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

MAY 5 2003

OFFICE OF
AIR AND RADIATION

Tim George
Senior Environmental Engineer
U.S. Steel, Fairfield Works
P.O. Box 599
Fairfield, AL 35064

Re: Petition for alternative fuel flow measuring devices and standards at U.S. Steel Units 5 and 8.

Dear Mr. George:

EPA has reviewed your March 7, 2003 petition under §75.66(a) in which U.S. Steel Fairfield Works (U.S. Steel) requested to use fuel flow measuring devices and standards that are not specifically listed in Part 75, Appendix D, §2.1.5.1. Specifically, U.S. Steel proposes to use an array of pitot tubes in the blast furnace gas (BFG) piping to Boilers 5 and 8 in order to comply with the fuel flow metering requirements in Appendix D.

EPA approves U.S. Steel's request to use an alternate fuel flow measuring method for BFG, with the conditions described below.

Background

U.S. Steel operates four boilers (Boilers 5, 8, 9 and 10) which have been identified as subject to the NO_X Budget Trading Program under the Alabama NO_X SIP Call rule. Sources subject to this rule are required to determine nitrogen oxides (NO_X) mass emissions as provided in §75.72. Specifically, these boilers are required to determine hourly NO_X mass emissions (lbs) by multiplying the hourly NO_X emission rate (lbs/mmBtu) by the hourly heat input rate (mmBtu/hr) and the unit or stack operating time. NO_X emission rate will be determined by the use of a NO_X-diluent continuous emissions monitoring system. Heat input rate will be determined for these units by the methodologies in Appendix D of Part 75. Part 75, Appendix D heat input measurements require the measurement of the fuel flow rate into the affected unit with an in-line fuel flowmeter. U.S. Steel's boilers have the capability of combusting natural gas and BFG from steel production operations. These gases are not mixed prior to entering the boiler. Therefore, a fuel flowmeter is required for each boiler.

Boilers 9 and 10 are tangentially fired and orifice fuel flow metering currently exists on both the natural gas feed pipe and the BFG feed pipe into each boiler. Boilers 5 and 8 are wall-fired boilers and have fuel flow metering only on the natural gas feed pipe into each boiler. Therefore, these two latter boilers require fuel flow metering of the BFG feed pipe into each boiler. Appendix D §2.1.5 of Part 75 requires that any fuel flowmeter used meet a flowmeter accuracy of 2.0 percent of the upper range value (i.e., maximum fuel flow rate measurable by the flowmeter) across the range of fuel flow rate to be measured at the unit. Flowmeter accuracy may be determined by design (orifice, nozzle and venturi only), by measurement under laboratory conditions, or by in-line comparison against a reference flowmeter.

The BFG feed piping to Boilers 5 and 8 lack adequate runs of straight section to accommodate orifice, venturi or nozzle metering, in accordance with American Gas Association (AGA) Report No. 3, as cited in Part 75 Appendix D §2.1.5.1. Moreover, that report applies to natural gas applications in pipelines with an inside diameter of less than 20 inches. The BFG feed pipe diameters for Boilers 5 and 8 are greater than 72 inches in diameter. Therefore, U.S. Steel proposes to use an array of pitot tubes in the BFG feed pipe for each boiler, which will meet the 2.0 percent accuracy requirements specified in Part 75 Appendix D §2.1.5.

Air Monitoring Corporation tested the pitot tubes for accuracy verification in a laboratory environment using wind tunnels (wind tunnel design standard ANSI/AMCA 210-99). In order to simulate flow disturbances, full-scale models of the BFG feed pipes for Boilers 5 and 8 were constructed in the laboratory. These models were designed for testing at 5 different flow rate ranges of the maximum expected flow of 44,800 acfm, which was based on the maximum rated capacity of the boiler burners. During the wind tunnel tests, four ASME standard nozzles were used to determine the actual flow rate through the ducts. The pitot tube array flow monitoring system wind tunnel results were compared to the ASME nozzle readings to determine the average error percentage. The average error percentage for the Boiler 5 pitot tube array was 0.58 percent, which is less than the required +/- 2.0 percent requirement. The average error percentage for the Boiler 8 pitot tube array was 1.3 percent, which is also less than the required +/- 2.0 percent requirement. All wind tunnel results were based on the use of air instead of BFG. However, the composition of both gases is very similar in molecular composition, and there is only a 5% difference between the molecular weight of air and BFG.

U.S. Steel believes that the wind tunnel models for BFG feed pipes for Boilers 5 and 8 provided a precise duplication of the expected flow patterns under a steady state flow, even though air rather than BFG was used. The expected flow velocities are relatively low (less than 27 feet per second), which should not create a great deal of turbulence through bends in the piping. Moreover, to demonstrate that the flow patterns in the wind tunnel were representative, U.S. Steel would have to traverse the BFG feed pipes under a constant flow condition and compare results with a model traverse. However, due to the high concentration of carbon monoxide in the BFG (approximately 22% of BFG is CO, or 220,000 ppmv) any gas released during a traverse would create severe safety problems. Also, leaks through any test port could create an explosive atmosphere in the vicinity of the test ports. Finally, the erratic nature of the blast furnace pressure and flow rates make it difficult to test under a constant flow condition. Therefore, comparison of wind tunnel velocity profiles with field profiles is not practical.

U.S. Steel notes that Boiler 5 will qualify as a peaking unit because the boiler has operated at less than 10% of it's rated capacity over the past three years. Because of this status, it is expected that NO_X allocations will be minimal for this boiler.

Finally, U.S. Steel states that it can calculate heat input values as specified in Part 75, Appendix F, §5.2.3, and during the scheduled relative accuracy test audits (RATAs) for Boilers 5 and 8 can compare heat input rates measured by the pitot tube array with these calculated heat input values. Boiler 8 has all of the monitoring equipment necessary to calculate heat inputs, except gas composition data needed to calculate F factors. To obtain these F factors, the stack gas will be sampled, and the composition of the gas analyzed by an independent laboratory. Based on the results of the comparison, bias adjustments can be made to the pitot tube array as necessary.

EPA Determination

EPA finds that because the configuration of the BFG ductwork limits the type of fuel flow monitors that can be installed, the proposed pitot tube arrays are an acceptable means of determining the fuel flow of BFG into the boilers.

With regard to the use of air in full scale models of the unit BFG ductwork, EPA acknowledges that safety considerations make testing of the pitot tube array using the actual unit ductwork impractical. Therefore, the use of full scale models to simulate the flow patterns of the BFG ductwork into the units in order to determine the pitot tube array accuracy is acceptable. The flow rates are sufficiently low to negate any difference in wall roughness between the wind tunnel and actual ductwork. Also, the use of air in the wind tunnel tests instead of BFG is acceptable due to the similar molecular weights of air and BFG.

With regard to the use of a pitot tube array as a means to accurately measure the BFG fuel flow to the boilers, EPA has reviewed and accepted the test results provided by U.S. Steel. The submitted test results demonstrate an accuracy for five different flow ranges of better than +/-2% as required by Part 75, Appendix D, §2.1.5. Also, the tests used to determine the accuracy of the pitot tubes used equipment traceable to National Institute of Standards and Technology (NIST) standards, as specified in Part 75, Appendix D, §2.1.5.1.

Consequently, EPA approves U.S. Steel's request for the use of an array of pitot tubes as a BFG fuel flow measuring device for Boilers 5 and 8. This approval is conditioned on the following requirements for each boiler:

Condition 1

At the time of annual RATAs, a test will be conducted for the pitot tube arrays to verify accuracy of the fuel flow measuring system versus calculated fuel flow rates. This test will serve as an equivalent fuel flow meter RATA.

A calculated heat input for each unit will be determined by using Equation F-17 in Part 75, Appendix F, §5.2.3.

$$HI = Q_W \frac{[(20.9/100)(100 - \%H_2O) - \%O_{2W}]}{F \times 20.9}$$

Equation F-17

Where: HI = Hourly heat input rate during operation, mmBtu/hr
Q_W = Hourly average volumetric flow rate during unit operation, wet basis, scfh
F = Dry basis F-Factor, dscf/mmBtu
$\%O_{2W}$ = Hourly concentration of O_2 during unit operation, percent O_2 wet basis.
$\%H_2O$ = Hourly average stack moisture content, percent by volume.

Stack gas will be sampled to determine the actual gas composition, which will be used to calculate the required F-Factors. The stack volumetric flow rate, $\%O_{2W}$ and $\%H_2O$ values will be obtained from actual stack monitors.

The heat input from the pitot tube array will be obtained by the methods specified in Part 75, Appendix D, §3.4. This method relies on the fuel flow rate and the gross calorific value (GCV) of the gaseous fuel.

The heat input values calculated by Equation F-17 will be compared to those obtained using the pitot tube array. Based on the results of the comparison, bias adjustments will be made to the pitot tube array as necessary. The relative accuracy of the pitot tube array shall not exceed 10% at any load level as provided in Part 75, Appendix D, §3.3.4.

Condition 2

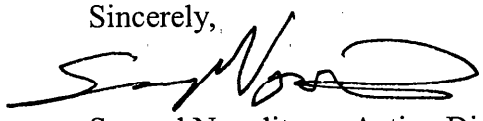
All procedures, the equipment used, and the accuracy of the procedures must be documented and included in the monitoring plan of Boilers 5 and 8.

Condition 3

A re-certification event for the BFG fuel flow monitoring system will require a RATA to be conducted for the BFG fuel flow monitoring system, as described in Condition 1 above.

EPA's determination in this letter relies on the accuracy and completeness of the information provided by U.S. Steel, in the March 7, 2003 petition, 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

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David Schilson, Jefferson County Department of Health
Manuel J. Oliva, EPA CAMD