SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

RULE 2011 --APPENDIX A - Protocol for Monitoring, Reporting, and Recordkeeping for Oxides of Sulfur (SO_X) Emissions – Chapter 4 – Process Units – Source Testing

(Amended January 7, 2005)

RULE 2011 PROTOCOL CHAPTER 4

PROCESS UNITS - SOURCE TESTING

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CHAPTER 4 - PROCESS UNITS - SOURCE TESTING

This chapter contains the test methods, procedures and source testing methodology necessary for a Facility Permit holder to establish an equipment or category specific emission rate for a SO_x process unit.

All required source tests for RECLAIM super compliant major SOx sources and process units shall be performed by testing firms/laboratories who have received approval under the District's Laboratory Approval Program.

A. Test Methods

The Facility Permit holder of all RECLAIM SOx sources, when required, shall source test each equipment using the following test methods and procedures referenced in the District Source Test Manual and 40 CFR Part 60, Appendix A:

1. Determinations and measurements prior to sampling:

a. Method 1.1 - sample points, stacks greater than 12 in. in diameter

b. Method 1.2 - sample points, stacks less than 12 in. in diameter

c. Method 2.1 - flow rate, stacks greater than 12 in. in diameter

d. Method 2.2 - flow rate, direct measurement

e. Method 2.3 - flow rate, stacks less than 12 in. in diameter

f. Method 4.1 - moisture

g. EPA Method 19 - calculated flow

2. Sulfur oxides concentration:

a. Method 100.1 - sulfur oxides, sulfur dioxide, carbon monoxide, carbon dioxide, and oxygen

b. Method 6.1 - for sulfur oxides in stack gas without ammonia present.

c. District Method 6.1 or Method 100.1 shall be used to determine SO_2 stack gas concentrations, if ammonia is not present in the stack gas. If ammonia is present in the stack gas, EPA Method 6 shall be used with the following modifications :

The sampling system shall be all borosilicate or quartz glass for any surface in contact with the sample gas up to the silica gel. No flexible tubing may be used between the probe and impingers or between impingers.

An in-stack filter holder, constructed of borosilicate glass or quartz glass, shall be used in place of a glass wool plug. The filter holder must provide a positive seal against leakage from the outside or around the filter. A high-efficiency glass fiber filter shall be used. The borosilicate or quartz glass probe shall be heated and its temperature maintained at greater than 225 ^{o}F.

Smith-Greenburg impingers shall be used instead of the midget impingers. The isopropanol impinger shall not be used. The first and second impingers shall contain 100 milliliters of 3% hydrogen peroxide, the third impinger shall be blank, and the fourth impinger shall contain silica gel.

The probe shall be washed separately with 3% hydrogen peroxide and analyzed separately from the impingers. The results of the two analyses shall be summed to provide a total SO_2 catch.

All samples shall be treated with an ion exchange resin for NH_3 interference. The ion exchange resin shall be Rexyn-R or equivalent.

d. Method 307.91 - for total sulfur compounds in fuel gas

3. Oxygen concentration:

a. Method 3.1 - molecular weight and excess air correction factor.

b. Method 100.1 - sulfur oxides, sulfur dioxide, carbon monoxide, carbon dioxide and oxygen

B. Summary of Testing Requirements

The Facility Permit holder is required to source test all Super Compliant major SOx sources which opt to use an equipment specific emission rate or concentration limit and SO_X process units which opt for an category or equipment specific emission rate as follows:

1. Super Compliant Major SOx Sources

Once a super compliant major SOx source has been approved, the Facility Permit holder shall:

A. source test the equipment once every four calendar quarters if using an equipment specific emission rate.

B. source test the equipment once every two calendar quarters if using an equipment specific concentration limit. The test shall include a single 60 minute SOx concentration test and a relative accuracy audit of the fuel measuring device. If after two years all tests show compliance, then the testing frequency can be reduced to once per year.

2. SOx Process Units

Emission factors are assigned to process units when the Facility Permit is issued. No source testing is required for a process unit, unless the Facility permit holder opts for an equipment or category specific emission rate. The Facility Permit holder is required to determine an equipment or category specific emission rate pursuant to subdivision (D).

C. Testing frequency

The Facility Permit holders of major SO_x sources shall source test as part of their quality assurance program. Process units shall be source tested every time the Facility Permit holder applies for an equipment or category specific emission rate.

D. Guidelines for Testing to Establish an Equipment or Category Specific Emission Rate

1. For process units, the Facility Permit holder has the option of calculating and reporting emissions based on an equipment-specific or category-specific emission rate, which is based on the average fuel sulfur content that is determined from a source test. The equipment-specific or category-specific emission rate shall be used to determine compliance with the facility's allocations.

2. In order to establish an equipment specific emission rate for a process unit without post-combustion control equipment, the fuel sulfur content shall be measured once per week over a quarterly period. This quarterly measurement shall be required whenever an alternative emission factor is established. If the process unit burns the fuel of which the sulfur content is treated prior to the combustion, the sulfur content shall be source tested at the downstream of the sulfur treatment system. The measured data set must pass the confidence interval test described in Chapter 4, Subdivision D, Paragraph 6 to be considered valid. The average sulfur content shall be converted into an equipment specific

emission rate using equations provided in Chapter 4, Subdivision D, Paragraph 4.

3. In order to establish an equipment specific emission rate for a process until with post-combustion control equipment, the exhaust SO_X concentration shall be source tested at the downstream of the control equipment at four different representative operating conditions of the proposed process unit. Such testing shall be done at least three times at each condition, but not consecutively. The measured data set must pass the confidence interval test described in Chapter 4, Subdivision D, Paragraph 6 to be considered valid. The average stack concentration shall be converted to an equipment specific emission rate using the equations provided in Chapter 4, Subdivision D, Paragraph 5.

4. For process units without post-combustion equipment, an average fuel sulfur content that satisfies the confidence interval test described in Chapter 4, Subdivision D, Paragraph 6, shall be converted into an equipment specific emission rate by the following equation:

For gaseous fuels,

$$EF_k = C_{kg} \times 0.166 \quad \text{(Eq.23)}$$

or

$$EF_k = C_{kl} \times 2.86 \quad \text{(Eq.24)}$$

For liquid fuels,

$$EF_k = C_{kl} \times S_l \times 166 \quad \text{(Eq.25)}$$

where:

EF_k = The equipment specific emission rate for gaseous or liquid fuel (lb/mmscf or lb/mgal).

C_{kg} = The average fuel sulfur content of gaseous fuel determined form Eq. 28 in Chapter 4, Subdivision D, Paragraph 6 (ppmv).

C_{ka} = The average fuel sulfur content of gaseous fuel determined form Eq. 28 in Chapter 4, Subdivision D, Paragraph 6 (grain/100ft^3).

C_{kl} = The average fuel sulfur content for gaseous fuel determined from Eq. 28 in Chapter 4, Subdivision D, Paragraph 6 (percent by weight).

s_l = The specific gravity of liquid fuel.

k = The different type of fuel.

Example Calculations:

(a) Equipment Specific Emission rate for process unit without post-combustion control equipment,

A 5 mmbtu/hr boiler burns natural gas. The average sulfur content of the gaseous fuel is 30 ppmv.

$EF_k = C_{kg} \times 0.166$
$EF_k = (30)(0.166)$
$= 4.98$ lb/mmscf of SO_X emission factor

(b) Equipment Specific Emission rate for process unit without post-combustion control equipment, but with pre-combustion sulfur treatment system

A 500 bhp ICE burns Diesel Oil. The specific gravity of the liquid fuel is 0.82. The average sulfur content determined after confidence interval test came out to be 0.05% by weight, which is the treated sulfur content.

$EF_k = C_{kl} \times S_l \times 166$
$= (.05)(.82)(166)$
$= 6.806$ lb/mgal of SO_X emission factor

5. For process unit with control equipment, the exhaust SO_X concentration and exhaust oxygen or stack exhaust flow rate shall be source tested at downstream of the control equipment and shall be converted to an equipment emission rate by one of the following equation:

when the exhaust oxygen is source tested,

$$EF_{k\,i} = PPMV_i \times (20.9/20.9\text{-}b) \times 1.662 \times 10^{-13} \times F_d \times V \quad \text{(Eq.26)}$$

when the stack exhaust flow rate is source tested,

$$EF_{ki} = PPMV_i \times (C/d) \times 1.662 \times 10^{-7} \quad \text{(Eq.27)}$$

where:

EF_{ki}	=	The equipment specific emission rate as specified in the Facility Permit (lb/mmscf for gaseous fuel or lb/mgal of liquid fuel)
k	=	Each type of fuel.
i	=	Each data source tested at each operating condition.
PPMV	=	The stack concentration of SO_X (ppmv).
b	=	The exhaust oxygen concentration determined from the source test (%).
F_d	=	The oxygen-based dry F factor for each type of fuel, the ratio of the dry gas volume of the products of combustion to the heat content of the fuel (dscf/10^6 Btu).
V	=	The higher heating value of the fuel for each type of

fuel.

C = The exhaust flow rate of the stack determined from the source test (dscf per unit time).

d = The fuel flow rate (mmscf per unit time for gaseous fuels, mgal per unit time for liquid fuels).

The exhaust flow rate shall be determined in consistent unit with fuel flow rate. For example, if C is measured as dscf per hour, d shall be measured as mmscf per hour or mgal per hour.

6. The criterion for acceptability of the average fuel sulfur content shall be a 95% confidence interval that the tested fuel sulfur contents shall be within 20% of the average fuel sulfur content. The average fuel sulfur content over a quarterly period shall be determined according to:

$$C_c = (1/n) \sum_{i=1}^{n} C_i \qquad \text{(Eq.28)}$$

$$S_c = \left[\sum_{i=1}^{n} (C_i - C_C)^2 / (n-1)\right]^{1/2} \qquad \text{(Eq.29)}$$

$$CC = t_{0.975}\, S_c/(n)^{1/2} \qquad \text{(Eq.30)}$$

$$\text{C.I. (\%)} = \frac{|CC|}{C_c} \qquad \text{(Eq.31)}$$

where:

S_c = The standard deviation (wt. %, grain/100 ft^3, or ppmv).

i = Each weekly testing

n = The number of quarterly testing data points, measured once a week, to determine the average sulfur content throughout the quarterly period.

Ci = The sulfur content (% wt., grain/100 ft3, or ppmv) determined at each weekly testing sampled on a random basis.

CC = The confidence coefficient

t0.975 = The t value determined from Table 4-A

Cc = The average sulfur content (%wt., grain/100 ft3, or ppmv) determined over a quarterly period.

C.I = The confidence interval with 95 % confidence level (%)

7. Category Specific Emission Rate for Process Units

a. For process units without post-combustion equipment, once an equipment specific emission rate has been established for a fuel source, such emission factor may be used as a category specific emission rate for a group of process units which all use the same fuel source.

b. For process units with post-combustion equipment, the Facility Permit holder has, in lieu of an equipment specific emission rate, the option to establish, in the Facility Permit, a category specific emission rate.

i A category specific emission rate is an average of equipment specific emission rates of a group of three or more process units which:

I. are the same type of equipment, i.e. equipment within a narrow range of rating, same manufacturer, family of model, and emission characteristics;

II. perform the same functions or processes;

III. meet the statistical limits of Subclause (D)(7)(b)(ii)(II); and

IV. are all located at a single RECLAIM facility.

A category specific emission rate must be approved by the Executive Officer and listed in the Facility Permit before it may be used to determine compliance with the facility's annual emission cap.

ii The category specific emission rate is determined by the following:

I. A minimum of three devices of the category must be tested, and equipment specific emission rates established for each of the three devices each meeting the statistical test methods for equipment specific emission rate in Paragraph (D)(6).

II. The three equipment specific emission rates will then be averaged to determine the category specific emission rate. The aggregate 36 tests of the three devices must pass a statistical "f-test" at a 95%

confidence level for the category specific emission rate to be considered valid.

III. Once the category specific emission rate has been established, approved as valid, and listed on the facility permit it can then be used to report emissions from the subject devices.

IV. To add one or more devices to this category specific emission rate, the new devices must meet the criteria in Clause (D)(7)(b)(i) and the facility must source test the new devices for one 30 minute run at each of the four loads the category specific emission rate was established. The results shall then be subjected, with the previous 36 tests, to the statistical "f" test and must meet at a 95% confidence level to be considered valid and the category specific emission rate applicable to the new devices.

Table 4-A - Table of the Factor $t_{0.975,n-1}$ for Obtaining One-Tailed Confidence Interval for the Mean

n*	$t_{0.975}$	n*	$t_{0.975}$	n*	$t_{0.975}$
6	2.571	10	2.262	13	2.179
7	2.447	11	2.228	14	2.160
8	2.365	12	2.201	15	2.145
9	2.306				

* The values in this table are already corrected for n-1 degrees of freedom. Use n equal to the number of individual values. 40 CFR Part 60, App B, Spec. 1.