



MEMORANDUM

DATE: June 2, 2005

SUBJECT: Cost Impacts Associated with NSPS for Stationary CI ICE

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TO: Sims Roy, EPA OAQPS ESD Combustion Group

The purpose of this memorandum is to provide an estimate of the cost impacts of the proposed new source performance standards (NSPS) for stationary compression ignition (CI) internal combustion engines (ICE). Costs associated with the proposed rule include costs of add-on emission control and activities related to engine certification for manufacturers, and the cost of initial notification, recordkeeping, and testing for certain engine owners and operators.

The total estimated costs of the proposed NSPS for stationary CI engines are presented in Table 1. The capital cost of control of the NSPS is estimated to be \$67 million in 2015, the model year for which all stationary CI ICE would have to meet final Tier 4 emission standards. The annual cost of control of the NSPS is estimated to be \$46 million in 2015. The total annual cost in 2015 is estimated to be \$57 million. Total estimated control costs by North American Industry Classification System (NAICS) codes are shown in Table 2 for the following industries:

- 335312 -- Motor and Generator Manufacturing
- 333911 -- Pump and Pumping Equipment Manufacturing
- 333912 -- Air and Gas Compressor Manufacturing
- 333992 -- Welding and Soldering Equipment Manufacturing

Table 1. Summary of Total Costs Associated with NSPS

Type of Cost	Total Costs (\$)						
	2011	2012	2013	2014	2015	2016	2017
Capital Control Cost	30,979,878	40,072,436	42,449,091	62,633,605	66,847,709	68,582,222	70,316,736
Annual Control Cost	4,376,759	10,421,567	16,843,561	26,083,667	36,069,319	43,310,598	56,807,506
Engine Certification	844,916	844,916	844,916	844,916	844,916	844,916	844,916
Initial Notification	5,768	5,768	5,768	5,768	5,768	5,768	5,768
Recordkeeping	10,194,065	12,540,355	15,014,194	17,562,107	20,218,455	22,949,698	25,755,835
Total Annual Cost	15,421,507	23,812,606	32,708,439	44,496,458	57,138,458	70,110,981	83,414,025

*Summed values may not total due to rounding.

Table 2. Summary of Control Costs Associated with NSPS by NAICS

NAICS	Control Cost (\$million)						
	2011	2012	2013	2014	2015	2016	2017
335312							
Capital control	25.7	31.8	33.2	46.2	49.9	51.2	52.4
Annual control	3.8	8.7	13.8	20.7	28.4	36.2	44.4
333911							
Capital control	1.4	2.1	2.3	4.2	4.3	4.4	4.5
Annual control	0.2	0.5	0.8	1.4	2.0	2.6	3.2
333912							
Capital control	3.1	4.9	5.5	9.8	10.1	10.4	10.6
Annual control	0.4	1.0	1.8	3.2	4.6	6.0	7.5
333992							
Capital control	0.8	1.2	1.5	2.5	2.6	2.7	2.7
Annual control	0.09	0.2	0.4	0.8	1.1	1.5	1.9

*Summing values in this table may not total to Table 1 values due to rounding.

Projected Number of New Engines

The projected number of new stationary CI internal combustion engines per year in the years 2011 through 2017 is given in Table 3. The methodology for determining the projected number of new stationary CI internal combustion engines is discussed in the memorandum entitled “Population and Projection of Stationary Engines.” The estimate given in Table 3 represents the number of new stationary CI engines per year and includes all applications. It is estimated that 80 percent of the total population of stationary CI engines are used in emergency service and that the remaining 20 percent are non-emergency engines.

Table 3: Projected Number of New Stationary CI Engines Per Year from 2011 through 2017

HP Range	2011	2012	2013	2014	2015	2016	2017
50-100	21,481	22,243	23,006	23,768	24,530	25,293	26,055
100-175	19,061	19,615	20,168	20,722	21,276	21,829	22,383
175-300	19,230	19,911	20,592	21,273	21,954	22,635	23,316
300-600	7,004	7,168	7,333	7,498	7,662	7,827	7,991
600-750	960	976	993	1,009	1,026	1,042	1,059
>750	4,781	4,908	5,034	5,160	5,287	5,413	5,539
Total	72,516	74,820	77,125	79,429	81,734	84,038	86,343

*The projected number of new stationary CI engines in this table represents non-emergency and emergency engines.

Cost of Control

Engine manufacturers must certify all their stationary non-emergency CI engines to final Tier 4 PM and NOx emission standards according to the schedule for nonroad diesel engines shown in Table 4. The final Tier 4 PM standards for stationary non-emergency CI engines greater than or equal to 25 horsepower (HP) are based on the use of catalyzed diesel particulate filters (CDPF). For stationary non-emergency CI engines greater than or equal to 75 HP, the NOx emission standards are based on utilizing NOx adsorbers. The EPA is not proposing any emission standards that are based on add-on control for NOx for stationary CI engines less than 75 HP. The proposed NSPS does not require emergency engines to meet emission standards based on add-on controls. Therefore, no control costs are associated with emergency

engines.

Table 4. Tier 4 Emission Standards Schedule for Engine Manufacturers

HP Range	Model Year	
	PM	NOx
<25	Tier 4 standard is not based on add-on control	
≤25 to <50	2013	Tier 4 standard is not based on add-on control
≥50 to <75	2013	
≥75 to <100	2012	
≥100 to <175	2012	2014
≥175 to <300	2011	2014
≥300 to <600	2011	2014
≥600 to ≤750	2011	2014
>750 to ≤1,200	2015	2015
>1,200	2015	2011

*The EPA does not expect there will be any stationary CI engines less than 50 HP and has therefore not included the cost of control for engines less than 50 HP in this estimate.

**Note that based on information used to estimate the projected number of new stationary CI engines, it appears that the majority of stationary CI engines greater than 750 HP are generator sets. Our estimates of NOx and PM emission reduction for engines greater than 750 HP are therefore based on the final Tier 4 emission standards for generator sets.

The cost of NOx adsorbers and CDPF are based on costs developed for the rule for nonroad diesel engines and were presented in the memorandum entitled “Control Costs for NOx Adsorbers and CDPF for CI Engines.” The capital and annual costs of NOx adsorber and CDPF are presented in Table 5. Total control costs for non-emergency stationary CI engines were estimated based on these control costs multiplied by the average HP for each HP range (also shown in Table 5) and the estimated number of new non-emergency engines. The total control costs were shown in Table 1.

Table 5. Capital and Annual Costs for NOx adsorber and CDPF

HP Range	Average HP	NOx Adsorber		CDPF	
		Total Capital Cost (\$/HP)	Total Annual Cost (\$/HP)	Total Capital Cost (\$/HP)	Total Annual Cost (\$/HP)
50-75	63	10	1	12	2
75-100	88	10	1	12	2
100-175	135	8	1	10	2
175-300	238	7	1	9	1
300-600	450	6	1	8	1
600-750	675	6	1	8	1
750-1,200	975	5	1	7	1
1,200-3,000	2,100	5	1	7	1
>3,000	5,000	5	1	7	1

*The EPA does not expect there will be any stationary CI engines less than 50 HP and has therefore not included the cost of control for engines less than 50 HP in this estimate.

Cost of Certification

Manufacturers of stationary CI engines will be required to certify their engines starting with the 2007 model year. Based on information received from engine manufacturers, EPA has estimated that about 200 engine families currently certified for nonroad use will be required to be certified to the rule for stationary CI engines. The EPA expects that minimal additional effort will have to be spent certifying these 200 engine families for stationary use also. It is estimated that the manufacturer will have to spend 1 hour per engine family to certify each engine family to the requirements of the stationary CI rule. It is assumed that a technical person will handle the certification at a rate of \$65 per hour. The EPA estimates a cost of \$13,000 per year to certify stationary CI engines that are currently certified to the nonroad CI engine rule.

In addition, EPA estimates that another 35 engine families that are used for stationary purposes only will be required to be certified to the emission standards of the rule. These engines are not currently certified to any nonroad standards and manufacturers of these engines would need to conduct all activities that are associated with obtaining certification for these engines. The EPA anticipates that the manufacturer burden to certify stationary only engine families will be the same as the manufacturer burden EPA has previously estimated for the certification of nonroad CI

engines¹.

A total of 1,077 nonroad engine families will be certified per year under the nonroad CI engine program. The EPA estimated that 10 nonroad engine families will be subject to selective enforcement audits (SEA), which equates to approximately 1 percent of the engine families. The EPA believes that it is reasonable to assume that the same percent of SEA would occur for stationary engines. In addition, for the nonroad CI engine information collection request, EPA took into account the manufacturers' need to investigate and report emission-related defects and assumed that 10 percent of the engine families trigger the defect-investigation threshold. The EPA assumed that manufacturers would require 126 hours of effort per engine family to perform the investigation and submit the required reports. Since stationary engines will be required to follow the certification program that is established for nonroad engines, the EPA believes that the same percentage of stationary engine families would have to conduct defect-reporting with the same amount of effort. A certification cost of \$2,156 per engine family for engine families that will be certified for stationary use only has also been included. Finally, consistent with the nonroad CI engine ICR, operation and maintenance costs associated with engine certification have been included. Operation and maintenance costs include expenses related to engine testing. Costs are for laboratory time, the use of test equipment, engine parts, fuel and other supplies, and fabrication of test tools and fixtures. The EPA estimates a total certification cost of about \$830,000 to certify engine families that are not already certified to nonroad CI standards. Table 6 presents a breakdown of the various costs related to the certification process.

¹Information Collection Request Support Statement. Information Requirements for Nonroad Diesel Engines (Nonroad Large SI Engines and Marine Diesel Engines) (Amendments). Spring 2004. Assessment and Standards Division, Office of Transportation and Air Quality, Office of Air and Radiation, U.S. Environmental Protection Agency. ICR Tracking Number 1897.07.

Table 6. Estimated Cost of Certifying Engine Families for Stationary Use Only

Requirement	Estimated Labor Hours per Engine Family			Labor Cost per Engine Family	O&M Costs per Engine Family	Number of Families	Total Cost per Year
	Mgr. @ \$73/hr	Tech. @ \$65/hr	Cler. @ \$33/hr				
Certification Application*	2	36	6	\$2,690	\$0	35	\$169,610
Recordkeeping	0.2	2.2	2	\$224	\$0	35	\$7,847
Certification/ Durability Testing	0	168	0	\$10,920	\$4,776	35	\$549,360
Selective Enforcement Audits	5	100	10	\$7,210	\$75,105	1	\$82,315
Defect Reporting	6	40	80	\$5,696	\$0	4	\$22,784
Total							\$831,916

*Cost for certification application includes fees assessed at \$2,156 per engine family.

Cost of Initial Notification

The rule requires owners and operators of non-emergency stationary CI engines that are greater than 3,000 HP or that have a displacement of 10 liters per cylinder or more to submit an initial notification. Engine manufacturers have indicated that approximately 160 stationary CI engines greater than 3,000 HP are sold each year. The EPA estimates that 20 percent of all engines are used for non-emergency purposes. This means that there are an estimated 32 new non-emergency engines greater than 3,000 HP sold each year that would have to submit an initial notification. According to manufacturers, eight engines with a displacement of 10 liters per cylinder or more are sold in the U.S. each year. All of these engines are assumed to be non-emergency engines and would have to submit an initial notification. Owners and operators of pre-2007 model year non-emergency stationary CI engines that are greater than 175 HP and that are not certified are also required to submit an initial notification. However, since the cost estimates in this memorandum are shown for the years 2011 through 2017, the cost of initial notification for pre-2007 model year engines are not presented. Owners and operators of emergency stationary CI engines are not required to submit any notifications.

The cost of an initial notification is estimated at \$144. The initial notification is based on 2 technical hours, which EPA estimates is a sufficient amount of time to prepare and submit the information associated with an initial notification. The management and clerical hours are estimated as a percentage of the technical hours

and are 5 and 10 percent, respectively. The labor rates, on a per-hour basis, were obtained from the Bureau of Labor Statistics web site (<http://www.bls.gov/news.release/ecec.toc.htm>) as posted for June 2004. The base labor rates are \$28.20 for technical personnel, \$32.12 for management, and \$13.91 for clerical. The total compensation rate is \$38.82 for technical personnel, \$45.29 for managerial, and \$19.92 for clerical. This accounts for paid leave, insurance, etc. The compensation rates were then adjusted by an overhead and profit rate of 167 percent. The final total wage rates are as follows:

Technical Personnel:	\$65 per hour
Management:	\$76 per hour
Clerical:	\$33 per hour

The total cost of submitting initial notifications was calculated using the following equation:

$$\left[\left(2 \text{ hrs} \times \frac{\$65}{\text{hr}} \right) + \left(0.05 \times 2 \text{ hrs} \times \frac{\$76}{\text{hr}} \right) + \left(0.1 \times 2 \text{ hrs} \times \frac{\$33}{\text{hr}} \right) \right] \times 40 \text{ Engine}$$

yielding a total cost for submitting initial notifications of \$5,768 per year, as shown in Table 1.

Cost of Recordkeeping

The proposed rule includes recordkeeping requirements that apply to owners and operators of certain stationary CI ICE. Owners and operators of emergency stationary engines are required to keep records of the hours spent operating during non-emergencies, i.e., during maintenance and testing. The rule requires that owners and operators limit this time to 30 hours per year. A non-resettable hour meter must be installed to keep track of operation during non-emergencies to ensure the hours of operation restricted by the rule is not exceeded. According to vendors, an hour meter is typically included with the engine, therefore, no separate cost of the hour meter was estimated. The EPA anticipates that minimal effort will be involved in recording the number of hours spent in emergency operation and estimates that about 1/2 hour per year of technical labor will be required to record and keep the appropriate records.

The EPA estimates that there will be 308,225 new emergency engines subject to the rule in the year 2011. This estimate includes 75 percent of 2006 model year emergency engines and 2007 through 2011 model year emergency engines. The cost of recording hours during non-emergency operation in 2011 was calculated as follows:

$$1/2 \text{ hr Technical Labor} \times \frac{\$65}{\text{hr}} \times 308,225 \text{ Engines}$$

yielding a total cost for recording hours of operation during non-emergencies of \$10,017,313.

Owners and operators of stationary CI ICE that are equipped with DPF are required to install a backpressure monitor that notifies the operator when the high backpressure limit of the engine is approached. Control technology vendors have indicated that a backpressure monitor is typically included with the equipment so no separate cost was estimated. Owners and operators are required to keep records of any corrective action performed after the backpressure monitor alerts the operator. The earliest a DPF would be required would be in the year 2011, therefore, recordkeeping costs associated with this requirement has been estimated for 2011 model year and later engines. The EPA expects that cleaning of the DPF will be conducted about once per year. This is based on what the California Air Resources Board estimated for the stationary CI engine regulation, where cleaning was expected to occur every 1,500 hours of operation. Information indicates that non-emergency engines operate on average about 1,000 hours per year, therefore, cleaning is anticipated to occur about once per year. Again, minimal effort is involved with keeping records of action taken after the backpressure monitor has alerted the operator that the high backpressure limit has been reached and EPA estimates that 1/2 per year of technical labor will be sufficient to document the action taken.

As mentioned, the earliest DPF would be required would be in the year 2011 and engines between 175 and 750 HP would be equipped with DPF in this year. The EPA estimates that 5,439 new non-emergency engines between 175 and 750 HP will come online in 2011. To estimate the cost of recording action taken following backpressure alerts in 2011, the following equation was used:

$$1/2 \text{ hr Technical Labor} \times \frac{\$65}{\text{hr}} \times 5,439 \text{ Engines}$$

yielding a total cost for recording action taken after backpressure alerts in the year 2011 of \$176,768. Adding the cost of recording backpressure alerts to the cost of recording the number of hours of operation during non-emergencies (\$10,017,313), yields a total recordkeeping cost of about \$10,194,100 in 2011, consistent with the figure shown in Table 1 for this year.

Cost of Testing

The majority of owners and operators of stationary CI engines covered by this rule will demonstrate compliance by purchasing a certified engine. There will be a period during which certified stationary non-emergency CI engines may not be available. The proposed NSPS requires that engine manufacturers certify their 2007 model year and later stationary CI engines to the nonroad diesel engine emission standards. The proposed rule also requires pre-2007 model year engines subject to the rule to meet emission standards based on current levels achieved. However, pre-2007 model year engines may not be available as certified engines since the proposed rule requires that engine manufacturers certify stationary engines starting with 2007 model year engines. Therefore, some owners and operators of pre-2007 model year engines will have to demonstrate compliance by other means. Options for demonstrating compliance include keeping records of engine manufacturer or control device vendor data and test results for a performance test conducted on a similar engine. The owner and operator may also demonstrate initial compliance by conducting a performance test on the engine. The EPA expects that most owners and operators will rely on information available from the engine manufacturer and control device vendor to demonstrate initial compliance and estimates that only 20 percent of stationary pre-2007 model year non-emergency CI engines subject to the rule will conduct a performance test. No performance testing is expected to occur after certified engines become available although the enforcing agency may request a performance test.

For purposes of estimating costs, it is assumed that 2006 model year engines will test in 2006 and based on the applicability date of the rule (engines ordered after the proposal date and manufactured after April 1, 2006), the EPA estimates that about 75 percent of 2006 model year engines will be affected by the rule and will have to comply with emissions limitations. A performance test is expected to cost approximately \$2,000 and EPA's projection estimates indicate that there will be approximately 12,200 new non-emergency stationary CI engines in 2006, of which 75 percent, or 9,150 will be affected by the rule. The cost of testing in 2006 was calculated as follows:

$$\$2,000 \text{ per test} \times 12,200 \text{ Engines}_{MY 2006} \times 0.75 \times 0.20$$

yielding estimated testing costs of about \$3.7 million for 2006 model year engines.