ANTELOPE VALLEY AIR QUALITY MANAGEMENT DISTRICT

RULE 1146 -- EMISSIONS OF OXIDES OF NITROGEN FROM INDUSTRIAL, INSTITUTIONAL, AND COMMERCIAL BOILERS, STEAM GENERATORS, AND PROCESS HEATERS

(Adopted: 5/13/94)

(a) Definitions

(1) ANNUAL CAPACITY FACTOR means the ratio of the amount of fuel burned by a unit in a calendar year to the amount of fuel it could have burned if it had operated at the rated heat input capacity for 100 percent of the time during the calendar year.

(2) ANNUAL HEAT INPUT means the actual amount of heat released by fuels burned in a unit during a calendar year.

(3) BOILER or STEAM GENERATOR means any combustion equipment fired with liquid and/or gaseous and/or solid fossil fuel and used to produce steam or to heat water and that is not used exclusively to produce electricity for sale. Boiler or Steam Generator does not include any waste heat recovery boiler that is used to recover sensible heat from the exhaust of a combustion turbine or any unfired waste heat recovery boiler that is used to recover sensible heat from the exhaust of any combustion equipment.

(4) BTU means British thermal unit.

(5) HEAT INPUT means the chemical heat released due to fuel combustion in a unit, using the higher heating value of the fuel. This does not include the sensible heat of incoming combustion air.

(6) NO_X EMISSIONS means the sum of nitric oxide and nitrogen dioxide in the flue gas, collectively expressed as nitrogen dioxide.

(7) PROCESS HEATER means any combustion equipment fired with liquid and/or gaseous and/or solid fossil fuel and which transfers heat from combustion gases to water or process streams. Process Heater does not include any kiln or oven used for drying, curing, baking, cooking, calcining, or vitrifying; or any unfired waste heat recovery heater that is used to recover sensible heat from the exhaust of any combustion equipment.

(8) RATED HEAT INPUT CAPACITY means the heat input capacity specified on the nameplate of the combustion unit. If the combustion unit has been altered or modified such that its maximum heat input is different than the heat input capacity specified on the nameplate, the new maximum heat input shall be considered as the rated heat input capacity.

(9) THERM means 100,000 Btu.

(10) UNIT means any boiler, steam generator, or process heater as defined in subparagraph (3) or (7) of this paragraph.

(b) Applicability

This rule applies to boilers, steam generators, and process heaters of equal to or greater than 5 million Btu per hour rated heat input capacity used in all industrial, institutional, and commercial operations with the exception of:

(1) boilers used by electric utilities to generate electricity; and

(2) boilers and process heaters with a rated heat input capacity greater than 40 million Btu per hour that are used in petroleum refineries; and

(3) sulfur plant reaction boilers.

(c) Requirements

(1) The owner or operator of any unit(s) shall not discharge into the atmosphere oxides of nitrogen, expressed as nitrogen dioxide (NO_2), in excess of the concentrations shown in the following table.

Input Capacity		Rated Heat Annual Heat Input	Gaseous, Liquid, or Solid Fossil Fuels
Equal to or greater than 5 million Btu per hour	And	Greater than 9 x 10^9 Btu p%r yr (90,000 Therms) fuel use	40 ppm (0.05 lb per10^6 Btu of heat input)
Equal to or greater than 40 million Btu per hour	And	Greater than 25% annual capacity factor	30 ppm
Equal to or greater than 40 million Btu per hour	And	Equal to or 25% annual capacity less than factor and greater than 9 x 10^9 Btu (90,000 Therms) per year fuel use	40 ppm

Carbon monoxide (CO) emissions from unit(s) subject to this subparagraph shall not exceed 400 ppm.

(2) Any unit(s) with a rated heat input capacity greater than or equal to 5 million Btu per hour and an annual heat input less than or equal to 9.0 x 10^9 Btu per year, shall:

(A) be operated in a manner that maintains stack gas oxygen concentrations at less than or equal to 3 percent on a dry basis for any 15-consecutive-minute averaging period; or

(B) be tuned at least twice per year, (at intervals from 4 to 8 months apart) in accordance with the procedure described in Attachment 1 or the unit manufacturer's specified tuneup procedure. If a different tuneup procedure from that described in Attachment 1 is used then a copy of this procedure shall be kept on site. If the unit does not operate throughout a continuous six-month period within a calendar year, only one tuneup is required for that calendar year. The operator of any unit(s) who specifies the tuneup option shall maintain a record for a period of two years verifying that the tuneup has been performed. No tune-up is required during a calendar year for any unit that is not operated during that calendar year; this unit may be test fired to verify availability of the unit for its intended use but once the test firing is completed the unit shall be shutdown. Records of test firings shall be maintained for a period of two years, and shall be made accessible to an authorized District representative upon request; or

(C) meet the NO_x and CO emission limits specified in paragraph (c)(1).

(3) The owner or operator of any unit(s) subject to subparagraph (c)(2) shall submit for the approval of the Executive Officer a compliance plan that demonstrates compliance with subparagraph (c)(2). Such plan shall contain:

(A) A list of permits of all units with the rated heat input capacity and anticipated annual heat input.

(B) For each unit listed, a selection of one of the three options specified in subparagraph (c)(2) to achieve compliance with this rule.

(C) Nonresettable fuel totalizing meter specifications for each fuel used, date of meter installation, records of fuel use for each unit during the last two years starting from March 1, 1991. The plan shall be disapproved if for any continuous 12-month period, the annual fuel usage exceeds 90,000 therms. In this case the unit shall have to comply with the emission limits specified in paragraph (c)(1).

(4) Any unit(s) with a rated heat input capacity greater than or equal to 40 million Btu per hour and an annual heat input greater than 200 x 10^9 Btu per year shall have a continuous in-stack nitrogen oxides monitor or equivalent verification system in compliance with 40 CFR part 60 Appendix B Specification 2. Maintenance and emission records shall be maintained and made accessible for a period of two years as to the Executive Officer.

(5) Any owner or operator who chooses the pound per million Btu compliance option specified in subparagraph (c)(1) shall install a totalizing fuel meter to measure the total of each fuel used by each individual unit, as approved by the Executive Officer.

(6) Any owner or operator of a unit not covered under the provisions of subparagraphs (c)(1) or (c)(4) based on annual heat input, shall:

(A) have installed by February 1, 1989 for units with a rated heat input capacity equal to or greater than 5 but less than 40 million Btu per hour, or by May 1, 1989 for units with a rated heat input capacity equal to or greater than 40 million Btu per hour, or at the time the unit is constructed, a totalizing meter for each fuel that demonstrates that the unit(s) operated at or below the applicable heat input levels; and

(B) have available for inspection by the Executive Officer by March 1 of each year, records listing cumulative annual usage of each fuel for the preceding calendar year. Records shall be maintained and made accessible to the Executive Officer for a period of two years; and

(C) demonstrate that the annual heat input is less than or equal to the applicable amount listed in subparagraph (c)(1) and/or (c)(4).

(7) If any unit subject to a compliance plan submitted pursuant to paragraph (c)(3) exceeds 90,000 therms of annual heat input from all fuels used in any calendar year after 1991, the operators shall:

(A) Within 4 months after the end of the calendar year during which the unit exceeded 90,000 therms of annual heat input, submit required applications for permits to construct and operate; and

(B) Within 18 months after the end of the calendar year during which the unit exceeded 90,000 therms of annual heat input, demonstrate and maintain compliance with paragraph (c)(1) and if applicable (c)(4) for the life of the unit; and

(C) Maintain compliance with requirements of paragraph (c)(2) until compliance with paragraph (c)(1) and, if applicable, (c)(4).

(d) Compliance Determination

(1) An owner or operator of any unit(s) shall have the option of complying with either the pound per million Btu or parts per million emission limits specified in subparagraph (c)(1).

(2) All emission determinations shall be made in the as-found operating condition, except no compliance determination shall be established during start-up, shutdown, or under breakdown conditions.

(3) All parts per million emission limits specified in paragraph (c) are referenced at 3 percent volume stack gas oxygen on a dry basis averaged over a period of 15 consecutive minutes.

(4) Compliance with the NO_x and CO emission requirements of paragraph (c)(1) and the stack-gas oxygen concentration requirement of paragraph (c)(2)(A) shall be determined according to procedures in District Source Test Method 100.1 - Instrumental Analyzer Procedures for Continuous Gaseous Emission Sampling (March 1989), or Method 7.1 - Determination of Nitrogen Oxide Emissions from Stationary Sources (March 1989) and Method 10.1 - Carbon Monoxide and Carbon Dioxide by Gas Chromatograph/Non-Dispersive Infrared Detector (GC/NDIR) - Oxygen by Gas Chromatograph-Thermal Conductivity (GC/TCD) (March 1989), or any other test method determined to be equivalent and approved before the test in writing by the Executive Officers of the District and the California Air Resources Board and the Regional Administrator of the United States Environmental Protection Agency, Region IX. Records of all source tests shall be maintained for a period of two years and shall be made available to District personnel upon request. Emissions determined to exceed any limits established by this rule through the use of any of the above-referenced test methods shall constitute a violation of this rule.

(5) For any operator who chooses the pound per million Btu of heat input compliance option of paragraph (c)(1), NO_x emissions in pounds per million Btu of heat input shall be calculated using procedures in 40 CFR Part 60, Appendix A, Method 19, Sections 2 and 3.

(e) Compliance Schedule

The owner or operator of units subject to this rule shall meet the following increments of progress:

(1) For owners or operators of units subject to subparagraph (c)(2), as of March 1, 1990, demonstrate final compliance with subparagraph (c)(2).

(2) For owners or operators of units with a rated heat input capacity equal to or greater than 10 million Btu per hour or equal to or greater than 40 million Btu per hour and less than 25 percent annual capacity factor that are subject to the 40 ppm emission limit specified in subparagraph (c)(1):

As of September 1, 1991, demonstrate compliance with subparagraph (c)(1) and, if applicable, subparagraph (c)(4).

(3) For owners or operators of units with a rated heat input capacity equal to or greater than 5 million Btu per hour, but less than 10 million Btu per hour, that are subject to the 40 ppm emission limit specified in subparagraph (c)(1):

As of March 1, 1992, demonstrate compliance with subparagraph (c)(1).

(4) For owners or operators of units with a rated heat input capacity equal to or greater than 40 million Btu per hour and an annual capacity factor greater than 25% that are subject to the 30 ppm emission limit specified in subparagraph (c)(1):

As of July 1, 1993, demonstrate compliance with subparagraph (c)(1), and if applicable, demonstrate compliance with subparagraph (c)(4).

(5) The provisions of subparagraph (c)(1) and/or (c)(4) shall become applicable for the life of the unit on March 1, of any calendar year if that unit operated for the previous calendar year at an annual heat input greater than the annual applicable heat input levels.

[SIP: Approved 9/6/95, 60 FR 46220, 40 CFR 52.220(c)(198)(i)(H)(1)]

ATTACHMENT 1

A. Equipment Tuning Procedure[1] for Forced-Draft Boilers, Steam Generators, and Process Heaters

Nothing in this Equipment Tuning Procedure shall be construed to require any act or omission that would result in unsafe conditions or would be in violation of any regulation or requirement established by Factory Mutual, Industrial Risk Insurors, National Fire Prevention Association, the California Department of Industrial Relations (Occupational Safety and Health Division), the Federal Occupational Safety and Health Administration, or other relevant regulations and requirements.

Should a different tuning procedure be used, a copy of this procedure should be kept with the unit records for two years and made available to the District personnel on request.

1. Operate the unit at the firing rate most typical of normal operation. If the unit experiences significant load variations during normal operation, operate it at its average firing rate.
2. At this firing rate, record stack gas temperature, oxygen concentration, and CO concentration (for gaseous fuels) or smoke-spot number[2] (for liquid fuels), and observe flame conditions after unit operation stabilizes at the firing rate selected. If the excess oxygen in the stack gas is at the lower end of the range of typical minimum values[3], and if CO emissions are low and there is not smoke, the unit is probably operating at near optimum efficiency - at this particular firing rate.
   However, complete the remaining portion of this procedure to determine whether still lower oxygen levels are practical.
3. Increase combustion air flow to the furnace until stack gas oxygen levels increase by one to two percent over the level measured in Step 2. As in Step 2, record the stack gas temperature, CO concentration (for gaseous fuels) or smoke-spot number (for liquid fuels), and observe flame conditions for these higher oxygen levels after boiler operation stabilizes.
4. Decrease combustion air flow until the stack gas oxygen concentration is at the level measured in Step 2. From this level gradually reduce the combustion air flow, in small increments. After each increment, record the stack gas temperature, oxygen concentration, CO concentration (for gaseous fuels) and smoke-spot number (for liquid fuels). Also observe the flame and record any changes in its condition.

---

[1] This tuning procedure is based on a tune-up procedure developed by KVB, Inc. for the United States EPA.

[2] The smoke-spot number can be determined with ASTM Test Method D-2156 or with the Bacharach method. ASTM Test Method D-2156 is included in a tuneup kit that can be purchased from the Bacharach Company

[3] Typical minimum oxygen levels for boilers at high firing rates are:
   1. For natural gas: 0.5% - 3%
   2. For liquid fuels: 2% - 4%

5. Continue to reduce combustion air flow stepwise, until one of these limits is reached:
   a. Unacceptable flame conditions - such as flame impingement on furnace walls or burner parts, excessive flame carryover, or flame instability.
   b. Stack gas CO concentrations greater than 400 ppm.
   c. Smoking at the stack.
   d. Equipment-related limitations - such as low windbox/furnace pressure differential, built in air-flow limits, etc.
6. Develop an O_2/CO curve (for gaseous fuels) or O_2/smoke curve (for liquid fuels) similar to those shown in Figures 1 and 2 using the excess oxygen and CO or smoke-spot number data obtained at each combustion air flow setting.
7. From the curves prepared in Step 6, find the stack gas oxygen levels where the CO emissions or smoke-spot number equal the following values:

Fuel	Measurement	Value
Gaseous	CO Emissions	400 ppm
#1 and #2 oils	smoke-spot number	number 1
#4 oil	smoke-spot number	number 2
#5 oil	smoke-spot number	number 3
Other oils	smoke-spot number	number 4

   The above conditions are referred to as the CO or smoke thresholds, or as the minimum excess oxygen level.
   Compare this minimum value of excess oxygen to the expected value provided by the combustion unit manufacturer. If the minimum level found is substantially higher than the value provided by the combustion unit manufacturer, burner adjustments can probably be made to improve fuel and air mixing, thereby allowing operation with less air.
8. Add 0.5 to 2.0 percent of the minimum excess oxygen level found in Step 7 and reset burner controls to operate automatically at this higher stack gas oxygen level. This margin above the minimum oxygen level accounts for fuel variations, variations in atmospheric conditions, load changes, and nonrepeatability or play in automatic controls.
9. If the load of the combustion unit varies significantly during normal operation, repeat Steps 1-8 for firing rates that represent the upper and lower limits of the range of the load. Because control adjustments at one firing rate may affect #onditions at other firing rates, it may not be possible to establish the optimum excess oxygen level at all firing rates. If this is the case, choose the burner control settings that give best performance over the range of firing rates. If one firing rate predominates, settings should optimize conditions at that rate.
10. Verify that the new settings can accommodate the sudden load changes that may occur in daily operation without adverse effects. Do this by increasing and decreasing load rapidly while observing the flame and stack. If any of the conditions in Step 5 result, reset the combustion controls to provide a slightly higher level of excess oxygen at the affected firing rates. Next, verify these new settings in a similar fashion. Then make sure that the final control settings are recorded at steady-state operating conditions for future reference.
11. When the above checks and adjustments have been made, record data and attach combustion analysis data to boiler, steam generator, or heater records indicating name and signature of person, title, and date the tune up was performed.

B. Equipment Tuning Procedure for Natural Draft-Fired Boilers, Steam Generators, and Process Heaters.

Nothing in this Equipment Tuning Procedure shall be construed to require any act or omission that would result in unsafe conditions or would be in violation of any regulation or requirement established by Factory Mutual, Industrial Risk Insurers, National Fire Prevention Association, the California Department of Industrial Relations (Occupational Safety and Health Division), the Federal Occupational Safety and Health Administration, or other relevant codes, regulations, and equipment manufacturers specifications and operating manuals.
Should a different tuning procedure be used, a copy of this procedure should be kept with the unit records for two years and made available to the District personnel on request.

1. PRELIMINARY ANALYSIS
    a. CHECK THE OPERATING PRESSURE OR TEMPERATURE.
    Operate the boiler, steam generator, or heater at the lowest acceptable pressure or temperature that will satisfy the load demand. This will minimize heat and radiation losses. Determine the pressure or temperature that will be used as a basis for comparative combustion analysis before and after tuneup.
    b. CHECK OPERATING HOURS.
    Plan the workload so that the boiler, steam generator, or process heater operates only the minimum hours and days necessary to perform the work required. Fewer operating hours will reduce fuel use and emissions. For units requiring a tuneup to comply with the rule, a totalizing non-resettable fuel meter will be required for each fuel used and for each boiler, steam generator, and heater to prove fuel consumption is less than the heat input limit in therms per year specified in the rule.
    c. CHECK AIR SUPPLY.
    Sufficient fresh air supply is essential to ensure optimum combustion and the area of air supply openings must be in compliance with applicable codes and regulations. Air openings must be kept wide open when the burner is firing and clear from restriction to flow.
    d. CHECK VENT.
    Proper venting is essential to assure efficient combustion. Insufficient draft or overdraft promotes hazards and inefficient burning. Check to be sure that vent is in good condition, sized properly and with no obstructions.
    e. COMBUSTION ANALYSIS.
    Perform an "as is" combustion analysis (CO, O_2, etc.) with a warmed up unit at high and low fire, if possible. In addition to data obtained from combustion analysis, also record the following:
        i. Inlet fuel pressure at burner (at high & low fire)
        ii. Draft above draft hood or barometric damper
            1) Draft hood: high, medium, and low
            2) Barometric Damper: high, medium, and low
        iii. Steam pressure, water temperature, or process fluid pressure or temperature entering and leaving the boiler, steam generator, or process heater.

iv. Unit rate if meter is available.

With above conditions recorded, make the following checks and corrective actions as necessary:

2. CHECKS & CORRECTIONS

a. CHECK BURNER CONDITION.

Dirty burners or burner orifices will cause boiler, steam generator, or process heater output rate and thermal efficiency to decrease. Clean burners and burner orifices thoroughly. Also, ensure that fuel filters and moisture traps are in place, clean, and operating properly, to prevent plugging of gas orifices. Confirm proper location and orientation of burner diffuser spuds, gas canes, etc. Look for any burned-off or missing burner parts, and replace as needed.

b. CHECK FOR CLEAN BOILER, STEAM GENERATOR, OR PROCESS HEATER TUBES & HEAT TRANSFER SURFACES.

External and internal build-up of sediment and scale on the heating surfaces creates an insulating effect that quickly reduces unit efficiency. Excessive fuel cost will result if the unit is not kept clean. Clean tube surfaces, remove scale and soot, assure proper process fluid flow and flue gas flow.

c. CHECK WATER TREATMENT & BLOWDOWN PROGRAM.

Soft water and the proper water or process fluid treatment must be uniformly used to minimize scale and corrosion. Timely flushing and periodic blowdown must be employed to eliminate sediment and scale build-up on a boiler, steam generator or process heater.

d. CHECK FOR STEAM, HOT WATER OR PROCESS FLUID LEAKS.

Repair all leaks immediately since even small high-pressure leaks quickly lead to considerable fuel, water and steam losses. Be sure there are no leaks through the blow-off, drains, safety valve, by-pass lines or at the feed pump, if used.

3. SAFETY CHECKS

a. Test primary and secondary low water level controls.

b. Check operating and limit pressure and temperature controls.

c. Check pilot safety shut off operation.

d. Check safety valve pressure and capacity to meet boiler, steam generator or process heater requirements.

e. Check limit safety control and spill switch.

4. ADJUSTMENTS

While taking combustion readings with a warmed up boiler, steam generator, or process heater at high fire perform checks and adjustments as follows:

a. Adjust unit to fire at rate; record fuel manifold pressure.

b. Adjust draft and/or fuel pressure to obtain acceptable, clean combustion at both high, medium and low fire. Carbon Monoxide (CO) value should always be below 400 parts per million (PPM) at 3% 0_2. If CO is high make necessary adjustments.

Check to ensure boiler, steam generator, or process heater light offs are smooth and safe. A reduced fuel pressure test at both high and low fire should be conducted in accordance with the manufacturers instructions and maintenance manuals.

c. Check and adjust operation of modulation controller. Ensure proper, efficient and clean combustion through range of firing rates.

When above adjustments and corrections have been made, record all data.

5. FINAL TEST

Perform a final combustion analysis with a warmed up boiler, steam generator, or process heater at high, medium and low fire, whenever possible. In addition to data from combustion analysis, also check and record:

a. Fuel pressure at burner (High, Medium, and Low).
b. Draft above draft hood or barometric damper (High, Medium and Low).
c. Steam pressure or water temperature entering and leaving boiler, steam generator, or process heater.
d. Unit rate if meter is available.

When the above checks and adjustments have been made, record data and attach combustion analysis data to boiler, steam generator, or process heater records indicating name and signature of person, title, company name, company address and date the tune up was performed.

This Page Intentionally Left Blank.