

SAN JOAQUIN VALLEY UNIFIED AIR POLLUTION CONTROL DISTRICT

RULE 4703 – STATIONARY GAS TURBINES

(Adopted August 18, 1994) (Amended March 16, 1995; Amended February 15, 1996; Amended October 16, 1997; Amended April 25, 2002)

1.0 Purpose

The purpose of this rule is to limit oxides of nitrogen (NOx) emissions from stationary gas turbine systems.

2.0 Applicability

The provisions of this rule apply to all stationary gas turbine systems, which are subject to District permitting requirements, and with ratings equal to or greater than 0.3 megawatt (MW) and/or a maximum heat input rating of more than 3,000,000 Btu per hour, except as provided in Section 4.0.

3.0 Definitions

- 3.1 Auxiliary Burner: any fuel burning device that increases the heat content of exhaust gas from a gas turbine. Duct burners, fired waste heat boilers, and fired heat recovery steam generators are considered auxiliary burners.
- 3.2 Combined Cycle unit: any stationary gas turbine which recovers heat from the gas turbine exhaust gases to heat water, generate steam, or preheat the inlet combustion air to the gas turbine.
- 3.3 Commercially Available: Any control technology or equipment which is offered by at least one vendor and guaranteed by the vendor to achieve the required emission control performance for a regular or full-scale operation within the United States.
- 3.4 Compliance Limit: maximum allowable oxides of nitrogen (NOx) or carbon monoxide (CO) emission levels.
- 3.5 Control System Operating Parameters: operating parameters that the APCO deems necessary to analyze when determining compliance, such as ammonia and exhaust gas flow rates and exhaust gas temperature for selective catalytic reduction; or humidity, water injection rate, exhaust gas flow rate and temperature for water injection.
- 3.6 Dry Low-NOx Combustion Technology (DLN): any turbine combustor design which uses multiple staging, air/fuel premixing or other modifications to achieve lower levels of NOx emissions as compared to conventional combustors.

- 3.7 Emergency Standby Unit: a stationary gas turbine system that is limited by permit condition to be operated only as a mechanical or electrical power source for a facility when the primary power source for a facility has been rendered inoperable due to failure beyond the reasonable control of the operator, except due to power interruption pursuant to an interruptible power supply agreement. Electricity generated by such a unit cannot be sold.
- 3.8 Gas Turbine: an internal combustion engine consisting of a compressor, a combustor, and a power turbine, that is gas and/or liquid fueled, with or without power augmentation. Two or more gas turbines powering one shaft shall be treated as one gas turbine.
- 3.9 Gas Fuel: any of the following fuels: natural gas, LPG, propane, digester gas, and landfill gas.
- 3.10 HHV: higher heating value of fuel.
- 3.11 LHV: lower heating value of fuel.
- 3.12 Liquid Fuel: any of the following fuels: kerosene, jet fuel, and distillate fuel oils. Sulfur content of the fuel oil shall be less than 0.05% by weight.
- 3.13 Major Overhaul: taking a stationary gas turbine out of service to replace or repair major components of the turbine. Major overhaul does not include taking a stationary gas turbine out of service exclusively to install emission control equipment.
- 3.14 Measured CO Emissions Concentration: measured carbon monoxide emissions corrected to 15 percent oxygen on a dry basis, ppm.
- 3.15 Measured NOx Emissions Concentration: measured oxides of nitrogen emissions corrected to 15 percent oxygen on a dry basis, ppm.
- 3.16 Power Augmentation: an increase in the gas turbine shaft output and/or the decrease in gas turbine fuel consumption by the addition of energy recovered from exhaust heat.
- 3.17 Public Service Unit: a stationary gas turbine system used to generate electricity for sale or for use in serving the public.
- 3.18 Rating: the continuous megawatt (MW) rating or mechanical equivalent by a manufacturer for a gas turbine without power augmentation.
- 3.19 Reduced Load Period: the time during which a gas turbine is operated at less than rated capacity in order to change the position of the exhaust gas diverter gate, not to exceed one hour.

- 3.20 SCR: Selective catalytic reduction.
- 3.21 Simple Cycle unit: any stationary gas turbine which does not recover heat from the gas turbine exhaust gases to preheat the inlet combustion air to the gas turbine, to heat water, or to generate steam.
- 3.22 Standard Conditions: defined in Rule 1020 (Definitions).
- 3.23 Stationary Gas Turbine: a gas turbine that is attached to a foundation, or a portable gas turbine that is operated at a facility for more than 90 days in any 12-month period.
- 3.24 Stationary Gas Turbine System: a stationary gas turbine, or a stationary gas turbine and the associated auxiliary burner.
- 3.25 Thermal Stabilization Period: the start up or shut down time during which the exhaust gas is not within the normal operating temperature range, not to exceed two hours.
- 3.26 Unit: a stationary gas turbine system.

4.0 Exemptions

- 4.1 The provisions of this rule, with the exception of Section 6.1, shall not apply to stationary gas turbine systems operated under the following conditions:
 - 4.1.1 Laboratory units used in research and testing for the advancement of gas turbine technology,
 - 4.1.2 Units limited by permit condition to be operated exclusively for firefighting and/or flood control.
- 4.2 The provisions of this rule, with the exception of Sections 6.1 and the record keeping provisions of Section 6.2, shall not apply to the following units:
 - 4.2.1 Emergency standby units limited by permit condition to operate less than 200 hours per calendar year for maintenance and testing purposes.
 - 4.2.2 Units less than 4 MW in rating and limited by permit condition to operate less than 877 hours per calendar year.

5.0 Requirements

5.1 NOx Emissions

NOx emissions concentrations measured for compliance with Section 5.0 shall be averaged over a three hour period, using consecutive 15-minute sampling periods in accordance with either the applicable test method in Section 6.4, or, if continuous emission monitors are used, all applicable requirements of 40 CFR Part 60, as detailed in Section 6.2. Any variations from these measurement requirements are subject to APCO and EPA approval prior to implementation.

5.1.1 Tier 1 NOx Compliance Limits

The owner or operator of any stationary gas turbine system shall not operate such unit under load conditions, excluding the thermal stabilization period or reduced load period, which results in the measured emissions concentration exceeding the applicable emission limits below, according to the Tier 1 Compliance Schedules listed in Section 7.0.

Table 5-1: Tier 1 NOx Compliance Limits

Stationary Gas Turbine Rating	Operating hours per year	NOx Compliance Limit, ppmv at 15% O ₂	
		Gas	Oil
4 MW and greater	< 877	42	65
> 0.3 MW but < 10.0 MW	≥877	42	65
10.0 MW and greater, without SCR	≥877	15 x EFF/25	42 x EFF/25
10.0 MW and greater, with SCR	≥877	9 x EFF/25	25 x EFF/25
General Electric Frame 7 with Quiet Combustors	Not applicable	18 x EFF/25	42 x EFF/25
Solar Saturn 1100 horsepower gas turbine powering centrifugal compressor	Not applicable	50	50

Where EFF (efficiency) is the higher of EFF₁ or EFF₂ below. An EFF that is less than 25 shall be assigned a value of 25.

$$EFF_1 = \frac{3412 \text{ Btu / kW - hr}}{\text{Actual Heat Rate at HHV (Btu / kW - hr)}} \times 100\%$$

EFF₁ is the demonstrated percent efficiency of the gas turbine only, as calculated without consideration of any downstream energy recovery from the actual heat rate (Btu/KW-hr); corrected to HHV and standard conditions, as measured at peak load for that facility.

$$EFF_2 = EFF_{mfr} \times \frac{LHV}{HHV}$$

EFF₂ is EFF_{mfr} after correction from LHV to HHV at peak load for that facility. EFF_{mfr} is the manufacturer's continuous rated percent efficiency of the gas turbine with air pollution control equipment at LHV.

5.1.2 Tier 2 NOx Compliance Limits

The owner or operator of any stationary gas turbine system shall not operate such unit under load conditions, excluding the thermal stabilization period or reduced load period, which results in the measured emissions concentration exceeding the applicable emission limits below, according to the Tier 2 Compliance Schedules listed in Section 7.2.

Table 5-2: Tier 2 NOx Compliance Limits

Turbine Classification Rating	Compliance Option (see Section 7.2)	NOx Compliance Limit, ppmvd at 15% O ₂	
		Gas Fuel	Liquid Fuel
a) Less than 2.0 MW Solar Saturn, driving a centrifugal compressor	Standard	50	50
b) No greater than 10 MW, if a DLN System is commercially available for the specific unit, as of April 30, 2003.	Standard	25	65
c) No greater than 10 MW, if a DLN System is not commercially available for the specific unit, as of April 30, 2003.	Standard	35	65
d) Greater than 10 MW, Combined cycle.	Standard	5	25
	Enhanced	3	25
e) Greater than 10 MW, Simple cycle, and permit condition for greater than 877 hrs/yr operation.	Standard	5	25
	Enhanced	3	25
f) Greater than 10 MW, Simple cycle, and permit condition for no greater than 877 hr/yr operation.	Standard	25	42
	Enhanced	5	25

5.1.2.1 For units with a Standard Option and an Enhanced Option shown in Table 5-2, the operator shall choose which option will apply and shall demonstrate and maintain compliance with that NO_x Compliance limit according to the applicable Tier 2 Compliance Schedule shown in Section 7.2. Units failing to demonstrate compliance with the applicable Standard Option limit by the applicable Standard Option Compliance Date, shall be required to meet the Enhanced Option Limit by the applicable Enhanced Option Compliance Date.

5.1.2.2 Any stationary gas turbine system equipped with a NO_x emission control device which results in emission reductions of at least 95%, shall be considered to meet the Tier 2 NO_x Compliance Limit. Percent emission reductions, if used to comply with Section 5.1.2, shall be calculated as follows:

5.1.2.2.1 For units with exhaust gas NO_x control devices, percent reduction shall be calculated using emission samples taken at the inlet and outlet of the control device.

5.1.2.2.2 For units without exhaust gas NO_x control devices and for units with an exhaust gas NO_x control device in combination with a second emission control device or technique, percent reduction shall be based on source test results for the uncontrolled unit and the unit after the control device(s) or technique(s) has been employed. When representative source sampling prior to the application of an emissions control technology or technique is not available, the APCO may approve the use of manufacturer's uncontrolled emissions information or source sampling from a similar, uncontrolled unit.

5.2 CO Emissions

The owner or operator of any stationary gas turbine system shall not operate such unit under load conditions, excluding the thermal stabilization period and the reduced load period, which results in the measured CO emissions concentration exceeding the compliance limits listed below:

Table 5-3: CO Compliance Limits

Stationary Gas Turbine	CO Compliance Limit, ppmv at 15% O ₂
Units not identified below	200
General Electric Frame 7	25
General Electric Frame 7 with Quiet Combustors	52
Less than 2.0 MW Solar Saturn gas turbine powering centrifugal compressor	250

6.0 Administrative Requirements

6.1 Emission Control Plan

The owner or operator of any existing stationary gas turbine system, unless exempted in Section 6.1.5, shall submit, to the APCO for approval, an emissions control plan of all actions, including a schedule of increments of progress, which will be taken to comply with the requirements of the applicable NO_x Compliance Limit in Section 5.0 and Compliance Schedule in Section 7.0.

6.1.1 Such plan shall contain a list that provides the following for each stationary gas turbine system:

- 6.1.1.1 Permit or identification number,
- 6.1.1.2 Name of gas turbine manufacturer,
- 6.1.1.3 Gas turbine model designation,
- 6.1.1.4 Rated shaft power output, (MW),
- 6.1.1.5 Name of auxiliary burner manufacturer,
- 6.1.1.6 Auxiliary burner model designation,
- 6.1.1.7 Rated heat input of the auxiliary burner, (MMBtu/hr)
- 6.1.1.8 Type of liquid fuel and/or type of gaseous fuel,
- 6.1.1.9 Fuel consumption (cubic feet of gas or gallons of liquid) of turbine and/or auxiliary burner,
- 6.1.1.10 Hours of operation in the previous one-year period,
- 6.1.1.11 Heat rate (Btu/KW-hr), corrected to HHV for each type of fueling (liquid/gas),
- 6.1.1.12 HHV for each fuel.

6.1.2 Such plan shall contain a list of all stationary gas turbine systems to be controlled, identifying the type of emission control to be applied to each unit, applicable emission standard from Section 5.0, and documentation showing current emissions of oxides of nitrogen.

- 6.1.3 Such plan shall contain support documentation for any systems exempt under the provisions of Section 4.0.
- 6.1.4 Such plan shall identify the applicable compliance schedule for each unit, as specified in Section 7.0. Each emission control plan for a unit subject to Section 7.1.2 or section 7.2.2 shall include the owner/operator's overhaul schedule.
- 6.1.5 The owner or operator of any existing stationary gas turbine system shall be exempt from the requirements of Section 6.1 provided all such turbines under his ownership or control have NO_x and CO emissions limits which are shown on the current Permit to Operate and which do not exceed the applicable Compliance Limits in Section 5.0.

6.2 Monitoring and Recordkeeping

The owner or operator of any stationary gas turbine system subject to the provisions of this rule shall perform the following actions:

- 6.2.1 Except for units subject to Section 6.2.3, for turbines with exhaust gas NO_x control devices, the owner or operator shall either install, operate, and maintain continuous emissions monitoring equipment for NO_x and oxygen, as identified in Rule 1080 (Stack Monitoring), or install and maintain APCO-approved alternate monitoring consisting of one or more of the following:
 - 6.2.1.1 periodic NO_x emission concentrations,
 - 6.2.1.2 turbine exhaust oxygen concentration,
 - 6.2.1.3 air-to-fuel ratio,
 - 6.2.1.4 flow rate of reducing agents added to turbine exhaust,
 - 6.2.1.5 catalyst inlet and exhaust temperature,
 - 6.2.1.6 catalyst inlet and exhaust oxygen concentration,
 - 6.2.1.7 other operational characteristics.
- 6.2.2 Except for units subject to Section 6.2.3, for turbines without exhaust-gas NO_x control devices and without continuous emissions monitoring equipment, the owner or operator shall monitor operational characteristics recommended by the turbine manufacturer or emission control system supplier, and approved by the APCO.
- 6.2.3 For units 10 MW and greater that operated an average of more than 4,000 hours per year over the last three years before August 18, 1994, the owner or operator shall monitor the exhaust gas NO_x emissions. The NO_x monitoring system shall meet EPA requirements as specified in 40 CFR Part 60 App. B, Spec. 2, 40 CFR Part 60 App. F, and 40 CFR Part 60.7 (c), 60.7 (d), and 60.13, or other systems that are acceptable to the EPA. The owner or

operator shall submit to the APCO information demonstrating that the emission monitoring system has data gathering and retrieval capability.

- 6.2.4 The owner or operator shall maintain all records for a period of five years from the date of data entry and shall make such records available to the APCO upon request.
- 6.2.5 The owner or operator shall submit to the APCO, before issuance of the Permit to Operate, information correlating the control system operating parameters to the associated measured NO_x output. This information may be used by the APCO to determine compliance when there is no continuous emission monitoring system for NO_x available or when the continuous emission monitoring system is not operating properly.
- 6.2.6 The owner or operator shall maintain a stationary gas turbine system operating log that includes, on a daily basis, the actual local time start-up and stop time, length and reason for reduced load periods, total hours of operation, type and quantity of fuel used (liquid/gas).
- 6.2.7 The owner or operator shall maintain a stationary gas turbine system operating log for units exempt under Section 4.2 that includes, on a daily basis, the actual local time start-up and stop time, total hours of operation, and cumulative hours of operation to date for the calendar year.

6.3 Compliance Testing

- 6.3.1 The owner or operator of any stationary gas turbine systems subject to the provisions of Section 5.0 of this rule shall provide source test information annually regarding the exhaust gas NO_x and CO concentrations, and, if used as a basis for Tier 1 emission limit calculations, the demonstrated percent efficiency (EFF) of the stationary gas turbine, or, for turbines complying with Section 5.1.2.2, the control efficiency of the emission control device.
- 6.3.2 The owner or operator of any stationary gas turbine system operating less than 877 hours per year shall provide source test information biennially regarding the exhaust gas NO_x concentrations at standard conditions and if used as a basis for Tier 1 emission limit calculations, the percent efficiency (EFF) of the stationary gas turbine.
- 6.3.3 The owner or operator of any unit with an intermittently operated auxiliary burner shall demonstrate compliance with the auxiliary burner both on and off.

6.4 Test Methods

The following test measures shall be used unless otherwise approved by the APCO and EPA.

- 6.4.1 Oxides of nitrogen emissions for compliance tests shall be determined by using EPA Method 7E or EPA Method 20.
- 6.4.2 Carbon monoxide emissions for compliance tests shall be determined by using EPA Test Methods 10 or 10B.
- 6.4.3 Oxygen content of the exhaust gas shall be determined by using EPA Methods 3, 3A, or 20.
- 6.4.4 HHV and LHV of distillate fuels shall be determined by using:
 - 6.4.4.1 ASTM D240-87, Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter, or
 - 6.4.4.2 ASTM D2382-88, Standard Test Method for Heat of Combustion of Hydrocarbon Fuels by Bomb Calorimeter (High-precision Method).
- 6.4.5 HHV and LHV of gaseous fuels shall be determined by using:
 - 6.4.5.1 ASTM D3588-91, Standard Practice for Calculating Heat Value, Compressibility Factor, and Relative Density (Specific Gravity) of Gaseous Fuels, or
 - 6.4.5.2 ASTM 1826-88, Standard Test Method for Calorific (Heating) Value of Gases in Natural Gas Range by Continuous Recording Calorimeter, or
 - 6.4.5.3 ASTM 1945-81, Standard Method for Analysis of Natural Gas by Gas Chromatography.
- 6.4.6 Demonstrated percent efficiency of the stationary gas turbine shall be determined using the facility instrumentation for gas turbine fuel consumption and power output. Power output values used to determine gas turbine efficiency shall be either:
 - 6.4.6.1 the electrical power output of the gas turbine, provided the gas turbine generates electricity; or
 - 6.4.6.2 the mechanical power output of the gas turbine, provided the gas turbine does not generate electricity.

6.5 Exempt and Emergency Standby Units

- 6.5.1 The owner or operator of any unit with an hour-per-year operation limit pursuant to Sections 4.2 or 5.0 must notify the APCO within seven days if the hour-per-year limit is exceeded. Except as provided in Section 6.4.2, if the hour per-year-limit is exceeded, the exemption shall be permanently withdrawn. Within 30 days after the exceedance, the owner or operator must submit a permit application detailing a plan to meet the appropriate compliance limit within 24 months. Included in this permit application, the owner or operator must submit an emission control plan including a schedule of increments of progress for the installation of the required control equipment. This schedule shall be subject to the review and approval of the APCO.
- 6.5.2 A public service unit operating during a state of emergency, when such emergency is declared by proclamation of the Governor and when the unit is located in the specific geographic location identified in the proclamation, shall be excluded from loss of exemption due to exceeding the hour-per-year limit for the operation during the state of emergency. If the unit exceeds the hour-per-year limit based solely on operation outside of the state of emergency, then loss of exemption shall apply according to Section 6.5.1.

7.0 Compliance Schedule

7.1 Tier 1 Compliance Schedule

Except for owners or operators of units subject to Section 7.1.4, owners or operators of all applicable stationary gas turbine systems shall submit the emission control plan required by Section 6.1 by May 31, 1995. All owner/operators shall demonstrate and maintain compliance with the applicable provisions of Sections 5.0 and 6.0 in accordance with the following Compliance Schedules:

- 7.1.1 Section 7.1.1 applies to unit not addressed by Sections 7.1.2, 7.1.3, 7.1.4, or 7.1.5.
- 7.1.1.1 By August 18, 1996, submit to the APCO a complete application for Authority to Construct for all modifications to each unit.
- 7.1.1.2 By August 18, 1998, demonstrate full compliance.
- 7.1.2 Section 7.1.2 applies to a unit not scheduled for a major overhaul between August 18, 1996 and August 18, 1998. Section 7.1.2 does not apply to any unit that will achieve full compliance with the limits in Section 5.0 through the exclusive use of an increased rate of water or steam injection.

7.1.2.1 By August 18, 1996, submit a complete application for Authority to Construct.

7.1.2.2 By August 18, 1998, demonstrate full compliance on at least 62% of the owner/operator's units.

7.1.2.3 By August 18, 2000 or 30 days after the completion of the next major overhaul following August 18, 1998, whichever comes first, demonstrate full compliance on all remaining units.

7.1.3 Section 7.1.3 applies to any unit which was originally designated to be modified with dry low NO_x combustion technology, as identified in the emission control plan required by Section 6.1, provided the owner/operator of such unit demonstrates that such technology will not be commercially available by August 18, 1998. The owner/operator of each applicable unit shall,

7.1.3.1 By February 18, 1998, submit a complete application for Authority to Construct for all modifications to each unit.

7.1.3.2 By August 18, 2000, demonstrate full compliance.

7.1.4 Section 7.1.4 applies to any unit equipped with water or steam injection that will achieve full compliance with the emission limits in Section 5.0 through the exclusive use of an increased rate of injection.

7.1.4.1 By November 18, 1994, submit a complete application for Authority to Construct for all modifications to each unit.

7.1.4.2 By March 18, 1995, demonstrate full compliance.

7.1.5 Section 7.1.5 applies to any unit that will achieve full compliance with the emission limits in Section 5.0 through the exclusive use of an increased rate of water or steam injection and that requires modification of the turbine water/steam injection system or modification to the water storage and treatment system. The owner/operator of each applicable unit shall,

7.1.5.1 By August 18, 1995, submit a complete application for Authority to Construct for all modifications to each unit.

7.1.5.2 By August 18, 1996, demonstrate full compliance.

7.2 Tier 2 Compliance Schedule

Owners or operators of all applicable stationary gas turbine systems shall submit the emission control plan required by Section 6.1 to the District by April 30, 2003. All owner/operators shall demonstrate and maintain compliance with the applicable provisions of Sections 5.0 and 6.0 in accordance with the following Compliance Schedules:

7.2.1 Operators complying with the Standard Option of Table 5-2 shall demonstrate and maintain compliance by the applicable Compliance Date:

Table 7-1: Tier 2 Standard Option Compliance Schedule

Turbine Classification Rating	Compliance Date
a) Less than 2.0 MW Solar Saturn, driving a centrifugal compressor	April 25, 2002
b) No greater than 10 MW, if a DLN System is commercially available for the specific unit, as of April 30, 2003.	April 30, 2004
c) No greater than 10 MW, if a DLN System is not commercially available for the specific unit, as of April 30, 2003.	April 30, 2003
d) Greater than 10 MW, Combined Cycle.	April 30, 2004
e) Greater than 10 MW, Simple cycle, and permit condition for greater than 877 hrs/yr operation.	April 30, 2005
f) Greater than 10 MW, Simple cycle, and permit condition for no greater than 877 hr/yr operation.	April 30, 2003

7.2.2 Notwithstanding Table 7-1, for an operator with multiple units no greater than 10 MW which will comply with the 25 ppmv Standard DLN Option for those units,

7.2.2.1 By April 30, 2004, demonstrate full compliance on at least 62% of those units which will comply with the Standard DLN Option.

7.2.2.2 By April 30, 2005 or 30 days after the completion of the next Major Overhaul following April 30, 2004 whichever is earliest, demonstrate full compliance on all remaining units which will comply with the Standard DLN Option.

7.2.3 Notwithstanding Table 7-1, for an operator with multiple units greater than 10 MW, which will comply with the Standard Option for those units,

7.2.3.1 By April 30, 2004, demonstrate full compliance on at least 62% of those units which will comply with the Standard Option.

7.2.3.2 By April 30, 2005, or 30 days after the completion of the next Major Overhaul following April 30, 2004, whichever is earliest, demonstrate full compliance on all remaining units which will comply with the Standard Option.

7.2.4 Operators complying with the Enhanced Option of Table 5-2 shall demonstrate and maintain compliance by the earlier of either

7.2.4.1 April 30, 2008, or

7.2.4.2 within 90 days following the next Major Overhaul, if that overhaul occurs after April 30, 2004.