UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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OFFICE OF
AIR AND RADIATION

Mr. Darren W. Woods
Refinery Manager
ExxonMobil Oil Corporation
Joliet Refinery
P.O. Box 874
Joliet, IL 60434-0874

Re: Petition to Use Alternative Moisture Default Values for Units 55B100 and 20B1 at the Joliet Refinery (Facility ID (ORISPL) 50627)

Dear Mr. Woods:

The United States Environmental Protection Agency (EPA) has reviewed the petition submitted under §75.66(a) by ExxonMobil Oil Corporation (ExxonMobil) on March 12, 2003. In this petition, ExxonMobil requested to use default moisture values in lieu of continuous moisture monitoring, for the purpose of making moisture corrections to the emissions data from the auxiliary boiler (Unit 55B100) and the combined-cycle turbine (Unit 20B1) at the Joliet, Illinois Refinery. EPA approves the petition in part, for the reasons discussed below.

Background

Units 20B1 and 55B100 at the Joliet, Illinois Refinery are affected units in the NO_x Budget Trading Program under 35 IAC 217 Appendix E. Thirty-five IAC 217 requires ExxonMobil to monitor and report nitrogen oxides (NO_x) mass emissions from these units during the ozone season (i.e., from May 1st through September 30th of each year). The NO_x mass emission monitoring must conform to the requirements of 40 CFR Part 75, Subpart H. Unit 20B1 is a combined-cycle unit consisting of a gas turbine and a heat recovery steam generator (HRSG). Unit 55B100 is dry-bottom wall-fired boiler used to produce process steam to the facility. Each unit combusts refinery fuel gas (RFG) as the primary fuel.

ExxonMobil uses dry-basis NO_x concentration monitoring systems and flow rate monitors to determine NO_x mass emissions from Units 20B1 and 55B100. When using this monitoring arrangement, a correction for stack gas moisture is needed to properly calculate the NO_x mass emissions. Part 75 provides two options for determining the stack gas moisture content. The owner or operator may either report an appropriate fuel-specific default moisture value, as provided in §75.11(b)(2), or, if this option is not viable, a continuous moisture monitoring system must be installed and operated. Because the rule does not provide a default moisture value for the refinery fuel gas, ExxonMobil is required to install and operate a continuous moisture monitoring system.

One way to continuously monitor moisture is to install wet and dry oxygen sensors. However, in the March 12, 2003 petition, ExxonMobil expressed concern that a moisture monitor of this type will have difficulty meeting the quality assurance requirements of Part 75, which could result in excessive monitor downtime and data loss. Therefore, ExxonMobil requested permission to use a default moisture value for each unit, based upon historical fuel sampling data submitted with the petition.

The flue gas moisture can be approximated from a knowledge of the fuel gas composition, by using standard stoichiometric combustion relationships and by properly considering the nitrogen component of the combustion air and the amount of excess air. ExxonMobil used this approach to estimate the moisture content of the flue gas for Units 20B1 and 55B100. The stoichiometric factors used in the calculations were taken from an American Gas Association publication entitled "Fuel Flue Gases" (1941 Edition).

ExxonMobil first determined the molar composition of the refinery fuel gas. Fuel samples were analyzed once daily for 365 days using an on-line gas chromatograph. From this data, by using the appropriate stoichoimetric relationship for each component in the fuel gas, ExxonMobil calculated the theoretical number of moles of H_2O produced by the combustion of each component (assuming complete combustion in the presence of excess air). The flue gas molar volume was then determined by summing the molar volumes of all combustion products from each of the combustion reactions and adding to this the molar volume of the nitrogen from the combustion air and the molar volume of excess air remaining after combustion. For the combined cycle unit (Unit 20B1) it was also necessary to account for the moles of H_2O present as a result of steam injection used for NO_x emission control in the gas turbine. The percent moisture was then determined by summing the molar volumes of H_2O produced in the combustion reactions (plus, for Unit 20B1, the H_2O from the steam injection) and dividing the result by the molar volume of the flue gas. The above methodology is similar to methods used by EPA during the development of the default moisture values provided in §75.11(b)(2).

The range of moisture values calculated from the fuel gas sampling data for the auxiliary boiler (Unit 55B100) was between 12.5% H_2O and 18.7% H_2O, averaging 15.8% H_2O with a standard deviation of ± 0.5% H_2O. The range of calculated moisture for the combined cycle unit (Unit 20B1) was between 3.9% H_2O and 14.1% H_2O, averaging 11.8% H_2O with a standard deviation of ± 1.0% H_2O. Based on these results, ExxonMobil proposed to use a moisture default value of 15.3% H_2O for Unit 55B100 and a default value of 11.8% H_2O for Unit 20B1.

In response to ExxonMobil's petition, EPA requested that ExxonMobil perform moisture testing at Units 20B1 and 55B100 using EPA Reference Method 4, in order to verify the accuracy of the selected default moisture values derived from the stoichiometric method. The requested verification testing was performed during the scheduled relative accuracy test audits (RATAs) of the flow monitors and the results were faxed to EPA on April 28 and May 1, 2003.

For Unit 55B100, the reference method testing averaged 16.3% H_2O on the day of the testing. For Unit 20B1, the reference method testing averaged 12.6% H_2O over the conditions tested. Since the average result from each set of reference method tests is within one standard deviation of the average value determined by the stoichiometric method, the data indicates that the default moisture values determined from the stoichiometric approach are reasonable.

EPA's Determination

EPA approves ExxonMobil's petition to use fuel-specific default moisture values in lieu of installing continuous moisture monitoring systems, but not the specific values requested in the petition. For the auxilary boiler (Unit 55B100) the approved fuel-specific default moisture value is 15.5% H_2O. For the combined-cycle unit (Unit 20B1) the approved fuel-specific default moisture value is 10.7% H_2O. For each unit, the approved moisture default was determined by ranking the moisture values calculated from the 365 days of fuel gas composition data and selecting the 10th percentile value as the default. This is consistent with the manner in which EPA determined the fuel-specific default moisture values for coal and wood combustion in §75.11(b)(1).[1] The 10th percentile value was selected because ExxonMobil will use Equation F-2 in Appendix F of Part 75 to calculate the hourly NO_x mass emission rate. In that equation, as the percent moisture decreases, the NO_x mass emission rate increases. Therefore, using a conservatively low moisture value in Equation F-2 greatly reduces the possibility of underestimating NO_x mass emissions.

EPA's determination relies on the accuracy and completeness of ExxonMobil's March 12, 2003 petition and the supplementary information submitted on April 28 and May 1, 2003 and is appealable under Part 78. If you have any questions regarding this correspondence, please contact Matthew Boze at (202) 564-1975.

Sincerely,

Samuel Napolitano, Acting Director
Clean Air Markets Division

cc: Louis Nichols, USEPA CAMD
Cecilia Mijares, USEPA Region 5
Scott Owens, IL EPA
Bradford S. Kohlmeyer, Exxonmobil

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[1]64 FR 28564, 28568 (May 26, 1999)