...etc. R10 will inform Shell of the number of copies required.