Signed Copy Dated January 1, 1995

MEMORANDUM

SUBJECT: De Minimis Values for NOx RACT

FROM: G. T. Helms, Group Leader
Ozone Policy and Strategies Group (MD-15)

To: Air Branch Chief, Region I - X

This memorandum presents information that we think would be useful to you as you are reviewing RACT rules with respect to de minimis values for NOX RACT. It was extensively coordinated with the OGC and the NOx work group.

The RACT requirements apply to major stationary sources in certain ozone nonattainment areas and throughout an ozone transport region. A source generally consists of several units which emit pollutants to the atmosphere. The sum of emissions from all units at a facility determines if a unit is major and, thus, subject to the RACT requirements. However, certain units at a facility may be so small that it is clear that no controls are reasonably available for those units, although RACT would still apply at the other units within the facility.

Regulatory agencies have typically included exemptions for very small emission units in their VOC RACT rules. The reason for the exemptions is that control requirements at very small units are generally not reasonable, considering technological and economic feasibility. A 15 pound/day cut-off level first appeared in 1966 in Rule 66 which was adopted by Los Angeles County. The 3 pound/hour and 15 pound/day cut offs were subsequently adopted into the Code of Federal Regulations, 40 CFR part 51, Appendix B in 1971. After the first CTG's were issued, EPA developed model regulations for VOC RACT. This guidance appeared in April 1978 and included the 3 pound/hour and 15 pound/day exemptions for 15 VOC source categories. Unless specified differently in other guidance, the EPA continues to recommend these cut-off levels as criteria for regulatory agencies to consider as they adopt or revise their VOC RACT rules.

As a result of the new NOx RACT requirements in the Clean Air Act Amendments of 1990, regulatory agencies are required to develop and adopt NOx RACT rules. In the process of drafting these rules, many agencies have included exemptions for very small NOx emission sources for the same reason noted above for VOC rules. Unlike the VOC rules, however, there is no well- established precedent with respect to NOx. Further, the values adopted by the various agencies include a wide range of exempt sources. Thus, it is difficult to give a specific de minimis value or range of such values for NOx as for VOC. The purpose of this memorandum is to provide technical data that may be used to evaluate NOx de minimis for various categories of sources.

Technical data on NOx de minimis levels is contained in attachments to this memorandum. The technical data are primarily derived from information contained in the recently completed NOx alternative control techniques (ACT) documents for four source categories as follows:

Stationary Gas Turbines
Internal Combustion Engines
Process Heaters
Boilers (Watertube Boilers; Firetube Boilers)

These ACT documents provide comprehensive data on the full range of potential NOx controls for each source category, including the economic and technological feasibility of various control processes.

In the evaluation of NOx de minimis levels, the following factors should be considered:

1. Emission rates for various source sizes (for example pound/hour).

2. Cost-effectiveness of controls.

3. Total emissions for a source category above various cut-off levels

4. Total number of sources in a category above various cut-off levels.

5. Exemptions contained in adopted State and local regulations.

6. Units which meet the Act definition of a major

source should generally not be considered de minimis.

As a result of this review, EPA does not recommend specific de minimis values, but presents the attached factors as a guide in the development and review of State de minimis rules. In addition, we strongly recommend that de minimis values be based on more than one factor.

If you have any questions please contact Ted Creekmore of staff at 919-541-5699.

Attachment

cc: NOx Work Group Members, Sally Shaver

ATTACHMENT 1
TECHNICAL DATA THAT MAY BE USED TO DETERMINE A DE MINIMIS RACT RULE FOR PROCESS HEATERS

This information is from the "Alternative Control Techniques Documents--NOx Emissions from for Process Heaters, " EPA-453/R-93-015, February 1993.

Tables 1 lists the five criteria used to estimate de minimis values. Table 1 also includes emissions of de minimis sources as a percentage of overall emissions. Table 2 include emissions by size (MMBtu/hr) of source. Table 3 gives cost effectiveness for the various control measures and fuels burned by process heaters. Table 4 includes a listing of State de minimis rules.

TABLE 1

NOx De Minimis Rules--Process Heaters				
Emissions by Size	Cost Effect-ness Envelop	Number of Sources	Emissions of Sources	State Regulations (MMBtu/hr)
ND:NG 50 MMBtu/hr= 4.9 lb/hr MD--50 MMBtu/hr= 9.85 lb/hr[1] SEE TABLE 2	See table 3	50 MM Btu/hr(exempts about 50% of sources)	About 20% of total Process Heater Emissions	MI <100 NJ NY DE <15 CA <5 See Table 4

Abbreviations
NG-Nitrogen Gas fired
ND-Natural Draft

[1]Emission factors for ND and MD process heaters are different. However they are the same for all capacity sizes of Process Heaters within each category.

MD-Mechanical Draft

TABLE 2--Emissions by Size of Process Heater

Model Capacity (MMBtu/hr)	Natural[2] Draft- Natural Gas lb/hr	Mechanical[3] Draft- Natural Gas lb/hr	Natural[4] Draft-Oil Dist/Resid lb/hr	Mechanical[5] Draft- Oil Dist/Resid lb/hr
5	.49	.99	1.0 2.1	1.6 2.7
50	4.9	9.85	10.0 21.0	16.0 26.0
69	6.7	13.6	13.8 29.0	22.1 37.2
135	13.2	26.6	27.0 56.7	43.2 72.9
100	9.8	19.7	20.0 42.0	32.0 54.0

[2]EF: .098 lb NOx MMBtu

[3]EF: .197 lb/MMBtu

[4]EF: .20/.42 lb/MMBtu

[5]EF: .32/.58 lb/MMBtu

TABLE 3--Cost Effectiveness Heat Inputs (MM BTU/hr)for $1300 per ton for Process Heaters

Type Control	Natural Draft-Natural Gas	Mechanical Draft-Natural Gas	Natural Draft-Oil Dist/Resid	Mechanical Draft-Oil Dist/Resid
LNB	75 (1430)	40(1330)	>69(1680)[6] <69(1190)	<135(658)[7] <135(477)
ULNB	50(1300)	<40(1,020)[8]	<69(892) <69(420)	<135(408) <135(245)

[6]This entry means: For LNB only one heat capacity was given, 69 MMBTU/hr. For distillate oil the size of a process heater that would be cost-effective would probably be >69 MMBtu/hr since the data shows a cost of $1680 at 69. For residual oil, the size of a process heater that would be cost-effective would probably be <69 because the cost at 69(1190) is below 1300.

[7]This entry means: For LNB only one heat capacity was given, 135 MMBTU/hr. For distillate oil the size of a process heater that would be cost-effective would probably be <135 MMBtu/hr because the cost at 135($658) is less than $1300. For residual oil, the size of a process heater that would be cost-effective would also probably be <135 because the cost at 135($477) is below $1300.

[8]This entry means: For ULNB the lowest heat capacity given was 40 MM Btu/hr where the cost is $1040 per ton of NOx removal. Thus, ULNB is cost effective over the range of heat capacity given (40-263 MM Btu\hr). In fact, since $1300 is the target cost, a smaller process heater of <40 MM Btu/hr may be cost effective.

SNCR	>186(2930)[9]	263(1420)	>69(2350) <69(1230)	135(1340) <135(880)
SCR	X	>263(3710)	X	>135(4160) >135(2480)
LNB+FGR	X	>263(1720	X	<135(1170) <135(961)
LNB+SNCR	>186(3150)	>263(1860)	>69(2740) <69(1430)	135(1490) <135(942)
LNB+SCR	X	>263(5530)	X	>135(3620) >135(3190)

LNB--Low NOx Burner
UNLD--Ultra Low NOx Burners
SNCR--Selective Non-Catalytic Reduction
SCR--Selective Catalytic Reduction
LNB + FGR--LNB + Flue Gas Recirculation
X--No Data

TABLE 4--STATE PROCESS HEATER RULES--DE MINIMIS RULES

STATE/DATE	RULE	COMMENT
MI	<_ 100 MMBTU/hr	
NJ 11/17/93 3/25/94	Overall: 25 t/y < 137 lbs/d 5/15-9/15	
NY 11/17/93 3/28/94	Overall: 3 lbs/hr; 15 lbs/day	

[9]This entry means: For SNCR the highest heat capacity given was 186 MM Btu/hr where the cost is $2980 per ton of NOx removed. Thus, SNCR is not cost effective over the range of heat capacity given (17-186).

CA 3/28/94 Some Districts	5 MMBtu/hr or 1 MM Btu/hr	Some Districts
DE	<15 MMBtu/hr Sources Operating only during the months November through March.	Annual capacity factor of less than 5%

ATTACHMENT 2

TECHNICAL DATA THAT MAY BE USED TO DETERMINE A DE MINIMIS RACT RULE FOR STATIONARY GAS TURBINES

This information is from the "Alternative Control Techniques Documents--NOx Emissions from Stationary Gas Turbines," EPA-453/R-93-007, January 1993, unless otherwise noted.

Tables 1 list five criteria used to estimate de minimis values. Table 2 include emissions by power output of gas turbines. Table 3 give cost effectiveness information for the natural gas and distillate oil fuels burned by gas turbines. Table 4 gives estimates of the size and relative power usage of the four major source types. Table 5 includes a listing of State de minimis values.

TABLE 1

NOx De Minimis Rules--Stationary Gas Turbines				
Emissions by Size	Cost Effect-ness Envelop	Number of Sources	Emissions of Sources	State Regulations
			Percent of total power for gas turbines: Standby/emergency: 2 Oil and gas industry: 7 Independ. elect. pow.: 4 Utilities: 87	
Table 2	Table 3	Table 4	For De Minimis value of 4.4 MW (15MMBtu/hr), would exclude: Most standby/emergency, Many oil and gas, Some independ. elect. pow. Few utilities turbines [10]	Table 5

[10] 4.4 MW de minimis for example purposes, not necessarily recommended.

TABLE 2
Stationary Gas Turbines
Uncontrolled/Controlled Emissions by Size of Gas Turbines
Control Method: Water Injection

Gas Turbine Model	Power[11] Output Megawatts (MMBtu\hr	Dist. Oil--Uncontrolled lb/hr	Dist. Oil--Controlled lb/hr	Nat. Gas--Uncontrolled lb/hr	Natural Gas--Controlled lb/hr
Saturn	1.1(3.4)	9.9	4.1	6.4	2.8
Centaur	3.3(11.3)	31.2	10.8	22.0	7.4
Taurus	4.5(15.4)	37.6	13.9	24.7	9.4
Mars T-12000	8.8(30.1)	107	24.9	69.4	17.0
LM2500	22.7(77.7	301	37.9	146	36.4
GT10	22.6(77.4	196	42.6	143	24.6
MS7001E	84.7(290)	822	243	544	154
MS7001F	161(551)	2190	417	1290	267

[11] 1MMBtu/hr equals .292 MW

TABLE 3--Stationary Gas Turbines
Gas Turbine Power Output Corresponding to $1300 per ton [12]

Type Control	Natural Gas Power Output--Megawatts (MMBtu/hr)	Light Distillate Fuel MMBtu/hr
Water Injection (WI)	17 (58.2)	12-14
Steam Injection	11 (37.7)	8-9
Selective Catalytic Reduction (SCR)[13]	42 ppm[14] 25 ppm[15]	42 ppm[16] 25 ppm[17]
WI + SCR	60 (205)	42-46
Dry Low NOx + SCR (9ppm)	11 (37.7)	No Reductions

[12]Boiler capacity is given in Megawatts (MW) with the equivalent MMBtu/hr that corresponds to an estimated cost of $1300 dollars per ton of NOx removed. Operating time is 8000 hrs/yr.

[13]Five year catalyst life assumed with the emission level for the combination of controls estimated at 9 ppmv.

[14]Least expensive controls $3,580 at 161 MW (549.5 MMBtu/hr) for control from 42 to 9ppmv.

[15]Least expensive controls at $6,980 at 83 MW (283.3 MMBtu/hr) for control from 25 to 9 ppmv.

[16]Least expensive controls $2649 per ton at 161 MW (549.5 Btu/hr) for control from 42 to 9 ppmv. Oil-fired cost effectiveness is approximately .74 of gas fired. Thus, $3,580 X .74 equals $2649.

[17]Least expensive controls $5165 per ton at 83 MW (283.3 Btu/hr) for control from 25 to 9 ppmv. Calculated as in footnote #7.

Dry Low-NOx	4[18](11.7)	No Reductions

[18]Entire range below $1300; 4 MW is the lowest capacity plotted.

TABLE 4--NUMBER OF SOURCES FOR STATIONARY GAS TURBINES [19]

Type of Source	Total Sources	Size Breakdown
Standby/Emergency Electric Power Generation	Estimated at 2% of total power use for 1985 (2000 MW)	Large number of turbine sales under 3.7 MW; operate on an as need basis; typically 75-200 hours\ yr. 1000 HP (.74 MW) is considered average horsepower.
Oil and Gas Industry	Estimated at 7% of total power use for 1985 (6000 MW)	Most turbines with .08 - 15 MW range (.27-51.4 MMBtu/hr) (107-20,100 HP) most operate continuously 8000 hrs/yr
Independent Electrical Power Producers	Estimated at 4% of total power use for 1985 (3600MW)	Range of turbines 1-100 MW; typically operate between 4000 and 8000 hours/yr
Electric Utilities-Peaking Units	Estimated at 87% of total power use for 1985 (89,000 MW)	Range of turbines 15-150 MW, most operate less than 2000 hours/ yr

[19]Information from EPA-450/2-77-017a, Standards Support and Environmental Impact Statement Volume 1: Proposed Standards of Performance for Stationary Gas Turbines, September 1977.

TABLE 5--STATE BOILER DE MINIMIS RULES
STATIONARY GAS TURBINES [20]

STATE/DATE	RULE	COMMENT
LA 11/17/93	< 3 MW (10.3 MMBtu/hr)	
TX 11/17/93	< 10 MW (34.2 MMBtu/hr)	
NESCAUM 11/17/93	<25MMBtu/hr (7.3 MW)	maximum heat input rate
NJ 11/17/93 3/25/94	<30 MMBtu/hr Overall: 25 t/y < 137 lbs/d 5/15-9/15	Waived if following cond. present: [21]
NY 11/17/93 3/28/94	<10 MMBtu/hr (2.92 MW)	
CA 3/28/94 S. Coast Bay Area Kern County	 <.3 MW (1.0 MMBtu\hr) " <10 MW (29.2 MMBtu\hr)	
DE	<450 hp (1.2 MMBtu/hr) (.33 MW) [22]	
CN 3/28/94	<100 MMBtu/hr (29.2 MW)	
NH 3/28/94	< 25 MMBtu/hr	facility-wide heat input
MASS 3/28/94	< 25 MMBtu/hr	

[20] Generally, it is not clear whether these de minimis values refer to whole plants (NJ, NY) or individual units.

[21] 1. Insufficient water supply or water of unsuitable quality; 2. No commercially available dry low-NOx combusters; 3. RACT is annual tune-up.

[22] 1 HP equals .00074MW equals .00253 MMBtu/hr

ATTACHMENT 3
TECHNICAL DATA THAT MAY BE USED TO DETERMINE A DE MINIMIS RACT RULE FOR INTERNAL COMBUSTION ENGINES

This information is from the "Alternative Control Techniques Documents--NOx Emissions from Stationary Reciprocating Internal Combustion Engines," EPA-453/R-93-032, July 1993, unless otherwise noted.

Tables 1 list five criteria used to estimate de minimis values. Table 2 include emissions by size of engines. Table 3 give cost effectiveness information for the various types of IC engines. Table 4 lists numbers of sources by the different fuels burned. Table 5 includes a listing of State de minimis rules.

TABLE 1

NOx De Minimis Rules--Internal Combustion Engines				
Emissions by Size (hp)	Cost Effect-ness Envelop	Number of Sources	Emissions of Sources	State Regulations (MMBtu/hr)
See Table 2	See Table 3	Table 4	Any De Minimis in the range of 100-350 HP Excludes about 95% of total emissions for spark ignition engines	DE <450 CA <50 Table 5
			Diesels--36% of emissions below De Minimis value	

TABLE 2--Emissions by Size of IC engines

Size Unit HP	SI: Rich-Burn[23] lb/hr	SI: Lean Burn[24] lb/hr	Gasoline[25] lb/hr	Diesel lb/hr[26]	Dual Fuel lb/hr[27]
100	3.48	3.7	1.14	2.65	
200	6.96	7.4	2.28	5.30	
500	17.4	18.5	5.70	13.23	
700				18.55	13
1000	34.75	37		26.5	18.7
1500					28

[23]EF = 13.9 t/y based on 8000 annual operating hours

[24]EF = 14.8 t/y based on 8000 annual operating hours.

[25]EF = 5.16 g/hp-hr from AP-42

[26]EF = 10.6 t/y based on 8000 annual operating hours.

[27]EF = 52.4 t/y based on 8000 annual operating hours.

TABLE 3
Cost Effectiveness Horsepower for $1300 per ton for IC Engines

Type Control	Spark Ignition (SI) (NG) Rich Burn	Lean Burn	SI Gaso-line[28]	Compression Ignition Diesel	Dual-Fuel
AF	200	700	ND		
IR	200	500	ND	250	700[29]
AF+IR	200[30]	700	ND		
NSCR or PSC	500-700		ND		
L-E Med	80[31]	200[32]	ND		> 1300[33]
L-E low	1000	900	ND		
SCR (low)	No Data	1400	ND	1900	3500

Abbreviations:
AF Air/Fuel Adjustments
IR Ignition Timing Retard
NSCR Nonelectric Catalytic Reduction
PSC Prestratified Charge
SCR Selective Catalytic Reduction
L-E Low Emission Combustion Design [34]

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[28]Assume cost effectiveness similar to Natural Gas SI engines.

[29]Entire range below $1300; 700 HP lowest plotted.

[30]More flexibility in adjusting engine than just IR or AF.

[31]Entire range below $1300; 80 is lowest HP plotted.

[32]Entire range below $1300; 200 is the lowest HP plotted.

[33]Least expensive controls cost $2200 per ton at about 7000 HP.

[34]Generally apply to new sources, not off the shelf technology for most existing sources.

A/F+IR	Parametric
NG	Natural Gas

TABLE 4--NUMBER OF SOURCES FOR IC ENGINES

Fuel Burned	Total Sources	Size Breakdown
Natural Gas	294,000 266,000 (90%) average HP is = 15	<_ 200 HP 94% of sources
Gasoline	64,100,000 63,000,000 (98%) average HP is 4	<_200 HP Almost 100% of sources Largest 40,000 sources averaged 150 HP
Diesel Oil[35]	606,000	545,000 <_ 350 HP or 90% 381,000 <_ 250 HP or 63%

[35]Duel Fuel Sources included with Diesel data.

TABLE 5--STATE IC RULES

STATE/DATE	RULE	COMMENT
LA 11/17/93	_> 300 hp	
TX 11/17/93	_> 150 hp Houston _> 300 hp Beaumont	
NESCAUM 11/17/93	_> 3 MM BTU/hr (1178 hp) [36]	
NJ 11/17/93 3/25/94	_> 500 hp; Overall: 25 t/y < 137 lbs/d 5/15-9/15	
NY 11/17/93 3/28/94	_> 225 hp for Severe Area _> 400 hp rest of State Overall: 3 lbs/hr; 15 lbs/day	
CN 3/28/94	3 MM BTU (1178 hp)	
CA 3/28/94 S. Coast	 _> 50 bhp	
Ventura	_> 50 bhp	
San Diego	_> 200 bhp	
SF Bay Area	_> 250 bhp_	
S. Basin	_> 50 bhp	
NH 3/28/94	4.5 MMBTU (1768 hp)	
MASS 3/28/94	3 MMBTU (1178 hp) operate >1000 hrs per yr	
RI 3/24/94	> 400 hp	

[36] Conversion Factor: 392.7 HP/MM Btu/hr

ATTACHMENT 4
OVERVIEW OF BOILER CATEGORIES [37]

Class/Type Fuel	Capacity Range (MMBtu/hr)	Number of Boilers	Total Capacity (MMBtu/hr)	Percent of Total Capacity
Commercial Institut.	.4 - 10	1,295,130	1,374,690	31
Industrial	10 - 1500	506,930	3,107,440	69
Watertube	.4 - 1500	50,495	2,552,500	57
Firetube	.4 - 50	275,075	1,033,300	23
Cast Iron	.4 - 10	1,476,490	896,200	20
Coal		214,00	815,830	18
Residual		389,104	1,223,800	27
Distillate		244,206	433,600	10
Nat. Gas		954,350	2,008,500	47

[37]Data from EPA-600/7-79-178a, Population Characteristics of Industrial/Commercial Boilers in the U.S., August 1979.

ATTACHMENT 5

TECHNICAL DATA THAT MAY BE USED TO DETERMINE A DE MINIMIS RACT RULE FOR WATERTUBE BOILERS (REVISED 10/17/94)

This information is from the "Alternative Control Techniques Documents--NOx Emissions from Industrial/Commercial/Institutional (ICI) Boilers," EPA-453/R-94-022, March 1994, unless otherwise noted.

Tables 1 list five criteria used to estimate de minimis values. Table 2 include emissions by size of boilers. Table 3 give cost effectiveness information for the various fuels burned by watertube boilers. Table 4 lists numbers of sources by the different fuels burned. Table 5 includes a listing of State de minimis values.

TABLE 1

NOx De Minimis Rules--Watertube Boilers				
Emissions by Size (MMBtu/hr)	Cost Effect-ness Envelop	Number of Sources	Emissions of Sources	State Regulations (MMBtu/hr)
			Watertube boil. are about 6% of total ICI boilers About 30% of ICI boiler capacity	
Table 2	Table 3	Table 4	For de minimis value of 10 MMBtu/hr, this would exclude: NG: 33% DIST 56% RESID 28% COAL 0%	Table 5

Abbreviations:

NG Natural Gas; DIST Distillate Oil;

RESID Residual Oil;

TABLE 2
Watertube Boilers
Uncontrolled Emissions by Size of Boilers(lb/hr)

Size Unit MMBtu /hr	Coal[38]	Residual Oil[39]	Distillat Oil[40] 10--100/ >100	Natural Gas[41] <_100/ >100	
1	0.69	0.36	0.13	0.14	
5	3.45	1.80	0.65	0.70	
10	6.90	3.60	1.30	1.40	
100	69.0	36.00	13.00/ 21.00	14.00	
250	172	90.00	-----/ 52.50	-----/ 65.00	

[38]EF = 0.69 lb/MMBtu based on .70 Capacity factor or 5600 operating hours per year.

[39]EF = .36 lb/MMBtu

[40]EF = .13 lb/MMBtu, 10--100 MMBtu/hr; .21 lb/MMBtu, >100.

[41]EF = .14 lb MMBtu <_ 100 MMBtu/hr; .26 lb MMBtu >100.

TABLE 3--Watertube Boilers (Single Burners-Packaged)
Boiler Size Corresponding to $1300 per ton [42]

Type Control	Natural Gas .66C	Natural Gas .50C	Distill. Oil .66C	Distill. Oil .50C	Residual Oil .66C	Residual Oil .50C	Pul Coal .66/.50C
SNCR	ND	ND	ND	ND	ND	ND	250/250
SCR	[43]	[44]	[45]	[46]	140	[47]	[48]
OT+WI	10[49]	10[12]	ND	ND	ND	ND	ND
OT+SCA	ND	ND	ND	ND	ND	ND	ND
LNB	10	175	10	160	10	50	250/600
LNB+FGR	75	240	25	250	10	200	ND

Abbreviations:
.66C .66 Capacity Factor .50 .50 Capacity Factor
ND No Data Pul Pulverized
SNCR Selective NonCatalytic Reduction

[42]Boiler capacity is given in MM Btu/hr that corresponds to an estimated cost of $1300 dollars per ton of NOx removed. Capacity factor: .66/.50. Costs based on 10 percent interest and 10 year capital amortization in 1992 dollars. Does not include the impact of Continuous Emission Monitoring systems, required on larger source in some areas.

[43]Least expensive controls $1800 at 250 MM Btu/hr.

[44]Least expensive controls $3900 per ton at 250.

[45]Least expensive controls cost $2180 per ton at 250 MMBtu/hr.

[46]Least expensive controls cost $4100 per ton at 250 MMBtu/hr.

[47]Least expensive controls cost $2190 at 250 MMBtu/hr.

[48]Least expensive controls $3000/3700 at 750 MMBtu/hr.

[49]Entire range below $1300; 10 is lowest capacity plotted.

SCR	Selective Catalytic Reduction
OT+WI	Oxygen Trim + Water Injection
OT+SCA	OT + Staged Combustion Air
LNB	Low NOx Burners
LNB+FGR	Low Nox Burners + Fluid Gas Recirculation

TABLE 4--NUMBER OF SOURCES FOR WATERTUBE BOILERS [50]

Fuel Burned	Total Sources	Size Breakdown
Coal: Pulverized	733	>250 MMBtu/hr--36% >100 " --100%
Natural Gas	18,291	>250 MMBtu/hr--3% >100 " --11% <10 " --33%
Distillate	8,000	>250 MMBtu/hr--1% >100 " --3% <10 " --56%
Residual Oil	15,953	>250 MMBtu/hr--2% >100 " --10% <10 " --28%

[50]Information from EPA-600/7-79-178a, Population and Characteristics of Industrial/Commercial Boilers in the U.S., August 1979. Includes both packaged and field-erected watertube boilers. Cost-effective data in Table 3 is only for single-burner packaged boilers.

TABLE 5--STATE BOILER DE MINIMIS RULES FOR INDUSTRIAL/COMMERCIAL BOILERS (INCLUDES WATERTUBE AND FIRETUBE) [51]

STATE/DATE	RULE	COMMENT
OH	<10 MMBtu/hr	
MI	<_100 MMBtu/hr	
LA 11/17/93	<_80 MMBtu/hr	
TX 11/17/93	<_100 MMBtu/hr	
NESCAUM 11/17/93	50--100 MBtu/hr case by case	
NJ 11/17/93 3/25/94	Overall: 25 t/y < 137 lbs/d 5/15-9/15	
NY 11/17/93 3/28/94	Overall: 3 lbs/hr; 15 lbs/day	
CN 3/28/94	< 5 MMBTU/hr	only tuneups required
CA 3/28/94 S. Coast	<_ 2 MMBtu/hr	Varies from 2-5 MMBtu/hr
Ventura	<_ 1 MMBtu/hr	1-5 MMBtu/hr
San Diego	<_ 5 MMBtu/hr	
SF Bay Area	<_ 1 MMBtu/hr	1-5 MMBtu/hr
S. Basin	<_ 5 MMBtu/hr	
NH 3/28/94	< 30 MMBTU	
MASS 3/28/94	< 20 MMBtu/hr (with PTE <25 TPY) operate >1000 hrs per yr	
MA 3/28/94	< 50MMBtu/hr	
RI 3/24/94	< 50 MMBtu/hr-only tuneups required	

[51] Generally, it is not clear whether these de minimis values refer to whole plants (NJ, NY) or individual units.

ATTACHMENT 6

TECHNICAL DATA THAT MAY BE USED TO DETERMINE A DE MINIMIS RACT RULE FOR FIRETUBE BOILERS

This information is from the "Alternative Control Techniques Documents--NOx Emissions from Industrial/Commercial/Institutional (ICI) Boilers," EPA-453/R-94-022, March 1994, unless otherwise noted.

Table 1 list five criteria used to estimate de minimis values. Table 2 include emissions by size of boilers. Table 3 give cost effectiveness information for the various fuels burned by watertube boilers. Table 4 lists numbers of sources by the different fuels burned. Table 5 includes a listing of State de minimis rules.

RECOMMENDATIONS

TABLE 1

NOx De Minimis Rules--Firetube Boilers				
Emissions by Size	Cost Effect-ness Envelop	Number of Sources	Emissions of Sources	State Regulations
			Firetubes boil. are about 15% of total ICI boil.; About 54% of ICI boil. capacity nationwide.	
Table 2	Table 3	Table 4	For Di minimis value of 25 MMBtu/hr, this would exclude: 99% of sources from NG, DIST, RESID. COAL?	Table 5

Abbreviations

NG Natural Gas; DIST Distillate Oil;

RESID Residual Oil;

TABLE 2
Firetube Boilers[52]
Uncontrolled Emissions by Size of Boilers(lb/hr)

Size Unit MMBtu /hr	Coal[53]	Residual Oil[54]	Distillat Oil[55]	Natural Gas[56]	
1	0.61	0.31	0.17	0.10	
5	3.05	1.55	0.85	0.50	
10	6.10	3.10	1.70	1.00	
100	61.0	31.00	17.00	10.00	
250	165.25	77.50	42.50	25.00	

[52]Based on .70 Capacity factor or 5600 operating hours per year.

[53]EF = 0.61 lb/MMBtu for tangential fired boilers.

[54]EF = .31 lb/MMBtu

[55]EF = .17 lb/MMBtu/hr.

[56]EF = .10 lb MMBtu.

TABLE 3--Firetube Boilers (Single Burners-Packaged)
Boiler Size Corresponding to $1300 per ton [57]

Type Control	Natural Gas .66C	.50C	Distill. Oil .66C	.50C	Residual Oil .66C	.50C	Pul Coal .66/.50C
OT+WI	[58]	[59]	ND	ND	ND	ND	ND
OT+FGR	[60]	[61]	[62]	[63]	30	[64]	ND
LNB[65]	10	175	10	160	10	50	250/250
LNB+FGR[14]	75	240	25	250	10	200	ND

Abbreviations:

.66C .66 Capacity Factor .50 .50 Capacity Factor
ND No Data Pul. Pulverized
OT+WI Oxygen Trim + Water Injection
OT+FGR OT + Fluid Gas Recirculation
LNB Low NOx Burners

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[57]Boiler capacity is given in MM Btu/hr that corresponds to an estimated cost of $1300 dollars per ton of NOx removed. Capacity factor: .66/.50. Costs based on 10 percent interest and 10 year capital amortization in 1992 dollars. Does not include the impact of Continuous Emission Monitoring systems, required on larger source in some areas.

[58]Least expensive controls $2400 per ton at 33.5 MM Btu/hr.

[59]Least expensive controls $2890 at 33.5 MMBtu/hr.

[60]Least expensive controls $3000 at 33.5 MMBtu/hr.

[61]Least expensive controls $4080 at 33.5 MMBtu/hr.

[62]Least expensive controls $1500 at 33.5 MMBtu/hr.

[63]Least expensive controls $2150 at 33.5 MMBtu\hr.

[64]Least expensive controls $1460 at 33.5 MMBtu\hr.

[65]No cost estimates made, cost effectiveness estimated to be the same as for watertube units, page 6-22 of EPA-453/R-94-022.

Range of Reductions:
OT + WF--15%(OT) + WR (55%)
OT + FGR-15% "   + FGR (40%)

TABLE 4--NUMBER OF SOURCES FOR FIRETUBE BOILERS [66]

Fuel Burned	Total Sources	Size Breakdown
Coal	26,328	>50 MMBtu/hr--0 25-50 " --1% <10 " --93% <1.5 " --73%
Natural Gas	126,923	>50 MMBtu/hr--0% 25-50 " --1% <10 " --92% <1.5 " --66
Distillate	48,141	>50 MMBtu/hr--0% 25-50 " --1% <10 " --92% <1.5 " --63
Residual Oil	73,683	>50 MMBtu/hr--0% 25-50 " --1% <10 " --92% <1.5 " --63%

[66]Informations form EPA-600/7-79-178a, Population and Characteristics of Industrial/Commercial Boilers in the U.S., August 1979.

TABLE 5--STATE BOILER DE MINIMIS RULES FOR INDUSTRIAL/COMMERCIAL BOILERS (INCLUDES FIRETUBE AND WATERTUBE) [67]

STATE/DATE	RULE	COMMENT
OH	<10 MMBtu/hr	
MI	<_100 MMBtu/hr	
LA 11/17/93	<_80 MMBtu/hr	
TX 11/17/93	<_100 MMBtu/hr	
NESCAUM 11/17/93	50--100 MBtu/hr case by case	
NJ 11/17/93 3/25/94	Overall: 25 t/y < 137 lbs/d 5/15-9/15	
NY 11/17/93 3/28/94	Overall: 3 lbs/hr; 15 lbs/day	
CN 3/28/94	< 5 MMBTU/hr	only tuneups required
CA 3/28/94 S. Coast	<_ 2 MMBtu/hr	Varies from 2-5 MMBtu/hr
Ventura	<_ 1 MMBtu/hr	1-5 MMBtu/hr
San Diego	<_ 5 MMBtu/hr	
SF Bay Area	<_ 1 MMBtu/hr	1-5 MMBtu/hr
S. Basin	<_ 5 MMBtu/hr	
NH 3/28/94	< 30 MMBTU	
MASS 3/28/94	< 20 MMBtu/hr (with PTE <25 TPY) operate >1000 hrs per yr	
MA 3/28/94	< 50MMBtu/hr	
RI 3/24/94	< 50 MMBtu/hr-only tuneups required	

[67]Generally, it is not clear whether these de minimis values refer to whole plants (NJ, NY) or individual units.