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

MAY 1 2003

OFFICE OF
AIR AND RADIATION

J. Douglas Sparkman
Manager
Catlettsburg Refining, LLC
P.O. Box 1492
Catlettsburg, KY 41129

Re: CEM Installation Extension Petition and Alternative NO_X Mass Monitoring Configuration Proposal, NO_X Budget Source Units 8CS and 8CN

Dear Mr. Sparkman:

EPA has reviewed your September 23, 2002 petition under §75.66(a) in which Catlettsburg Refining, LLC (Catlettsburg Refining) requested an extension of deadline for installation and certification of a continuous emission monitoring system (CEMS) for its existing Residual Catalytic Cracking Unit (RCCU) and Heat Recovery Units (HRUs) (Catlettsburg Units 8CS and 8CN), which combust exhaust from the RCCU and other fuels. In addition, Catlettsburg Refining requested to use an alternative nitrogen oxides (NO_X) mass monitoring methodology for the HRUs after the RCCU is converted to a Fluidized-Bed Catalytic Cracking Unit (FCCU) and the HRUs begin combusting exhaust from the FCCU and other fuels. The RCCU will be converted to an FCCU during the plant refinery modernization project that began in April 2002 and that will significantly reduce emissions from the plant.[1] The conversion is scheduled to begin in October 2003. Just as all exhaust from the HRUs and the RCCU currently flows through a single common stack, all exhaust from the HRUs and the FCCU will flow through that stack. The HRUs, but not the RCCU or the FCCU, are NO_X Budget units subject to the NO_X Budget Trading Program under the NO_X State Implementation Plan (SIP) Call.

Catlettsburg Refining requested: to extend the CEMS installation and certification deadline until after the conversion of the RCCU to an FCCU; and to use an alternative

[1] As part of the plant refinery modernization project, Catlettsburg Refining will also permanently shut down an existing FCCU and associated boiler (Unit 64). EPA will address separately Catlettsburg Refining's July 22, 2002 petition concerning the installation and certification of CEMS for that FCCU and boiler.

NO_X mass monitoring methodology to subtract the NO_X emissions from the FCCU, which are measured along with the HRU NO_X emissions at the common stack. Under the alternative methodology, NO_X, carbon dioxide (CO_2), oxygen (O_2), and carbon monoxide (CO) CEMS on the HRU common stack will be used to determine NO_X mass emissions in the combined flue gas from the HRUs and the FCCU, and NO_X, O_2, CO_2, and CO CEMS in the duct exhausting from the FCCU to the HRUs will be used to determine NO_X mass emissions from the FCCU alone. Elbow flow meters with pitot traverses will be used to determine the flow from the FCCU exhaust duct to the HRUs. NO_X mass emissions for the FCCU will be subtracted from the NO_X mass emissions at the common stack.

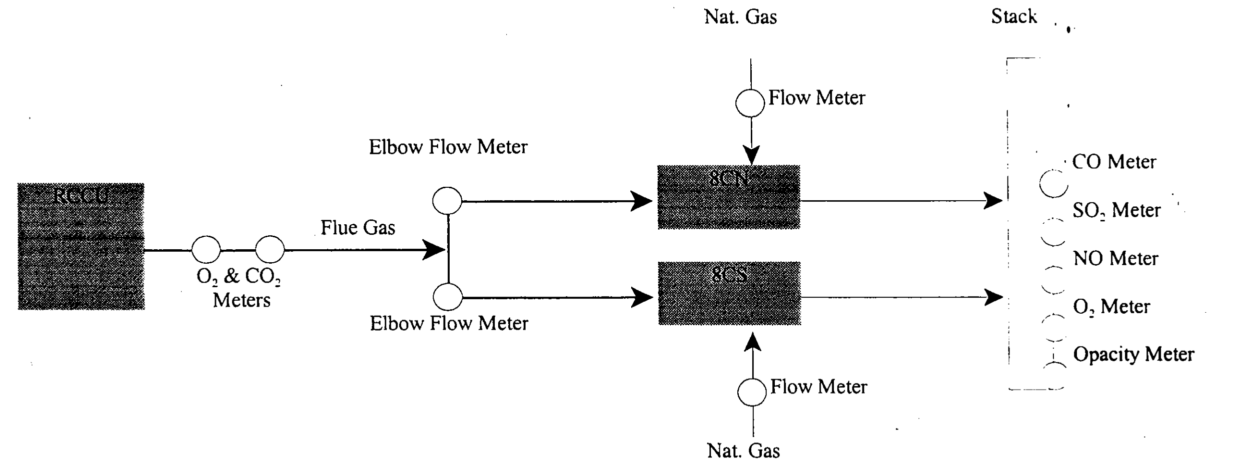
EPA approves Catlettsburg Refining's requests to extend the deadline for CEMS installation and to use a subtractive apportionment methodology for the HRUs, with the conditions described below.

Background

Catlettsburg Refining operates two HRUs (Units 8CS and 8CN) associated with an existing RCCU. The HRUs, which are NO_X Budget units, share a common stack with flue gas from the RCCU, which is not a NO_X Budget unit. The HRUs are required to install and certify CEMS, in accordance with 40 CFR Part 75, to measure NO_X emissions from the HRUs by May 1, 2003. The requirement to hold allowances at least equal to the HRUs' NO_X emissions begins May 31, 2004.

Catlettsburg Refining has received a synthetic minor permit (Permit No. VF-02-001, issued March 29, 2002) from the Kentucky Department for Environmental Protection for its refinery modernization project. This permit states that the existing RCCU will be converted to an FCCU (see Figure 1) and requires shutdown of an existing FCCU. The new FCCU will use hydro-treated gas oil as its primary raw material and produce fuel gas, mixed C3/C4 hydrocarbons, gasoline, light and heavy cycle oil, slurry, and coke as its products.

Existing RCCU System



Converted FCCU System

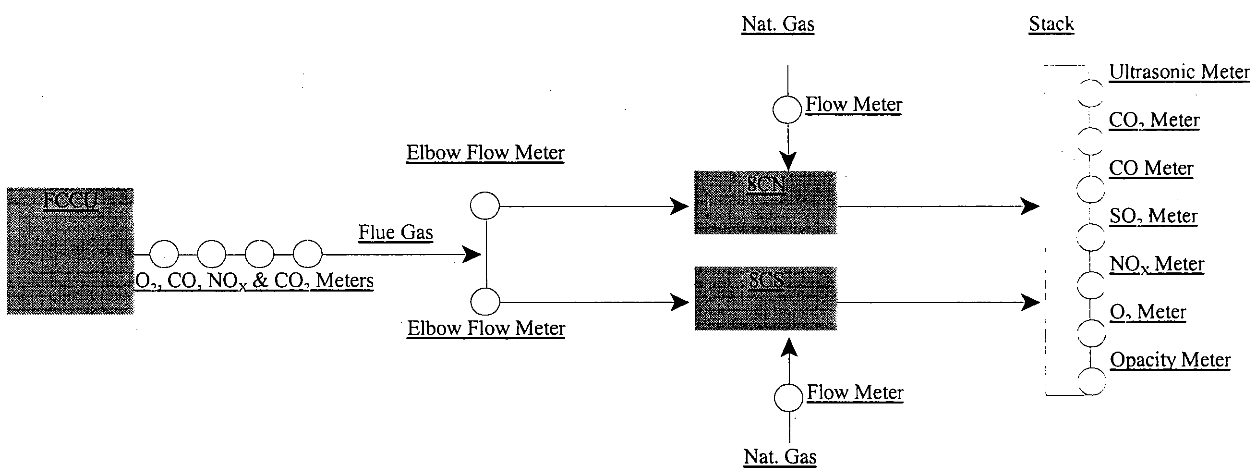


Figure 1. Schematic of Existing and Converted Systems

1. CEM Installation Extension until RCCU-to-FCCU Conversion

Catlettsburg Refining stated that, if CEMS were installed and certified by May 2003 and data collected through September 2003, the data collected would not be representative of the post-unit conversion operation in the ozone season in 2004 and thereafter due to the major process and equipment design changes involved in the RCCU-to-FCCU conversion. The RCCU will be expanded and converted to an FCCU whose fuel and combustion products will differ from those of the RCCU. As a result, the flue gas combusted along with natural gas by the HRUs will be significantly different after the RCCU-to-FCCU conversion than before such conversion. For example, the current RCCU flue gas contains approximately 2-3% CO, while the flue gas from the converted FCCU will contain an insignificant amount of CO. Also, the NO_X content of the flue gas will be significantly less, with the amount of NO_X depending on both the type of additives used in the FCCU catalyst regenerator process and the hydro-treating of the feedstock to remove the nitrogen. After start up of the new FCCU, an optimization study will be conducted to determine the minimum achievable emission rates with the additives and hydro-treating. Further, the CEMS used before and after the RCCU-to-FCCU conversion will differ. During the conversion, additional monitoring equipment (i.e., NO_X, CO_2, and flow CEMS at the common stack and O_2, NO_X, CO_2 and CO CEMS at the FCCU ductwork) will be installed, which will assist in evaluating NO_X emissions from the FCCU. Because of the change in facility operation and the changed concentration profile of the flue gas after the RCCU-to-FCCU conversion, the existing elbow flow monitors, and any new CEMS installed at the RCCU ductwork or the common stack before the conversion, would have to be re-certified after the conversion.

2. Proposed Monitoring Strategy

As discussed above, each HRU, but not the FCCU, is a NO_X Budget unit. Since all flue gas, and thus all NO_X, produced by the HRUs and the FCCU will exhaust out the common stack, the NO_X produced in the FCCU needs to be subtracted from the total NO_X from the common stack in order to yield the HRUs' emissions, for which allowances must be held starting May 2004. Catlettsburg Refining requested to use the following subtractive monitoring methodology:

- Install NO_X and CO_2 CEMS (dry) at the stack, in addition to the existing O_2 monitor.
- Install a stack flue gas flow monitor.
- Install O_2, NO_X, CO_2, and CO CEMS (dry) in the converted FCCU flue gas ductwork.
- Calibrate two FCCU-flue-gas-to-HRU elbow flow meters with pitot traverses. From the pitot traverse flow, an elbow flow coefficient will be developed. The elbow meters will be used as flow monitoring devices for the FCCU flue gas.
- Calculate the % moisture in the FCCU flue gas based upon a nitrogen and oxygen balance around the FCCU.
- Calculate the % moisture in the HRU stack gas based upon measured fuel gas composition, oxidizer vent composition, FCCU calculated % moisture, measured stack flow, measured stack O_2, ambient conditions, and combustion stoichiometry.
- Provide data input to the Data Acquisition and Handling System (DAHS).

- The DAHS will use the collected data to calculate the NO_X mass emissions from the FCCU and subtract this value from the total NO_X mass emissions at the stack.

Catlettsburg Refining proposed to calculate the NO_X mass emissions from HRUs by subtracting NO_X mass emissions from the FCCU from the NO_X mass emissions measured at the common stack utilizing the following equations:

3. <u>Equations 1 through 4 for Calculating of NO_X mass for each HRU</u>

Equation 1: $NO_X\ Mass_{HRU} = NO_X\ Mass_{Stack} - NO_X\ Mass_{FCCU}$

Where:
$NO_X\ Mass_{HRU}$ = Reportable NO_X emission for the HRUS (lb/hr)
$NO_X\ Mass_{Stack}$ = Measured, combined NO_X mass emissions from the common stack (lb/hr)
$NO_X\ Mass_{FCCU}$ = Measured, combined NO_X mass emissions from the FCCU (lb/hr)

Equation 2: $NO_X\ Mass_{FCCU} = (1.194x10^{-7})\ NO_{X(FCCU)}\ (1\text{-}H_2O_{FCCU}\% / 100)\ Q_{FCCU}$

Equation 3: $NO_X\ Mass_{Stack} = (1.194x10^{-7})\ NO_{X(Stack)}\ (1\text{-}H_2O_{Stack}\% / 100)\ Q_{Stack}$

Where:
$NO_{X(FCCU)}$ = NO_X concentration measured on a dry basis at the FCCU ($ppmv_{dry}$)
Q_{FCCU} = Wet, total flue gas volumetric flow rate at the FCCU elbow flow monitors (scfh) at 14.696 psia and 68° F.
$H_2O_{FCCU}\%$ = FCCU Moisture content (mole%) – Calculated by a nitrogen and oxygen balance
$NO_{X(Stack)}$ = NO_X concentration measured on a dry basis at the common stack ($ppmv_{dry}$)
Q_{Stack} = Wet, total flue gas volumetric flow rate at the common stack (scfh) at 14.696 psia and 68° F.
$H_2O_{Stack}\%$ = Stack Moisture content (mole%) – Calculated

Combining the above equations yields the following equation:

Equation 4: $NO_X\ Mass_{HRU} = 1.194x10^{-7}\{NO_{X(Stack)}\ (1\text{-}H_2O_{Stack}\% / 100)\ Q_{Stack} - NO_{X(FCCU)}\ (1\text{-}H_2O_{FCCU}\% / 100)\ Q_{FCCU}\}$

4. <u>Equations for Determination of Moisture Content</u>

As set forth in the above equations, the NO_X concentration will be measured on a dry basis at the FCCU and at the common HRU stack, while the FCCU wet flue gas volumetric flow rate will be measured at each elbow flow monitor and at the common stack. Consequently, equations are presented for calculating the moisture content of the FCCU flue gas and the common stack flue gas.

The moisture content of the FCCU flue gas will be calculated using a nitrogen and oxygen balance around the FCCU. Catlettsburg Refining provided supporting calculations of the moisture content of the FCCU flue gas, which were developed from the engineering principles of conservation of moles. The basis of these calculations is the fact that the mole flow of components from the atmosphere combustion air and coke going into the FCCU regenerator must equal the flue gas mole flow of components coming from the FCCU regenerator for a steady state operation.

The moisture content in the common stack will be determined using the fuel gas composition, composition of caustic oxidizer off-gas added to the HRUs, calculated moisture content in the FCCU flue gas, measured stack O_2, ambient conditions, and combustion stoichiometry.

5. Equations 5 through 8 for Calculation of Heat Input for each HRU

Equation 5: $CO_2\ Mass_{HRU} = CO_2\ Mass_{Stack} - CO_2\ Mass_{FCCU}$

Where:

$CO_2\ Mass_{HRU}$ = CO_2 mass emission from HRU combustion (tons/hr)

$CO_2\ Mass_{Stack}$ = CO_2 mass emissions from the common stack (tons/hr)

$CO_2\ Mass_{FCCU}$ = CO_2 mass emissions from the FCCU (tons/hr)

The total CO_2 mass emissions from the common stack is shown in Equation F-2 of Appendix F, Part 75, as a function of the stack flow and CO_2 concentration in the common stack. The CO_2 mass emissions contributed by the FCCU also follow the same relationship.

Equation 6: $CO_2\ Mass_{Stack} = (5.7x10^{-7})\ CO_{2(Stack)}\ (1\text{-}H_2O_{Stack}\% / 100)\ Q_{Stack}$

Equation 7: $CO_2\ Mass_{FCCU} = (5.7x10^{-7})\ CO_{2(FCCU)}\ (1\text{-}H_2O_{FCCU}\% / 100)\ Q_{FCCU}$

Where:

$CO_{2(Stack)}$ = CO_2 concentration measured on a dry basis at the common stack (mole%)

$CO_{2(FCCU)}$ = CO_2 concentration measured on a dry basis at the FCCU (mole%)

The CO_2 concentration will be measured by the CEMS in the FCCU flue gas stream and the common stack. The total heat input to both HRUs can be calculated by rearranging Equation G-4 of Appendix G, Part 75, as follows:

Equation 8: $HI_{HRU} = (2000)\ CO_2\ Mass_{HRU} / F_C / U_F / MW_{CO2}$

Where: HI_{HRU} = Heat input to both HRUs (mmBtu/hr)
F_C = Carbon based F-Factor apportioned based on heat input contribution per Equation F-8 in Appendix F, Part 75 (scf CO_2 / 10^6 Btu)
U_F = 1 / 385 scf CO_2/lb-mole at 14.696 and 68°F
MW_{CO2} = Molecular weight of CO_2 (44.01)

EPA's Determination

EPA finds that, because of the significant changes in flue gas composition and monitoring equipment that will result from Catlettsburg Refining's RCCU-to-FCCU conversion under its permit between October 2003 and the 2004 ozone season, there is no purpose in requiring installation and certification of CEMS by the commencement of the 2003 ozone season. The requirement to hold allowances covering the emissions does not begin until May 2004. In general, the main purpose of requiring CEMS installation and certification one year earlier (i.e., by May 2003) is to provide a period during which any problems with the CEMS can be resolved so that emissions are monitored properly once the allowance holding requirement begins.

However, that purpose would not be realized in this case. Catlettsburg Refining plans to make significant changes to modernize its facility, including the RCCU-to-FCCU conversion. Given Catlettsburg Refining's ongoing investment in its refinery modernization project and the requirements in its permit (e.g., the required shutdown of the existing FCCU) related to that project, EPA maintains that the RCCU-to-FCCU conversion is highly likely to occur. The conversion will result in changes in the flue gas handling system and facility operation that may significantly affect the flow or concentration profile at the FCCU and at the HRUs. As a result, any CEMS installed and certified at the common stack or the ductwork before the conversion would have to be recertified after the conversion. See 40 CFR 75.20(b). Under these circumstances, there would be little purpose in requiring CEMS installation in May 2003, before the conversion.[2]

Consequently, EPA approves Catlettsburg Refining's request to extend the deadline for CEMS installation and certification until after the conversion of the RCCU to an FCCU. This extension is conditioned on the CEMS meeting the requirements discussed below in today's letter and on completion of the CEMS certification by May 1, 2004.

[2] Moreover, Catlettsburg Refining indicates that it will have to shut down the RCCU in order to certify the existing elbow flow monitor and that extending the certification deadline will allow the such certification to take place during the shutdown for the RCCU-to-FCCU conversion.

EPA also approves the use of the subtractive monitoring methodology, described above, to determine the NO_X mass emissions of the HRUs, with the following modifications and conditions:

- Catlettsburg Refining must use the equations cited in the September 23, 2002 petition and November 27, 2002 supplemental submission.

- The two FCCU-flue-gas-to-HRU elbow flow monitors with pitot traverses must meet all initial certification requirements as specified in Appendix D, Section 2.1.5 of Part 75 (Initial Certification Requirement for all Fuel Flowmeters).

- The flow, moisture, and gas (CO_2, SO_2, NO_X) CEMS components on the common stack and the moisture and gas CEMS at the FCCU ductwork must be certified in accordance with Part 75, and the quality assurance and quality control procedures for the CEMS must conform with Appendix B of Part 75.

- Catlettsburg Refining must conduct annual RATAs on the FCCU and stack moisture sensors as provided in 40 CFR 75.20(c)(6) to verify calculation methodologies to a reference method.

- The flow-to-load test in Appendix B of Part 75 relates the flow at the common stack to the steam load or gross heat rate at the time of the RATA and evaluates the condition of the flow monitor on a quarterly basis as a quality assurance test for the flow monitor. In this case, because a significant part of the flow in the common stack is from flue gas contributed by the FCCU and because the steam load of the HRUs is impacted by the heat from the FCCU flue gas, as well as the heat from combustion of natural gas and CO in the HRUs, it is possible that neither the steam load or the gross heat rate will be proportional to the flow measured by the flow monitor. Catlettsburg Refining is therefore not required to perform the Appendix B flow-to-load tests.

- For the common stack CEMS, Catlettsburg Refining must use the standard missing data procedures in §§75.31, 75.33, 75.35, 75.36 and 75.37.

- Standard missing data procedures in Part 75, which tend to overstate emissions, cannot be used for the FCCU ductwork CEMS because the NO_X mass emissions from the FCCU are subtracted from the NO_X mass emissions at the common stack to determine the emissions from the HRUs. In order the ensure that the emissions from the HRUs are not understated, Catlettsburg Refining must use inverse missing data procedures for the NO_X concentration CEMS at the FCCU exhaust duct. For example, substitute the 10th percentile value when the standard missing data procedures in §75.33 require the 90th percentile value and use the 5th percentile value in lieu of the 95th percentile value. Should it become necessary to substitute maximum potential values due to continued monitor outages, Catlettsburg Refining must use zeros for the NO_X CEMS in the FCCU ductwork. Further, the missing data procedures must reflect the fact that the FCCU does not have a clearly definable load. Table 1 summarizes these points:

Table 1. Non-Load Based Missing Data Procedure for NO_X Concentration CEMS at FCCU Exhaust Duct

Trigger conditions		Calculation routines	
Monitor data availability (percent)	Duration (N) of CEMS outage (hours)[1]	Method	Lookback period
95 or more	$N \leq 24$	Average	2160 hours*
	$N > 24$	10th percentile	2160 hours*
90 or more, but below 95	$N \leq 8$	Average	2160 hours*
	$N > 8$	5th percentile	2160 hours*
80 or more, but below 90	$N > 0$	Minimum Value	2160 hours*
Below 80, or operational bin indeterminable	$N > 0$	Use 0 ppm	None

* Quality-assured CEMS hours during unit operation
[1] During unit operation.

EPA's determination in this letter relies on the accuracy and completeness of the information provided by Catlettsburg Refining, LLC in the July 22, 2002 petition and subsequent supporting information, and can be appealed under Part 78. If you have any questions or concerns about this determination, please contact Manuel J Oliva, at (202) 564-0162.

Sincerely,

Samuel Napolitano, Acting Director
Clean Air Markets Division

cc: Wilson Haynes, EPA Region III
John S. Lyons, Kentucky DEP
Manuel J. Oliva, EPA CAMD